AID 1380-1X (9-70)

PIO/T

DEPARTMENT OF STATE
AGENCY FOR
INTERNATIONAL DEVELOPMENT

PROJECT IMPLEMENTATION ORDER/TECHNICAL SERVICES

1. Cooperating Country: Africa Regional

2. PIO/T No. 698-357-3-61130P7

3. [X] Original or Amendment No. _____

4. Project/Activity No. and Title
African Primary Science Program
698-11-690-357

DISTRIBUTION

5. Appropriation Symbol: 72-1111004

6.A. Allotment Symbol and Charge: 154-61-698-00-69-11

6.B. Funds Allotted to: [X] A.I.D./W [ ] Mission

7. Obligation Status: [X] Administrative Reservation [ ] Suboblligation

8. Funding Period (Mo., Day, Yr.): From 7/1/71 to 6/30/72

9.A. Service to Start (Mo., Day, Yr.): Between 6/15/71 and 7/15/71

9.B. Completion date of Services (Mo., Day, Yr.): 6/30/76

10.A. Type of Action: [X] A.I.D. Contract [ ] Cooperating Country Contract [ ] Participating Agency Service Agreement [ ] Other

10.B. Authorized Agent: AID/W

Estimated Financing $1.00 =		(1) Previous Total	(2) Increase	(3) Decrease	(4) Total to Date
11. Maximum A.I.D. Financing	A. Dollars		325,000		325,000
	B. U.S.-Owned Local Currency				
12. Cooperating Country Contributions	A. Counterpart				
	B. Other				

13. Mission References

14. Instructions to Authorized Agent: AID/W is requested to contract with the Educational Development Center (EDC), 55 Chapel Street, Newton, Massachusetts 02160, to perform the requested technical services requested by this PIO/T as a practical application of the developmental work satisfactorily performed by the EDC for A.I.D. under contract AID/csd-772. The EDC has been selected for this service because it is felt that the effective implementation of this project must be built on the experience gained, materials developed and the contacts made with African schools, teachers and government officials by the EDC in its performance under contract AID/csd-772, which is terminating on June 30, 1971.

15. Clearances – Show Office Symbol, Signature and Date for all Necessary Clearances.

A. The specifications in the scope of work are technically adequate
AFR/TAC, RSmall

B. Funds for the services requested are available
AFR/MGT, JBeard 5/12/71

C. The scope of work lies within the purview of the initiating office and approved Agency Programs
AFR/TAC, DAtwell

D.

E.
AFR/TAC, MBelcher

F.

16. For the cooperating country: The terms and conditions set forth herein are hereby agreed to

Signature and Date:

Title:

17. For the Agency for International Development

Signature: Murray Gray

Title: Deputy Director, AFR/MGT/CD

18. Date of Issuance: May 14, 1971

AID 1380-1X (9-70) PIO/T	Cooperating Country: Africa Regional	PIO/T No. 698-357-3-611	Page 2 of 5 Pages
	Project/Activity No. and Title: African Primary Science Program 698-11-690-357		

SCOPE OF WORK

19. Scope of Technical Services

A. Objective for which the Technical Services are to be Used These technical services will provide for the implementation of an African Primary Science program (APSP).

B. Description The program will promote curricular reform and new approaches to teaching primary science in five African countries --- Sierra Leone, Ghana, Uganda, Kenya and Tanzania. 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 curric ulum development centers in participating countries through a special training program developed for this purpose, and (3) support to the Science Education Programme for Afric (SEPA) --- an African based and directed organization which will ultimately assume comple responsibility for leadership and coordination of African science programs.

C. Technicians

(1) (a) Number	(b) Specialized Field	(c) Grade and/or Salary	(d) Duration of Assignment (Man-Months)
1	Project Co-director (½ time)	9,500	24 man months
1	Administrative Director	18,000	24 man months
1	Secretary	8,000	24 man months
1	Editor (½ time)	6,000	24 man months
1	Science Consultant (1 day/wk @ 125)	6,500	12 man months
4	Science Educators	18,000	24 man months eac
1	Executive Secretary (SEPA)	8,400	24 man months
1	Secretary (SEPA)	2,500	24 man months

(2) Duty Post and Duration of Technicians' Services

1 Science Educator in Tanzania
1 Science Educator in Uganda
2 Science Educators in Ghana
1 Ex Sec (SEPA) in Ghana
1 Secty in Ghana
1 Proj Coord in U.S.
1 Admin Dir in U.S.
1 Secty in U.S.
1 Editor (half-time) in

(3) Language requirements

N.A.

(4) Access to Classified Information

Not necessary

(5) Dependents [X] Will [ ] Will Not Be Permitted to Accompany Technician

D. Financing of Technical Services

(1) By AID - $ 302,000 (2) By Cooperating Country --

AID 1380-1X (9-70) PIO/T	Cooperating Country: Africa Regional	PIO/T No. 698-357-3-611	Page 3 of 5 Pages
	Project/Activity No. and Title: African Primary Science Program 698-11-690-357		

20. Equipment and Supplies *(Related to the services described in Block 19 and to be procured outside the Cooperating Country by the supplier of these services)*

A. (1) Quantity (2) Description	(3) Estimated Cost	(4) Special Instructions
Materials, supplies, logistics for meetings and workshops	23,000	

B. Financing of Equipment and Supplies

(1) By AID - $ 23,000 (2) By Cooperating Country -

21. Special Provisions

[X] A. This PIO/T is subject to AID (contracting) (PASA implementation) regulations.

[X] B. Except as specifically authorized by AID, or when local hire is authorized under the terms of a contract with a U.S. Supplier, services authorized under this PIO/T must be obtained from U.S. sources.

[X] C. Except as specifically authorized by AID/W, the purchase of commodities authorized under this PIO/T will be limited to the U.S. under Geographic Code 000.

[X] D. Other *(specify)*:

(1) International travel and per diem, as well as local travel costs, are to be paid in local currency to the maximum extent possible.

(2) American Technicians shall be afforded the privileges and immunities normally granted to all USAID contract personnel.

22. Reports by Contractor or Participating Agency (Indicate type, content and format of reports required, including language to be used if other than English, frequency or timing of reports, and any special requirements)

1. Twenty-five copies to AID/W of a progress report, due semi-annually.

2. Fifty copies of a final report, summarizing the history and accomplishments of the entire program, together with a complete listing of all publications.

23. Background Information (Additional information useful to Authorized Agent and Prospective Contractors or Participating Agency; if necessary cross reference Block 19.C(4) above.)

For the research and development phase of this program refer to AFR/csd-772 and related reports. For this continuing project refer to Non-Capital Project Paper (PRCP) dated March 30, 1971.

24. Relationship of Contractor or Participating Agency to Cooperating Country and to AID

A. Relationships and Responsibilities

B. Cooperating Country Liaison Official

Permanent Secretaries, Ministries of Education in Sierra Leone, Ghana, Uganda, Kenya and Tanzania.

C. AID Liaison Officials

Principal Education Advisor, AFR/TAC, AID/W

AID 1350-1X (9-70) PIO/T	Cooperating Country: Africa Regional	PIO/T No. 698-357-3-611	Page 5 of 5 Pages
	Project/Activity No. and Title: African Primary Science Program 698-11-690-357		

LOGISTIC SUPPORT

25. Provisions for Logistic Support

A. Specific Items (Insert "X" in applicable column at right. If entry needs qualification, insert asterisk and explain below in C. "Comments")

	In Kind Supplied By		From Local Currency Supplied By	
	AID	Cooperating Country	AID	Cooperating Country
(1) Office Space		X		
(2) Office Equipment		X		
(3) Housing and Utilities	a/			
(4) Furniture	a/			
(5) Household Equipment (Stoves, Refrig., etc.)	a/			
(6) Transportation in Cooperating Country	a/			
(7) Interpreter Services				
Other: (Specify) (8)				
(9)				
(10)				
(11)				
(12)				
(13)				
(14)				
(15)				

B. Additional Facilities Available From Other Sources

C. Comments

a/ These costs to be paid by technicians from allowances authorized through the contract when not provided by the cooperating country.

AID 1850-1X (8-70)

PIO/T

DEPARTMENT OF STATE
AGENCY FOR
INTERNATIONAL DEVELOPMENT

PROJECT IMPLEMENTATION ORDER/TECHNICAL SERVICES

1. Cooperating Country: Africa Regional

Page 1 of 6 Pages

2. PIO/T No. 698-357-3-6123109

3. [X] Original or Amendment No. _____

4. Project/Activity No. and Title: African Primary Science (Evaluation) 698-11-690-357

DISTRIBUTION

5. Appropriation Symbol: 72-1121004

6.A. Allotment Symbol and Charge: 254-61-698-00-69-21

6.B. Funds Allotted to: [X] A.I.D./W [ ] Mission

7. Obligation Status: [X] Administrative Reservation [ ] Suboblligation

8. Funding Period (Mo., Day, Yr.) From 4/1/72 to 12/31/72

9.A. Services to Start (Mo., Day, Yr.) Between 4/1/72 and 5/1/72

9.B. Completion date of Services (Mo., Day, Yr.) 11/1/72

10.A. Type of Action: [X] A.I.D. Contract [ ] Cooperating Country Contract [ ] Participating Agency Service Agreement [ ] Other

10.B. Authorized Agent: AID/W

Estimated Financing $1.00 =		(1) Previous Total	(2) Increase	(3) Decrease	(4) Total to Date
11. Maximum A.I.D. Financing	A. Dollars		45,000		45,000
	B. U.S.-Owned Local Currency				
12. Cooperating Country Contributions	A. Counterpart				
	B. Other				

13. Mission References

14. Instructions to Authorized Agent: AID/W is requested to issue a Task Order under the existing limited quantity basic agreement with American Institutes of Research, 1775 K Street, N.W. in Washington, D.C. to perform the evaluation services requested in this PIO/T. AIR is recommended because it is felt that the firm possesses the experience, appropriate contacts with African schools, teachers, and government officials involved, and has the professional competence in all project areas to properly evaluate it. It is recommended that the contractor being evaluated, Education Development Corporation, and AFR/TAC confer to determine optimum courses of action and that the contractor develop from these a work plan for the evaluation which will be approved by A.I.D. prior to the actual commencement of the work.

15. Clearances – Show Office Symbol, Signature and Date for all Necessary Clearances.

A. The specifications in the scope of work are technically adequate
AFR/TAC:GJespersen

B. Funds for the services requested are available
AFR/MGT:JBeard JHB 4/13/72

C. The scope of work lies within the purview of the initiating office and approved Agency Programs
AFR/TAC:DAtwell

D.
AFR/TAC:AHardie E.L.M. 4/17/72

E.
AFR/TAC:PLyman

F.
AFR/DP:RPatchen

16. For the cooperating country: The terms and conditions set forth herein are hereby agreed to

Signature and date:

Title:

17. For the Agency for International Development

Signature:

Title: Dep. Director, AFR/MGT/C

18. Date of Issuance: 4/14/72

SCOPE OF WORK

19. Scope of Technical Services

A. Objective for which the Technical Services are to be Used The objective will be to evaluate the African primary science and mathematics programs in seven English-speaking African countries.

B. Description The African Mathematics Program has been implemented in Ethiopia, Kenya, Sierra Leone, Liberia, and Ghana. The African Science Program has been implemented in Kenya, Tanzania, Sierra Leone, Ghana and Uganda. A total of seven countries are involved in the two programs which have been developed and implemented by the Education Development Corporation.

The first phase of the program was scheduled for completion by the end of December, 1971, and included promotion of curricula reform, development of new and practical approaches to teaching the curriculum, improving effectiveness of in-service and pre-service teacher education, and providing technical advisory assistance to the host governments in making optimum use of the instructional materials which were developed in the materials workshops.

(continued)

C. Technicians

(1) (a) Number	(b) Specialized Field	(c) Grade and/or Salary	(d) Duration of Assignment (Man-Months)
Indefinite	Education Program Evaluations	R-4 or R-3	15

(2) Duty Post and Duration of Technicians' Services Various countries as stated in Block 19, above. Services to be applied as required for a period of 12 calendar months after the effective date of this contract.

(3) Language requirements

English. Some knowledge of host country languages will be helpful.

(4) Access to Classified Information

None

(5) Dependents ☐ Will ☒ Will Not Be Permitted to Accompany Technician

D. Financing of Technical Services

(1) By AID - $ 45,000 (2) By Cooperating Country - None

20. Equipment and Supplies *(Related to the services described in Block 19 and to be procured outside the Cooperating Country by the supplier of those services)*

A. (1) Quantity	(2) Description	(3) Estimated Cost	(4) Special Instructions
N/A			

B. Financing of Equipment and Supplies

(1) By AID – $ (2) By Cooperating Country –

21. Special Provisions

[X] A. This PIO/T is subject to AID (contracting) (PASA implementation) regulations.

[ ] B. Except as specifically authorized by AID, or when local hire is authorized under the terms of a contract with a U.S. Supplier, services authorized under this PIO/T must be obtained from U.S. sources.

[X] C. Except as specifically authorized by AID/W, the purchase of commodities authorized under this PIO/T will be limited to the U.S. under Geographic Code 000.

[X] D. Other *(specify)*: The evaluation team must include one or more African educators to participate actively in the evaluation.

22. Reports by Contractor or Participating Agency (Indicate type, content and format of reports required, including language to be used if other than English, frequency or timing of reports, and any special requirements)

The contractor shall submit a proposed work plan within 30 days after signing the contract and shall submit a final report which sets forth the findings and recommendations of the contractor as a result of the evaluations.

23. Background Information (Additional information useful to Authorized Agent and Prospective Contractors or Participating Agency; if necessary cross reference Block 19.C(4) above.)

Background data is available in the AFR/TAC office, in the office of Education Development Corporation, and in host country government offices.

24. Relationship of Contractor or Participating Agency to Cooperating Country and to AID

A. Relationships and Responsibilities

B. Cooperating Country Liaison Official Permanent Secretaries, Ministries of Education in Sierra Leone, Kenya, Uganda, Ghana, Tanzania, Ethiopia and Liberia.

C. AID Liaison Officials

Project Manager, AFR/TAC, AID/W

AID 1350-1X (9-70) PIO/T	Cooperating Country: Africa Regional	PIO/T No. 698- 357-3-6123D09	Page 5 of 6 Pages
	Project/Activity No. and Title: African Primary Science Evaluation 698-11-690-357		

LOGISTIC SUPPORT

25. Provisions for Logistic Support A. Specific Items (Insert "X" in applicable column at right. If entry needs qualification, insert asterisk and explain below in C. "Comments")	In Kind Supplied By		From Local Currency Supplied By	
	AID	Cooperating Country	AID	Cooperating Country
(1) Office Space		X		
(2) Office Equipment		X		
(3) Housing and Utilities	a/			
(4) Furniture	a/			
(5) Household Equipment (Stoves, Refrig., etc.)	a/			
(6) Transportation in Cooperating Country	a/			
(7) Interpreter Services				
Other: (Specify) (8)				
(9)				
(10)				
(11)				
(12)				
(13)				
(14)				
(15)				

B. Additional Facilities Available From Other Sources

C. Comments

a/ These costs to be paid by technicians from allowances authorized through the contract when not provided by the cooperating country.

AID-1300-1X (7-69) CONTINUATION SHEET	DEPARTMENT OF STATE AGENCY FOR INTERNATIONAL DEVELOPMENT	[X] Worksheet [ ] Issuance	PAGE 6 OF 6 PAGES
		1. Cooperating Country: Africa regional	2.a. Code No.
FORM SYMBOL	TITLE OF FORM	2.b. Effective Date	2.c. [X] Original OR Amendment No.
PIO/T	Project Implementation Order/ Technical Services	3. Project/Activity No. and Title: African Primary Science Evaluation 698-11-690-357	

Indicate block numbers. Use this form to complete the information required in any block of a PIO or PA/PR form.

19. B.

The evaluation should cover the three major phases of the program:

(1) The preparation or development phase which prepared teacher training programs, curricular modifications, and materials of instruction and made them available to the host governments -- this includes performance of the Education Development Corporation in recruitment of personnel, obtaining counterparts, adherence to planned schedules of operation, and fulfillment of project implementation goals;

(2) Value of input to participating African countries -- to be determined through objective evidence which specifies the degree of utilization or non-utilization of the new programs and materials, or which identify changes, if any, in educational programs or the approaches to teaching the curricula; and

(3) Local assessment of project accomplishments -- includes assessment of material to be provided by African educators and/or administrators, by A.I.D. personnel, and by contractors personnel.

The evaluators final report must reflect a resume of findings and set forth his recommendations for the future development of the project.

AID 1350-1X (7-71)

PIO/T

DEPARTMENT OF STATE
AGENCY FOR
INTERNATIONAL DEVELOPMENT

PROJECT IMPLEMENTATION ORDER/TECHNICAL SERVICES

1. Cooperating Country: Africa Regional

Page 1 of (5) Pages

AAC-343

2. PIO/T No.: 698-356-3-6157206

3. [X] Original or Amendment No. _____

4. Project/Activity No. and Title: African Primary Science Program 698-11-690-357

DISTRIBUTION

5. Appropriation Symbol: 72-11X1025

6.A. Allotment Symbol and Charge: 425-61-698-00-69-51

6.B. Funds Allotted to: [X] A.I.D./W [ ] Mission

7. Obligation Status: [X] Administrative Reservation [ ] Implementing Document

8. Funding Period (Mo., Day, Yr.): From 4/1/75 To 6/30/75

9.A. Services to Start (Mo., Day, Yr.): Between CONTINUING

9.B. Completion date of Services (Mo., Day, Yr.): 6/30/75

10.A. Type of Action: [X] A.I.D. Contract [ ] Cooperating Country Contract [ ] Participating Agency Service Agreement [ ] Other

10.B. Authorized Agent: AID/W

Estimated Financing $1.00=		(1) Previous Total	(2) Increase	(3) Decrease	(4) Total to Date
11. Maximum A.I.D. Financing	A. Dollars		167,000		167,000
	B. U.S.-Owned Local Currency				
12. Cooperating Country Contributions	A. Counterpart				
	B. Other				

13. Mission References

14. Instructions to Authorized Agent

This amendment to the original PIO/T (698-357-3-6113087) and contract AID/afr-791 provides for the following: (1) an additional $167,000 which is required to fund services through to completion of contract services on 6/31/75; (2) a revised objective and scope of work in blocks 19a and b; (3) and a revised schedule of technician services in block 19c. Please amend subject contract to reflect changes.

All other provisions of the original contract as amended remain unchanged.

15. Clearances – Show Office Symbol, Signature and Date for all Necessary Clearances.

A. The specifications in the scope of work are technically adequate
AFR/RA, JBCarson JBCarson

B. Funds for the services requested are available
AFR/RA, JKBeard JKBeard 11/27/74

C. The scope of work lies within the purview of the initiating and approved Agency Program
AFR/RA, JEHill JEHill

D.

E.
AFR/RA, DCox DCox

F.

16. For the cooperating country: The terms and conditions set forth herein are hereby agreed to

Signature and date:

Title:

17. For the Agency for International Development

Signature: E. Dennis Conroy

Title: Director, AFR/RA

18. Date of Signature: Nov. 29, 1974

GPO 867-266

Project/Activity No. and Title
African Primary Science Program
698-11-690-357

SCOPE OF WORK

17 Scope of Technical Services

A. Objective for which the Technical Services are to be Used

To provide the population in selected African countries with an improved primary education in science.

B. Description

The purpose of the APSP is to develop the skills of local professional personnel in Ghana, Kenya, Sierre Leone and other English speaking countries in the teaching of modern science concepts. The program will be accomplished through (1) the knowledge and exchange of ideas obtained at workshops and seminars for science educators; (2) the development and implementation of program materials into the primary schools; (3) the provision of appropriate science materials for teaching science throughout primary grades and use in training colleges; and (4) the support of the continued growth and development of SEPA (Science Education Program for Africa).

C. Technicians

(1) (a) Number	(b) Specialized Field	(c) Grade and/or Salary	(d) Duration of Assignment (Man-Months)
1	Project Director (½ time)		7 (11/74 - 6/75)
1	Area Director (10% time)		7 " "
1	Admin. Asst. (½ time)		7 " "
1	Consultant (part-time)		12 man days
2	Science Educators (Kenya)		14 (11/74 - 6/75)

(2) Duty Post and Duration of Technicians' Services

(3) Language requirements

NA

(4) Access to Classified Information

Not necessary

(5) Dependents ☒ Will ☐ Will Not Be Permitted to Accompany Technician

D. Financing of Technical Services

(1) By AID - $158,900

(2) By Cooperating Country -

20. Equipment and Supplies *(Related to the services described in Block 19 and to be procured outside the Cooperating Country by the supplier of these services)*

A. (1) Quantity (2) Description	(3) Estimated Cost	(4) Special Instructions
Materials, supplies, logistics for meetings and workshops	$8,100	

B. Financing of Equipment and Supplies

(1) By AID - $8,100 (2) By Cooperating Country -

21. Special Provisions No change

☐ A. This PIO/T is subject to AID (contracting) (PASA implementation) regulations.

☐ B. Except as specifically authorized by AID, or when local hire is authorized under the terms of a contract with a U.S. Supplier, services authorized under this PIO/T must be obtained from U.S. sources.

☐ C. Except as specifically authorized by AID/W, the purchase of commodities authorized under this PIO/T will be limited to the U.S. under Geographic Code 000.

☐ D. Other *(specify)*:

22. Reports by Contractor or Participating Agency (Indicate type, content and format of reports required, including language to be used if other than English, frequency or timing of reports, and any special requirements)

No change

23. Background Information (Additional information useful to Authorized Agent and Prospective Contractors or Participating Agency; if necessary cross reference Block 19.C(4) above.)

Non-Capital Project Paper (PROP)
dated 28 Feb., 1974

24. Relationship of Contractor or Participating Agency to Cooperating Country and to AID

A. Relationships and Responsibilities

B. Cooperating Country Liaison Official

Permanent Secretaries; Ministries of Education in Ghana, Kenya, Sierre Leone and other English speaking countries.

C. AID Liaison Officials

Project Manager, AFR/RA, AID/W

AID 1380-1X (9-70) PIO/T	Cooperating Country: Africa Regional	PIO/T No. 698-356-3-6157206	Page 5 of 5 Pages
	Project/Activity No. and Title: African Primary Science Program 698-11-690-357		

LOGISTIC SUPPORT

25. Provisions for Logistic Support

A. Specific Items (*Insert "X" in applicable column at right. If entry needs qualification, insert asterisk and explain below in C. "Comments"*)

	In Kind Supplied By		From Local Currency Supplied By	
	AID	Cooperating Country	AID	Cooperating Country
(1) Office Space		X		
(2) Office Equipment		X		
(3) Housing and Utilities	a/			
(4) Furniture	a/			
(5) Household Equipment (*Stoves, Refrig., etc.*)	a/			
(6) Transportation in Cooperating Country	a/			
(7) Interpreter Services				
Other: (*Specify*) (8)				
(9)				
(10)				
(11)				
(12)				
(13)				
(14)				
(15)				

B. Additional Facilities Available From Other Sources

C. Comments

a/ These costs to be paid by technicians from allowances authorized through the contract when not provided by the cooperating country.

Pinyles 6980357-(12)
PD-AAC-343
pt files AFR/DP
698-357

Mr. Robert G. Huesmann, AFR/DP

February 14, 1974

Dan Cox, AFR/NARA/TEC

13P

African Primary Science Project Committee Meeting

A meeting was called by the APSP Committee Chairman for 2:30 P.M., 13 February 1974 in room 4725 to discuss the revised PROP. The following persons were in attendance:

Ms. Mabel Meares, AFR/DP
Ms. Joan Coe, AFR/CWA
Ms. Jeannette Carson, AFR/NARA
Dr. Edwin Martin, AFR/DS
Mr. Peter Daniells, AFR/CWA
Mr. Ronald Penny (Intern)
Mr. Ullmont L. James, AFR/NARA
Dr. Samuel E. Fuhr, AFR/NARA
Dr. Dan Cox, AFR/NARA

Discussion:

The purpose of the meeting was stated, after which a brief history of the project was reviewed. It was noted that a revised PROP was required because of a number of slight changes of emphasis that have developed since the original PROP of 30 March 1971. Basically these changes involve increased program emphasis in Kenya, Ghana and Sierra Leone and the need for increased emphasis on the development of Science Education Program for Africa (SEPA) which is the regional secretariat and provides African leadership, guidance and direction to the science program.

Earlier, a draft PROP was forwarded to DP; DP in turn sent copies to CWA and DSA for comment and review. The review resulted in a number of comments which were forwarded in memoranda Donoghue to James, dated 12 December 1973, and Brooks to James, dated 12 December. The points raised in both memoranda were thoroughly discussed. Much of the discussion concerned recommendations made by the American Institute of Research (AIR) in the report of a project evaluation dated February 1973. The NARA analysis of the AIR report served as the source of information that put most of the questions to rest. The analysis noted that NARA concurred with all of the AIR recommendations that were raised in this meeting but noted that most of the AIR recommendations were either beyond the scope of the project or would require considerable funding.

Since receipt of the Donoghue memorandum, NARA has developed a PAR which outlines in considerable detail progress achieved. It was suggested that a copy of the PAR accompany the revised PROP, PIP and the report of this meeting to DP. The Committee felt that all of these materials would present a more complete picture of the project.

The Committee hereby recommends that the attached proposed PROP be approved.

Enclosure: a/s

Drafted: AFR/NARA/TEC: DCox: md: 2/14/74

Clearance:

AFR/NARA, ULJames

AA/AFR, Dr. Samuel C. Adams, Jr.
Robert G. Huesmann

FEB 2 1974

AFR/DP, Robert G. Huesmann

African Primary Science Project

This is essentially a revision for the record since the project has been proceeding for some time now on the basis of the revised objectives. There is a reduction in funding requirements due to original overestimates (for a change), but the final year of obligation is still FY 1975, unchanged from the original PROP.

AFR/DP:RGHuesmann:pc:2/26/74

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Mr. Robert G. Huesmann, AFR/DP **DATE:** February 26, 1974

FROM : Dan Cox, AFR/NARA/TEC

SUBJECT: African Primary Science Project Committee Meeting

A meeting was called by the AFSP Committee Chairman for 2:30 P.M., 13 February 1974 in room 4725 to discuss the revised PROP. The following persons were in attendance:

Ms. Mabel Meares, AFR/DP
Ms. Joan Coe, AFR/CWA
Ms. Jeannette Carson, AFR/NARA
Dr. Edwin Martin, AFR/DS
Mr. Peter Daniells, AFR/CWA
Mr. Ronald Penny (Intern)
Mr. Ullmont L. James, AFR/NARA
Dr. Samuel E. Fuhr, AFR/NARA
Dr. Dan Cox, AFR/NARA

Discussion:

The purpose of the meeting was to discuss possible continuance of the African Primary Science Project through FY 1975 based on the A.I.R. report. It was noted that a revised PROP was required according to the requirement set forth in the original PROP of 30 March 1971. Therefore, in accordance with this requirement, the revised PROP incorporates revised project objectives in accordance with the recent project evaluation conducted during October and November 1972 by the American Institute for Research (A.I.R.). In addition, the Committee agreed upon the need to reduce the total costs estimate of $1.5 million in the original PROP to $1.2 million. The current estimates reflect further cost-benefit analysis, whereas the contractor's projections estimates were more or less planning figures.

Regarding the time span between the date of the evaluation and the date of the PROP revision, the Committee can only note the chain of events that took place.

(1) Even though the evaluation was conducted in October and November of 1972, the report was not submitted until February 1973.

(2) AFR/NARA, after receiving the report, proceeded to revise the PROP. On October 9, 1973 an Action Memorandum for the Assistant Administrator for Africa through Hogan was sent up for approval. This was done without proper review of the revised PROP. So, AFR/DP in turn sent copies to CWA and ESA for comment and review which did not take place until 12 December 1973. What happened between October and December is anyone's guess. I might point out that the project committee was not organized

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until December 13, one day after the memoranda Donoghue to James dated 12 December 1973, and Brooks to James, dated 12 December 1973 commenting on the revised PROP.

(3) On 13 February 1974 the Committee met. At this meeting the points raised in both memoranda were thoroughly discussed. The review resulted in the concurrence of all of the A.I.R. recommendations that were raised but noted that most of the A.I.R. recommendations were either beyond the scope of the project or would require considerable funding.

Since receipt of the Donoghue memorandum, NARA has developed a PAR which outlines in considerable detail progress achieved. It was suggested that a copy of the PAR accompany the revised PROP, PIP and the report of this meeting to DP. The Committee felt that all of these materials would present a more complete picture of the project.

The Committee hereby recommends that the attached proposed PROP be approved.

Enclosure: a/s

Drafted:AFR/NARA/TEC:DCox:md:2/26/74

Clearance:

AFR/NARA, ULJames(draft)
AFR/DP, MMeares(draft)

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : AA/AFR, Dr. Samuel C. Adams, Jr. **DATE:** 20 APR 1971

FROM : AFR/DP, David Shear

SUBJECT: Approval of Project Authorizations for Africa Primary Science and Africa Mathematics.

We are in agreement with the TAC recommendation that you approve the attached PROPs. However, the CWR comments which question the marginal priority of these projects, given other possible uses for the funds, must be considered seriously. We discussed these issues and agreed in the TAC Transition Planning Review that these projects should be subject to an intensive evaluation this summer to determine, among other things, if some satisfactory transfer of the curriculum components can be effected on an accelerated basis or if there are sound reasons for extending the activities.

The current TAC transition paper reflects a final termination date of FY 1973 which is inconsistent with the dates shown in the attached Project Authorizations. Pending the planned evaluation it is impossible to determine final dates and funding requirements. We have therefore inserted into Block 10 of the Project Authorizations, that approval is being given only through FY 1973 with the stipulation that the evaluation will attempt to identify the possibilities of accelerated achievement of project objectives or rationale for project extension.

We recommend that you approve the two subject PROPs with the above condition.

cc:
AFR/CWR, F. Spencer
AFR/TAC, M. Belcher
AFR/NA, E. Moore
AFR/EAF, A. Ellis
AFR/CWA, S. Baron

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

April 1, 1971

ACTION MEMORANDUM FOR THE ASSISTANT ADMINISTRATOR FOR AFRICA

THRU: AFR/DP, Mr. David Shear

FROM: AFR/TAC, Marjorie S. Belcher

Problem: Request to approve PROPs for African Primary Science Program and African Mathematics Program.

Discussion: The two subject PROPs are submitted together for approval because of the similarity of goals, strategies, and issues. Both projects constitute the second phases of extensive centrally funded research and development projects. While some local adaption of materials will continue, the primary thrust of activities in the future is to assist African based organizations to educate teacher educators, ministry personnel, and university personnel in the philosophy, material and methodology of the inductive approaches to teaching and learning. This innovative approach to learning derives from the need to relate curricular experience to cultural custom, while providing the African learner with the skills necessary to become a problem solving, questioning citizen of the modern world in which he lives.

As traditional teacher centered, lecture/learn approaches continue to be the mode of instruction in most of Africa, it would be a waste of U.S. and African money merely to distribute the materials developed in the earlier R & D phase of these projects. What is clearly called for are the NSF-type of workshops and seminars for teachers and supervisory staffs which contributed to the change in U.S. philosophy and methodology during the past fifteen to twenty years.

Because of the rapid acceptance of these approaches by African educators and the institutionalization of both projects through the establishment of African management committees the time frame for U.S. assistance is proposed for five years for both the Mathematics Program (FY 1970-1974) and for the Primary Science Program (FY 1971-1975).

The programs are conducted in English speaking countries in Africa, with contract personnel based in Sierra Leone, Ghana, Ethiopia and Kenya. The managers of the Ivory Coast ETV project have made inquiries about using the primary science material in that project, thus indicating an African interest in using these materials in Francophone countries.

There are now over 2,000,000 primary school children in seven English speaking countries being instructed in modern mathematics as a direct result of the R & D phases of the program. In the same countries 200,000 secondary school students and 60,000 future primary school teachers are using Entebbe mathematics materials.

The science materials have now been completed and acceptance is growing. Malawi, for example, has prescribed their adoption as the primary science curriculum throughout the country.

The geographical desks of the Bureau have cleared the two PROPs, with the exception of CWR, whose abstaining memo is attached. This submission is a revision of the African Mathematics Program PROP approved June 19, 1970. The PROP is complete in its current form with the exception of a time phased schematic diagram depicting targets and work plan discussed in the PROP. The schematic will form Appendix B on its receipt from the Contractor.

The approval of the Science PROP will constitute first approval. FY 1971 Funds will be required as follows:

African Mathematics Program $330,000.
African Primary Science Program $270,000.
The Congressional Presentation requests FY 1972 funds for these projects as follows: Mathematics, $300,000, Science, $310,000.

Funding will remain at these levels for Fiscal years 1973 and 1974.

Recommendation: That you sign the two attached Project Authorizations.

Approved _____

Disapproved _____

Date _____

AGENCY FOR INTERNATIONAL DEVELOPMENT (A.I.D.)

PROJECT AUTHORIZATION

1. PROJECT NUMBER	3. COUNTRY	4. AUTHORIZATION NUMBER
698-11-690-357	AFRICAL REGIONAL	0183
2. PROJECT TITLE		5. AUTHORIZATION DATE: 4/26/71
AFRICAN PRIMARY SCIENCE PROGRAM		6. PROP DATED: March 30, 1971

7. LIFE OF PROJECT

a. Number of Years of Funding: 5
Starting FY 1971; Terminal FY 1975

b. Estimated Duration of Physical Work After Last Year of Funding (in Months): 12 months

8. FUNDING BY FISCAL YEAR (in U.S. $ or $ equivalent)	DOLLARS		P.L. 480	LOCAL CURRENCY Exchange Rate: $1 =			
				U.S. OWNED		HOST COUNTRY	
	GRANT	LOAN	CCC + FREIGHT	GRANT	LOAN	JOINTLY PROGRAMMED	OTHER
Prior through Actual FY 71	324						
Operational FY 72	327						
Budget FY 73	286						
B + 1 FY 74	286						
B + 2 FY 75	251						
B + 3 FY							
All Subsequent FY's							
TOTAL	1,474						

9. DESCRIBE SPECIAL FUNDING CONDITIONS OR RECOMMENDATIONS FOR IMPLEMENTATION, AND LIST KINDS AND QUANTITIES OF ANY P.L. 480 COMMODITIES

None

10. CONDITIONS OF APPROVAL OF PROJECT

Project approval is given only through FY 1972 pending an evaluation ~~in FY 71 to determine if it is feasible to accomplish project objectives by fiscal funding extended beyond FY 1973 or if the project warrants longer extension~~ in FY 71/2 to determine the future of this project. The Evaluation Team should include appropriate African educators.

(Use continuation sheet if necessary)

11. Approved in substance for the life of the project as described in the PROP, subject to the conditions cited in Block 10 above, and the availability of funds. Detailed planning with cooperating country and drafting of implementation documents is authorized.

This authorization is contingent upon timely completion of the self-help and other conditions listed in the PROP or attached thereto.

This authorization will be reviewed at such time as the objectives, scope and nature of the project and/or the magnitudes and scheduling of any inputs or outputs deviate so significantly from the project as originally authorized as to warrant submission of a new or revised PROP.

A.I.D. APPROVAL	CLEARANCES	DATE
Samuel C. Adams Jr. (SIGNATURE)	AFR/TAC, MBelcher	4/1/71
	AFR/DP, DShear	4/2/71
AA AFR, Samuel C. Adams, Jr. (TITLE) 4/26/71 (DATE)	DAA/AFR, PBirnbaum	4/23/71
	A/CONT	

ACTION MEMORANDUM FOR THE ASSISTANT ADMINISTRATOR FOR AFRICA

THRU: AFR/DP, Mr. David Shear

FROM: AFR/TAC, Marjorie S. Belcher

Problem: Request to approve PROPs for African Primary Science Program and African Mathematics Program.

Discussion: The two subject PROPs are submitted together for approval because of the similarity of goals, strategies, and issues. Both projects constitute the second phases of extensive centrally funded research and development projects. While some local adaption of materials will continue, the primary thrust of activities in the future is to assist African based organizations to educate teacher educators, ministry personnel, and university personnel in the philosophy, material and methodology of the inductive approaches to teaching and learning. This innovative approach to learning derives from the need to relate curricular experience to cultural custom, while providing the African learner with the skills necessary to become a problem solving, questioning citizen of the modern world in which he lives.

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The geographical desks of the Bureau have cleared the two PROPs, with the exception of CWR, whose abstaining memo is attached. This submission is a revision of the African Mathematics Program PROP approved June 19, 1970. The PROP is complete in its current form with the exception of a time phased schematic diagram depicting targets and work plan discussed in the PROP. The schematic will form Appendix B on its receipt from the Contractor.

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African Primary Science Program $324,000.
The Congressional Presentation requests FY 1972 funds for these projects as follows: Mathematics, $300,000, Science, $310,000.

Funding will remain at these levels for Fiscal years 1973 and 1974.

Recommendation: That you sign the two attached Project Authorizations.

Approved _____

Disapproved _____

Date _____

Drafted
AFR/TAC, RSmail

Clearance:

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : AFR/TAC, Miss Marjorie Belcher

DATE: March 18, 1971

FROM : AFR/CWR, Fermin J. Spencer

SUBJECT: PROP for African Primary Science Program and
PROP for the African Mathematics Program

I have discussed my views with you Marjorie, and also with Bob Smail regarding the subject PROPs.

I honestly feel that both of these programs would provide marginal contribution to the development of Africa. When one takes into consideration that we are in a transitional period, that we have been phasing down on formal education projects of this nature, and that we are at best transporting to a less-developed part of the world, a couple of programs which in our own country have had marginal benefit to the field of education, I think it behooves us to reconsider and perhaps not fund these projects.

There are a number of other points I could mention which would militate against our funding these projects. Let me first discuss the Math Project. The PROP says that it is the intention of the Min. of Education to introduce the materials or the technique of this program to the various countries involved. We have no feeling as to whether or not the African nations really want to accept this proposal. To be sure, the materials have been developed. The new math is well known to most Africanists in the field of development. I am not so sure that they buy it. Here is one guy who doesn't buy it. I am not sure that Africans would buy it. Further, I am concerned that the program would be carried on in strictly Anglophone countries, i.e., Ghana, Liberia, Sierra Leone, Ethiopia and Kenya. I suppose that it would be almost impossible to try to work in a Francophone area, particularly since the problems we face with the French and their desire that French culture dominate African education. Here, I will reflect some of my own experiences in introducing new curriculum materials. The big problem is not necessarily younsters who are being taught, but the teachers who are doing the teaching. Most of the teachers in Africa, and to a certain extent, those in the five countries effected, are ill-prepared (most of them have little but an elementary education themselves). How we can expect these ill-prepared teachers to accept a relatively new program and teach it effectively, is hard for me to comprehend. This especially so in light of the fact that here in the U.S., it has taken us about fifteen years to get new math incorporated into the curriculum. Even so, the difficulties are great, and it would not surprise me at all if the fad were chucked aside. What I am saying in essence is that if we are going to do anything in education in the less-developed countries, we should stop exporting our fads.

As far as the science program is concerned, the same comments that I have for math hold here. I understand that a large number of science units have been developed. I had the opportunity to see some of these units which were developed at Njala University College in Sierra Leone. I can say categorically that I was not impressed. As I pointed out to Bob Smail, about fifteen years ago, I developed some of these same units during a summer work-shop, but take no credit or pride of authorship. However, I say basically these same units at Njala, only with African titles. Again, what we see is a transplant of material developed in this country being given a little bit of cosmetic treatment called African, and then dubbed a new program. I know of a hundred different ways in which we can spend our money better. In light of all the difficulties we face, I would strongly disapprove the approval of both of these programs.

ccMr. Smail, AFR/TAC
Mr. H. Freeman, AFR/TAC

6480357-(13)
PD-AAL-343
37P

A RESEARCH AND DEVELOPMENT PROGRAM

in

BEGINNING SCIENCE CURRICULUM

FOR ENGLISH-SPEAKING TROPICAL AFRICA

26

This proposal requests partial support of the program for a period of ~~22~~ months beginning August 1, 1964. For this purpose, the sum of [redacted] is sought from the Agency for International Development.

$520,000

Submitted by

EDUCATIONAL SERVICES INCORPORATED
Watertown, Massachusetts

May 5, 1964

FOREWORD

The pages which follow deal with some of the specifics of a program of research and development in science education, in and for the English-speaking countries of Tropical Africa. These specifics make up one aspect of the larger African Education Program of Educational Services Incorporated, which includes also the Entebbe Mathematics Workshop and a Languages Program, and which is intended in later years to respond to still other African needs. All these activities are embedded in a broad context, which will be set forth in this foreword.

The African Education Program has been planned and is being conducted as a program of research and development, carried on in the field and intended to extend over a period of years. It proceeds by gathering in Africa experts in the subject-matter under consideration, in pedagogy, and in the arts and crafts associated with the teaching and learning processes. Numerically the African participants dominate these gatherings, but expertise is provided primarily by Americans and, to a lesser extent, British scholars and teachers.

The first stage of any phase of the Program is the development of new curriculum materials, new teaching methods and devices and new teacher-training techniques. From the outset, African teachers are associated with these activities so that a small cadre of trained teachers may be available concurrently with the earliest experimental materials.

In the second stage, the small number of trained teachers carry the experimental materials into African schools, and submit them to the rigors of classroom use. Their experience is fed back into the process of development, regulating it as it continues.

As the materials begin to approach final form, the third stage begins, in which experiments are undertaken in the training of large numbers of teachers.

Any phase of the program will be considered complete when the classroom materials have been developed to the point at which they are ready for widespread use, and when materials and techniques for the creation of large numbers of trained teachers have been perfected. At that point, the period of research and development should be considered at an end. Materials will be in existence, to enter into the educational mainstream in any fashion that governments or educational systems choose to adopt.

This pattern may be exemplified, at least in part, by the Entebbe Mathematics Workshop, which is now active in all three stages. The first experimental materials, for Primary I and Secondary I, were produced during the summer of 1962. Classroom use began during the following academic year, and the information from this early use was utilized during the summer of 1963 to revise these early materials; in addition, materials were prepared for Primary II and Secondary II. All these materials are in experimental use during the current academic year. In addition, a text for use in the training of teachers was produced during the summer of 1963, and was used experimentally in seven institutes during the winter of 1963-1964.

It will be noticed that none of these stages is as yet complete. In particular, the teacher-training program has only been broached; it is certainly probable that the development of new techniques for the training of teachers must precede any real breakthrough.

As the outline above indicates, the process of evaluation is a continuing one, in which experts on testing play a major part. Each Entebbe Workshop, for example, includes a testing group. It is expected that evaluation will be intensified as materials begin to approach their final form. Ultimately, of course, the most valid evaluation will be made by the several host countries, and will determine their decision to adopt or to ignore the completed materials.

Relationships of any phase of the program with existing institutions or with complementary programs must be permitted to develop as the program proceeds. Initially it is important that a beginning be made with a clean slate, and that participants be able to find their own way back to fundamentals. But since the participants themselves come from educational institutions, inevitably close associations develop around specific activities. Again, the Entebbe experience is instructive: by its third year it had developed close associations with Ministries of Education in Nigeria, Ghana, Northern Rhodesia, Liberia and Sierra Leone; with the University of Ghana, the University of Nigeria at Ibadan, the University of Nigeria at Nsukka, Cuttington College and Makerere College; with the Harvard University Nigerian program, the Stanford Arithmetic Project and the Madison Project. With its teacher-training program now in development, it hopes to develop new associations with Columbia University's Teachers for East Africa Program, the Ford Foundation efforts in Nigeria and East Africa, and with programs now being developed in the United Kingdom.

Although in early stages of any program the emphasis appears to be on the development of materials for the classroom, the criterion of success or failure is the extent to which means are found to create a large corps of teachers capable of using the materials effectively. This is particularly true in Africa, where it is extremely desirable to create a teaching profession as an important part of the employment pattern; Africa, like all under-developed areas, needs jobs for its people far more than it needs labor-saving devices. Programs begin with the production of materials for the classroom because it is only upon the basis of such materials that teachers can be efficiently trained, but the proliferation of teachers lies at the heart of all the activities, and an exponential growth in the numbers of teachers over the first several years is essential if any program is to be termed a success. Because the African Education Program is young, this intent is not as apparent as it might be, or as it certainly will become with the passage of time.

It might also be stated that as the later stages are reached, it becomes important to associate developing industries and commercial enterprises with the program, making them aware of the opportunities for the general economy that lie in the area of education. Indigenous interests, governmental and commercial, must be aroused if the educational program is ever to be free from the need for outside assistance. This is not likely to be of major consequence in the Entebbe program, but can be of considerable significance in the science program.

In summary, we see the African Education Program as engaged in research and development leading to the establishment of models, all of them built where they may be seen and understood. These models will be successful only if they embody workable systems which can be copied, adapted and reduced to practice by those who are convinced that they stand to gain.

I. SUMMARY

The proposal which follows seeks [redacted] for partial support of the development of curricular materials in elementary science for use in English-speaking Tropical Africa, during the period ~~July~~ Aug. 1, 1964 through ~~August 31~~ Sept. 30, 1966. These funds will, together with funds from The Ford Foundation, initiate a long-range program similar to the mathematics program already in being.

The support requested here will complete the first phases of the total program, which will include an "African Science Meeting" in West Africa in December 1964, in which African, British and American scientists and educators will meet to survey the extent of the task and its urgency, examine existing programs and decide upon further activities. The procedures are similar to those employed with great success in launching the mathematics program.

Included with this proposal is an account of the likely course the program will take during its first three-and-one-half years. It should be understood that these larger plans are subject to conclusions reached at the 1964 African Science Meeting.

The proposal is divided into the following sections:

II. Background

III. Needs and Opportunity

IV. The Existing Mathematics Program

V. Special Considerations

VI. The Science Program

VII. Financing

VIII. Budget, 1964

IX. Later Stages

II. Background

The activities for which support is asked here are part of the African Education Program of Educational Services Incorporated, and the direct outcome of a six-week meeting held during the summer of 1961 at Endicott House in Dedham, Massachusetts. At that meeting, twenty African, five British and thirty American educators and scholars set forth guidelines for an ambitious program of cooperative effort in education for the English-speaking countries of Tropical Africa.

The first folio of the report of the Endicott House Conference is appended to this proposal. As will be seen in that report, major curriculum revisions were recommended in Mathematics, Science, Language and Social Studies and Humanities. An approximate time-table suggested that work in Mathematics might begin at once, in Language and in Science soon thereafter, and in the Social Studies and Humanities only in the more distant future. The general intent of all these recommendations was to bring to bear, within Africa, the talents of African scholars and educators upon something that would approach a Pan-African level; to offer them the direct and continuing assistance of Americans and British with experience in curriculum reform; and to mount within Africa massive curriculum reform programs of the sort that have been so influential within the United States during recent years. The ultimate intention was to create in Africa institutional resources that might in time permit African educators themselves to initiate and carry out educational research and development on a scale commensurate with African needs.

The plans of the Endicott House Conference have been pursued in the intervening two years with remarkable fidelity. A mathematics program (of

which considerably more will be said below) was launched almost at once, and has already made an impact upon African education. A modest Language program began in 1962, and is progressing favorably. E.S.I. has established firm ties in all the countries of English-speaking Tropical Africa, and enjoys cordial relations with Ministries of Education and with educational institutions. Difficulties which accompanied the early stages of the Mathematics program and which indeed were inseparable from the boldness of the approach have been overcome.

During the years that have passed since the Endicott House Conference, E.S.I. has conducted many of its other activities with an eye to later African programs. In particular, African scientists and science teachers were invited both in the summer of 1962 and the summer of 1963 to participate in the workshops conducted by the Elementary Science Study; twelve Africans have so far taken part in these workshops and one remained for the intervening academic year. These has also been minor African participation in the E.S.I. Social Studies Program.

The success of the mathematics program and of these other activities has led African ministries and individual African educators to urge upon E.S.I. the need to embark upon an African program in elementary science, even in the absence of any awareness on their part that this has been from the outset the intention of the African Education Program. In some cases - in particular Nigeria, Ghana, and Southern Rhodesia - programs have been initiated in the expectation that support would be forthcoming

from E.S.I. In the present atmosphere, it is likely that similar programs will be initiated elsewhere, imposing upon E.S.I. the choice of dispersing its limited financial resources over a wide range of uncoordinated efforts, or of denying assistance upon which many of these initiatives are relying.

Despite the realization that science curriculum reform will be far more difficult to carry out that mathematics reform, E.S.I. believes that the opportunity to embark upon a major program in science now presents itself most forcefully, and that there is every reason to fall in with African desires at this juncture.

III. The need and opportunity

Knowledgeable Africans are well aware of the major deficiencies in curricula currently offered in their schools. These curricula, for the most part, are somewhat pallid copies of British curricula, and reflect in only the most superficial aspects particular African circumstances and needs. They tend, moreover, to lag a generation or more behind current practices in Britain itself, and are thus inappropriate in still another dimension. Beyond this, simply by reason of being British, present curricula are not entirely welcome to the present nationalistic spirit. Finally, African educational leaders are aware that if they are to close the gap between Africa and the west, they will need curricula specifically designed for the purpose.

All this makes the notion of massive curriculum reform extremely welcome within Africa. And nowhere is the need more widely felt than in the area of science. There is an acute realization that science courses prepared in Britain (or indeed in the United States or anywhere else) are wildly irrelevant to African teachers and African children. There is an equally acute realization that the industrial growth which Africans hope to stimulate must rest on a foundation of widespread scientific literacy that is now totally absent. There is an awareness, even in the more advanced African countries, that their own resources are not likely to be adequate to the task of building a new curriculum and training teachers in its use.

E.S.I.,in the past, like other institutions, has received repeated requests for assistance from African countries, both in regard to the Physical Science Study Committee materials and to elementary science. Within the limitations of its own capacities, in the absence of financial support

for such activities, E.S.I. has attempted to assist African countries in their efforts to adapt PSSC materials, although E.S.I. has taken the view that these materials are not necessarily appropriate for Africa. Until now, however, E.S.I. has declined to act in elementary science.

This reluctance has been dictated by the belief that until quite recently elementary science instruction, unlike mathematics instruction or secondary-school science instruction, was inadequately understood within the United States itself, and that until we ourselves enjoyed greater capabilities in elementary science, we were poorly equipped to offer counsel or aid to others.

In the past few years, however, the United States has begun to remedy its own deficiencies. E.S.I. has created its own Elementary Science Study, and has made significant progress in two years of sustained work. Other major programs are moving ahead at the University of California-Berkeley, the University of Minnesota, the University of Illinois, and elsewhere. It is reasonable now to say that the United States can contribute, in both materials and familiarity with effective procedures, to elementary science curriculum reforms in Africa.

In sum, there exists at this moment a remarkable conjunction of favorable circumstances:

1. The African countries feel an urgent need to move ahead in science curriculum reform;
2. The success of the mathematics program makes the E.S.I. African Education Program a favored instrument for these new activities;
3. A body of knowledge now exists within the United States which can be directly and immediately put to use.

It is doubtful that any major educational program, in Africa or elsewhere, has begun with such favorable auspices.

IV. Description of the existing mathematics program

Because it indicates so clearly the goals and the mechanisms of an African curriculum reform program, and because to some extent it can serve as a prototype for further activities, the mathematics program will be briefly described.

At the close of the Endicott House Conference, a steering committee of distinguished American mathematicians was formed, and immediately set about preparing for activities in Africa. The first of these was a five-day meeting at the University of Ghana at Legon, outside Accra, Ghana, during December, 1961. Most of the steering committee was present, as well as several other American and British mathematicians and fifty-five African and expatriate educators and ministry officials from Sierra Leone, Nigeria, Ghana, Tanganyika, Uganda and Kenya. The meeting began with a general review of existing American curriculum reform programs in mathematics. A warm discussion of the relevance of these programs, and more particularly the methodology of curriculum reform, followed, and the question of joint Anglo-American-African efforts was deliberated. In the outcome, participants from all the African countries represented at Accra agreed in principle to a joint effort, and nine working groups were formed to prepare for a major writing workshop during the summer of 1962.

The workshop was held at Entebbe, Uganda. (The location has since given a name to the program and its output, which are now generally known as "Entebbe Mathematics" and "Entebbe materials".) Twenty American and

British mathematicians joined forty Africans and expatriates from the six countries represented at Accra, together with Liberia, Zanzibar, Nyasaland and Nothern Rhodesia. Material produced at the workshop was published in the fall of 1962, and used experimentally in all the participating countries during the first half of 1963.

A second workshop was convened in Entebbe during the summer of 1963. Approximately one-half the original participants were invited to the second workshop, and new participants brought the total to a figure slightly larger than that of the previous year. At this time, Ethiopia joined the program with three participants.

The 1963 workshop has only recently concluded. At this stage, the program can show the following tangible achievements:

1. Textbooks for Primary I and Primary II have been completed, and a copious set of teachers' guides prepared.
2. Similarly, the textbooks and teachers' guides have been completed for Secondary I and Secondary II.
3. A background volume for African mathematics teachers has been completed.
4. A manual for the production, with indigenous materials, of mathematical "hardware" has been completed.
5. A cadre of more than a hundred Africans has been formed, constituting and influential agency for further activities.
6. Experimental classes have used portions of the materials with uniformly encouraging results, and the beginnings of a feedback loop have been established.

To this list should be added intangible accomplishments which may be at least as important:

1) The following is quoted from remarks made at a meeting of representatives of the Agency for International Development by Dr. O. Ukeje of the University of Nigeria, Nsukka, Eastern Nigeria:

> "The Entebbe Mathematics Workshop is not only a project to make available new concepts and new methods in mathematics to African countries, but also it is to me an experiment in international cooperation, and a successful one at that. Here we have for the first time American professors and teachers of mathematics, British officials, professors and teachers of mathematics, African government officials, lecturers and teachers of mathematics -- people from different nationalities, cultures and backgrounds working together harmoniously for the good of Africa and progress of mankind. To me, and I am sure, to most participants, particularly the African participants, the participation in this experiment has been an invaluable experience. I have personally learned a good deal both in mathematics and in group cooperation; and I am sure others have done the same. It is indeed an experience which I think every participant will always remember and appreciate. Those who have made this experience possible can very well feel sure that they have made a remarkable contribution not only in the development of Africans and Africa but also in the fostering of the brotherhood of man."

2) Working relationships, both formal and informal, have been established with ministries of education, universities and colleges throughout Africa.

3) The Entebbe workshop has succeeded, where more explicit efforts had failed, in effecting working relationships within individual African countries between universities and Ministries of Education.

The program now has firm plans, with Ministry and AID support, for use of the Entebbe materials in a program of teacher training during the coming year. By the beginning of the 1964-65 academic year, more than 300 African

teachers will have been familiarized with the materials, in addition to 100 or more who will have used the materials experimentally in earlier years. The foundations will have been laid for an exponential growth in the number of teachers familiar with the materials. Further plans, although less firm, are ambitious, and there is at least a reasonable probability that the Entebbe materials will be in widespread use within Africa in five years.

All this, of course, would be little more than motion for motion's sake without some assurance that the new materials are significantly better than those they replace. The texts have been scrutinized carefully by mathematicians and educators, in the United States and elsewhere. They have been enthusiastically, and at times even immoderately, approved, particularly those prepared for primary grades.

V. Special Considerations

If only because so much reliance is being placed upon experience gained in the mathematics program, it is well to emphasize some of the important differences between problems in mathematics education and problems in science education, and the manner in which those differences must be reflected in the elementary science program.

The most significant of these lies in the heavy reliance of elementary science upon laboratory experience. The science teacher must have at hand equipment far more elaborate than the chalk and blackboard of the mathematics teacher. This is a major problem wherever science is taught; in Africa it is an extremely grave matter. Education budgets do not extend to laboratory equipment even at levels that would be derisory in the United States. Thus the obligation is imposed upon a science program to invent useful laboratory equipment that can be produced at the cost of a few pennies, or even a fraction of a penny. Under any circumstances this would be difficult enough, but even here Africa is at a new disadvantage. In the United States, much has been done by adapting for use in science education industrial products turned out in large quantities primarily for other uses; thus battery-driven electric motors built to drive toy automobiles can serve a dozen different purposes in a science laboratory. Africa, without a major industrial base, has no such industries and hence offers only limited scope to this kind of opportunism.

The shape of an African science program is likely to be determined by the inventiveness of those who design it. For this reason, the present program contemplates 1) the participation at all stages of technicians with experience in the design and production of laboratory experiments and laboratory

equipment and 2) the establishment within Africa of a sizable facility for experiment and equipment design and pilot production, under the direction of American technicians.

The science program will also be forced to take a more particularistic view of problems in science education as they are to be found in the various areas of Africa. With only trivial reservations, it can be said that mathematics in Nigeria is much the same as mathematics in Uganda; the equivalent statement can not be made of elementary science. Biology teaching must vary as flora and fauna vary. Electrostatic experiments which might contribute to a knowledge of physics in Kenya would be a waste of the student's time in much of neighboring Tanganyika. Those elements of science education which might be of great consequence in public health will not necessarily be the same in different areas.

Such problems are likely to increase in importance as the program continues. In the present program, they are reflected only in budgetary provisions for the establishment of centers of operation in both East and West Africa, beginning in 1966, each to be directed by a Western scholar with experience in problems of African elementary science education -- experience, hopefully, which will have primarily been generated during the early phases of the program.

In the long term, the science program is likely to require a far more copious battery of learning aids than mathematics. Consideration of the use of motion pictures, in the classroom and on television, should not be deferred beyond the first stages of the program. In time it is possible that a motion picture studio inside Africa will be required to fill the needs of this and perhaps later educational programs. No provision is made in this proposal for motion pictures.

Finally, the science program will make unusual demands upon African teachers, which will be (in view of their own educational backgrounds and their customary procedures) even more taxing than those made by mathematics. By the time that the period with which this proposal deals nears its end, the needs for teacher training will be equally urgent, and more demanding, than those for curriculum construction.

VI. The Program

The African Science Program has already been initiated with the first steps towards recruitment of a Steering Committee. These steps are still in progress, but the following have already agreed to attend all or part of an organizational meeting:

Henry A. Gleason, Hartford Seminary Foundation. Professor Gleason is an expert in the field of Linguistics and a member of the Language Program of the African Education Study.

David Hawkins, University of Colorado. Professor Hawkins is Director of the Elementary Science Study of Educational Services Incorporated.

Alan Holden, Bell Television Laboratories. Dr. Holden is a chemist with considerable experience in curriculum reform.

John Irvine, Massachusetts Institute of Technology, Professor of Chemistry.

William T. Martin, Massachusetts Institute of Technology. Professor Martin is Chairman of the Department of Mathematics, Chairman of the African Mathematics Program, and Chairman of the Cambridge Conference on School Mathematics

Robert Morison, Rockefeller Foundation. Dr. Morison is Director of the National Sciences Division.

Phillip Morrison, Cornell University. Professor Morrison has been associated with the Physical Science Study Committee since its beginning, and has been active in a wide range of curriculum activities including the Elementary Science Study.

Edward M. Purcell, Harvard University. Professor Purcell is a Nobel Laureate of Physics.

Thomas Weller, Harvard Medical School. Dr. Weller is a Nobel Laureate of Medicine.

Jerrold R. Zacharias, Massachusetts Institute of Technology. Professor Zacharias has been the initiator of many of the more significant curriculum programs of the past seven years.

Professor Jerome B. Wiesner of the Massachusetts Institute of Technology, formerly the President's Science Advisor, will attend the meeting, contingent on his return from a long foreign trip by June 2nd. In any case it is very probable that he will take part.

It is not likely that all of these will serve on a steering committee, but their experience and high interest make it probable that a large proportion will do so.

The Steering Committee will be augmented, with particular emphasis on those who are now active in Elementary Science Curriculum reforms throughout the United States. The proportion of biologists on the final Steering Committee will be such as to reflect the importance of biology in an African program.

In two further respects, the steering committee will change over the next year. 1) Many of those listed above have commitments which will not permit them to devote a major portion of their time to the program. For this reason, the committee will be augmented with scientists who will be able and willing to participate on a continuing and sustained basis in the day-to-day operation of the program. 2) An attempt will be made to include two or more British scientists, of the stature of those listed above. E.S.I. has always contemplated a strong British participation in its African Education Program. This has taken place so far by the association of British scholars in all phases of the program, but policy and planning have remained in the hands of American steering committees. In the two years that have passed since the program began, familiarity in the United Kingdom with E.S.I. and with the African Education Program has increased, and it is now appropriate to build upon this familiarity by associating the British more intimately with future activities. Discussions have taken place with Sir Andrew Cohen, Director of the Department of Technical Cooperation for the British government, and in more general terms with Leslie Farrer-Brown, director of the Nuffield Foundation. The matter will be pursued further when funds are assured.

Determination of policy and supervision of the operations of the elementary science program will be the direct responsibility of the steering committee. It will be not only the privilege of the committee to modify the

program as it proceeds; it will indeed be its duty to follow the program as it develops and to see that at every stage its activities respond to changing needs and to accumulated experience.

The program for the period covered in this proposal, which will be presented in some detail in the next few pages and which is reflected in the budget attached to the proposal, should be read in the light of the role that the steering committee is expected to play. In almost every respect it is a contingent proposal, in which each stage must necessarily be dependent upon the experience gained in previous stages.

There is considerable confidence at E.S.I. that the first phase of the program, beginning with the full recruitment of the steering committee and concluding with the African Science Meeting in December 1964, is realistic and will proceed in close accordance with plans.

Despite the fact that activities after 1964 cannot be precisely stated until completion of the meeting in December 1964, it is essential that E.S.I. be assured of support for at least the following year. It would be imprudent to begin the program without such support, if E.S.I. is to look for the association of African ministries and individuals with the program: each phase of the program implies the following phase and E.S.I. can not honorably permit itself to fall into a position where it is making implicit commitments without the funds with which to honor them.

Clearly the program, if it is as successful as it promises to be, must continue over the long term. A later section is devoted to some of these long-term questions. In the remainder of this section, plans for the period March, 1964 - December, 1965 are given in as much detail as is realistic; it will be seen that plans for 1965 are somewhat more vague than those for 1964. In addition, skeletal outlines are given for 1966-1967. Similarly, in Section VIII

the budget for 1964 is presented with considerable assurance; the budget for later years more tentatively. The budget for 1966 covers only the first five months of the year. Expenses for activities which are expected to last throughout the year 1966 are calculated at 5/12ths of the annual cost.

A. March, 1964 - December, 1964

Beyond the activities of the steering committee, some principal lines of action will be followed.

It will be necessary to establish an understanding with African ministries of education. During the summer months E.S.I. consultants and personnel will visit the African countries. With the help of the A.I.D. Education Officers and the fine contacts made through the Entebbe Mathematics program, it is intended to extend the existing understanding with these ministries, to outline plans and seek co-operation for the December meeting.

African scientists and science educators should be identified with the program as soon as possible. The full co-operation of the A.I.D. Education Officers with their local knowledge will make this task much easier. The summer visitors, using also such help as is available from the African educators at University and school level who work on the Mathematics program, will be asked to make these contacts and to identify people who might contribute to the December deliberations.

Finally, liaison with existing national endeavors on science education reform will be maintained and every effort made to help and stimulate such work where it is non-existent.

During the summer of 1964, three major activities are planned:
1) participation by three scientists and two technicians in the effort begun under Dr. Babs Fafunwa in Eastern Nigeria. Dr. Fafunwa has been associated with

the African Education Program since its inception, and with the assistance of E.S.I. has initiated a small elementary science effort at the Harden Institute of Education in Nsukka. Dr. Fafunwa was with the E.S.I. Elementary Science Study during the summer of 1963, and two members of that study assisted him in a brief workshop held in January in Nsukka. 2) Provision of scientific and technical assistance for other workshops being planned in Ghana, in Northern Rhodesia and perhaps elsewhere. 3) A brief meeting at Entebbe late in the summer, at which the small cadre of participants will meet with each other and with a group from the mathematics workshop. The purpose of these activities will be to lay a base for major pan-African activities. In addition, this time and the following months will be used to recruit participants and provide guidelines for the December conference.

The conference would bring together for five days, possibly in Nsukka, a large proportion of the members of the steering committee; other American scientists, and particularly those associated with elementary science curriculum programs; their colleagues from the United Kingdom; and Ministry, university and schools representatives from English-speaking Tropical Africa. A.I.D. Education Officers from the African countries participating will be invited to attend the final session of the conference. The accomplishments and intentions of American and British curriculum reforms would be presented to the African participants and their relevance to African problems and needs explored. The meeting will be asked to consider the need and urgency of the task of science curricular reform in Africa, the need for a joint Anglo-American-African effort, and what time, funds and expenditure of energy such an effort would require.

Discussions which have already taken place make it reasonably certain that the meeting will proceed to fix a time, a place and to some extent the participants for an eight-week summer workshop, to be held in Africa during the summer of 1965

and to engage the efforts of 20-22 Americans and British (including expatriates) and 30-40 Africans. Groups will be formed in the U.S., the U.K. and Africa to prepare materials and plans for the workshop. It is hoped that local A.I.D. Education Officers may find it possible to co-operate in implementing plans made for their own territories.

B. Calendar year 1965

Work groups in all three areas will be active during the first six months of 1965. Steering committee and staff will concern themselves with planning the workshop.

The summer workshop will engage in three principal activities:

1. The establishment of guidelines for an elementary science course curriculum during some or all of the pre-college years;
2. The preparation of text material for some portions of this extensive curriculum;
3. The invention of laboratory experiments appropriate to the African environment and to African financial and industrial resources.

At the close of the workshop, completed text materials would be edited and printed, in preparation for limited experimental use in the schools.

Emerging from the workshop would also be a facility for experimental design and pilot production of laboratory materials. The facility would be directed by two Western technicians, would employ African labor, and would be fully equipped for shop work and small-scale production. Its first responsibility would be the production, on a limited scale, of laboratory equipment designed at the workshop and intended for limited experimental use; it would thereafter be the producing arms of the program in Africa.

LATER STAGES

C. Calendar year 1966

A second summer workshop would be the principal activity in 1966. The shop facility would continue in action, and limited experimental work would be carried on.

Early in the year, centers will be established in East and West Africa to direct continuing activities, supervise experimental use of materials and feed-back, and provide assistance to Ministries and to teachers using the new materials. Each center will be directed by a scientist or technician who has had close association with the program.

D. January 1, 1967 - September 30, 1967

The program would continue into a third summer workshop.

E. Further plans

This proposal extends only to September 30, 1967. Previous experience indicates that even before this period concludes, the process of training teachers to use the new material must have begun. By the fall of 1967, a substantial amount of classroom material and a sizable corps of teachers should be available to provide a controlled experimental program in the schools.

The teacher-training program itself will have revealed by then special needs, which may well lead to an attempt to provide motion picture production facilities in Africa.

VII. FINANCING

Educational Services Incorporated began to incur charges against the science program early in 1964.

As in earlier portions of the African Education Program (the Endicott House Conference, the Mathematics Program and the Language Program) E.S.I. has sought support from sources other than AID, and in particular from the Ford Foundation. The ability of the Ford Foundation to move quickly upon such requests, and its willingness to provide seed money for ambitious ventures, have proved invaluable.

For this reason, the Ford Foundation was asked to provide $250,000 in order to ensure that E.S.I. would be able to begin activities in March, 1964, as well as to make those commitments for subsequent months that were essential if plans were to be made for the summer of 1964 and the Christmas period. Those funds were accordingly granted.

The Ford grant, together with the total of ~~$544,054~~ 525,000 sought in this proposal, will carry the program through May 31, 1966. Well before that time, E.S.I. will be able to make estimates for further activities.

The prefatory note to the section of this proposal which deals with the budgets states the manner in which costs have been allocated between the Ford Foundation grant and the present proposal.

Earlier, it was suggested that capital investment within Africa may be necessary at some later date. Where it is possible in the West to call upon existing commercial organizations to provide laboratory materials, textbooks, films and other necessities, it may be necessary in Africa to create such organizations.

Discussions have already been opened with the Bank for Reconstruction and Development. Officials of the Bank have expressed their support of the principles and procedures of the African Education Program, and have indicated a willingness to consider long-term, no-interest loans in furtherance of the program when the moment arrives that will make such action desirable.

It might be stated here also that it is the long-term intention of E.S.I. to convert the two centers it hopes to establish in West and East Africa into independent institutions, with joint Anglo-American African directon. Should this task seem practical during the period of this proposal, E.S.I. would determine in discussions with A.I.D. the proper disposition of funds and assets arising from approval of this proposal, either turning them over to the new institutions or continuing to exercise primary responsiblity.

VIII. BUDGET

The budgets which follow cover the period August 1, 1964 - May 31, 1966. Each calendar year is treated separately; there are, therefore, three budgets to be considered: August 1, 1964 - December 31, 1964; calendar year 1965; January 1, 1966 - May 31, 1966.

During the first two of these periods, a column headed "Other Funds" shows those expenditures which will be part of the total program but which will not be charged to the AID contract. These supplementary funds are already in hand. They are already being used to support the program during the period March 1, 1964 - August 1, 1964, which is not covered here. They are shown on the 1964 and 1965 budgets so that the full scope of the program during these years will be manifest.

In allocating support between AID and other funds, differing considerations enter during each of the three calendar years covered in whole or in part in this proposal:

1) August 1, 1964 - December 31, 1964. General expenses have been allocated at a ratio of two to one between AID and Ford Foundation, to reflect the fact that full support was provided by the Ford Foundation between March and August. All charges for summer activities are allocated to Ford funds, since AID funds will not be available at the beginning of the summer. Some Ford funds are also utilized for the December meeting, bringing it up to optimum size.

2) 1965. General expenses are shared equally between AID and Ford. Some Ford funds are also allocated for the summer workshop, bringing it up to optimum size.

3) January 1, 1966 - May 31, 1966. During this period the balance of Ford funds will be used to create permanent E.S.I. establishments within East and West Africa. These expenditures are not shown on the accompanying budgets.

Assumptions made in the budgets that follow are based on experience with the mathematics program, now in its third year. It has been necessary, however, to make certain gross assumptions in those areas where the science program will have special needs. Fringe benefits for American staff members resident in Africa are intended to amortize costs of home leave after two years overseas.

1964

(August 1 - December 31)

		Total	AID	Ford
STAFF	Project director (1/3 time)	3,300	2,200	1,100
	Executive assistant (full time)	5,700	3,800	1,900
	Secretaries (1 2/3 time)	3,960	2,640	1,320
	Fringe benefits at 15%	1,785	1,190	595
STAFF TRAVEL	Project director (inc. 1 African trip)	3,500	3,500	--
	Executive assistant (inc. 2 African tr.)	4,000	4,000	--
	do.	4,000	--	4,000
STEERING COMMITTEE	Fees at $100 a day	6,000	4,000	2,000
	Domestic travel	6,000	6,000	--
	2 Africa trips	4,000	4,000	--
	do.	4,000	--	4,000
CONSULTANTS	U.S. - 20 man-days at $75	1,500	1,500	--
	do.	1,500	--	1,500
	U.K. - 10 man-days at $50	500	500	--
	do.	500	--	500
	Africa - 50 man-days at $25	1,250	1,250	--
	do.	1,250	--	1,250
	Travel - U.S.	2,000	1,000	1,000
	Travel - U.K.	500	250	250
	Travel - Africa	1,000	500	500

(1964 continued)

		Total	AID	Ford
MATERIALS & SERVICES	Rent	1,000	500	500
	Telephone & cable	2,000	1,000	1,000
	Reproduction & mailing	500	250	250
SUMMER ACTIVITIES -- NSUKKA	Fees - Scientists (2)	8,000	--	8,000
	Fees - Technician	2,000	--	2,000
	Travel	3,000	--	3,000
	Local transport	500	--	500
	Board & room -- (3 x $16 x 60)	2,880	--	2,880
	Air freight	1,000	--	1,000
SUMMER ACTIVITIES -- ENTEBBE	Fees - Africans	700	--	700
	Travel	7,000	--	7,000
	Board & room -- (20 x $16 x 10)	3,200	--	3,200
	Local transport	300	--	300
	Air freight	700	--	700
SUMMER ACTIVITIES -- OTHER	Fees - Scientists (2)	8,000	--	8,000
	Technician	2,000	--	2,000
	Travel	3,750	--	3,750
	Board & room (3 x $16 x 60)	2,880	--	2,880
	Local transport	500	--	500
	Air Freight	1,000	--	1,000

(1964 continued)

		Total	AID	Ford
DECEMBER MEETING	Fees			
	Americans (8)	4,000	4,000	--
	Americans (4)	2,000	--	2,000
	British (4)	1,500	1,500	--
	British (2)	750	--	750
	Africans (20)	5,000	5,000	--
	Africans (10)	2,500	--	2,500
	Travel (including staff)			
	Americans (10)	10,000	10,000	--
	Americans (4)	4,000	--	4,000
	British (4)	2,400	2,400	--
	British (2)	1,200	--	1,200
	Africans (20)	5,000	5,000	--
	Africans (10)	2,500	--	2,500
	Board & room (34 x $20 x 6)	4,080	4,080	--
	Board & room (16 x $20 x 6)	1,920	--	1,920
	Air freight	2,100	1,400	700
	Local transport	600	400	200
	Local services	600	400	200
	Equipment rental	900	600	300

SUMMARY

STAFF	14,745	9,830	4,915
STAFF TRAVEL	11,500	7,500	4,000
STEERING COMMITTEE	20,000	14,000	6,000
CONSULTANTS	10,000	5,000	5,000
MATERIALS & SERVICES	3,500	1,750	1,750
SUMMER ACTIVITIES - NSUKKA	17,380	--	17,380
SUMMER ACTIVITIES - ENTEBBE	11,900	--	11,900
SUMMER ACTIVITIES - OTHER	18,130	--	18,130
DECEMBER MEETING	51,050	34,780	16,270
TOTALS	158,205	72,860	85,345
INDIRECT COSTS AT 15%	23,731	10,929	12,802
GRAND TOTALS	181,936	83,789	98,147

1965

(Calendar Year)

		Total	AID	Ford
STAFF	Project director (1/3 time)	7,500	3,750	3,750
	Executive assistant (full time)	14,000	7,000	7,000
	Secretaries (1 2/3 time)	9,500	4,750	4,750
	Fringe benefits at 15%	4,650	2,325	2,325
STAFF TRAVEL	Project director (inc. 1 African tr.)	3,500	1,750	1,750
	Executive asst. (inc. 3 African trips)	6,000	3,000	3,000
STEERING COMMITTEE	Fees	6,000	3,000	3,000
	Domestic travel	6,000	3,000	3,000
	African travel	6,000	3,000	3,000
CONSULTANTS	U.S. - 40 man-days at $75	3,000	1,500	1,500
	Travel	5,000	2,500	2,500
	U.K. - 20 man-days at $50	1,000	500	500
	Travel	500	250	250
	African - 200 man-days at $25	5,000	2,500	2,500
	Travel	2,000	1,000	1,000
MATERIALS & SERVICES	Rent	2,400	1,200	1,200
	Telephone & cable	3,600	1,800	1,800
	Reproduction & mailing	600	300	300
	Office supplies & equipment	1,000	500	500

(1965 continued)

		Total	AID	Ford
SUMMER WORKSHOP	Fees			
	Americans (9 at $4000)	36,000	36,000	--
	Americans (3 at $4000)	12,000	--	12,000
	Africans (35 at $1000)	35,000	35,000	--
	British (4 at $2000)	8,000	8,000	--
	British (2 at $2000)	4,000	--	4,000
	Technicians (2 at $1500)	3,000	3,000	--
	Technicians (1 at $1500)	1,500	--	1,500
	Clerk-drivers (2 at $500)	1,000	1,000	--
	Local labor	1,000	1,000	--
	Administrative officer	3,000	3,000	--
	Travel			
	U.S. - Africa (16 at $1000)	16,000	16,000	--
	U.S. - Africa (4 at $1000)	4,000	--	4,000
	U.K. - Africa (4 at $600)	2,400	2,400	--
	U.K. - Africa (2 at $600)	1,200	--	1,200
	Africa-Africa (35 at $300)	10,500	10,500	--
	Board & Room			
	55 x $16 x 56	49,280	49,280	--
	10 x $16 x 56	8,960	--	8,960
	Equipment purchase	1,500	1,500	--
	Equipment rental	1,500	1,500	--
	Conference rooms	1,200	1,200	--
	Library	1,000	1,000	--
	Transport			
	Air freight	3,000	3,000	--
	Sea freight	1,000	1,000	--
	Local	5,000	5,000	--
SHOP	Technicians (2 at $14,000 p.a., 3 mos.)	7,000	7,000	--
	Upset costs	2,000	2,000	--
	Fringe benefits at 30%	2,100	2,100	--
	Travel	5,000	5,000	--

(1965 continued)

		Total	AID	Ford
SHOP (cont.)	Local labor	7,500	7,500	--
	Rent	1,200	1,200	--
	Shop supplies	15,000	15,000	--
	Materials and services, miscellaneous	5,000	5,000	--
PUBLICATION	Editing and printing	25,000	25,000	--
	Distribution	5,000	5,000	--

SUMMARY

STAFF	35,650	17,825	17,825
STAFF TRAVEL	9,500	4,750	4,750
STEERING COMMITTEE	18,000	9,000	9,000
CONSULTANTS	16,500	8,250	8,250
MATERIALS AND SERVICES	7,600	3,800	3,800
SUMMER WORKSHOP	211,040	179,380	31,660
SHOP	74,800	74,800	--
PUBLICATION	30,000	30,000	--
TOTALS	403,090	327,805	75,285
INDIRECT AT 15%	60,464	49,171	11,293
GRAND TOTALS	463,554	376,976	86,578

1966

(January 1 - May 31)

STAFF	Five-twelfths of $35,650 (See 1965 budget)	14,850
STAFF TRAVEL	Five-twelfths of $9,500 (See 1965 budget)	3,875
STEERING COMMITTEE	Five-twelfths of $18,000 (See 1965 budget)	7,500
CONSULTANTS	Five-twelfths of $16,500 (See 1965 budget)	6,875
MATERIALS & SERVICES	Five-twelfths of $7,600 (See 1965 budget)	3,165
SHOP	Supplies at $10,000 p.a.	4,165
	Technicians at $28,000 p.a.	11,665
	Fringe benefits (30%)	3,500
	Local labor at $20,000 p.a.	8,330
	Travel at $3000	1,250
	Rent at $2400 p.a.	1,000
	Materials and services at $15,000 p.a.	6,250

SUMMARY

STAFF	14,850
STAFF TRAVEL	3,875
STEERING COMMITTEE	7,500
CONSULTANTS	6,875
MATERIALS AND SERVICES	3,165
SHOP	36,160
TOTAL	72,425
INDIRECT COSTS AT 15%	10,864
GRAND TOTAL	83,289

SUMMARY - 22 Months

1964	$ 83,789
1965	376,976
1966	83,289
	~~$544,054~~ 520,000

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PD-AAL-943

A Proposal to the

Agency for International Development

For the Continuation of the

AFRICAN ELEMENTARY SCIENCE PROGRAM

in

Tropical Africa

This proposal requests the sum of $1,499,839 for the period July 1, 1966 through June 30, 1968 for the continuation of the African Elementary Science Program, AID Contract No. csd-772.

Gilbert Oakley, Jr.
Vice President, ESI

Submitted by

Educational Services Incorporated
Newton, Massachusetts
February 23, 1966.

I. SUMMARY

This proposal to the United States Agency for International Development requests the sum $1,499,839 to support the work of the African Science Program during the next two years, beginning July 1, 1966 and extending through June 30, 1968. The African Science Program seeks sustained support for this period so that its members can count on continuity in planning the activities proposed for the next two years and can select the scientists and educators for proposed work and offer them firm commitments in advance of the scheduled work program.

It is intended that these funds will be applied primarily toward establishing the science program on a wider scale than is now possible by

a) addition of science centers for both development and instruction in the participating African nations and ministerial regions and

b) preparation and testing of a greater diversity of science materials for the primary grades, with particular emphasis on those aspects of the program that will hasten the formation of a large corps of teachers trained in classroom use of the new materials and given some insight into the fundamentals of the pertinent scientific disciplines.

The summer workshops planned for 1966 and 1967 will concentrate upon what is needed to provide a variety of materials for classroom testing and to prepare adequate manuals and materials to assist in the enlarged teacher education aspects of the program. The science centers, staffed jointly by representatives from Educational Services Incorporated and the host countries, will complement and supplement, throughout the year, the summer workshops; by providing a range of testing situations, the centers will make it possible for curriculum development and evaluation and teacher education to proceed throughout the year in a number of countries.

The experience of the African Education Program at this time indicates (perhaps with more enthusiasm than intellectual certainty) that the attitudes toward learning which the new science materials are intended to inculcate are as relevant to African as to American children, and that these materials can be used by non-specialist science teachers with some measure of accomplishment. The materials that already have been produced have proved efficacious, and they are welcomed in the African schools, by students and teachers. The African educators now associated with the program are no longer content to adopt patterns of education that have become obsolete, and they recognize that instruction in science (or in any other discipline) cannot properly be "handed down" on paper in a syllabus that views the world with simple illustrations and adult constrictions. The idea of diversity of materials and diversity of teaching approaches -- of the abundance of learning and teaching aids that give both student and teacher some evidence of belief in the natural world -- is now accepted by those who have worked with the African Science Program. Despite the relatively short time the Program has been in existence, a perhaps significant change has taken place and profound change may become possible in the future.

The activities delineated in this proposal are based upon the experience of the African Education Program's work in Africa since 1961, following the Endicott House Conference held in Dedham, Massachusetts. It is not the purpose of this proposal to review all the work that has been initiated since then, in mathematics and in science. Various reports and published text material have been submitted to the Agency for International Development over the years; reports on the Science Program's Kano Conference in February, 1965, and the syllubus of experimental teaching materials produced at last summer's science workshop at Entebbe, as well as a formal report of the workshop, have been submitted to the Agency. It is the belief of the members of the African Education Program's

planning committee, that the accomplishments of the Science Program would be made more effective by the granting of funds to support continuing work over the two-year period.

II. BACKGROUND OF THE AFRICAN ELEMENTARY SCIENCE PROGRAM

The major concern of the English-speaking nations in Tropical Africa is not whether they can sustain political independence but whether they can achieve intellectual independence; not whether they can become involved with nuclear energy and nuclear reactors but whether the people can be freed from a fatalistic attitude towards life. They are less interested in the prospects of manufacturing transistors than in the prospects of growing sufficient food. An increase in their rate of exports of rare minerals is less important to them than a decrease in the infant and adult mortality rate (in Sierra Leone eight out of every ten babies die before they are one year old). Teaching the people to understand the implications of balance-of-payments must wait until they learn that typhoid is more likely to come from drinking dirty water than from a witch's spells.

In August 1960 an International Conference on Science in the Advancement of New States was held at the Weizmann Institute at Rehovoth, Israel, attended by scientists, educators and government officials from around the world. This Conference served as a fulcrum between those who believed that the most sophisticated aid in the form of computers and nuclear reactors and the like, should be given to new nations and those who believed that fundamental assistance in health and education and agriculture should come first.

A physicist at the Massachusetts Institute of Technology, Dr. Jerrold R. Zacharias, found himself in total agreement with Dr. Solomon B. Caulker, the Vice Principal of Fourah Bay College, at Freetown, Sierra Leone. Both men recognized the need to reform the teaching of science and mathematics in the schools in Africa, and they knew that although outside help would be needed, the process of developing viable forms of educational assistance must be carried out in Africa by men of good will and scientific achievement working cooperatively.

Dr. Caulker was killed when his plane crashed on the way home from the Conference; Dr. Zacharias, who is also the Director for Academic Affairs of ESI, returned to the United States determined to pursue Dr. Caulker's suggestion. Accordingly, he organized a six-week meeting at Dedham, Massachusetts, in 1961, at which a group of forty-eight scholars, representing many disciplines, formally brought into being the African Education Program. This meeting--which came to be known as the Endicott House Conference--established a plan of action for making innovations in education in the African schools. Fifteen Africans, from Ghana, Nigeria, Sierra Leone, and Uganda, participated. They and the Americans and representatives from the United Kingdom decided that reforms should be made in mathematics and science and other disciplines, and that these reforms should follow closely techniques recently developed in the United States by collaboration of the university scholars and school teachers working with pilot classes under experimental conditions, and with teacher education an integral component of the projects.

The African Mathematics Program was the first group of the African Education Program to begin work, and it has accomplished much since its inception five years ago. The materials produced at four successive summer workshops in Africa are the groundwork for a sequence of mathematics textbooks designed to present in a systematic and logical manner, exciting to both students and teachers, some of the fundamental mathematical ideas and skills essential in a modern, technologically-based society. The mathematics materials are being used in experimental classes in schools and teachers' colleges in ten African nations: Ethiopia, Ghana, Kenya, Liberia, Malawi, Nigeria, Sierra Leone, Tanzania, Uganda, and Zambia. Other nations have expressed interest in adopting these materials throughout their school systems; but they have been discouraged until the materials can be tested and revised and until those nations are prepared to offer sound

teacher education programs in the use of the materials. Thirty-three textbooks have been published in experimental editions for the primary and secondary schools, and teachers' guides and mathematics textbooks for use in teacher education programs. Over one hundred thousand textbooks are being tried out in approximately six hundred schools in Africa.

The mathematics workshops, with an average attendance of sixty participants each year, and the teacher education institutes, nineteen of which have been held over the school year, have demonstrated the style in which improved science instruction for the schools can be developed. Although the reform of science instruction is different from the work in mathematics (and more difficult) the science program undoubtedly benefits from the experience of the mathematics program. Mathematics already had a place in the African elementary curriculum whereas science instruction, beyond personal hygiene and nature study, was all but non-existent. Awareness of the need for reform was easier to stimulate in mathematics than it would have been in science, and from this beginning receptivity to new ideas has spread. Furthermore, the political and occasional educational restrictions on cooperation have largely been surmounted by the mathematics programs; the science program benefits from the accomplishment and good will of the mathematics program. Thus, the timing in inaugurating a science program has been fortunate.

Perhaps the main reason that mathematics came first in Africa lies in the nature of the subject itself; for all its subtlety mathematics is the easiest study to transport into the classroom. Only chalk and blackboard or paper and pencil are needed to bring into the classroom a vast body of complex models for new ways of looking at numbers, ideas and the world. Insights obtained from mathematics make more effective use of materials that are representative of the world of science. Then,too, the innovations in mathematics instruction in the

United States made by several groups, including the School Mathematics Study Group, the University of Illinois Arithmetic Project, the Syracuse University-Webster College Madison Project, and the Stanford Arithmetic Project, had reached a comparatively advanced stage of development, and the experience gathered from these efforts could most readily be applied to the African situation.

Since the mathematics program was initiated, ESI's Elementary Science Study and other curriculum improvement groups have done much to develop new ways of teaching science to young children in the United States. On the urging of African educators who had participated in the Endicott House discussions and been impressed with these U.S. developments, the African Elementary Science Program was formally organized last February at Kano, Nigeria.

After study of African needs by the various representatives from the United States, the United Kingdom, and the African nations, it was decided to hold a summer workshop, at Entebbe, Uganda, to begin intensive development of new science materials for African primary school children. The printed results of this workshop have been submitted to the Agency, and although most of the twenty-seven units developed by the participants bear too close a resemblance to many of the units developed by the Elementary Science Study in the United States, the workshop achieved one of its primary objectives of creating a give-and-take atmosphere among the Africans; they were able to exchange ideas, suggestions, try out materials in local schools, work with many kinds of materials, study certain aspects of biology, physics, mathematics, and chemistry--or the earth and life and physical sciences--in free discussion (and often argument) with able scientists from other countries. The workshop was held under the chairmanship of Dr. J. S. Goldstein, professor of physics at Brandeis University. Dr. Goldstein will direct next summer's workshop at Entebbe; his colleagues will include professional biologists, physicists, chemists, and physicians.

Educators from eleven African nations worked with the materials of science at the workshop and many are now engaged in trial teaching of the units prepared there. They are also working, along with ESI representatives, on the preparation and adaptation of new science units for their particular regions. The Africans came from Ghana, Kenya, Liberia, Malawi, Nigeria, Basutoland*, Sierra Leone, Rhodesia*, Uganda, Tanzania, and Zambia; they collaborated at the workshop with scientists from Sweden, the United Kirgdom, and the United States. A suggestion at least of the potentialities of the African Elementary Science Program was revealed by the workshop; as a way of involving Africans in curriculum research and the development and trial teaching of science materials, the workshop was successful; it may be anticipated that in the years ahead, first-rate materials will be produced, tested and evaluated, revised, and then implemented in the schools.

Although the African Education Program was not formally organized until the winter of 1965, several Africans, upon their own initiative and with the advice of individuals at ESI, had begun to develop science units for the schools, working with simple, inexpensive and available native materials, such as bamboo, tin cans, mud, sand, and water, and taking into account the environment of the child and his teacher. Many of these same materials are used in the United States, of course.

One of the centers of this activity was at the Institute of Education at the University of Nigeria, at Nsukka. The work was directed by Dr. A. Babs Fafunwa, Dean of the Faculty of Education; he was assisted by Mr. M.B.R. Savage, a representative of ESI's Elementary Science Study and a former staff member of the Study in Watertown. In one of his reports on his work in elementary science for the schools, Dr. Fafunwa wrote: "It seems to me that if Africa in general and

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*Participation from Basutoland and Rhodesia was made possible by private foundation support.

Nigeria in particular is to move from the Eighteenth Century to join a world where science has already become a dominant cultural factor, she needs a built-in scientific attitude on a mass scale. ... The exciting world of science must be brought within the reach of the average Nigerian if the gap between Nigeria and the rest of the world is to be shortened and if she is to exchange her role as a spectator for that of an actor in this scientific world. Indeed, no major industrial revolution can either take place or be sustained, no new society can be built or maintained in a continent where the masses are still held down largely by magic and superstition. ... The main lever to be manipulated in achieving the built-in scientific attitude that I speak of is the education of the very young and the informal education of the adult."

The African continent has a population of 250,000,000 people and school-age population of 50,000,000 (only a small portion of whom attend school); it is estimated that eighty per cent of the people and their schools are to be found in rural areas. Science, as a discipline, is less than forty years old in most parts of Africa. African education has been described as a race between the teacher and the magician to see who gets the child first. The magnitude of the task in Africa is as vast as the challenge, but it is not overwhelming. It may take decades for an impact to be made on whole generations; yet the beginnings made now in modest but ambitious education programs may provide greater rewards than will more costly programs directed to other ends. The total cost of the African Education Program, both mathematics and science, is a microscopic fraction of the total sum of $40 billion given in American foreign aid to other nations since the end of the Second World War.

The conditions that seem essential for continuation of a successful educational assistance program in Africa now are assured. The community of American scholars will provide continuing assistance to the programs. In the

common market of education, which should not be limited by any boundaries, it is heartening to see evidence that a community of African scholars can work cooperatively among themselves and with those from other nations in the West. The cooperation of the Ministries of Education and of examining groups has now been obtained. Most important, that programs of significance and integrity can be initiated, staffed, and accepted, has been demonstrated. References to various appended reports, as well as others already submitted to the Agency, show broad and sustained participation from African colleges and universities throughout the regions where work is in progress. Any national or regional rivalries that may have existed at any time in the past have been subordinated to the needs of the programs, and it has proved entirely practical to hold multi-national teacher training institutes, for instance, as well as the Entebbe and Mombasa workshops. This record of success, and the accumulation of good will, should diminish skepticism that similar cooperation will be difficult to come by when work on other disciplines, including history and the social sciences, is begun.

The foregoing summary should not be taken to mean that there has been an outpouring of African scholars into either the science or mathematics programs. The Africans themselves would hasten to point out that Africa cannot supply in either numbers or quality the mathematicians and scientists necessary to command programs of the type now being introduced; nonetheless, the African nations are providing educators with some competence, as many as they can spare, and they are prepared to continue their support and to augment it when possible. While it must be recognized that the major portion of the work has been done in Africa, with Africans predominant in number, in both the mathematics and science programs, the broader decisions--decisions on direction, on rate of progress, on selection of participants, on the selection of workshops and teacher education and science

curriculum instructional centers--have to a large extent been made by Americans. Even so, it now appears feasible that in the next several years, an organization or organizations in Africa will be established with wise counsel and supporting assistance to provide a more active African hand in the guidance and determination of the programs. The introduction of curriculum development centers, envisaged in the proposal, in all the participating nations, will markedly bring about the kinds of alliances between scientists, mathematicians and educators in the African universities and colleges that would lead to indigenous administrative and academic action.

III. SCIENCE DEVELOPMENT WORKSHOPS

Because educational activities must be designed with the intimate cooperation of the nations for which they are planned, and because this type of cooperation cannot be brought into being on demand, the workshop approach achieves considerably more than curriculum development alone. The workshops held in Africa by the mathematics program over the past four years, and the science workshop held last summer, have engendered understanding and appreciation. The various African nationals participating have glimpsed the immense benefits to be gained for their nations and regions by working cooperatively among themselves and with Americans. Although this is not the major purpose of the workshops, these results should not be overlooked; in a real way, this spirit of cooperation mixed with national pride helps to bring to all the activity of the program a sense of immediacy, high purpose, and continuing commitment.

The science workshop to be held for a six-week period this summer, at Dar Es Salaam, Tanzania, and the one to be held in the summer of 1967 will accordingly benefit in less tangible but visible ways from the earlier ones.

At the first workshop, the participants set out to lay guidelines for science curricula, designed for African use, and covering the entire school period and to prepare and adapt materials for experimental use in schools and for teacher training. The experimental materials produced have been tried in pilot classes, under close supervision, and evaluated, at the "decentralized" science centers in Kenya and Eastern Region, Nigeria, and at other centers. Over the past year, it has become evident that much revision must be done on many of the units prepared last summer; that additional units will have to be prepared reflecting either an omission in the past or fulfilling a unique regional need; that attention must be directed toward the problem of teacher education and training; that major consideration at the 1966 workshop must be given to developing a

teachers' guide and basic concept book, imparting with clarity, simplicity, and honesty some of the fundamental considerations for an investigative, experimental approach to science teaching. The new approach, open-ended and inductive, cannot be learned by reading alone, nor can it be taught by rote. It demands insight that comes from working with all the materials that go into a classroom, including laboratory apparatus that must be inexpensive enough for all children to own or have ready access to, yet engineered with accuracy and durability. By doing science in this manner, the African educators have learned first hand exactly what is meant by the improved new curricula and by allowing a rich diversity of materials to enter a primary school classroom. The workshop this coming summer should benefit from the experience of the previous one, even as the succeeding workshops in mathematics have built upon the experience of the previous ones.

At the workshop in 1966, the primary emphasis will be on:

a) Continuing the development of science materials and learning aids first prepared at the 1965 workshop, in light of a school year's revision, evaluation and experimental teaching;

b) To begin work on science materials in areas that were not adequately covered in 1965;

c) To prepare a teachers' guide, stressing the concepts, points-of-view, and techniques of the newer approaches to science teaching in the elementary schools. African teachers in the primary grades who have had experience with the materials in the classrooms during the school year will assist in preparing the guide;

d) To begin planning the strategies that would enable a large-scale teacher training program to get under way at colleges, universities, and science curriculum instructional centers;

e) To correlate the experience of the two existing science curriculum instructional centers with the work in progress and with the selection and operation of the proposed additional centers to be established following the workshop;

f) To select those African educators and scientists who would best provide the direction and leadership of the African Science Program in the future, and to give them supplementary and selective aid;

g) To continue the search for and development of evaluative techniques that would be valid and would reflect the particular African situation, with major emphasis on finding sound ways of evaluating materials and not necessarily people; evaluation is discussed in Section V of this proposal.

h) To prepare for use among the participants and other selected teachers a body of science materials, including laboratory apparatus, visual aids, tests, and written science units, similar in structure but more extensive than the body of materials produced at the 1965 workshop;

The workshop to be held in the summer 1967 would concentrate, accordingly, on the revision and evaluation of existing materials and development of new materials so there could be enough science units to enable all the grades in the primary school to use to some extent an experimental science curriculum. Testing and examination would receive much attention; since adequate tests have yet to be devised in the United States that reflect sense and sensibility to both teacher and student, it may be premature to state categorically and without qualification that adequate and useful tests will actually come into being by 1967, either in the United States or overseas, in Africa. The major problem

of teacher training also would receive major attention at this workshop. If the experience gained over the past five years in curriculum reform and improvement in Africa is to be exploited fully and wisely, then means must be found and strategies developed to recast the undergraduate curriculum of prospective teachers to guarantee continued curriculum innovation in the schools and to prevent stagnation in the colleges. The faculties of teacher education schools in Africa will have to be brought intimately into the activities of contemporary curriculum reform. If curriculum reform is to have more than a temporary impact on educational practice in Africa, the effort must turn increasingly to the faculties of those colleges whose predominant concern is to prepare teachers. At the 1967 workshop and thereafter, the African Science Program will begin to direct its efforts more toward the immense problem of how to train teachers to make the best use of the science materials. It must be recognized that the science centers that are now attached to colleges and universities are making headway in exactly this direction. This program will limit it's efforts to working with teachers only in the context of the experimental program.

IV. CURRICULUM DEVELOPMENT CENTERS

The science program must take a more localized view of problems in science education as they are to be found in the separate regions of Africa. With only trivial reservations, it can be said that mathematics in Nigeria is much the same as mathematics in Uganda; but the equivalent statement cannot be made for elementary science in all Africa. Biology teaching in the lower grades must vary as flora and fauna vary. Electrostatic experiments that might enliven physics in dry Kenya would be a waste of the student's time in the humidity of neighboring Tanzania. The specific consequences of science education in public health will not necessarily have the same weight in different areas. All the science materials developed at Entebbe, no matter now diversified the viewpoints of the developers, cannot be expected to travel equally well in all nations. The curriculum development centers that we will cooperate with in each of the participating African nations and ministerial regions can be expected to make the necessary transitions to provide for appropriate local use and testing.

Within the context of this program the centers will be concerned with:

a) The continued development, trial teaching and regional adaptation of primary science curriculum materials;

b) In-service training programs for primary school teachers;

c) Consultation and guidance for science tutors at local primary teacher training colleges;

d) The provision of guidance to ministries of education on science syllabus revision.

The science centers, based on the planning already done by a number of participating countries, will take different forms. Some will be university oriented; others will be operated directly by the ministry of education. These differences tend to reflect the major source for change in the local countries. In some participating countries the concern with primary science is only part of a larger concern with curriculum development in a number of subjects.

The African Education Program would also provide funds for the materials, tools, supplies, resource books, necessary to carry on experimental design work, and funds for travel by the science educator to conduct in-service training courses for teachers and teacher training college tutors, and to bring in such teachers and tutors to the center for instruction. ESI staff members would concern themselves with the priorities and educational objectives of the host country and would work under the administrative direction of host country personnel.

In most of the centers ESI will assign a science educator to serve as the nucleus for the development work in primary science carried on in his region. In a few centers we plan to assign an additional one or two staff to investigate the extent to which a modest 'team' approach will accelerate the production of materials. There is a strong conviction that, especially during the initial stages of a center's operation, the additional manpower will provide a significant thrust to the program.

The centers will be an African institution created with African resources and augmented by American staff members. The extent to which this program will be successful in Africa will be determined by the extent to which the African ministries will commit their own limited resources of manpower, facilities and funds. To date the Africans have been more than willing to press on with the program on this basis.

V. EVALUATION

Pronouncements of intransigent goals in education are as misleading as wrong, for education, by its nature, is an experiment, and an incomplete one. The measure of success can be read only in profoundly subtle ways: the invisible, quiet and delicate balancing of inquiry and understanding that occurs in each classroom, between each student and his teacher. No scheme has yet been devised that adequately and truly defines the transfer or "mixing" of knowledge and insight in the classroom; tests may measure accomplishment at a given period of time on a set body of materials; they seldom measure understanding.

The evaluation of programs of such social action as education or public health is controversial. On the one hand, there are those who argue that no action of this type should be continued unless it can be proven to be effective. On the other hand, there are those who believe that evaluation is both destructive of the effort being evaluated and impossible to carry out effectively, in any case, due to the complex interactions of the factors involved. It is likely that both of these views represent extremes, but it is not particularly useful to say that the truth lies somewhere in between unless fairly precise statements can be made concerning the types of evaluation that are effective and those that are not. Some of the assumptions underlying these two positions are not factual but are based on strong opinions assigning priorities to important human goals. Those who wish to have an evaluation of a social action program early in its development usually assume that a rather restricted goal of the program is the only relevant goal. For instance, it is assumed that efforts to teach mathematics to third grade children have as their only goal an increase in the mathematical skills of this particular group of children. Those who oppose "evaluation" often see the teaching of mathematics as a vehicle for accomplishing a wide range of objectives which include increasing mathematical skills but which also include developing

logical thinking, changing motivation and interest patterns, and so forth. Such individuals often think that premature evaluation may interfere with the achievement of long range goals.

We shall assume here that the primary purpose of an evaluation of teaching methods is to provide simple feedback of information on success or failure to those developing the curriculum so that they can try to improve their own efforts. With this as a goal, then methodology loses some of its awe-inspiring character. A real beginning can be made by a clear separation of the goals of evaluation from those of curriculum development and by recognizing that evaluation is a means to an end. We are then likely to interpret evaluation broadly to include a number of activities: the day-to-day observation of results by those carrying out the teaching program; the more systematic observation of results by independent and perhaps less biased observers; intuitive evaluations by those with unique training or unique opportunities for spotting special aspects of the program; systematic experimental studies with controls; and so forth. Each of these approaches may play a useful role in an evolving curriculum which is modified by a process of successive approximations, but each must also be judged with practical common sense, since each of these approaches in some way complements the others.

Just what is being evaluated is not always clear. In some sense it is possible to evaluate almost any type of human activity, but in designing a specific evaluation program, there are obvious advantages in being clear. In this discussion, we are talking about the evaluation of specific teaching methods that are in some way bound to specific subject matter. It is convenient to call these "units". We are not evaluating students, teachers, school systems, our success in recruiting good teachers, our success in developing motivation in teachers, etc.

There are many different ways in which the patterns of thinking of the uneducated African are incompatible with imaginative scientific thinking. In my opinion, the crucial issue is that people who rely heavily on "traditional explanations for natural events" are not only robbed of the use of more scientific explanations; they don't even see that there is a difference in kind between their traditional explanations and the scientific ones. This means that even if they manage to learn scientific "facts" they do not have the full use of them because they are likely to be fitted into traditional views on causality, and they are not likely to increase the problem-solving skills of the individual student. Our great scientists may be highly intelligent, and they may have a great mass of factual knowledge at their command, but what makes them successful is that they have by successive steps learned to solve problems posed by nature. They can transfer problem-solving techniques from one area to another.

It does not seem to be too difficult to find out whether students have acquired scientific "facts". It is much more difficult to determine whether students have developed new problem-solving skills as a result of a series of teaching exercises. It is even more difficult to know whether students can carry over problem-solving methods from one task to another. We need to develop evaluation methods that are concerned with this aspect of learning. If people believe they are interested in teaching effective scientific problem-solving, yet try to evaluate their results by finding out if students have acquired facts clearly, they are unsure what their curriculum development goals are. They not only don't get an answer to the question they believe they are interested in, they also shift the perception of the goal in the minds of everyone concerned.

An evaluation process may provide useful information and yet interfere in some way with the realization of broad teaching objectives. For instance, an evaluation program can antagonize the teachers or the students and in this way

spoil the very program it is designed to assist. Evaluation often takes time that could be spent in other ways; it often requires a somewhat compulsive attitude toward record keeping which is not compatible with a spirit of enthusiasm or with moment-to-moment flexibility in exploiting chance occurrences in the classroom. Because it is easier to evaluate simple skills like memorization of facts than the more complex skills of inductive reasoning, evaluation programs sometimes work subtly to lead the teacher to prefer those teaching strategies that lead to easily measureable results, even if these are less important in the long run than those that are difficult or impossible to measure. Evaluation programs often employ outside teachers and observers. Such individuals, even if they are friendly and are motivated to assist the teacher, may inhibit the processes of teaching or learning. These examples are not listed to discourage evaluating methods of teaching. It would be just as easy to describe evaluation methods that are not in conflict with any teaching goals. They are mentioned to emphasize that since such conflicts can occur, it is important for those planning or carrying out evaluation to be aware of this fact and to act to minimize the conflict whenever possible, and to be aware that evaluation goals are really subordinate to the teaching goals.

An evaluation of the effectiveness of a teaching unit is really an experiment of considerable complexity, if we wish to know at some level of confidence how far we can safely generalize from our conclusions. It is useful to examine an analogy, the evaluation of the effectiveness of drugs in treatment of disease. Since drugs are given to complex human beings, a large number of individual differences may influence the outcome, namely age, sex, inherited differences, previous learning, personality differences, attitude, and many others. Each of these really represents an alternative explanation for results we attribute to our drug treatment. The real point of experimental design, in my opinion, is to

select the most plausible alternative explanations that might account for our treatment effect and then design studies in which these factors are held constant, are varied systematically, or are investigated to determine that they behave in a random fashion. Among the most difficult factors to "control" in drug studies are those attitudes in both subjects and investigators that can be lumped under the heading of suggestibility. Drug studies must be designed to evaluate this type of factor. We have a similar problem in evaluating the effectiveness of teaching methods, with the additional difficulty that one additional group of persons can be suggestible--the teachers. All of this suggests that if teaching experiments are to be designed so carefully that we can be very sure which component of the total situation is contributing the major component of the alleged treatment effect, we must be very thorough indeed in planning an elaborate design.

Experiments on rats can be carried out by a few well-trained technicians. Studies on human beings require the same or greater training, but it turns out that many more people are often involved as experimenters and many additional skills are needed. Human beings must be treated like human beings. This requires that some of the members of the experimental team be sensitive to human needs and skillful in arranging for compliance to simple requests. They must, however, also meet the requirements for careful experimental design and careful uniform reporting of observations. These skills are not easy to find in the same individuals. As a result, teams are often set up. This adds still another requirement--an effective team leader. There can now be the difficulty that the team may be bigger than the group of people being studied or that at least such a large team will be a distracting influence. A major quality that is required in investigators of human behavior is the willingness to be found wrong. It requires a great deal of sophistication to be comfortable while ones' favorite hypothesis is torn to shreds by a systematic team.

Research always goes on in a larger social setting. Studies of rats can be done out of sight of most people in a laboratory, so that they often do not need much evidence of real social approval to be possible. Studies of human behavior cannot be hidden and should not be hidden. As a result, any good investigation of human behavior must occur in a social setting that is congenial. It is often very difficult to know what the reaction to a study will be until it has begun. Pilot studies are often required to find out whether certain types of investigation are feasible.

The evaluation of a teaching method can be considered as a scientific experiment requiring the most sophisticated techniques of design and statistics, and highly trained teams of investigators,and a receptive social setting. If these requirements are not met, the result may be at best meaningless and at worst destructive. Systematic investigation should not be abandoned when it is difficult, but it should not be begun if it is impossible. Instead of beginning an investigation that cannot be effective, it might be reasonable to substitute a strategy of developing the capacity to investigate; but this effort should be kept in scale. The evaluating tail should not wag the teaching dog.

During the summer of 1965 Dr. Anthony Elite attended the summer workshop at Entebbe. Dr. Elite is a psychiatrist interested in the new and rapidly expanding field of social psychiatry and in the effects of culture and cultural change on cognitive processes. He went as a participant observer, not as a therapist or teacher. His objectives were to enter as fully as possible into the activities of the workshop and to develop personal friendships with the participants. In this role he attempted to discuss evaluation informally, recording in his notes the opinions and attitudes of each. He also observed behavior in workshops to see if opinions in private and behavior in groups were reasonably consistent. He also hoped to observe as many teachers in the classroom as possible to attempt to

detect the subtle psychological factors that interfere with the teaching of scientific problem-solving by inductive methods. This turned out to be difficult because there were only limited opportunities to see typical rural African classrooms. It should be stressed that he was not trying to find out whether individuals held "correct" or "incorrect" opinions. In fact, he had no pre-conceptions of the "right" answers. He merely wished to know what the range and character of opinion was. Needless to say, he was probably influenced in his personal views by the general spirit of the workshop, just as the other participants were. He also hoped to learn from those African participants who had knowledge of local conditions what unique difficulties in teaching might be encountered in their areas. He did not encourage discussions of evaluation at a technical level. It is obvious that this method of obtaining information has its limitations, but it does not tend to contaminate the field by telling each participant what opinions are expected. This method was able to detect difficulties that would face systematic evaluation only by picking them up in opinion. No systematic evaluation of units was attempted.

Opinions on evaluation varied widely among the African participants, much as they did among those from the U.S. and the U.K. Many individuals felt that evaluation of units was premature and would interfere with the enthusiasm of teachers in developing and using new units. Other Africans with considerable respect for traditional teaching methods were not sure that the new methods of teaching were superior to those with which they were familiar and suggested that some comparisons might be desirable.

There were marked differences among the participants in their knowledge concerning different methods of evaluation. It seems possible to draw the conclusion that few countries could carry on large-scale systematic evaluations utilizing rigid experimental designs with their own personnel.

One problem emerged that might interfere with systematic evaluation of units. It was clear that although a large number of studies were done to develop science teaching units, the finished report was not always the most useful product of the activity. All of the participants were learning from one another. This mutual education will probably continue to be an important dividend of workshops for some time. If units were immediately subjected to critical review and comparison with other units, the teachers who developed them might be hurt and might tend to participate in invention with less enthusiasm. This conclusion needs to be checked by other methods.

A review of all of the units developed shows that the differences in opinion on the goals of curriculum development were reflected in the units themselves. It does not seem desirable to fix on a specific set of goals for these units. Early attempts at evaluation might crystalize goals and they might tend to be different than they would be if there were a longer period of experimenting with teaching methods.

I conclude from this set of observations that it is premature to begin systematic testing of science units being developed for use in African schools, for three reasons. First, the Africans themselves do not have the experience and personnel to carry them out. Second, it is not desirable to have evaluations done by outsiders. Finally, the curriculum development activity is playing a useful role in encouraging free discussion of teaching methods among both African and other participants which might be inhibited by too much insistence on evaluation at this time. Instead of beginning immediately to evaluate, it would be more desirable in the long run to develop the "capacity to evaluate" in the groups of African teachers who will cluster about the new centers. The notion of capacity should be interpreted broadly to include a number of things: background knowledge of the goals of evaluation and their relation to curriculum development goals;

personnel; knowledge of experimental design, and many others. The most important of all is that evaluation should be regarded as a tool used in the trial-and-error development of teaching instruments and not as a way of finding fault with a particular way of doing things.

The evaluation program is being kept small when compared with the overall workshop activity. It consists of three components, all of which provide sensible guidelines for research:

a) Developing the Capacity to Evaluate.

b) Conducting Feasibility Studies (to determine whether systematic studies are possible, whether they are acceptable to the social system in which they are to occur, and whether they could be destructive toward other social goals).

c) Conducting Pilot Evaluation Studies.

VI. PLANNING THE PROGRAM

The African Education Program has special needs that should be taken into account in planning for the next two years. Every program of curriculum development is a complex one, but the vast problems ahead in Africa offer particular challenge, as well as promise. The nature of the task can best be understood if the program discussed in this proposal is considered a project in research and development.

The initial phase of research may end with the introduction of new materials in the classroom, but the developmental phase does not end there. New materials demand changes in the pre-service and in-service education of teachers. It is unrealistic to schedule rigorously each stage of a research and development program, with specific goals and target dates. Preparation of new materials and development of a program to train teachers to use these materials may have to proceed simultaneously, even though testing and feedback may call for major revisions of the materials before they can go into the classroom.

Without maximum flexibility, a research and development program in education could fail to take advantage of unexpected opportunities. The procedures that are to be followed during the next two years can be outlined--as they have been, with the increasing inter-action between the curriculum development work at the workshops and the testing, evaluation, and development of these materials through the regional curriculum development centers-- but some of the turning points must be spelled out in the direction and progress of the program. It is anticipated that there will be at least another three year's of activity along the lines indicated in this proposal. The development of new course materials in science, the education and training of teachers, and the evaluation of the materials will continue to be the major concern of the African Elementary Science Program.

APPENDIX A.

PLANNING COMMITTEE - AFRICAN ELEMENTARY SCIENCE PROGRAM

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KANO, NIGERIA, CONFERENCE PARTICIPANTS - FEBRUARY, 1965

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APPENDIX B.

SCIENCE CENTER DEVELOPMENT PLANS

GHANA

Discussions held with the Ghanaian Ministry of Education and representatives of the University College of Science Education, Cape Coast, in the summer of 1965 revealed that a decision has been reached to establish a Science Centre at the University. Ghana has pledged a graduate science teacher and an elementary science teacher to the Centre, and the University has agreed to second one of its lecturers. ESI is currently recruiting a qualified science innovator.

KENYA

The Primary Science Centre in Kenya is already well established in Nairobi as part of the Curriculum Development Centre of the Ministry of Education. An ESI appointed Science Innovator, Mr. Wm. S. Warren, has been working at the Centre since September 1965. An active program of unit development and teacher training is currently under way (see Appendix C).

LIBERIA

A decision has been reached to proceed with plans for the Liberian Science Centre. Government and University representatives have met and decided that the Centre would come under the aegis of the Department of Education with support from the University, which has already been pledged. ESI is awaiting official word from Dr. Doris Banks-Henries of the Department of Education before proceeding with recruitment of science innovator.

MALAWI

A visit by Messrs. Aldrich and Robins of ESI in November, 1965, revealed that plans are well along for establishment of a Science Centre at the Domasi Teacher Training College near Zomba. The Malawian science innovator has been identified and facilities are being made available. ESI has a skilled science innovator available to take up assignment in Malawi. Official acceptance of offer is expected momentarily.

NIGERIA

Eastern Region

ESI has a science innovator, Mr. M.B.R. Savage, currently located at the Science Centre at the University of Nigeria, Nsukka. Work is progressing on local adaptation of Entebbe units and other materials.

Mid-West Region

ESI has a qualified innovator available for assignment to the Ministry Science Centre planned at Benin City. Plans for the development of the Centre are well along and the Ministry appears to have made the necessary commitment of resources. Official acceptance of ESI's offer of help is awaited.

Western Region, Northern Region and Federal District

Plans for establishment of centers in these three regions are still in early stages of development.

SIERRA LEONE

Word has just been received that plans have been completed and approved for a new Science Curriculum Development Centre to be located at the University of Njala. ESI is proceeding with recruitment of suitable innovator. Assurances have been received that significant local talent will be devoted to the centre.

TANZANIA

The Ministry of Education has recently notified ESI of its acceptance of ESIs proposed Innovator, Dr. Eugene Godfredsen. Dr. Godfredsen's credentials have just been forwarded to Washington for AID approval. The Science Centre in Tanzania will be organized under the Institute of Education located at the University College of Dar es Salaam. Facilities will be available by the summer of 1966 and it is expected that Dr. Godfredsen will be on the job by September 1, 1966.

UGANDA

A visit to Kampala in November 1965 by Messrs. Aldrich and Robins revealed that although there seemed to be a general agreement that a Science Centre was desirable, no decisions or real planning had been done. A preliminary Science Centre plan had only just been submitted for consideration. It is possible that the Institute of Education may become the guiding authority for the Ugandan Centre when it becomes a reality.

ZAMBIA

A meeting with Ministry of Education officials in Lusaka in November revealed real interest in a Zambian Science Centre. An appropriate physical location appeared to be a major problem although Lusaka was mentioned by most as the logical location. The Centre will in all probability be operated under direct Ministry supervision. ESI has a qualified innovator for posting to Zambia but no official acceptance has been received.

2/13/66

APPENDIX C.

CURRICULUM DEVELOPMENT CENTRE (SCIENCE SECTION)
P.O. BOX 30231
NAIROBI, KENYA

PROJECT PLAN 1966 - PRIMARY SCIENCE TRIAL SCHOOLS

In order to gain a better evaluation of the new primary science materials both textual and physical, that are being developed at the Curriculum Development Centre, it is necessary to run trial classes in a limited number of schools. The information gained from the teachers and the students will be invaluable in helping to determine how these materials should be revised before receiving wider distribution. The following is the projected plan to accomplish this objective. This trial teaching will be on an experimental basis and none of the materials will be widely distributed until all concerned in the education system have had an opportunity to assess their value.

I. Primary Schools

It is necessary to select twelve schools, six from the Kiambu District and six from the Nairobi City Council District in order to obtain a representative sample of schools for these experimental trial classes. Each of the three persons assigned to the Primary Science Section of the Curriculum Development Centre will work with four of these schools. In order to minimize the disruption in each school, the trial classes will include two standards from each school. Trial classes will be run in Standards IV through VII. A diversity of schools should be selected so that the evaluation will be more meaningful in terms of the Kenya school system. Among the twelve schools selected there should be: rural and urban schools, NPA and Non-NPA schools, large and small schools, single stream schools and multiple stream. In general it would be best to select schools that have not had experimental programs in the past.

II. Primary Science Materials

The materials that will be tried will follow the content as set forth in the syllabus. The major difference between these materials and the present materials will be the approach to teaching the topic. Rather than relating facts of science the approach will be to have the students work through simple experiments using homemade equipment. The students will then learn the process of science through solving the problems presented in these experiments. The teacher's role will be to act as a guide rather than a conveyor of facts. The following topics will be used for the trial classes: (topic names are taken from present syllabus):

1. Behaviour of local plants and animals.
2. Properties of liquids.
3. Properties of air and other common gases.
4. Weight, size and volume of objects with an emphasis on balancing for comparison.
5. Study of local soils and the variables required to increase productivity - agricultural base.
6. Study of mechanics.
7. Study of heat.
8. Study of weather.
9. Study of light.
10. Study of rocks and soils.

These trial classes will be designed to enhance rather than detract from the preparation for KPE. However, the main objective will be to teach the students how to think rather than memorize facts.

The materials brought into the classes for the trial teaching will be composed of things like bottles, tin cans, matches, water, boxes, simple balances, etc.

This material will be paid for by the Curriculum Development Centre and will be left at the schools at the termination of the trial teaching. The latter will be done in hope that the teachers will continue to use this "Homemade" equipment.

III. Procedure

Each of the three people assigned to the primary science section will spend on the average half a day per week in each school working with two standards. In some instances the person from the Centre will teach the class, in other instances the regular class teacher will teach the class and in others they will jointly teach the class. In addition there will be monthly meetings attended by the teachers from the trial classes and the primary science personnel to discuss the material being used in the trial classes and to construct simple equipment for use in the classroom. The transportation to and from these meetings will be paid by the Curriculum Development Centre. The teachers who participate in the trial classes will have to be released half a day per month to attend in-service meetings at the Centre. The personnel from the primary science section will work in the schools during the regularly scheduled classes so as to keep the interference with the regular schedule to a minimum.

The information gained from these trial classes from both the teachers and the students will be used to revise the materials so that they will be more suitable to the local situation. The trial teaching will be carried out during the first term.

IV. Progress Reports

A progress report will be submitted to the Director of the Curriculum Development Centre with copies to the Chief Education Officer, Nairobi City Council and the County Education Officer, Kiambu District, at the end of the term. This report will contain a proposal for further trial teaching during the second and third terms.

V. Additional Activities

The personnel from the Primary Science Section will be working on other projects to aid in the development of primary science materials as follows:

1. Each member of the primary science staff will be trial teaching materials in one of the Teacher Training Colleges.
2. Orientation sessions on the new approach to science will be held for the other Teacher Training Colleges.
3. Science Tutors from the Teacher Training Colleges that attended the December Seminar held at the Curriculum Development Centre will conduct trial classes in their areas using the same materials that will be used in the aforementioned schools. The information obtained from these trial classes will also be used in revising the materials.

CDC
27th January, 1966.

APPENDIX D.

SUMMARY BUDGET

African Elementary Science Program

July 1, 1966 - June 30, 1968

Summary	7/1/66-6/30/67	7/1/67-6/30/68
	$	$
Administration	113,020	102,020
Science Centers	337,250	482,500
Workshops	218,798	210,226
Overhead	47,046	67,715
Total	716,114	862,461

Total Two-year Program Cost	$1,578,575
Less:	
1. 1/18/66 requested reallocation of current contract funds to cover 1966 Workshop commitments	62,200
2. Program costs funded under existing contract for period 7/1/66 - 7/30/66	16,536
Total Net Two-year Program Cost	$1,499,839

Program Direction & Administration	7/1/66 to 6/30/67	7/1/67 to 6/30/68
Staff		
	$	$
Project Director	16,000*	17,000
Secretary	6,000*	6,500
Clerical assistance	3,000	5,000
Staff Travel		
Project Director (2 Africa visits/year)	5,000	5,000
Recruitment travel	2,000	2,500
Planning Committee		
Chairman @ $100/day	5,200*	5,200
Consultant fees @ $100/day	4,000*	4,000
Overseas Travel	19,000	19,000
Local Travel	1,500	1,500
Subsistence & meeting facilities @ $22/day	1,320	1,320
Materials & Services		
Telephone & cable	5,000*	5,000
Reproduction & mailing, office supplies	5,000*	10,000
Printing	40,000	20,000
Total Program Direction & Administration	113,020	102,020

*Approximately 8% of figures shown funded under present contract.

Science Centers	7/1/66 to 6/30/67	7/1/67 to 6/30/68
Science Educators		
	$	$
Salary $15,000 9 (14)	135,000*	210,000
Pre-service training expense	7,500	10,000
Travel: family & personal effects 7 (7)	35,000	35,000
Local Transport $4,000 9 (12)	36,000*	48,000
Allowances $5,000/yr 9 (14)	45,000*	70,000
Fringe Benefits ave. 15%	20,250*	31,500
Services		
Consultants $50/day x 30 days x 9 (12)	13,500*	18,000
Equipment services $3,000/yr 9 (12)	27,000*	36,000
Labor $1,000/yr 9 (12)	9,000*	12,000
Teacher Training: materials & services $1,000 x 9 (12)	9,000	12,000
Total Science Center Costs	$337,250	$482,500

*Approximately 5% of figures shown funded under existing contract

Note: Numbers in parenthesis indicate figures applicable to '67-'68 program.

African Science Workshops	1966	1967
Staff salaries	$	$
Workshop Administrator (7 weeks) $300	2,100	2,100
Administrative Assistant (7 weeks) $150	1,050	1,050
3 secretaries 7 weeks $125	2,625	2,625
Clerical hire 8 man weeks $100	800	800
Local workshop & Lab. labor, Drivers, Artists	3,500	2,900
Fringe Benefits ave. 15%	1,525	1,525
Stipends		
20 U.S. & U.K. participants ave. @ $400 x 6 weeks	48,000*	36,000
35 African participants @ $130 for 6 weeks	27,300*	27,300
Consultants 40 days @ $50	2,000	2,000
Local teachers 6 x $5/day x 30	900	-
Travel		
20 U.S. & U.K. participants @ $1,300 (15)	26,000	19,500
35 African participants $700	24,500	24,500
2 U.S. Science Center Personnel $700 (14)	1,400	9,800
5 Staff $1,200	6,000	6,000
Per Diem costs 25 x $15 x 4	1,500	1,200
35 x $15 x 2	1,050	1,050
Room and Board		
62 Participants & Staff x $16/day 52 for 44 days	36,608*	38,016
10 for 49 days	7,840	7,840
Misc. meals - official visits & part-time participants	1,200	800
Meeting room & Work Shop Rental	2,000	2,000

Materials & Services (cont'd)

	1966	1967
Materials & Services		
	$	$
Stationery, duplicating & office supplies & services	1,900	1,900
Printing	3,100	3,100
Equipment & film rental & purchase	1,200	1,200
Visa, passport & inoculation fees	1,000	900
Medical expenses	700	700
Freight charges	3,500	3,000
Local transport	5,000	5,000
Reference & text books	1,300	700
Telephone, cable & postage	700	700
Lab materials, wood & other Work shop supplies	2,500	2,500
Total Workshop Expense	$218,798	$206,706

*Approximately 55% of items indicated to be covered by reallocation of funds under existing contract.

Note: Numbers in parenthesis indicate figures applicable to '67-'68 program.

A Proposal to the

Agency for International Development

for the Continuation of the

AFRICAN PRIMARY SCIENCE PROGRAM

in

Tropical Africa

6980857 - (15)
PD-AAC-343
56p

This proposal requests the sum of $969,785 for the period July 1, 1969 through June 30, 1971 for the continuation of the African Primary Science Program, AID Contract No. csd-772.

Kevin H. Smith
Acting President

Submitted by

Education Development Center
Newton, Massachusetts
December 1, 1968

Revised January 21, 1969

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INTRODUCTION

This proposal seeks the sum of $969,785 for a two year extension of the African Primary Science Program, July 1, 1969 to June 30, 1971. It is expected that this requested extension will permit essential completion of the research and development and pre-implementational components of the program.

A portfolio of materials, varied in scientific subject matter, and suited to the age range of primary school children will have been prepared in form suitable for inclusion in the curricula. Development and trial use of techniques and materials appropriate for teacher training in science, both pre- and in-service, will have taken place. Emphasis will have been directed toward the development of the human resources within program countries necessary for both future materials development and the carrying of these developments into the schools. Relevant experience gained by the program since its inception relative to the complex operational problems to be faced will have been crystallized in a manner usable by those carrying on the work within each country.

This multi-dimensional science curriculum revision effort is intended to assist participating countries in becoming as self-sustaining as possible by mid-1971. If necessary, further external aid for implementational efforts beyond that date would be sought by the various governments involved on the basis of plans developed in consultation with program personnel.

PROGRAM HISTORY

Two preceding proposals, involving initiation and extensions of the program, have outlined in detail the history of EDC's African Education Program, of which this primary science work is part. Discussion here will be limited, therefore, to a summary of important developments over the past seven years which have influenced programming.

African Education Program

The activities outlined in this proposal are based upon the experience of the African Education Program dating from its inception in 1961. In September 1961 a conference of African and American educators and scientists, now known as the Endicott House Conference, was held to examine the needs and priorities for education in English speaking tropical Africa. The work of this conference has proved to be a milestone in efforts to improve the quality of education in that part of the world. The ideas of Africans were widely solicited, giving real credence to the priorities thus established. The fidelity with which developments of the African Education Program have followed those initial recommendations testifies to their validity, as proved over time and under changing conditions.

African Mathematics Program

At the Endicott House Conference the decision was reached to begin with a program for introducing new mathematics into Africa. The subject matter was seen to have constancy over the eleven constituent countries, making feasible a

multi-national effort. Furthermore, the development of modern mathematics in the United States was well advanced, providing valuable experience upon which to capitalise.

The African Mathematics Program has made remarkable progress. Series of texts for students and teachers for primary and secondary schools and the teacher training colleges have been prepared and revised, based on wide trial experience in African schools. Numerous institutes and workshops have been held for the training of teachers and teacher trainers. Considerable progress has been made in the development of cadres of mathematicians and mathematics educators to carry on the task of implementation. Above all, a commitment to introduce modern mathematics into the primary and secondary schools has been made by a number of participating countries.

African Primary Science Program

The African Primary Science Program (APSP), first organized at a planning conference held in Kano, Northern Nigeria in 1965, was the second of what was visualized at Endicott House as five discreet parts of an overall African Education Program. Experience derived from the Mathematics Program convinced planners that the accent of work in science should be at the primary school level; it would provide a more manageable task; it recognized that primary education was terminal for a high proportion of African children; and, most practically, the primary school curricula were not subject to the same type of external examination system as the secondary schools and were consequently seen to have greater potential for innovation.

However, a different format of program operation was clearly called for. The subject matter of science would not be the same throughout Africa

as environmental factors differ considerably. The breadth of science learning possibilities necessitates the selection from myriad possibilities areas of study considered most relevant to each country and its educational priorities.

To accomplish this localization, the need for a mechanism within each participating country was seen. The establishment of Science Centers was encouraged with program assistance, not as arms of EDC but as local institutions responsive to local direction and, in the main, staffed by local personnel. Such Centers were seen as the beginning points for the continued development of local capabilities and the institutionalization of curriculum development as a dynamic process.

As African nations develop, as science knowledge advances, and as the quality of teaching improves, continued revitalization of the science curricula is a necessity if the rigidity of past colonial education is to be avoided. Materials developed now reflect only the present readiness of students and teachers for new classroom experiences as nurtured by conventional schooling. It is reasonable to assume that more challenging materials will be required as the horizons of new students are widened in their early schooling.

Experience over three years has borne out the wisdom of this primary school concentration. Ministries of Education have been under particularly severe pressure to expand school facilities. However, with the secondary schools hard put to assimilate more than a small fraction of primary school leavers, Africa has been forced to rethink its primary school education objectives in terms of those ever increasing numbers of children for whom a maximum of seven years will constitute total exposure to formal education.

What can be done realistically during those primary school years to acquaint students sufficiently with the world around them, and to enable them to cope effectively with it? How can the ever present fatalistic attitude toward life be eradicated and citizens be helped to gain the understanding that they do, in fact, have the power to influence their own futures? Above all, how can children be encouraged to continue learning throughout their lives. Science, in this context is seen as learning to learn, learning to understand and to cope with the environment and make meaningful the world around, with a developing sense of personal control.

PROGRAM PHILOSOPHY

There is now recognition that the Program is a curriculum development program directing its involvement to the whole of the educational enterprise. New materials are a means rather than an end. They are the vehicle for achieving far reaching changes in the total school environment. Cooperative technical assistance can provide the tools to do the job - in the form of new materials - and help in the creation of new institutions and provide a context for the growth of local expertise, but the harnessing of these tools to effect change can only be done by individuals in the countries involved.

The Program conceives curriculum development to be a dynamic force. The purpose of new materials is not to supplant old curriculum but to convey the point that education is truly a creative undertaking which depends upon mutual development of teachers and students alike; to suggest the creation of profitable mutual learning situations for teachers and students. The measure of the success of the first portfolio of materials is the extent to which their depth and richness can be exploited in creative ways by students and teachers working together. There is no right way to use the materials; there are many right ways, as varied as the teachers themselves.

Imbedded in this idea is the concept of the teacher as a curriculum developer. The danger inherent in the curriculum development institution idea is that it implies that materials can be created independent of the classroom and transmitted to teachers as the new curriculum without requiring the interaction and creativity of every classroom teacher. Curriculum development institutions are recognized as only one, albeit an important,

source of new ideas for classroom exploration which can engage children and teacher in meaningful learning. Some possible impacts of the learning outcomes are outlined by Dr. F.O. Okediji, Ibadan University.[1]

Possible Implications for the Individual, Community and Society

1	2	3
Individual	Community	Society
1. Ability to conceptualize and discover problems; creativity; an inquisitive mind even when clear-cut goals are not yet given; capacity to define new problems that establish new needs and goals for action	1. Making of local entrepreneurs	1. Manpower needs fulfilled in industry, education, technological organization, commerce, government, etc.
2. Thinking logically (model construction)	2. Making of community leaders activating community initiative in the manufacture of locally-made scientific equipment	2. Changes in the value system of the society-less emphasis placed on tradition
3. Self-reliance and desire to reach excellence	3. Improving the standard of living of the people in the community	3. Improving the standard of living of the society in general
4. Receptivity to ready-made concepts and information, and better means to attain already given and accepted goals		4. Efficient allocation of resources; and also more efficient utilization of local resources
5. Career opportunities in agriculture, medical technology, teaching of science, industrial and commercial occupations, game management, etc.		5. More efficient operation of public bureaucracies

1. Evaluation Programme, A.P.S.P. by E.A. Yoloye, P.11; extracted from a paper by F.O. Okediji, Nairobi Evaluation Meeting Report, Vol. I, Attachment V.

To achieve, or begin to look for ways to accomplish such changes, the attitudes and skills of teachers must be based on an approach to children using materials which have the following characteristics:

1. The focus of study should be the concrete phenomena themselves e.g. plants, animals, stones, liquids, stars, shadows, etc. First hand experience with materials is essential.

   The phenomena of the natural and man-made world are complex. They have different significance for different people. Telling about them does not carry all their complexities and fascination. Nor does "telling about" them alone allow opportunities for children to develop ability and confidence in finding out for themselves.

2. The materials selected should capture and hold the attention and interest of children

   In some cases, the materials may be sufficient in themselves to suggest things to do. In some cases, questions and suggestions from the teacher are necessary to reveal interesting possibilities which the children may not have thought of themselves. In some cases alternatives should be available for children with divergent interests.

3. The materials should reveal that there is not always one right answer.

   This can be at a variety of levels. At one level, children may arrive at different answers to the same question and all the answers may be equally acceptable. At another level, the teacher often will not be able to answer questions that arise, and there is no other way to find out in the classroom except by carrying out an investigation. At another level, questions may arise to which no one can find an answer, and, to which, indeed, no one in the world yet knows the answer.

4. Materials should allow opportunities for a variety of different ways to find out - some patient watching, some resourceful tool making, some clever experimental design, some sudden insight, some constant repetition, some imaginative guessing, some tight logical thinking, some trying at a tentative idea, some frustration, some recourse to other people, books, radio, film, etc.
5. The classroom experiences should lead to social interaction among children - where they develop a common body of experience; accept and respect other points of view; attempt to substantiate their own points of view; cooperate to solve problems together.
6. To a large extent, the materials should be simple and familiar - so the children's experiences outside school are met here in a fresh way. This in itself may develop the awareness that the children can continue their investigations on their own in everything they do. More directly, some materials may take the form of setting out to work on a problem that comes from outside school such as health, care of food, cooking.

It is not infrequently argued that the learning embodied in this type of science teaching is not sufficiently utilitarian for present day Africa. The argument continues that the most practical kind of education at this particular point in time would involve the imparting of information and skills to help children cope with the immediate and pressing problems with which they are faced in their environment. An understanding of practical farming skills and of the importance of clean water and adequate sewage disposal to health are then seen as being of primary importance.

Why then accent logical thinking? The answer is a complex one so important to a real and sustained breakthrough in African education. A

fundamental goal of African education is to provide permanent literacy. But literacy, it is felt, is seen to have an important dimension beyond the basic ability to understand and to communicate with other humans. It is a qualitatively different kind of literacy which involves an in-depth understanding of the world around. It is this kind of thinking literacy which enables individuals to cope effectively with environmental problems, particularly new and different ones.

It is the ability to cope with the new and different which is so vital for new citizens of developing nations of the world. It is the ability to transfer learning from one situation to another which will be all important in a rapidly developing and changing society. Just as the program looks for favorable operation of the multiplier effect in its programming, so it also should be with the learning which takes place in the classroom. It is important, given the limited amount of exposure to formal schooling for most children, that the skills and attitudes acquired will serve usefully in a variety of situations, not just the one context in which they were originally learned. It is multiple purpose learning rather than single purpose learning which is demanded by Africa today.

This is not to argue that these two positions are mutually exclusive. Indeed they are not. There is every reason to select topics for teaching science which have an obvious relevance to the world in which African children live and which deal with important problems which they will confront. In this way the development of cognitive skills can find an anchor in reality. And further, the specific learning of scientific information which is an important and natural fallout from such study can indeed form the basis for understanding and solving immediate problems. Unit topics have been chosen with this point in mind. Such units as Soils, Chicks, and Mosquitoes are but a few obvious examples. The program does take the position, how-

ever, that to limit science learning opportunities to those materials which pass a test of practical utility would be to stunt the very growth of literacy which the program seeks so ardently to promote.

The potential to help people live more meaningful lives in a predominately rural Africa has encouraged Ministries of Educaton there to place emphasis on science in the schools. There seems little doubt that materials for the classroom generated by and through this program will find their way into the curriculum of countries of East, West and Central Africa. Commitment to introduce or change the science curriculum has already been made in such widely divergent areas as Sierra Leone, Tanzania and Malawi - to name only three.

FUTURE OF PROGRAM

There is a strong commitment to this change, to transform a system of education widely recognized as inadequate for modern day Africa. This desire for something uniquely "African" is linked with developing national aspirations. The desire for change is in some measure politically inspired. This can be most helpful in providing a supporting ambience for social change in education, since such change is only part of wider social, economic and political transformations.

General perception of the prevailing education system as something foreign and imposed rather than indigenous provides a force to reorient that which presently exists. There is also recognition of the significant parallel between the philosophy ingrained in the APSP and the indigenous African education. This was imbedded deeply in the culture of many tribes before colonization, and developed out of basic needs identified over the centuries. This program does not seek a return to tribal education, but is attempting to reinstitute a basic underpinning of relevance as the foundation for a system of education for 20th century Africa. It strives also to build the capacity and flexibility within Africa to enable education to adapt more easily to the future.

Human Resources

The accent on human development underlines a basic program belief that it is investment in people - curriculum developers, teacher trainers, adminis-

trative officials of the Ministries of Education and teachers themselves - that is truly important.

Since inception, the program has encouraged the appointment and development of counterparts for program science educators stationed in Africa: this effort has been successful thus far. However, it has become apparent that the counterpart idea falls short of what is required for the total task. Now that materials development is seen as only part of a larger project to effect change, it is evident that exposure to the materials development aspect alone is insufficient to develop the necessary in-country implementational skills.

It is now apparent that a new kind of sociological expertise embodied in a cadre of people knowledgeable about the program and its objectives is required before change can be visible in the schools. These must be local people intimately familiar with the "ecology" of local education and attuned to nuances and subtleties beyond the range of expatriate ability to comprehend.

A Foundation proposal is now outstanding which seeks to explore the possibilities of developing innovational teams in each country where implementation is a possibility of the near future. Innovational training is intended to provide a range of experience with implementation efforts in several different contexts which could be used in addressing the problem in different parts of Africa. This will require extensive consultation with Ministries of Education in each country to select appropriate individuals and to determine the types of experiences and training most suitable for the development of innovational teams.

To recognize that dependence on local innovation . capacity to carry forward new methods of science teaching into the schools of Africa is necessary is to recognize also that the pace of implementation may be slower and the methods different from those which might have been chosen by the program. However, the posture of this program now felt to be most appropriate dictates that any involvement which inhibits or detracts from the development of local initiative is not in the best interest of this conception of aid.

Teacher Training

Occurring simultaneously with the development of a cadre of personnel with the potential to see curriculum in this dynamic mode, is the identification of need to seek manpower resources to effect change in the attitudes, skills and abilities of teachers already in schools and in the process of training. The program has addressed itself to this researching of possibilities in both the pre-service and in-service training of teachers. It is in teacher training where the multiplier effect is greatest, that attention must be directed. There is a need to know how to help teachers change their attitudes and classroom methods as well as to know what resources are necessary to carry the process through effectively.

It is logical to assume that materials intended to convey a new philosophy of science education cannot be fully capitalized upon, nor their potential adequately seen, in conventional teacher training programs. Teachers in training seem to do better in handling new science materials if exposed to these materials in new and unconventional ways which interrelate their own personal learning and their teaching experience. New ideas on how this might be done will be aggressively pursued over the next two years, centering

around two basic, but frequently overlooked fundamentals:

1) Meaningful development of teacher training techniques and materials must take place with the active participation of both students and teachers. The consideration of teacher training can not be pursued profitably in meetings of experts gathered to discuss the subject in a vacuum. Since the problem and its resolution revolves around the utilization and development of people, it is essential that these people be actively involved in all developments. Only in this way can both the possibilites and limitations of new approaches be explored adequately. Working in on-going innovative teacher training situations is viewed as the most profitable program commitment.

2) Teachers must develop a new perception of their own roles. They must be helped to see themselves as active participants both in the development of the materials they will be using in the classroom, and in the learning which takes place there. Teachers must be helped to understand that it is as important for children to formulate questions which stimulate independent investigation as to know answers.

A program objective is to develop and test, in the months ahead, several ideas for organizing and conducting teacher training activities appropriate to the materials generating from this program. These ideas are expected to take root out of several teacher training workshops planned for the spring of 1969 in institutions now engaged in the training of primary school teachers, and concerned with contemporary science education.

These workshops will depend on the use of the faculty and student body of the institution in question, augmented by a small number of outside resource people. There is strong conviction that involving teachers actively and deeply in the processes of materials development and childrens' learning - in a real sense giving the teacher a "piece of the action" - will bring about a deeper understanding of the role of the teacher. Teachers must learn to conceive of themselves as integral parts of the "curriculum development" network. This seems to dictate the heaviest emphasis on teachers in training - first because there is more time and opportunity to build up this concept, and secondly, student teachers would be less likely to have acquired ingrained ideas of teaching in a more conventional framework.

This is a difficult task, as teachers in training will have been conditioned by the teaching to which they themselves have been subjected. This new role will demand of the teacher a measure of creativity and sensitivity rarely called upon before. Teachers will need to learn to cope with uncertainty and the incompleteness of their own understanding of science. "I don't know. Let's see how we can find out together" would better replace the "Let's get back to the subject at hand." It is obvious that the development of this concept of the teaching role will take time and diligence.

Materials Development

One beginning point of any curriculum effort in science for the primary schools is the creation of new materials for the classroom which will convey the philosophy of the program through a variety of content matter. Materials development work must focus on problems of relevance to African

children in their daily lives, and must represent the priority concerns of the governments involved. Subject areas such as agriculture, public health, environmental education, must be stressed, but at the same time it would be a disservice to limit the scope of scientific inquiry only to these areas of primarily national concern. It is important to convey to children and teachers alike that fascinating and profitable scientific exploration possibilities abound in the commonplace. A variety of content areas can best convey the true richness of science.

The program's portfolio of materials will use the unit as its basic building block: a unit is seen as the basic "stuff" out of which scientific inquiry evolves. Each covers an area of science of interest to children, as proven through an intensive program of trial testing in schools. Each unit is developed as an array of possibilities for profitable exploration, and is intended as the basis for further development by each teacher through actual classroom use.

Units will vary in method of treatment in the classroom. Some can be pursued over a contiguous block of time; others, particularly in biology, may involve only short period of observation daily or weekly over a more extended period. Still others may require only very brief treatment and are seen to be most valuable in aiding a teacher to acquire the necessary confidence to continue further with other materials.

The production of such a portfolio of science materials (see Appendix C) will become the building blocks for science curricula. The materials can be used across the age spread of the primary school and each country will be able to select materials appropriate to its needs. Seventy units are envisaged at this time as being necessary to provide materials for all primary levels. This would make available approximately ten units for each

year of the primary school. This does not infer that the materials themselves are more than examples of what can be produced for use in curriculum building but given below is the basis of how such a curriculum could be built.

The materials fall naturally into two distinct groups, those for lower elementary and those for upper elementary grades. The lower elementary materials are less structured and are geared to the operational stages as defined by Piaget. The upper elementary materials put emphasis on the concrete operation with materials and are more demanding both in terms of skills and abilities, manipulative and cognitive.

The resolution of thinking on this has developed from a crude analysis of content to a much more sophisticated look at what was being asked of both teachers and pupils. The analysis technique provides the resolution to show the relationship between various units. Appendix A is a draft monograph of possible curriculum structures using program materials.

It is anticipated that by July 1, 1969, approximately fifty units will have been prepared for availability by Fall 1969, developed from ideas generated at program workshops.held in the summers of 1965, 1966 and 1967 and at Science Centers. Continued accent on materials development will be required to reach the desired number by the time of anticipated phase-out in mid 1971. Personnel selected for the next phase of the program will be chosen, in part, for their ability to continue this work.

If materials development were directed toward unit development alone, its one dimensional character would undoubtedly fall short of recognizing the full scope of the problem. As a parallel, considerable attention will be devoted to continuing work on a "Children's Science Reader" series. These brief books are designed to increase children's exposure to science beyond their classroom experience. It is expected that they will be available through schools to share and discuss with parents and siblings in the

home. Content matter will stress possibilities best suited to independent study.

Other Areas of Materials Development

Development of simple and inexpensive equipment to be used in conjunction with the activities proposed in the various unit materials is required. Equipment design has depended largely upon the use of materials readily available to the rural primary school - wood, stones, water, earth, etc. Obviously, beyond the natural resources available for science learning certain other materials are needed. It is the program's intent to look at the nature of this additional equipment and to perceive the minimum necessary to promote adequate learning in science fully taking into account present financial realities of African nations.

Need is seen as well for other supporting materials, possibly including some with self-teaching aspects. Of course, the basic teacher's guides for the various units are supportive in that they assist teachers in programming their lessons. However, beyond the materials and suggestions supplied it is hoped that teachers will expand into new areas following the interests of the pupils.

In this aspect of development, careful consideration would be given to possible uses for self-learning and semi-programmed materials that might serve as additional resources for teachers. To this end the following preliminary suggestions are made. The program would:

1) Look at the possibilities of providing teacher readers which help them to learn some of the content of science, that rely not solely on reading but on participation in practical experimentation as individuals. Suggestions have already been made that before using a unit teachers should try out some of the experimental work. Into these new materials would be worked some of the background science that the teachers need.

2) Take some of the unit materials already produced and restructure them into work cards. These essentially are cards detailing the variety of experiments that can be done in one field of science which can be distributed by the teacher to pupils. They are an aid to the organization of classrooms and pupils. A sample work card unit will be produced paralelling the unit on the human body. The unit and the work cards will complement each other.

3) Explore in depth the possibilities for self-guided learning at the training college level. Here there are a whole spectrum of possibilities that can be examined. Specific consideration will be given to 8 mm film loops, short 16 mm films, film strips, self programmed texts (one such text on Pendulums is in preparation), tape recordings with slides and particularly to the possible use of mass media, both TV and radio, for pre-service and in-service training of teachers. These aids would be aimed at providing the teacher with relevant background information as well as involving the teacher in experiment and observation in order to develop the basic approach advocated for the classroom. The teachers will thus learn as later they will teach.

4) In the area of formative evaluation, tools which would help the teacher analyze his own classroom performance are seen to have great potential value. Work is already being undertaken in this connection.

Crystallization of Experience

The focus of the APSP continues to move towards the development of in-country capacity to carry out broad educational change. To capitalize fully on program experience since 1965, the desirability of crystallizing "know-how" relative to a variety of operational problems is clearly seen. This exercise can best be characterized as "closing the feed-back loop". Detailed and valuable operational experience has been gained in such areas as carrying on the materials development task; working effectively with teachers in the classroom; involving administrative people from the Ministries of Education and other bodies actively and productively in the innovative process; handling conflicting demands within the culture for science materials; and capitalizing on other outside resources to further development work.

It is expected that this wealth of program experience prepared in monograph form will contribute to the thinking of personnel involved in planning and working in implementation.

Planning for Implementation

Changing an educational system with thousand of teachers is a job that is a continuum once begun. A wide spectrum of understanding must be accepted as inevitable from the outset.

Several countries, now active program participants, may not find it possible to marshal the necessary resources to carry science education speedily forward into the schools. This fact is probably inevitable whenever termination of external assistance is considered, and ways must be found to respond to these particular problems. The program could perhaps be of real service in helping to plan for continuation of the work calling upon other

external sources of assistance. The opportunity to involve other external agencies such as UNESCO, UNICEF and the U. S. Peace Corps should be fully explored in this connection and indeed groundwork is already being laid.

Evaluation

The development of the evaluation program lays heavy emphasis on the procedures which better allow the achievement of the program goals. It also begins to define the long term effects of an approach to learning which lays stress on individual initiative and discovery.

The evaluation program looks at three aspects:

1. The assessment of the approaches to teacher training both in-service and pre-service.
2. The assessment of the materials as to their effectiveness in classrooms as aids to change in teacher behavior.
3. The assessment of the individual child. Here it is hoped it will be possible to look for and establish the acquisition of skills, abilities, and attitudes as outlined in the program philosophy.

Particular emphasis will be placed on aspect 1, the assessment of teacher training techniques. With the increasingly important role seen for the teacher in the ultimate success of the program, it is important to know the efficacy of various kinds of training. Knowledge of this type would be of help to Ministries of Education and foreign assistance organizations in planning implementation efforts. In the development of the future work plans for the various science centers outlined in the section that follows, special attention was given to the opportunities for carrying on different kinds of teacher training methods which might then be assessed systematically. Future planning reflects a delicate balance of in-country plans

for teacher education and program research needs.

A preliminary finding with respect to teacher education is already evident in the planning of both this program and of the Ministries of Education in several countries. It is revealed in the heavier than usual emphasis on pre-service as opposed to in-service education for teachers. Early experience in program countries clearly suggests that concentrated training of teachers-in-training at the training colleges offers the best possibilities for changed classroom behavior.

A full time evaluator is now working in Africa, in cooperation with Dr. E. A. Yoloye, the evaluation co-ordinator, developing procedures and priorities, and gathering data based on the work done at the conferences at Akosombo, Ghana, 1967, and Nairobi, Kenya, 1968.

Within this context of the evaluation program, the need is seen to assist in the development of an African cadre of evaluators. In this we will not only be involved in the evaluation of this particular program, but will be initiating a search for new ways to approach evaluation of other new curricula.

Country by Country Programming

With the need for gathering the necessary tools and resources to carry forward toward implementation over the next two years, internal programming becomes critical. As APSP moves rapidly to achieve the convergence of materials development, teacher training expertise, and local capacity to carry forward implementation, it is intended that program resources, particularly people be deployed in a manner which would maximize opportunity for convergence. Specific criteria for the location of science educators for the next two years will be:

1. Identification of the countries where APSP can best complete t he Research and Development activities outlined above.
2. Identification of countries where commitment to bring new science education materials and methods into the schools has been demonstrated by the host government.
3. Identification of countries where EDC presence is vital to continued progress.
4. Identification of countries where EDC can recruit or continue capable people.

A fitting together of the various requisite pieces suggests a carefully structured framework for carrying forward the final developmental stage, country by country.

Ghana

Accent here will be on pre-service training but with a specific look at how Ghana's resources, both in trained people and finance, can be capitalized upon. The viability and usefulness of sub-centers to broaden the geographical impact of teacher training activities, and to pro-

vide for continuing and varied input of new and revised materials for training college curricula would be explored. Ghana is an important model to explore because of the comparatively large number and variety of teacher training institutions as compared with other countries and the higher proportion of local as opposed to expatriate staff at these institutions. It is planned that two program science educators would continue in Ghana, one for the full two-year period and the second for 1 1/2 years.

Kenya

Past experience in Kenya has been geared to look at the effects of building up an increased number of expatriate staff to view the effects on materials production, school implementation, etc. Now that these roles have been taken over by a significant number of Kenyans working in Primary school science, there will be a reduction in APSP staff. However, it will be important to continue a program presence in Kenya to provide contact for feeding into a relatively large effort materials from other centers and to permit feedback to other centers on the use of program materials in Kenya.

Continued presence in Kenya will also enable the program generally to profit from the unique resources available in Kenya, the education program of the Kenya National Parks, the work of the African Wildlife Leadership Foundation and the National Museum specifically. Coordinated work with these bodies will be of great value in developing materials for environmental education. There is well recognized need for such materials for all of Africa which cannot be adequately met through other centers.

Malawi

APSP involvement of one person would continue in Malawi for a period not to exceed one year. This is in accordance with a schedule agreed upon

with the Malawi Ministry of Education, subject, of course, to continued USAID financing.

Malawi experience is particularly valuable because:

1. Problem of preparing for implementation is more manageable due to relatively small size of total problem and consequent ease in taking prerequisite steps for implementation.
2. A significant program of materials has been developed for use in Malawian schools, and a schedule for a pattern of implementation has been drawn up. Initially this has taken the form of the training of a group of students who are now working in demonstration schools attached to teacher training colleges. It is envisaged now that the Teacher Training College tutors and area inspectors have been brought together in a course, they can function as a team to further implement the Program. Wider scale implementation is planned.
3. It permits an opportunity to interrelate the perceived need for agriculture and science curricula in primary schools. APSP materials will fall into both areas and attempt to interrelate what are at present separate subjects.
4. Withdrawal in 1970 will enable Malawi to test effectiveness of input provided by other external aid such as U.S. Peace Corps and UNICEF in carrying on program of change in conjunction with local personnel. Both organizations are deeply involved in primary science at the moment.

Nigeria

Nigeria is unique in the Program, in that local personnel are carrying out all operations. Financial support is provided through the program, but additional assistance is felt to be necessary. APSP would be interested in supporting an additional Science Educator in Lagos, preferably an African. Efforts have been made to inter-relate APSP with cooperative development work in Lagos and the Western State, using the resources of the Universities of Lagos, Ibadan, and Ife.

In Lagos at this time, both development work and implementation are planned. Ten experimental schools have been designated and are currently preparing and reviewing materials in classroom trials. When available, these materials will be implemented into trial schools - the speed of this to be determined by the Lagos State Ministry of Education.

A Science Adviser has been appointed to work in schools, and there is active cooperation with Lagos University staff at the University based curriculum development center.

Sierra Leone

The program proposes to continue one of its staff members at the Science Curriculum Development Center at Njala University for one year beyond July 1, 1969. Accent of activity here would be on:

1. Development of in-service teacher training schemes operated through the Center and its two sub-centers. The sub-centers in particular are important since they are staffed without program help and valuable information can be gained on the capacity of local nationals to carry forward the program.

2. Testing feasibility of utilizing resources at Njala as a re-

gional facility servicing Liberia and perhaps other West African countries as well.

3. Heavy involvement of in-service teachers in preparation and modification of science materials.

Tanzania

Two program science educators would continue in Tanzania for the full two year period to mid-1971. The main thrust here would be on work at the Teacher Training Colleges, developing new materials for training pre-service teachers and trying several models of teacher training that may have broader applicability across the program. These models would investigate such variables as the content of training college science courses and the integration of teaching practice with new science materials. Envisaged is the building up of strategies for wider implementation involving teacher training colleges and the cooperation of teachers in training and in-service teachers in the community.

Uganda

A two year APSP input in curriculum development at Makerere University will be completed in December 1969. This continues to provide valuable information on the feasibility of preparing new materials and for change in school curricula generated at a base outside the Ministry of Education. The continuation of such an effort would be dependent on the Ministry of Education's development of a plan to change the present science curriculum to incorporate, in part, APSP approaches and the commitment of additional financial and personnel support to further the work.

If the above plan were adopted, it would seem that Program personnel authorization required to complete the research and development component of the program would look as follows:

	1/1/69	7/1/69	1/1/70	7/1/70	1/1/71	7/1/71
GHANA	2	2	2	1	1	0
KENYA	4	1	1	1	1	0
MALAWI	1	1	1	0	0	0
NIGERIA		1	1	1	1	0
SIERRA LEONE	1	1	1	0	0	0
TANZANIA	2	2	2	2	2	0
UGANDA	1	1	1	1	1	0
TOTAL	11	9	9	6	6	0

Future Implications

1. Widespread Use of the Program Materials

Over the period of the development of this program, frequent requests have been made for copies of materials, and we know of their use in a variety of ways in countries outside Africa including America.

It would seem appropriate to have some structured trial as to the use and applicability of the materials in countries around the world. To this end the following is suggested as a basis:

That in the fall of 1969 a number of countries inside and outside of Africa receive a package of materials available from this program. The materials would be sent in multiple sets to USAID Mission, Ministries of Education and where appropriate to local universities.

That during the period of the next contract extension, those countries requesting help would be given assistance. This assistance is seen as being

supplied in a number of ways.

A. E.D.C. during this period would provide a service function in finding experts to assist countries in the understanding and use of the materials. They would be available also to assist in the setting up of institutional structures and relationships to initiate a prerequisite trial program possibly moving toward implementation. These experts would be available for short periods and preferably would be people who were already intimately familiar with the program. It is, however, appreciated that there could well be a need for certain language skills as well as for understanding of the program, depending upon the country to which assistance is provided.

B. That in one continent at least, some effort might be made to bring together interested MOE officials, scientists and teachers to initiate a regional consideration of the program. The mutual support and interchange of ideas between contiguous countries has added much to APSP and would appear to be a profitable model to explore elsewhere.

C. Developing out of the wide use of program materials there might well be a facet of research and development that would be significant for further work.

Given that a country adopted the materials and was interested in following through to implementation, it might be most profitable to place one experienced person to work as advisor in the development of strategies for curriculum development for a period of at least one year.

The learning arising from this would be related to further resolution of how:

1. to use program material most effectively,
2. to capitalize on experience gained in the African Program,
3. to relook at the instituting necessary for the establishment of the curriculum as a dynamic,

4. to use the evaluation tools developed.

This might well lead to new conceptions of effective aid in the education sector.

2. Implications for Secondary School Science Teaching

Looking to the future, the program is concerned not only for those children finishing formal education at primary school level, but also for those continuing on to the secondary school. With the expected impact of the program on the child and his ways of working and thinking, it would now seem to be an opportune time to incorporate a small scale one country investigation into the implication of APSP philosophy for secondary school science teaching. Such investigation would include possible inclusion of APSP approaches and philosophy into the first two years of secondary school and might well develop into a major materials development and teacher training project.

An opportunity already exists to work in this area. A request for assistance has been received from the Institute of Education in Tanzania to which this program would wish to respond by providing an additional staff person to work in that country.

SUMMARY LINE ITEM BUDGET

African Primary Science Program

July 1, 1969 - June 30, 1971

Expense Item	1969-70	1970-71
Salaries and Consultant Fees	229,150	168,800
Allowances	20,400	8,300
Transportation and Subsistance	84,000	57,200
Conferees - Stipends	14,900	4,500
Hotel Accommodations and Conference Facilities	24,400	12,300
Other Direct Costs	130,350	84,850
Overhead @ 32.87% of Salaries	60,842	41,547
Yearly Budget totals	564,042	377,497
Two year Total	941,539	
Fee based on 3% of Total Costs	28,246	
TOTAL SUMMARY BUDGET	969,785	

BUDGET

PROGRAM DIRECTION AND ADMINISTRATION	7/69-6/70	7/70-6/71
Staff		
Salaries		
Project Director	18,000	20,000
Administrative Director	16,000	17,500
Materials Developer (1/2 time)	9,000	4,500
Editor (1/2 time)	5,000	5,000
Clerical Assistance (2)	14,000	15,400
Fringe Benefits	8,150	8,150
	70,150	70,550
Staff Travel		
2 visits to Africa	4,000	4,000
Local travel	2,000	2,000
Advisory Committee		
Chairman, consulting fees	5,200	5,200
Consultant fees for meetings		
2 local meetings, 10 people @ $100/day	2,000	2,000
Local travel	500	500
Africa Meeting		
Travel	13,600	13,600
Stipends	2,400	2,400
Room and Board	2,000	2,000
Other Meeting Costs	500	500
Materials and Services		
Unit Printing @ $1,000 each	23,000	23,000
Art, photographic, secretarial and writing services	5,000	5,000
local consultants, 30 days @ $75	2,250	2,250
Postage and Telephone	3,000	3,000
Stationery, duplicating, office supplies	7,500	7,500
Equipment rental	1,000	1,000
Rent	3,500	3,500
Publications and materials	1,000	1,000
Maintenance	1,950	1,950
Special Materials Distribution to USAID		
200 copies each 40 units @ $1/copy	8,000	
200 copies film @ $80	16,000	
Shipping and mailing	1,000	
Total Program Direction and Administration	$175,550	$150,950

SCIENCE CENTERS	1969-70	1970-71
Ghana		
Science Educator salaries (2)	28,000	15,000
Moving and Travel expenses to post	2,000	2,000
Fringe Benefits	3,650	1,950
Allowances	5,000	3,500
Center Operating Expenses		
local travel	2,000	1,500
materials and services	500	500
workshop and course costs	2,000	2,000
printing	9,000	6,000
other	1,000	1,000
	53,150	33,450
Kenya		
Science Educator salaries	14,000	14,000
Moving and Travel	9,000	4,000
Fringe benefits	1,850	1,850
Allowances	1,100	---
Center Operating Expenses		
local travel	1,000	1,000
materials and services	8,500	4,000
workshop and course costs	2,000	2,000
printing	9,000	6,000
other	1,000	1,000
	47,450	33,850
Malawi		
Science Educator salary (3/4 yr.)	11,000	----
Moving and Travel expenses to post	2,500	----
Fringe benefits	1,450	----
Allowance	1,000	-----
Center Operating Expenses		
local travel	1,500	----
materials and services	2,000	----
workshop and course costs	2,000	----
printing	1,500	----
other	500	----
	23,450	
Nigeria		
Consultant Fees	2,000	8,000
Center Operating Expenses		
local travel	300	300
materials and services	1,000	1,000
workshop and course costs	1,500	2,000
printing	---	7,600
other	500	1,000
	5,300	19,900

SCIENCE CENTERS	1969-70	1970-71
Sierra Leone		
Science Educator salary	14,000	---
Fringe benefits	1,850	---
Allowance	3,800	---
Moving and travel expenses to post	800	---
Center operating expenses		
local travel	3,500	---
materials and services	5,000	---
workshop and course costs	2,200	---
printing	5,000	---
other-- postage, shipping etc.	1,500	---
	37,650	
Tanzania		
Science Educator salary	42,000	21,000
Fringe benefits	5,500	2,750
Allowance	7,500	2,800
Moving and Travel expenses to post	4,000	8,000
Center Operating Expenses		
local travel	3,500	1,500
materials and services	1,000	1,000
workshop and course costs	1,000	1,000
printing	5,000	5,000
other	1,500	1,500
	71,000	44,550
Uganda		
Science Educator salary	14,000	14,000
Fringe Benefits	1,850	1,850
Allowance	2,000	2,000
Moving and Travel expenses to post	5,000	4,000
Center Operating Expenses		
local travel	1,000	1,000
materials and services	1,000	1,000
workshop and course costs	2,000	1,000
printing	1,800	1,200
other	500	500
	29,150	26,550

OTHER PROGRAM ACTIVITIES	1969-70	1970-71
Materials Development Workshop		
Travel	9,000	---
Conferee stipends	6,400	---
Room and Board	6,300	---
Other Costs	2,000	---
	23,700	
Teacher Training Meetings		
Travel	10,000	5,000
Stipends	8,000	4,000
Room and Board	2,200	1,100
	20,200	10,100
Writer's Workshop		
Travel	4,800	4,800
Stipends	500	500
Room and Board	700	700
Other costs- secretarial etc.	600	600
	6,600	6,600
Evaluation		
Consulting fees	6,000	6,000
Travel	4,000	4,000
	10,000	10,000
Total Direct Costs	478,200	335,950

APPENDIX A

DEVELOPING A CURRICULUM WITH AFRICAN PRIMARY SCIENCE PROGRAM UNITS

The African Primary Science Program does not intend to provide a ready-made curriculum for all African schools. It does intend to provide a series of educational scientific activities, referred to as units, from which many equally valid curricula could be built.

Each unit focusses on some natural phenomenom that is of interest in itself, rather than focussing on particular skills or on isolated information. The content and approach of the units take advantage of a child's curiosity by presenting situations that cause a person to ask: "What's going on here? What is this?" Then the pupils and the teachers bring to bear every intellectual skill they know or can devise to answer their questions. Thus, the pupils learn science by acting like scientists. They learn scientific skills by developing them, finding they are useful, and practicing them. When they have finished a unit they are satisfied not because they have learned some intellectual skills of which they may not be aware, but because they have satisfied their curiosity about a part of their world, and because they feel a power that can enable them to go on learning in this way. They have learned about a representative sample of scientific knowledge, not because they had to, but because they wanted to understand some part of what goes on around them.

The African Primary Science Program will develop approximately seventy such units or samples of scientific behavior and knowledge. This number would provide about ten units for each of the six or seven years of primary school. In building a curriculum, it is impossible and irrelevant to try to cover all of science in any selection of topics. What is hoped for is a good sample of phenomena that will be intriguing to most of the pupils most of the time and that will provide an opportunity to develop skills in thinking and a taste of

the usefulness and beauty of scientific knowledge.

Each unit is related to several others in that a question answered in one unit may easily lead to raising a question related to another unit, or a skill or tool developed in one unit may be needed in another unit.

Some of these interrelationships may be shown in what we have come to call a "Loops and chains diagram." Loops--because these relationships may lead from one unit to another and back again. Chains--because some ideas or skills can be developed progressively from one unit to another to another. Figure 1 shows a sample of 10 units arranged in such a diagram and Figure 2 shows some of the questions and skills that form the links between units. So that one can form a clearer picture of the units that are linked together on this chart, they are described at the end of this section.

Table I summarizes some of the general objectives that are developed by these units.

It is planned that a catalog would be developed that would describe each unit briefly and give other information such as grade level, approximate length of time to cover the unit, and cost, if any, of necessary materials. Part of this catalog would also be a series of "loops and chains diagrams."

The loops and chains diagrams will be helpful to a Ministry of Education in selecting the units that it wished to build into its curriculum. The chart will also give a Ministry ideas of where the African Primary Science Program units may link up with its own units and where there are gaps for which a Ministry might develop more units. For the teacher* the charts will provide guidance as to the possible order in which he may like to proceed through the units.

Figure 3 shows one possible path through this sample of units. Note that it is not necessary to proceed in a linear order. It is possible, and sometimes desirable, for different groups in the class to pursue different activities and

* or the headmaster

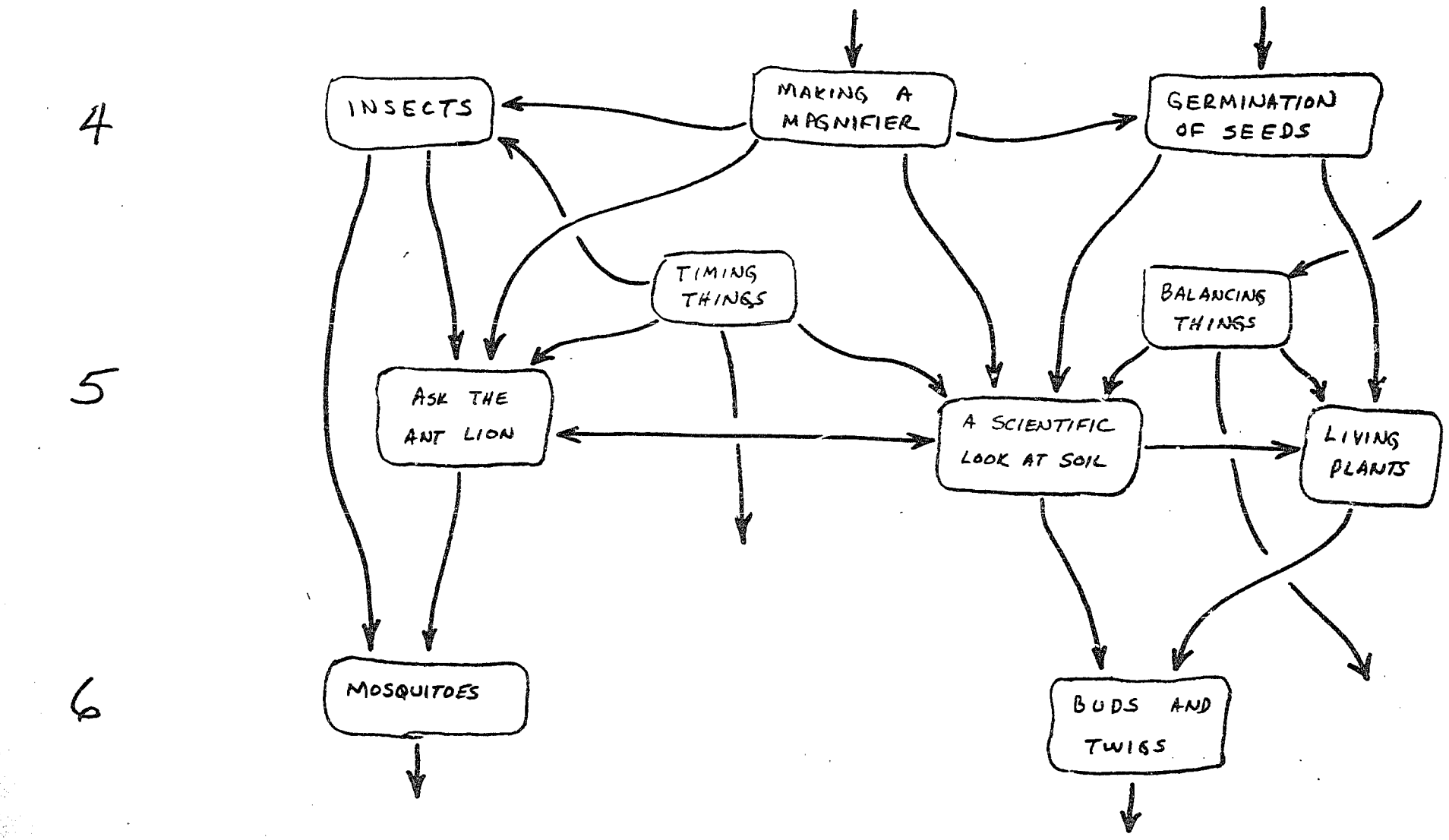
units at the same time. A unit such as Germination of Seeds may necessarily proceed slowly at some points. While children are waiting for seeds to sprout, they could be involved in watching insects or other activities. With such a chart the teacher has some of the information at hand to make a decision at any time as to which way it is best to proceed. He may change his plans wisely, knowing what the connections are between the activities the class has already pursued and those activities that are available.

The units of the African Primary Science Program form a large resource of scientific phenomena and activities out of which many curricula relevant to local needs and interests may be built. Brief descriptions of each unit and "Loop and chain diagrams" will be available to guide curriculum developers and planners in the selection and sequencing of units and to guide teachers in their use.

A SECTION OF A "LOOPS AND CHAINS" DIAGRAM

Figure 1

SHOWING SOME LINKS BETWEEN UNITS

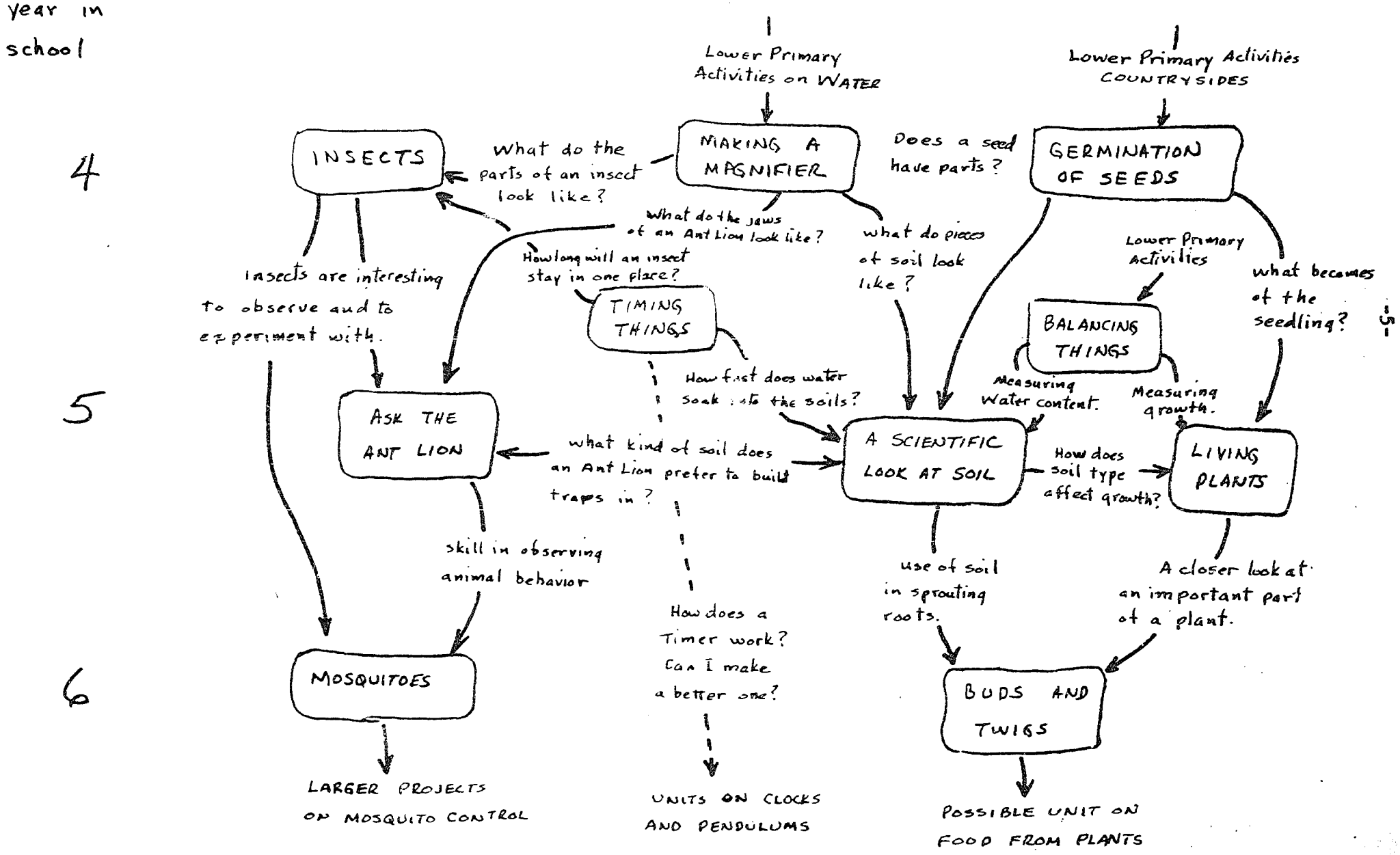


(The next chart shows what some of these links are.)

A SECTION OF A "LOOPS AND CHAINS" DIAGRAM

Figure 2

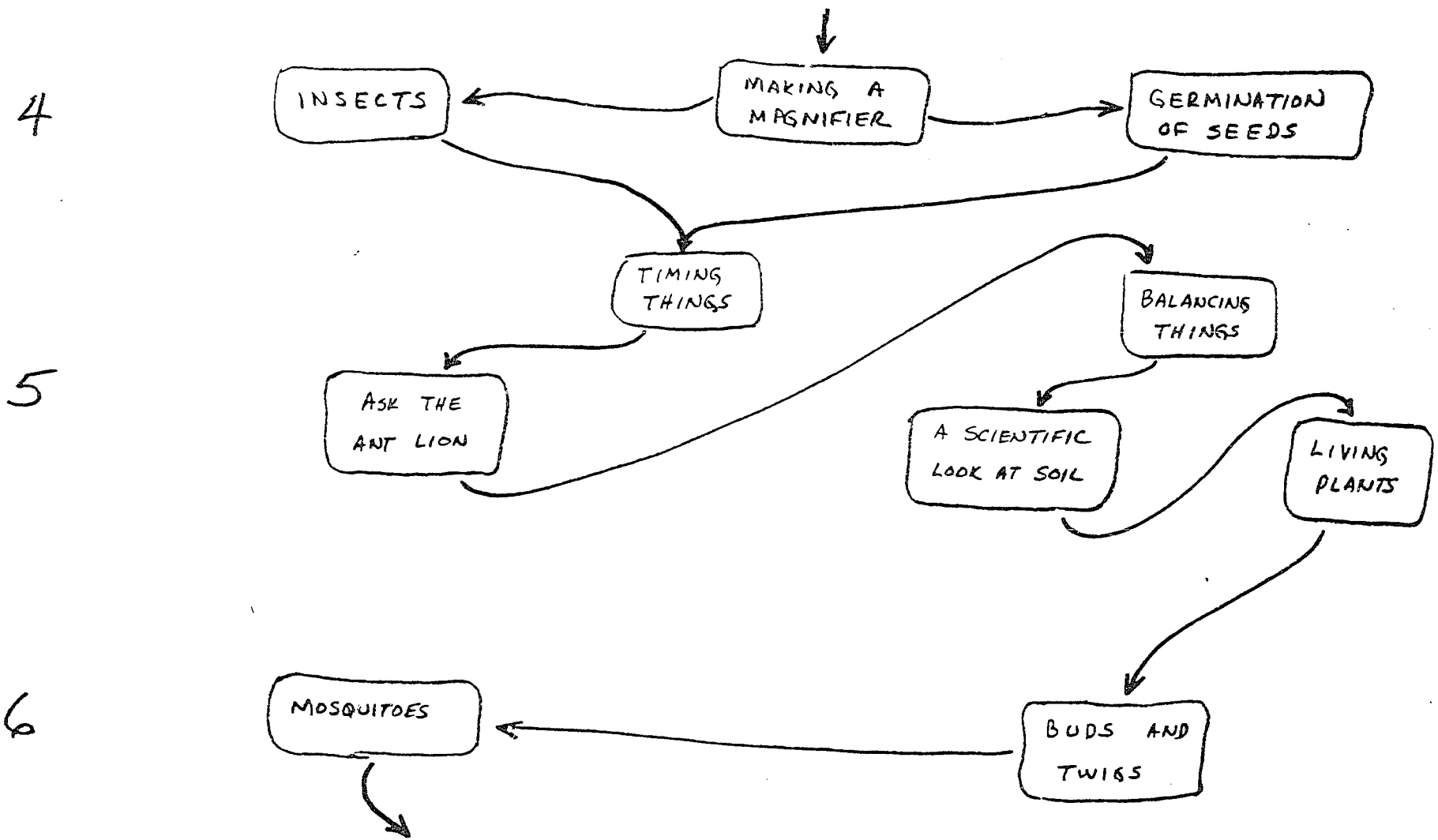
Showing how skills and activities form possible Links between units



A SECTION OF A "LOOPS AND CHAINS" DIAGRAM

Figure 3

Showing one possible order in which to pursue these units



Note: Insects and Seeds could be pursued at the same time with groups of students working on whichever unit interested them.

TABLE I

SOME GENERAL OBJECTIVES WHICH ARE REINFORCED BY A SAMPLE GROUP OF APSP UNITS

	MAKING A MAGNIFIER	GERMINATION OF SEEDS	INSECTS	TIMING THINGS	BALANCING THINGS	A SCIENTIFIC LOOK AT SOIL	ASK THE ANT LION	LIVING PLANTS	BUDS AND TWIGS	MOSQUITOES
A. Cognitive Skills										
1. Ability to make careful and objective observations			✓	✓	✓	✓	✓	✓		✓
2. Ability to see possible casual relationships and to make predictions based upon them		✓	✓		✓				✓	✓
3. Ability to discover statistical relationships and to make predictions based upon them		✓	✓			✓	✓	✓		✓
4. Ability to classify materials to show relationships and to record observations in a way that reveals relationships readily		✓	✓		✓	✓	✓	✓	✓	✓
5. Ability to invent and carry out simple experiments		✓	✓			✓	✓	✓	✓	✓
B. Motor Skills										
1. Ability to use common materials to make simple instruments and necessary apparatus	✓		✓	✓	✓				✓	✓
2. Ability to make reliable measurements with simple equipment				✓	✓	✓				
C. Affective Awarenesses, Responses, and Values										
1. Pupil realizes that his environment is full of things from which he can learn. Likes to raise questions about common occurrences.	✓		✓			✓	✓	✓	✓	✓
2. Realizes that he has the ability to generate knowledge from his own observations and thinking. Likes to try out ideas he has invented himself and to try variations of suggested ideas.	✓		✓	✓		✓	✓	✓	✓	✓
3. Realizes that all book knowledge was originally invented or discovered by other human beings and is like the knowledge he can discover for himself.		✓	✓	✓			✓		✓	✓
4. Realizes that printed words and diagrams can tell him useful things about the world that he can verify for himself.		✓						✓	✓	
5. Realizes that printed words and diagrams can tell him how to make and do new things that he has never seen or done.	✓			✓	✓					

DESCRIPTIONS OF SAMPLE GROUP OF UNITS

MAKING A MAGNIFIER

This is a unit that introduces children to the microscopic world. With their own hands they make the tools that are used to magnify. They make a usable 10 power magnifier from stiff paper, a matchbox and a water drop. They begin to understand how this magnifier works. But most important, pupils see that everyday objects can look very different when seen through a magnifier. Even the most familiar things look wonderful, beautiful and very different. Later, they can use their simple magnifier as a tool in their work on other units.

GERMINATION OF SEEDS

This unit is intended to give a first detailed look at the process of seed germination. The activities begin by letting the children examine some common seeds. They are then presented with the challenge of making their seeds grow. After observing the various conditions under which seeds can germinate, they are led to the problem of finding the best length of time for soaking seeds in order to germinate them quickly. The parts of a seed are studied and the purpose of the various parts are investigated. Tests are devised for determining the quality of a batch of seeds. Finally, wild seeds are brought to the classroom and compared with those already studied. Throughout the unit the children are encouraged to play a major role in deciding what to do - the teacher is merely the guide.

INSECTS

This unit encourages children to take a closer look at the insects they see every day. They hunt them, collect them and try to keep them for a short

while. The children experiment to find out what foods and living conditions their insects prefer. Then they are encouraged to take a second look at where they found the insects, in order to see the condition under which the insects usually live.

Other questions that may be brought up and investigated by the children are: Do insects lose water? What do insects become as they grow? How can male insects be told apart from female ones? How do some insects keep from being eaten by other animals? Can we find any damage done by insects? Are any insects useful?

Suggestions are given for raising and experimenting with many common and interesting insects. Children find that, for every question they can answer about insects, there are many new questions they want to ask.

TIMING THINGS

During this unit the children make clocks out of simple materials. The unit starts with a game in which it would be a great advantage to have a good way to measure a short time. The children are encouraged to invent ways of making a simple timer. They make water clocks, burning clocks, swinging clocks and sun clocks.

The children compare their clocks and find that some are more reliable than others. After setting their clocks so that they can all measure time in seconds, they use their clocks in other experiments and activities.

An optional extension of the unit is to develop a timer that will run for several hours. Suggestions are given for the construction of a water clock and a weight driven pendulum that will run for the length of the school day. These serve as a facinating introduction to simple machines and technology.

BALANCING THINGS

This unit is under development at present. It will begin with some

situation in which the children disagree about the relative weights of some objects as judged by their senses alone. The children will be encouraged to invent a way to resolve their disagreements by improvising an instrument, a simple balance, out of common materials. Some problems out of which the disagreement arises might be trying to decide which is the better buy in the market, two small pineapples or one large one for the same price; trying to put a set of objects of different density into order according to their weight; or trying to find out which weighs more, a cigarette tin of gari or of rice or of corn meal.

Study and comparison of the balances devised will lead to their improvement in reliability, strength and sensitivity. Devising sets of multiple weights and calibrating them by a single standard would be necessary if the home-made balances are to be used in the work-a-day world.

A SCIENTIFIC LOOK AT SOIL

This unit encourages children to take a close look at a common and important material: the soil they walk on and work in every day.
Here are some of the things children may learn from this unit:
How to find out what soils are made of.
How to compare soils taken from different locations.
How to make and keep records of their findings.
How to set up and conduct simple experiments in order to solve some of the problems that arise.

a. How water has a different effect in different kinds of soil.

b. How water is taken up by soils. (They will see that there is a relation between the particles that make up the soil and the way water behaves in soil.)

Most important of all, they will learn skills and techniques to enable them to carry on for themselves and study any kind of soil. They can learn to use these skills to solve problems concerning the soils they will work with in the future.

ASK THE ANT LION

This unit is an elementary study of animal behavior. The ant lion, a universally available, safe insect larva, is used as a tool to stimulate observation, investigation, scientific inquiry, and genuine scientific methods in children. The motto is: "Ask the Ant Lion" and not the teacher. It leads the children to many problems and gives them an opportunity to solve these problems themselves by manipulating the ant lions and placing them in various situations to which they will respond in their typical ant lion way, thus showing the answer. The "What will happen if..." type of question, posed by the children or the teacher, gives the children numerous chances for using their ingenuity in experimentation, and to rely on themselves and their increasing ability to find an answer to a problem.

LIVING PLANTS

The unit is made up of a series of problems and experiments designed to make the children more familiar with the complexity of growing plants, how fast they grow, how they grow: up, down, and why. They discover that every plant grows in its own way, yet there are similarities. They are free to explore as much as they can and, in any way they wish, the behaviour of growing plants. Skills such as accurate measuring and weighing are developed but, above all, the children solve their own problems by studying and manipulating living plants.

BUDS AND TWIGS

This unit is an experimental study of plant stems. Twigs from a variety of plants are collected and placed in water. Day to day changes are recorded, primarily by children's drawings. The child manipulates the stem or the environment to promote or retard the production of roots, buds,

leaves or flowers. He forms hypotheses as to the functions of stems and then uses his specimens to test his hypotheses.

Plant materials are readily available at little or no cost. The teacher must select those plants from his area which are most suitable. This will require some experimental work as part of his preparation. The plants selected should be ones which respond quickly. Advantage should be taken of this quick response and, if possible, a class period should be scheduled daily even if only for a few minutes in order to observe changes.

MOSQUITOES

During this study of mosquitoes, children work on several different problems. They experiment with finding ways of making the larvae swim to the bottom of the water in a clear container and they discover how to keep them there. Pupils do project work around the school as well as around their homes to find where mosquitoes live. They begin to try to control the mosquito population in their neighbourhood.

APPENDIX B

THOSE INVITED TO JOIN APSP ADVISORY GROUP, NOVEMBER 1968

ADU-AMPOMA, Mr. S.M.	Principal Education Officer, Science Education, Box M.45, Accra, Ghana
BENJAMIN, Dr. T.D.	48 Marshall Road, Yonkers, New York U.S.A.
BELANGER, Dr. Maurice L.	Longfellow Hall, Appian Way, Cambridge, Massachusetts, U.S.A.
COLE, Mr. Edmund T.	Department of Education, New England, Freetown, Sierra Leone
FAFUNWA, Prof. A. Babs	Acting Vice Chancellor, University of Ife, Ile-Ife, Nigeria
FASMAN, Prof. Gerald D.	Brandeis University, Graduate School of Biochemistry, Waltham, Massachusetts, U.S.A.
GOLDSTEIN, Dr. Jack S.	Astrophysics Inst., Brandeis University, Waltham, Mass. U.S.A.
KAJUBI, Mr. W. Senteza	Director, Institute of Education, Box 262, Kampala, Uganda
MARTIN, Prof. W. T.	16 Swan Lane, Lexington, Massachusetts, U.S.A.
MEENA, Mr. E.	A.C.E.O. Teacher Training, Ministry of Education, Dar es Salaam, Tanzania
MORRISON, Dr. Philip	Massachusetts Institute of Technology, 6-308, Cambridge, Massachusetts, U.S.A.
ODHIAMBO, Dr. T.R.	Zoology & Botany Department, University College, Nairobi, Kenya
ROWE, Prof. Mary Budd	Science Education Department, Teachers College, Columbia University, New York
THELEJANE, Mr. T. Sohl	University of Botswana, Lesotho, and Swaziland, Maseru, Lesotho
WALTON, Mr. William U.	Education Development Center, 55 Chapel Street, Newton, Massachusetts, U.S.A.
WARREN, Mr. William S.	Education Development Center, 55 Chapel Street, Newton, Massachusetts, U.S.A.
WESTON, Dr. William H.	10 Sunset Road, Wellesley, Massachusetts, U.S.A.
WILLIAMS, Dr. Awadagin	Fourah Bay College, Freetown, Sierra Leone
YOLOYE, Dr. E. A.	Department of Education, University of Ibadan, Ibadan, Nigeria
ZACHARIAS, Prof. J.R.	Massachusetts Institute of Technology, 6-207, Cambridge, Massachusetts, U.S.A.

Appendix C

A. Trial Materials to be Completed by 6/30/69

Ant Lions
Bud & Twigs
Chicks
Chima Makes a Clock
Corn Weevils
Estimating Numbers
Human Body
Liquids and Papers
Living Plants
Lower Primary (13 separate pieces)
Making Things Look Bigger - Magnifier
Making Things Look Bigger - Making a Microscope
Magnifiers and Microscopes - Combined Teacher's Guide
Mini Units
Moonwatchers
Mosquitoes
A Book about Pendula
Pendulums
Playground
Powders
Seeds
Seeing Weather
Sinking and Floating
Soil
Sour or Soapy
Stars over Africa
Strangers in the Sky
Using the Sky
How the Sky Looks
A Model of the Sky
Teachers Book for Stars
Sound
Tilapia
Timing Things
Yeast

B. New Materials Under Development

Balancing - Mid primary
Balancing - Upper primary
Metals and Soldering
Magnets and Motors
Strings and Fibres
Tools
Probability
Pottery
Moulds
Clocks II
Making a Telescope

B. New Materials Under Development (cont'd.)

What is the Moon
Insect Behaviour
Butterflies
Light, Shadows and Images
Simple Machines
Village Technology
Wood
Glues, Pastes and Gum
Colour
Wildlife Readers
Water Book
Spinning Things
Construction

APPENDIX D

KANO, NIGERIA, CONFERENCE PARTICIPANTS - FEBRUARY, 1965

ABUBAKAR, Dr. Iya	Ahmadu Bello University, Zaria, Nigeria
ACQUAYE, Mr. J.F.K.	Department of Education, University of Ghana, Legon, Ghana
AGIOBU-KEMMER, Mr. R.S.G.	Federal Ministry of Education (Broadcasting and Science) Lagos, Nigeria
CHIRA, Mr. Clement O.,	Ministry of Education, Enugu, Nigeria
COLE, Mr. E.T.	Ministry of Education, New England, Freetown, Sierra Leone
COLE, Mr. Magnus	Njala University College, Njala, Sierra Leone
FAFUNWA, Dean A. Babs	Faculty of Education, University of Nigeria, Nsukka, Nigeria
FATIMEHIN, Mr. J.O.	Principal, Ransome-Kuti College, Moor Plantation, Ibadan, Nigeria
FERRON, Dr. Oscar	Department of Education, Ahmadu Bello University, Zaria, Nigeria
GILBERT, Mr. P.G.S.	Department of Education, University College of Rhodesia and Nyasaland, Salisbury, Rhodesia
GITAU, Mr. John H.	Chief Inspector of Schools, Ministry of Education, Nairobi, Kenya
GOLDSTEIN, Dr. Jack S.	Astrophysics Institute, Brandeis University, Waltham, Massachusetts, U.S.A.
HAWKINS, Mrs. Frances L.	Elementary Science Study Field Representative, 511 Mountain View, Boulder, Colorado, U.S.A.
HYDER, Dr. Mohamed	Department of Zoology, The University College, Nairobi, Kenya
JONES, Mr. R. L.	La Bone Secondary School, Osu, Accra, Ghana
KANYENDA, Mr. Pearson M.	Domasi Teachers' College, Domasi, Malawi
KASS, Dr. Edward H.	Director, Channing Laboratory, Boston City Hospital, Boston, Massachusetts, U.S.A.
KINUNDA, Mr. Michael	Senior Mathematics & Science Inspector, Inspectorate Unit, Ministry of Education, Dar es Salaam, Tanzania
LEWIS, Mr. Jefferson	Department of Education, Monrovia, Liberia
LEWIS, Prof. L. John	University of London Institute of Education, Malet Street, London, England

LIVERMORE, Dr. Arthur H.	Deputy Director of Education, American Association for the Advancement of Science, Washington, D. C., U.S.A.
MARTIN, Prof. W. T.	Department of Mathematics, Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A.
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