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FINAL REPORT

TO

USAID

ON

AFRICAN MATHEMATICS PROGRAM

Contract No. USAID afr-711

JUNE 26, 1970 to MAY 31, 1975

submitted by
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55 Chapel Street
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FINAL REPORT ON THE
IMPLEMENTATION PHASE OF THE
AFRICAN MATHEMATICS PROGRAM (AID afr-711)

June 26, 1970 to May 31, 1975

I. INTRODUCTION

The African Mathematics Program (AMP) has concluded its work in assisting the reform of the teaching of mathematics throughout English-speaking tropical Africa. AMP, begun shortly after independence had arrived for many of the countries participating in the program, was based on a strong desire to introduce new ideas in modern mathematics education into the schools of Africa. AMP was only part of a larger movement to modernize all elements of the curriculum. The program has involved African and American mathematicians and mathematics educators, together with a few British, over a period of 13 years, almost an unprecedented period for foreign technical assistance work.

Expectations of the contribution that such a program could make were high on both sides of the Atlantic. Some of these expectations turned out, upon analysis, to be realistic; others soon were seen to be impossible of attainment, at least in the short run.

It is the purpose of this report to summarize program results and to discuss the weaknesses, as well as the successes, on the basis that important lessons are to be learned from both. A more comprehensive evaluation, "The Critical Issues Study," undertaken during the final two months of the contract, seeks to gain deeper understanding of the issues and problems posed by AMP.

This AMP final report will attempt to highlight activities and accomplishments in more summary fashion, leaving fuller discussion to documents emanating from the aforementioned study. Here, we deal specifically with the implementation phase of the program, occurring during the period June 1970 to May 1975. At the same time, frequent reference is made to the earlier work of AMP for purposes of conveying a better sense of the totality of program efforts throughout Africa.

A constant tension exists between developing country needs and external agency needs. For the developing country, the need is for 'staying power' in dealing with difficult and complex educational reform problems. For the external agency, the need is to sustain political support for its work through engaging in current, challenging and short-term projects with specific measurable outcomes. This tension was, and is, very much apparent in the work of the African Mathematics Program. After nearly 14 years of research, development and implementation effort, it is only now that real impact on primary school classrooms is being felt in those countries served. Reform of national curriculum is a generational effort of monumental proportions. External resources, because of their limited size, cannot greatly accelerate reform. They can influence the quality and direction of that reform, and this, AMP has done.

EDC as a research and development institution was privileged to be engaged in this effort. While the AMP grew out of EDC's own and other programming efforts directed at American schools, the opportunity to re-look at serious and important educational questions in different cultural contexts has done much to enrich EDC's operations at home. As a simple

example, the need to work in learning environments where severe financial limitations exist with respect to the purchase of materials for mathematics has been useful for EDC in re-evaluating curriculum development in America.

Mathematics Education in Africa

Consideration of the African Mathematics Program is best made in the light of a more general discussion of Mathematics and education in African countries. Underlying formal education systems in any country are broad economic and social issues. The first part of this report discusses some of these issues in the context of foreign assistance efforts in education, primarily in mathematics. The remainder of the report will concentrate on the African Mathematics Program in particular.

Large percentages of national budgets go to education in Africa. Effectiveness and style vary, but many of the problems and hopes are shared. Establishing a sense of national identity and developing human resources for an independent technology are common goals. Both encompass questions of sovereignty and political implications inherent in education. Many education issues have political aspects: the language of instruction, the ethnic background of teachers, the amount of foreign exchange spent on texts, who passes what kind of examinations, and so on. Any foreign assistance program to education affects and is affected by political decisions at some level. Mathematics is no exception.

A 'literacy' in mathematics is common in new places of power and prestige in Africa; doctors, economists, military technicians, engineers and agricultural experts all require sophistication in mathematics.

Those majoring in chemistry, physics, electrical engineering, statistics, etc., require university level mathematics. Use of computers, and communications equipment - many of the symbols of being modern - demand a certain level of mathematical thinking by those in the fields. The university mathematician is admired for his mastery of a difficult, important subject and he is comfortably rewarded.

Mathematics is associated with the modern sector of society and with the future. Its importance within primary and secondary curriculums is not seriously questioned by high ministry officials. The demand for better mathematics education comes from within these countries; it is not an imposition from the outside. But because mathematics is (indirectly) associated with these rising symbols of power, the way in which it is taught is in part a societal problem. The vast majority of people in these countries will not be assimilated into the modern sector. They will be farmers, traders, shop-keepers and fishermen. There is need for important balances of emphasis in primary and secondary school in order to offer appropriate educational tools for those who will drop out and those who will continue their education. An outside agency involved in curriculum reform affects this balance, consciously or unconsciously.

Many subtle biases exist in education systems that must be explored. One example is a strong urban bias in mathematics. The opportunities to pursue and apply mathematics are far greater (and more obvious) in the cities; heavy curriculum emphasis on math is more reasonable to a city student than to a rural student. And the "modern" mathematics, perhaps more than the traditional math, permits a good teacher to do much more (as opposed to just more) than a poor teacher. The new material opens

up opportunities for good teachers to challenge their students more than does traditional math. Since good teachers are more often found in urban centers, the gap in education opportunity between rural and urban areas is frequently widened.

Formal education systems in Africa tend to be urban-oriented and designed to serve the needs of an emerging technology. Lip-service might be given to the new insight that a shepherd boy has gained when he drops out after primary two and returns to tend his animals, but the design of the education system is for those who complete all twelve years. In one participating country 300,000 start Primary One, about 30,000 pass Grade 6, but less than 3,000 will enter university. What kind of mathematics could be taught in the first three years by rural teachers that would have an impact on a future farmer?

Curriculum development emphasizing rural improvement requires a cautious approach. Educational reform in rural areas might be pushed as a substitute for other developments such as land reform and alternative market systems which could have far greater impact on the life of the rural people. Implementation of curriculum development more properly follows rather than precedes the political changes. Yet one cannot implement something that does not exist. The important distinction is between experimentation and implementation.

When considering the process of modernization, and the role of education within it, many questions come to the mind of one who enjoys the special qualities of life in different parts of Africa. The teaching advocated by many of those associated with modern mathematics is the 'discovery method.' This method encourages close interaction in the

classroom (teacher-student and student-student). It is a step toward child-centered, activity oriented education and away from authoritarianism in the classroom. Somehow this is suggestive of a style possible in classrooms which can deeply affect larger attitudes about life, and particularly about the society in which the African child is raised. Personal observation and reading about many African societies shows that this very 'discovery method,' learning by observing, is the major way-of-life from early childhood.

Choices in educational change in Africa operate under economic constraints. Development of a textbook series is a long and expensive process. Often what happens in a classroom is only vaguely related to the spirit of the text. What teachers and students do with a given body of material is the crucial factor. All standard textbook series available in Africa now clearly set down the principles of mathematics from Grade I to university. One view of education development holds that it is better to help teachers teach better that which they already know, than to change the curriculum. (It is sometimes argued that traditional mathematics taught well is better than modern mathematics taught badly.)

The examination system also plays a prominent role in the structure of education. At different steps along the way, students are allowed to continue their education largely in accordance with scores. The purpose of learning too often degenerates into passing an examination. Competition is encouraged; cooperation is discouraged. This exam domination seems a colonial hold-over, and contrasts most sharply with a system where fellow-workers and peers play as important a role in advancement as does academic ability. In African societies, mathematics

ability correlates highly with success in further schooling. This supports an examination system of selection, which grants opportunity for advancement based solely on intellectual aptitude.

Whatever the arguments about the role of mathematics in the curriculum, a study of the African Mathematics Program begins from the basic point that with the single exception of language, no subject receives more attention in the schools of Africa than Mathematics.

II. A BRIEF HISTORY OF THE AFRICAN MATHEMATICS PROGRAM

The African Mathematics Program was the first of several programs initiated by EDC as the result of a conference of African, British and American scholars and educators. The conferees met during the summer of 1961 to determine how they might assist Africa in curriculum development and research.

AMP was intended to improve the quality of mathematics teaching and to develop in each country a nucleus of people knowledgeable in mathematics and capable of undertaking continued improvement of mathematics curriculum.

1. Initial Development: 1962 - 1969

The Program was established in 1962. It brought together a group of African and American mathematicians and educators to prepare a new series of modern mathematics textbooks for grade levels Primary I through 'A' level school certificate, and for teacher training colleges.

In the summer of 1962 and continuing each of seven years, the first Pan-African workshop was held in East Africa to prepare the new modern mathematics texts. Participating in these seven workshops were mathematicians and educators from 10 English speaking African countries: Ethiopia, Ghana, Kenya, Liberia, Malawi, Nigeria, Sierra Leone, Tanzania, Uganda and Zambia, as well as the United States and several from the United Kingdom. The development plan called for field testing of newly prepared materials in each participating country during the year following the textbook preparation. Each subsequent workshop would undertake revision of the prior year's work, based on the field test experience, and prepare a following year's preliminary text.

By 1969 a complete textbook series in modern mathematics had been developed and field tested for seven years of primary school and for the primary teacher training colleges. In addition, two series of texts were prepared for the secondary schools, one for a four-year and the other a five-year program.

In all, 67 prototype volumes of modern mathematics have been developed:

Primary	20
Secondary	42
Five-year Program	20
Four-Year C Program	14
Additional Mathematics O level	4
Advanced Mathematics A level	4
Teacher Training	4
Entebbe Primary Series Guide	<u>1</u>
Total	67

This writing effort involved 186 Mathematicians and mathematics educators, of whom 55% were African, 40% were American, and the remainder were mostly British.

Complementing the preparation of textbooks was a parallel program in teacher training. That teachers hold the key to successful implementation of modern mathematical ideas in all schools, has long been recognized. Teacher training institutes financed principally by the African Mathematics Program were held in participating countries. These institutes were designed to introduce teachers to the new pedagogical approaches and mathematics textbooks in particular. By 1969, more than 5,000 teachers and teacher educators had attended 71 institutes in 10 different countries.

Further, beginning in 1966 under Ford Foundation auspices, the ABC Institute Program ran for three successive summers at the University College, Nairobi, Kenya. This program concerned itself with upgrading the mathematical teaching competence of senior mathematics educators of the 10 participating countries. Under the program, a small cadre of people drawn from universities, training colleges, and Ministries of Education were trained to undertake the necessary curriculum reform and to assist with the implementation of a new mathematics curriculum in their respective countries.

The ABC Institute produced three pilot teacher education films which have been distributed to mathematics tutors participating in the Institute program. These films depict actual African classroom situations, using modern mathematics approach and materials. Eighteen audio tapes on various mathematical topics related to teacher education were made. A syllabus source book for use in African teacher training colleges and in-service courses was produced.

The focus of the seven year period 1962-1969 was on production of the necessary modern math materials to undertake widespread reform of mathematics teaching in the public schools of the 10 participating countries. In addition, the trial of various mechanisms designed for large-scale teacher training of modern math were tested in preparation for its widespread implementation.

2. Regional Mathematics Programs: 1970-1975

Two Regional programs for the implementation of modern mathematics into the schools of 5 participating African countries were inaugurated in 1970. Again, these were under USAID auspices. The regional mode of

operation was influenced by American foreign aid policy existing at that time. In 1969, four meetings had been held with USAID officials and representatives of various African governments relative to that mode of operation. The meetings included the following groupings of nations:

<u>Meeting place</u>	<u>Countries included</u>
Accra, Ghana	Ghana, Liberia, and Sierra Leone
Nairobi, Kenya	Ethiopia, Kenya, Tanzania and Uganda
Lagos, Nigeria	All Nigerian states
Roma, Lesotho	Botswana, Lesotho, Malawi, Swaziland, and Zambia

Two regional mathematics programs, one in East Africa and one in West Africa emerged from these meetings. Participating were those countries which were prepared at that time to commit themselves to regional cooperation for the implementation into their schools of modern mathematics based on Entebbe materials.

Ghana, Sierra Leone and Liberia participated in the West African Regional Mathematics Program (WARMP); in the East African Regional Mathematics Program (EARMP) Ethiopia and Kenya collaborated on a similar project. Needs common to the countries were identified and solutions outlined through Regional Programming efforts.

In East Africa, textbook revision activity for the teacher training colleges was undertaken by Ethiopian and Kenyan mathematics educators, under the leadership of an American university mathematician. In addition, extensive teacher training implementation activities in Kenya and Ethiopia were begun with resident program mathematics educators located in each country.

The Regional mode of operation relied heavily on administration by African nationals. The Administrator for each program was responsible to a Regional Management Committee of officials of the Ministry of Education and universities in his country, and to EDC.

In East Africa, the Regional headquarters of EARMP was established in Addis Ababa, Ethiopia and the administrator was a senior Ethiopian civil servant.

In West Africa, the Regional program was headquartered in Accra, Ghana. The administrator, again responsive to a management committee of representative officials from the three participating countries, was a senior African educational administrator. The WARMP employed mathematics educators and editors for the revision work required for primary, secondary and teacher training textbooks and also for the extensive teacher training preparatory work going on in all participant countries.

1970 marked the transition from a program of research and development to a program of implementation of modern mathematics into the schools. Of the ten countries originally in the AMP, five (Ghana, Liberia, Sierra Leone, Ethiopia and Kenya) were prepared to undertake at that time the large scale effort necessary to introduce mathematics into their schools. This was to be done at different stages which fit the development of their education systems.

Nigeria, Lesotho, Malawi, Tanzania and Zambia, who had taken part in the earlier stages, either had other educational priorities which took precedence at the moment, or planned to continue their own educational development work on a more independent basis.

During the implementation phase of the mathematics program undertaken by EDC, it was planned that work would be directed toward institutionalizing the Pan-African cooperative efforts begun by the regional programming. Governments would be encouraged to examine the possibilities of establishing legal organizations to carry out the regional programming work in mathematics in both East and West Africa. With the continued shortages of people trained in mathematics curriculum development, it was hoped that participating African countries would recognize the value of creating a mechanism for sharing scarce resources on a more permanent basis.

III. PROGRAM RESULTS, CURRENT STATUS, AND PLANS FOR THE FUTURE

Program results are summarized in this section in four general categories in accordance with the Activities/Outputs Relationships Charts developed for use by the program and its monitors in April, 1971 (see Appendix 1, p.59).

1. Personnel Training: Tutors and Supervisors
2. Preparation of Instructional Materials
3. Development of Evaluation and Editorial Expertise
4. Plans for the Future

1. Personnel Training: Tutors and Supervisors

A priority need of the countries participating in the regional program efforts in both East and West Africa in 1970 was supervisory personnel trained in modern mathematics. Training was to encompass their being able to undertake the massive in-servicing of each country's primary school teachers, who would be required to implement the use of modern mathematics materials and methods in all schools. Actual in-servicing of teachers (which number in excess of 50,000 in Kenya alone) was not to begin until materials and trained people were available. Both were expected as outputs of this program.

With respect to personnel, the group to be trained for the purpose of in-servicing teachers was to consist of teacher training college mathematics tutors and field supervisors, and inspectors of primary schools. Training cadres of 200 such individuals in East Africa and another 200 for West Africa was planned. No careful delineation of numbers for each participating country was formulated, although it was

anticipated as proportional to the population of primary school teachers in each country. Thus, for planning purposes, training programs and program manpower were deployed to produce roughly equal numbers of trained manpower in Kenya and Ethiopia. In West Africa, Ghana would receive assistance in training more than twice the number of personnel needed for Liberia and Sierra Leone combined.

Training of these cadres of nationals to undertake the in-servicing of primary teachers was accomplished through combination residence institutes and correspondence course programs conducted by program mathematics educators stationed strategically throughout the regions. (It was envisioned that each trainee would undergo a two-week in-residence course or institute in modern mathematics materials and methods based on the new program teacher training materials in each of two successive years during the long vacation break. These two institutes would be connected through a correspondence course modelled extensively on earlier correspondence programs conducted by EDC under Ford Foundation auspices.) See Exhibit 1.

Exhibit 1

Regional Mathematics Program : Middle-Level Personnel Training

	<u>No. of Training Colleges</u>	<u>1st Batch of Participants Trained Dec '70/Nov '72</u>	<u>2nd Batch of Participants Trained Dec '72/Nov '74</u>
<u>Ethiopia</u>	5	Total 46 including: 38 Supervisors 8 TTI Teachers	50
<u>Kenya</u>	23	Total 47 including: 20 TTC Tutors 27 Pr.School Ins- pectors	47 plus additional group of 25
<u>Ghana</u>	70 (approx)	Total 60 TTC Tutors	67
<u>Liberia</u>	3	Total 9 including: 1 Tutor 1 Min.of Edu- cation official 7 Teachers	19
<u>Sierra Leone</u>	4	Total 16 including: 5 TTC Tutors 11 Teachers	25
TOTAL	105	178	233

Heavy stress during the implementation of subject contract has been on improving the skills of the mathematics tutors at the primary teacher training colleges. Permanent improvement in mathematics teaching was seen as achievable only through reoriented and improved pre-service training of new teachers at the colleges. Institutes conducted by the program were designed to work with these tutors along with field supervisory people in the Ministries of Education. Field follow-up was expected to increase the effectiveness of the institute training through discussion and emphasis on those aspects of the training which tutors found difficult.

Experience during the period 1970-1973 revealed problems in attempting appropriate field follow-up for tutors. The amount of time

needed by program mathematics educators, as well as travel demands, were heavy and communications, poor. By the end of 1973 it was concluded that field visitations were at best marginal uses for limited program funds. An alternative program of mini-institutes was developed by mathematics educators as a more effective way to devote their time.

Under this alternate field scheme, small groups of tutors numbering five to seven gathered for five days in one location for intensive but informal sessions directed at improving understanding of the new teacher training materials of AMP. (Each participant was to attend three mini-institutes in order to complete the training.) In total, 182 persons participated in this activity during 1974 in West Africa. The mini-institute program was followed throughout the balance of program life in both East and West Africa. Travel and physical demands on program personnel were significantly reduced with what were conceded to be salutary results.

In East Africa, organization of the institutes was on an individual country basis. That is, both Ethiopia and Kenya conducted programs involving only nationals of each country. In West Africa, because of the disparity in size between the three participating countries, a more regional programming effort was planned. One set of courses was held for a large section of Ghana exclusively. Another was conducted for the remainder of Ghana, together with Liberia and Sierra Leone.

Those completing the combined residence and correspondence course were issued certificates of completion by the East and West African Regional Mathematics Programs. It was hoped that these certificates would be recognized in the future as valid for purposes of upgrading.

Program targets for East Africa were met substantially. The program of training followed the outlines proposed in the original plan. Approximately 50 participants attended each residence course or 'institute,' as the courses were called. Approximately 80% of all those participating in the course completed all parts over the two year period. Those who did not complete an 'institute' failed most frequently with the correspondence work. Even so, some additional participants finished the prescribed work late and the actual completion percentage neared 85%.

In West Africa, results were not as impressive. For Ghana as a whole, approximately 50% completed all aspects of the course and were awarded certificates. However, results were poorer for Liberia and Sierra Leone, where difficulty arose in obtaining sufficient numbers of people qualified to participate. Both countries, in a sincere effort to cooperate fully with the program, attempted to find unusually well qualified primary teachers to attend the various training activities, since supervisors and inspectors were virtually non-existent and the numbers of training college tutors was small. Both countries probably would need to rely on such trained primary teachers in their later implementation efforts. Participation by teachers was widespread, although they had less background in mathematics and less obvious opportunity to use the training. Continuation with the program proved to be a problem, and completion rates were low.

In East Africa, results of these efforts have approached the numbers of teacher trainers originally targeted. But both Ethiopia and Kenya have undergone such primary school expansion during the period 1970-1975 that those numbers, once thought to be adequate for conducting

the required in-service program, now appear to be only one-third the number needed. Both countries are most interested in continuing the work; both are publicly committed to introducing modern mathematics into their primary schools.

In West Africa, the problem created by shortages of trained personnel in Sierra Leone and Liberia still remains. Some progress has been made, particularly in Sierra Leone, yet both countries are embarking on large-scale implementation plans with inadequate manpower to accomplish the tasks. Further help in training teacher-trainers is still a critical need. Both countries have developed programs addressed to this continuing need. Additional manpower trained in modern mathematics for in-service work in Ghana is not at issue; Ghana is moving ahead on its own, relying heavily on locally available manpower.

2. Preparation of Instructional Materials

Targets for materials production during the five year period covered by the contract were textbooks for primary schools, secondary schools and teacher training colleges. These materials were to be based primarily on Entebbe materials produced by the African Mathematics Program between 1962 and 1969, but revised on a more regional basis to reflect conditions in East and West Africa.

The following specific materials would be prepared accordingly:

1. Teacher Training: Two volumes of teacher training materials for use in training colleges in both East and West Africa; each volume to cover one year of material;
2. Primary schools: Six or seven volumes of primary mathematics materials for students, with accompanying teacher guides for West Africa only.
3. Secondary schools: An estimated eight volumes of student and teacher texts adapted from existing Entebbe texts; and six to seven subsidiary mathematics pamphlets, for West Africa only.

Preparation of materials was to be accomplished through writing workshops held each summer in East and West Africa. Mathematicians and mathematics educators from each participating country were expected to contribute to the writing in order to assure that the end product would be appropriate for use in each country.

Program plans were to produce text materials through the manuscript preparation, editing, illustrating, and final typing stages in order that camera ready copy could be made available to each country for final printing without need for further change.

All program targets with respect to materials were met, with the exception of the subsidiary mathematics pamphlets, judged to be unnecessary. In fact, to satisfy the special needs of certain participating countries, additional textbook preparation activity was necessary. Particularly in West Africa, writing workshops were needed to prepare a special seven year primary series for use in Sierra Leone. This meant not only a text for the final year (not required in either Ghana or Liberia), but necessitated minor modification in the Primary 5 and 6 texts for Sierra Leone. Further teacher training texts were produced as planned for both East and West Africa. But in addition, a one volume guide for those teacher training texts was developed for use in both Regional Programs. (See Exhibit 2.)

Exhibit 2

TEXTBOOK PREPARATION

	<u>No. Volumes Completed to Camera Ready Copy</u>
I. WEST AFRICAN REGION MATHEMATICS PROGRAMME (WARMP)	
1. PRIMARY 1, 2, 3, 4, 5, and 6 Pupil's Book and Teachers' Guide	12
PRIMARY 7 Pupil's Book (Sierra Leone only)	1
2. TEACHER TRAINING VOLUMES I and II and Teachers' Guide	3
3. SECONDARY 1, 2, 3, 4, 5 Pupil's Books 1, 2, 3, (4 and 5) Teachers' Guide and/or answer book	9
TOTAL WARMP TEXTS	25
II. EAST AFRICAN REGIONAL MATHEMATICS PROGRAMME (EARMP)	
TEACHER TRAINING VOLUMES I and II and Teachers' Guide	3
TOTAL EARMP TEXTS	<u>3</u>
TOTAL NUMBER OF VOLUMES PREPARED	28

The implementation plan for production was to be the sharing between the participating countries in each region of the camera ready copy of the various texts produced. Hopefully, through the Regional Management Committees, appropriate sharing arrangements could be worked out to the satisfaction of all. This was a hope only, leaving considerable concern lest the cooperative machinery break down.

Recent experience with country printing efforts has, in reality, lessened the need for such a sharing arrangement. In West Africa, where the problem was most acute since three countries needed access to manuscripts, only Sierra Leone has printed directly from the camera ready copy. Ghana has arranged through a commercial publisher in Singapore to typeset the primary books in order to cut down on paper volume. Thus the size or bulk of WARMP primary texts are reduced by nearly one third, more than compensating for the additional cost of typesetting. Liberia is planning to make minor text revisions before printing the primary series. It is likely that teacher training texts will undergo slight individual country modification, proving xerox copies of materials to be satisfactory.

In East Africa the problem is largely solved. Teacher training materials were produced jointly for the two participating countries. Both countries already have done individual printings of Teacher Training Volumes I and II. Only the guide for these volumes, where quantities required are small, has not been completely printed. There has been discussion of a combined printing to serve the needs of both countries; no final decision had been reached at the time of program termination there in December, 1974.

Although program targets with respect to materials were met in all cases, it was accomplished only with monumental effort on the part of program staff. The difficulties of text preparation in Africa are still great. To mention two, well-trained personnel are not available yet to handle mathematical typing, and proofreading ability is inadequate. As well, needs for editing materials, such as cutting tools, paste, typits, and copy facilities remain difficult to fulfill.

Although an extensive program of materials preparation was undertaken under regional program auspices, no government could give final assurance of its intent to use such materials in advance of appropriate review. Assurance was given that modern math for the primary schools and teacher training colleges was being adopted, and that regional program materials would be carefully considered. But such assurance fell short of final commitment to the use of all AMP materials. However, every country involved in the program is committed now to the use of the teacher training materials produced by the Program. Almost universally they have been judged high in quality.

In East Africa, since the priorities were teacher training college course revision, both the Ethiopian and Kenyan Governments have printed quantities of EARMP materials directly from camera ready copy provided. In West Africa, priority in each country lies with primary materials. See Exhibit 3 for full details.

Exhibit 3

COUNTRY TEXTBOOK PRODUCTION

PROGRESS AND PLANS

May 31, 1975

<u>Country</u>	<u>Primary</u>	<u>Teacher Training</u>	<u>Secondary</u>
LIBERIA			
Produced	None	None	None
Plans	Print Primary 1 WARMP texts after minor modification.	Intend to use WARMP texts but no specific production plans to date.	Min. Education committee to review WARMP Secondary materials for possible use. Chaired by WARMP writers so favorable decision expected.
SIERRA LEONE			
Produced	Printed 50,000 copies WARMP Primary 1 Pupil Book, 4,000 P1 Teachers' Guide at cost of \$46,000.	None Committee has met and made minor revisions of WARMP materials in preparation for printing.	None
Plans	Primary 2 materials to be printed by mid-1975 one grade of materials to be printed each following year. P3 and 4 at printers.	Future printing of WARMP T.T. materials likely. T.T. Vol.1 now at printers.	Secondary schools to review WARMP materials with likely recommendation that they be accepted for use.
GHANA			
Produced	200,000 copies each of Primary 1 & 2 Pupil Books printed with Teachers' Guides.	T.T. Vols. 1 & 2 printed for use in Training Colleges.	WARMP materials on approved list for Ghana schools.
Plans	Primary 3 Pupil Book and Teacher texts now being printed.	Printing of Guide expected.	Secondary schools to review. Recommendation expected to government to print.

	<u>Primary</u>	<u>Teacher Training</u>	<u>Secondary</u>
KENYA			
Produced	NOT PART OF PROGRAM. KENYA PRODUCING OWN SERIES AT LOCAL EXPENSE	Printed 5,000 copies each of Teacher Train- ing Vols. I & II.	NOT PART OF PROGRAM
Planned	-	To print guide for Vols. I & II, possibly combined printing for Ethiopia,	-
ETHIOPIA			
Produced	Ethiopia producing own Primary series at local expense	Printed 10,000 copies T.T. Vol. 1.	NOT PART OF PROGRAM
Planned	-	Print 5,000 copies. T.T. Vol. II presently at printer awaiting paper supply. Plan to buy 200 copies of Guide from Kenya print run.	-

Nine, rather than eight secondary volumes were prepared, the ninth being a Secondary 5 text for West Africa, needed if the full series was to be considered by the review committees in the various countries. In the latter stages of the West African Regional Mathematics Program it became apparent that the review process for secondary texts in all three countries was considerably different from the process for primary or teacher training texts. Secondary schools traditionally have been given greater latitude than primary schools in selecting course materials. It seems unlikely that any series of secondary mathematics will be adopted throughout a country's secondary schools. More likely several alternatives would be adjudged as appropriate and placed on the approved list from which secondary schools select.

Such a procedure has caused problems for the program because the review is typically done by secondary school headmasters and mathematics teachers. Thus, in order to have WARMP materials reviewed, it was necessary to have more than a single camera ready copy available to each ministry for printing. Resolution of this review issue has been to produce review copies of Secondary 1 and Secondary 5 together with the tables of contents of the intervening Secondary 2, 3, and 4 texts, for distribution to the various review bodies in each West African country. Two hundred copies of the material necessary for this purpose have been printed and despatched to individuals in each country who will oversee the review.

Since the WARMP secondary texts have been revised by a writing team composed solely of African Mathematicians and mathematics educators, and because the revision work has produced the only secondary series fully

responsive to the new West African Examinations Council's syllabus for modern mathematics, it is expected that the WARMP materials will receive a positive reception.

3. Development of Evaluation and Editorial Expertise

This phase of the implementation, although perhaps of lowest priority, proved the most difficult to implement, but considerable progress can be reported. Success of this aspect of the regional program efforts depended upon each participating government. Each had to be willing and able to designate appropriate local individuals to work with program personnel on evaluation and editing tasks required by the program. Uniformly, in the face of other priorities, countries were unable to commit scarce manpower full-time to evaluation or editing activities. Some countries appointed personnel to be available on a part-time basis, but such an arrangement proved less than satisfactory because those appointed already had heavy work schedules. Notwithstanding, four of the five participating countries (Ethiopia was forced to transfer its evaluator nominee to other duties) did designate a person who gained some benefit from the association. (The ministry was coordinator of evaluation activities involving the regional program.)

All selected personnel were given a three month residence evaluation course at the International Center for Educational Evaluation at the University of Ibadan in Nigeria. That exposure to such studies resulted in several people being able to undertake local evaluation of importance to their Ministries.

Development of editorial expertise proved more difficult. As was the case with evaluation personnel, cooperating Ministries of Education

often could not find suitable manpower to undertake this training on behalf of the program. These manpower shortages resulted in the burden of editing falling upon program personnel without local support during the first three years of the program. In East Africa, editorial assistance was lacking throughout the entire program period. In West Africa, it did become available by 1974. By that date, each country had designated an individual to assist with editing tasks under the direction of the program editor. Considerable work experience with competent direction has produced at least one individual able to direct further editing work of the mathematics texts in each participating West African country.

Another competence required for the preparation of mathematics texts for African schools is skilled mathematical typing. This need was not sufficiently recognized by the program at the outset. Nonetheless, such typing skill has been developed (again) under the direction of the program editor in Ghana. The necessary typing skill still does not exist in Sierra Leone and Liberia.

International Cooperation

Although it was never explicitly stated in formal contract language, EDC hoped that African countries participating in AMP might find their self-interest well served by the creation of a legal organization for international cooperation in continuing mathematics education development. Management committee meetings in both East and West Africa during 1972-75 devoted considerable discussion to this question. While the specific purposes to be served by such an organization never crystallized, it was generally viewed as a technical assistance agency in

mathematics education within Africa. Such a mechanism could share scarce personnel in this field and conduct joint programming efforts to solve educational problems common to more than one country.

Developments toward creating an international legal organization progressed further in West than in East Africa. A draft constitution for a West African School Mathematics Organization (WASMO) was prepared, circulated and widely discussed. Ghana, Liberia and Sierra Leone considered formal acceptance of the constitution of such an organization, through discussions and "acceptance in principle" at highest governmental levels. But firm commitment to the establishment of WASMO has been lacking to date. It is clear that considerable additional time and effort will be required before satisfactory answers to the purposes, functions and finances of such an organization can be resolved.

In East Africa, regional grouping proved over the course of five years to be sufficiently artificial that no serious attempt to legalize educational cooperative efforts between Kenya and Ethiopia was ever made.

4. Plans for the Future

There is no turning back for the five countries engaged in the regional mathematics programming efforts in East and West Africa. All have made abundantly clear their intent to move ahead with the introduction of modern mathematics into their schools, particularly at primary and teacher training levels. These decisions represent enormous commitments of time, energy and money. Variations in the materials and methods used in schools will appear among participating countries. This variation reflects the increased level of sophistication in curriculum development and could be considered a positive legacy of the AMP.

With or without external assistance, it is clear that improvement in mathematics will continue.* As one member of the EARMP Management Committee expressed the feelings of his government: "We will continue regardless of external support. Unfortunately, the pace of development will be slower without help."

An impression has been created during this regional programming phase that most of the resources supporting implementation tasks in cooperating countries has come through external aid sources. Nothing could be further from the truth. In fact, the bulk of programming has been locally financed and run. This fact has been difficult to document in detail and thus has been insufficiently communicated. Such communication problems speak volumes about the need for closer collaboration in planning between external aid and local development plans. Unless these can be seen in proper context, the erroneous impression will remain that external aid is the total effort being made.

*Some countries have moved ahead with ambitious plans to extend and accelerate the teaching of mathematics in their primary schools based on the conviction, rightly or wrongly, that continued external support would be available. Continuation programs for the next three year period were requested by USAID, which further encouraged countries that extended external assistance might be possible.

IV. THE AFRICAN MATHEMATICS PROGRAM: ANALYSIS

A strength of the African Mathematics Program from its beginning in 1961 has been its emphasis on the development of human resources. Every aspect of the program, from writing textbooks to teacher training, was designed with the intention of transferring as many useful skills as possible to people in the participating countries. Not only was the emphasis on human resources a major part of the AMP for fourteen years, but the idea itself was supported and encouraged in the governments of many countries, including the United States.

The following section analyses issues raised in four major components of The Program over the past fourteen years:

- A. Materials Production
- B. Teacher Training
- C. Institution Development on a Regional Basis
- D. Evaluation

A brief look at content is in order before beginning a component-wise discussion of The Program. The Entebbe Mathematics Series is not overly abstract and unrelated to traditional mathematics or needs. Any such impression is unwarranted. Comparisons should be directed first to the Highway Arithmetic Series which dominated African Primary schools in the late 1950's and early 1960's. Other comparisons then can be made with more recent African adaptations of British, American and African texts.

The following table of contents of the EARMP Teacher Training text, Fundamental Concepts, Vol. 1, illustrates the type of AMP content being discussed.

1. Sets, Number, Numeral
2. Addition and Subtraction
3. Multiplication and Division
4. Number Games and Activities
5. Integers
6. Introduction to Geometry
7. Measurements
8. Introduction to Motion Geometry
9. Fractions and Operations on Fractions
10. Rational Numbers
11. Geometric Constructions, Patterns and Models
12. Equations and Inequalities
13. More about Whole Numbers
14. Decimal Fractions
15. Blending Arithmetic and Geometry
16. Ratio and Proportion
17. More about Sets

New topics (e.g. Sets, Inequalities, Motion Geometry) are included.

Familiar topics are treated in new ways (Addition, Fractions, Equations).

The most important differences lie in emphasis on understanding of value over rote learning, and in the grade level at which certain topics are introduced (elementary geometry in early primary school, for example).

There also are important differences in methodology which encourage student participation and thought.

A. Materials

The majority of materials produced by the African Mathematics Program over the past fourteen years has been textbooks. Some tests, one set of audio tapes and three pilot films were done, but over 120 different volumes of texts and teachers guides are the bulk of the work. Many reasons can be given for emphasis on textbook series as opposed to

self-contained units (written, oral or visual). Probably primary in influence in the early sixties was a confidence on the part of Americans in the techniques and substance of the curricula recently developed in the United States, and the commitment there to textbook series. Prototype texts were written to replace existing texts. Production of supplementary materials was not the goal, rather alternative materials were being produced. The spiral method (re-introducing the same topic in new and more sophisticated ways over time) was a major objective and required textbooks for its simplest use.

Reasons within Africa argued for production of a prototype series of textbooks. Respectability in the eyes of the Ministries of Education was particularly important, since Ministry officials would be the ones to grant approval if the program were eventually to be implemented. Any math curriculum had to respond to the domination of the existing examination system. A curriculum that could not lead to a West African Examinations Council, a Cambridge Overseas Examination (or its successors) or a School Leaving Examination certificate would not be taken seriously by Ministries.

Another consideration favorable to texts was the monopoly of British companies (e.g. Longmans) over textbook sales to British colonies and former colonies. Africans at that time (early 1960's) were opposed to this British domination. A 'no copyright' series of texts was very welcome as an alternative to British textbooks.

1. Writing Efforts and Outcomes

The reasons stated previously and the genuine enthusiasm generated at the 1962 Writing Workshop at Entebbe, brought about a great demand for trial sets of books. Pressure from African educators involved with the program in the fall of 1962 resulted in the decision to have the Primary One books ready in four months, instead of sixteen months as had been planned. This decision set the pattern for the next six years of writing workshops. The pressure for books, quickly and in quantity, very early on, gave the program an implied sense of implementation rather than experimentation.

The same scheduling occurred in the early WARMP writing workshops. Books written in the summer were to be produced by January for classroom trials. Many times this led to classes beginning without books available. Program decision-makers consistently underestimated the time required from writing a workshop draft to supplying books for the classroom.

The textbooks were written in workshops rather than by other perhaps more 'efficient' means. Human resource development was major to the entire program, and the training of Africans in textbook writing skills was considered as important as the production of the books. Gathering together African and American mathematicians, teachers and textbook writers also accomplished the goal of skill sharing. Many of the Americans had had experience with the workshop technique in the U.S. (SMSG for one). Workshops are more 'democratic,' encourage group decision-making, and maximize use of the varied experiences of large numbers of people. The joint effort also promoted the acceptability of the result.

While a dozen writing workshops were held by the African Mathematics Program between 1962 and 1974 (smaller groups in each workshop were assigned separate writing tasks), their style varied considerably, as did their effectiveness. The choice of writing group chairman seemed to be a crucial factor in the functioning of the writing group. Another crucial factor was a core of members returning each year to the same basic task (e.g. writing primary books). Very possibly, writing groups working under tight supervision of the chairman were more effective both in product and training than more loosely organized groups. The working relationship, exchanging ideas and influencing outcomes, between the general editor and the writing group chairman seems to have been important to the quality of the final product.

In theory, a component of the writing has been classroom trial. This has not worked well. The press of time in the Entebbe phase of the writing meant that trials were more to demonstrate the quality of the texts than to be of use in the writing/rewriting work. There was little rewriting done initially.

Classroom trials were a major component of the WARMP phase of the writing. However, editing delays meant that classes to be observed were late in receiving books, and assessment of the class's reaction to the books was made more difficult.

Classroom trials are a part of the broad question of evaluation. How the texts are used in the classroom provides feedback to writing groups. There are two parts to the problem: getting the feedback and getting the writers to consider the feedback. Feedback procedure for the early Entebbe books was in questionnaire form in the teacher's

guide, which was to be completed and sent to EDC, Newton. Observation of classrooms by the General Editor and conversations with teachers using the texts were the only feedback in the WARMP writing task. It is difficult to observe classes in three countries and edit books at the same time; inadequate program manpower resulted in a less-than-adequate feedback system.

All writing for the African Mathematics Program was done on an international basis, but there was confusion reported on the part of those writing about how much local adaptation was required. Some shuddered to think of the possibility of adulterations; another thought future adaptations would inevitably vary in quality or be but successive approximations of the Entebbe ideal. Adaptations have varied: from merely changing the names and units of measure - to major re-writing. If major re-writing was to be required in each country, then the question is whether it might not have been better to do the writing nationally in the first place. (cf. D.A. Brown's Report, Appendix 3, p.69.) As already noted, national writing efforts were not a possibility under USAID aegis five years ago, due to AID's commitment to regionalism.

Another area in which different expectations existed among participants in the Entebbe writing workshops was whether materials were being written for experimental or for implementation purposes. The reports and words of the organizers were of prototypes and experimentation, but the mood and spirit was of implementation. Little rewriting on the basis of classroom trials took place. The training aspect of a rewriting task was also largely lost. The message of action, if not words, was that books were prepared in one session, printed and

implemented. The mood of implementation continued to affect the follow-up programs that had to be couched in the language of regionalism.

One government, Tanzania, was very disappointed with the termination of the writing phase of the program in 1969. Tanzania had made a large commitment to the Entebbe program. In that country, the primary books were translated into Swahili, and widespread usage in primary school was in anticipation of aid in an evaluation, rewrite effort that did not materialize. Tanzania was using Entebbe secondary materials as well. Tanzania found regionalism unacceptable, and a potential feedback for rewriting and improvement of the yet experimental texts was lost to EARMP. Conversely, in West Africa, where the major rewriting took place, few Primary Three classes using the original Entebbe books were to be found for evaluation purposes.

2. Production Problems and Alternatives

Details of production, both time and cost, deserved more attention in the preparation of the texts. A common problem was classrooms without books because of consistent under-estimation of production time. The lack of books was common in all subjects, and it complicated instruction in this case where heavy reliance was placed on them in the curriculum design.

Another issue related to cost of production was the great expense of paper, of which the AMP books use a great deal. Rarely was economy of page space a major consideration in the writing of the books, especially early on. Cost and availability of paper were a trivial consideration to Americans, until a few years ago. But to African governments who now must pay for the paper, the expenditure was, and is a major consideration.

Western educated people, both African and American, are predominantly reading/writing oriented. Many rural people are not. Complicated geneologies are carefully memorized. Rituals, histories of families and people are sometimes passed down in disciplined, established forms which rely solely on memory. Learning by rote, if it stops there, is bad, and justifiably attacked in the school setting. A liturgy of mind-expanding mathematical ideas memorized, but with pacing for calls and responses of creative thinking, might not be bad. An analogy is that of traditional West African dance which is highly disciplined, intricate, powerful and creative. The adjectives could apply to mathematics as well. Could the model of dance, especially where it involves audience involvement of call and response, be used to develop units of mathematics which are not text dependent?

B. Teacher Training

1. Methods

The most widely recognized, important and difficult problem in education in Africa today is teacher training. Expectations in any teacher training assistance program must be kept in the perspective of the tremendous size of the task. The African Mathematics Program, through a variety of techniques over the past fourteen years, contributed to teacher education in various ways.

Large numbers (over 5,000) of teachers were introduced briefly to coming changes in mathematics curriculum. Smaller numbers engaged in more concentrated work on the mathematics associated with the new curriculum. Resident workshops of two or more weeks' duration (usually called Institutes) provided in-depth training.

Much of the important work with tutors and teachers in the field was in 'energy-generation.' Interest in mathematics has been encouraged and supported on many fronts. Mathematicians, maths educators and ministry people worked together to improve the methodology and the content of teaching.

The work of teacher training in the African Mathematics Program was done primarily by program mathematics educators. Their task was to organize and run workshops and correspondence courses, and make individual classroom visits. It was a demanding and complex task, not the kind of work to be undertaken in isolation. Communication, first hand, between math educators was essential. Specific goals and structures aside, the work was again one of energy generation, to first develop the enthusiasm for studying mathematics and then to provide the content while the energy was there. (The sense of teamwork and training that goes on at this level is vital to the work of the maths educator.)

The mini-institutes were an attempt to gather teacher training tutors in fives and sixes for one week of intense work together, in order to improve opportunity for learning. Late in the program it was recognized that there was a very real danger of spreading the training effort too thin. Attempts by the math educators to visit every teacher training tutor for a day or two gave little time for discussion of content or methodology. The mini-institutes were a big improvement, both from the standpoint of increasing content taught and of increasing contact between teachers in a given area.

Within the narrow limitation of the maths educators work, prompt

payment of reasonably generous per diems at residential mini-institutes by the math educator himself from AID funds seemed appropriate. Lacking funds for that, there remained a not unusable, sometimes effective appeal to tutors to attend and work in the interest of being better teachers. Whatever the conclusion of how to reward, methods and resources available to motivation cannot be ignored in a teacher training in-service effort.

A facet of teacher training by the African Mathematics Program in the late 1960's worth mentioning again, is the ABC Institute Scheme of 1966, 1967 and 1968. An excellent idea that worked well, the ABC Institute Scheme brought together in a summer residential course three senior training college tutors from each country, the mathematics supervisor from the Ministry of Education and an African mathematician from the national university.

Teachers of future teachers and supervisors of teachers were the major targets for training in the past five years. Emphasis was on developing a cadre of local people in each country who will continue to conduct the massive in-servicing of primary teachers.

2. Pros and Cons*

In practice, work with the teacher training tutors seems to have been more successful than with the supervisors. The tutors usually had considerable background in mathematics, while the supervisors frequently did not. The retention and subsequent transfer of 'what gets learned' was higher with tutors. Supervisors had another problem in that they traditionally do not get to visit their teachers as often as desirable,

*See also Overview on page 45.

due to lack of transportation, office complications, or other calls on their time. Close contact with supervisors was essential because of their familiarity with the realities of the educational system. Some kind of work with supervisors/inspectors on the part of the math educator was necessary to improve his effectiveness with the teacher training tutors.

The most productive of the techniques used in teacher education (in-service) were the institutes and mini-institutes; the least productive were the correspondence courses. This needs to be qualified in that a small number of participants, inclined favorably toward correspondence-type work, benefited greatly from it. But most participants, due to personal style and press of time, found it difficult to master the time and discipline to follow the correspondence lessons. Techniques of teacher training which involve human interaction are likely to be more successful. However, special individualized correspondence courses might profitably be set up for those who are of that bent.

People in the field soon knew by experience those key people who could make best use of help given. Field personnel also knew how to pace themselves to accomplish specific important local goals. The emphasis was (and should be) on human resource development, but not in a countable (so many certified) or particularly testable way.

3. Suggestions for Improvements

Limitations on resources available to a continuing effort such as AMP are inhibiting to a math educator. The following proposal might provide more utilization of such a person's talent. The math educator should have available one or more counterparts provided by local funds,

preferably recent graduates of teacher training colleges, to work closely with him as apprentice math specialists for a period of one year. By apprentices participating in the activities of the math educator, such as teacher training, mini-institutes, classroom observations, newsletter preparation or whatever direction the activities take, much of the experience of the maths educator would be transferable to the African nationals. This experience multiplied by four or five (years), and including the effects of the activities involved, might make a large contribution per dollar spent to a country's math teacher education program. Existing field personnel who already have much experience in these countries should not be lost. Rather they should be persuaded to stay with the program by provision of future stable jobs.

The question of teacher motivation often arose in connection with institutes and correspondence courses during the program. How can motivation be provided for in-depth study of a difficult subject such as mathematics? The most obvious answer for many was money, either through higher salaries paid for greater skill because of training, or through prompt payment of reasonably generous per diems at institutes. This answer also might not seem foreign or unwelcome to a teacher training tutor or inspector. Of course, a higher salaried post would be up to the ministries after they were to make a real and substantial commitment to maths teacher training.

Analyzing the ABC Institutes, they may have been ten years ahead of their time for realization of their potential. In 1966 not all invitations to these Institutes could be filled because the key

positions were often occupied by expatriates. Now the situation has changed; the desired participants would be available from many countries.

The Institutes were staffed by the highest quality American and African mathematicians and the presentations were meaty. Separate classes for each type of participant appealed to his or her specific need. University mathematicians took part in a high-powered seminar in addition to acting as tutors for the other participants. Over three summers, a core of people in each country from varied but important parts of the education system shared a common math experience.

4. Conclusions

In the broad picture, training teachers to cope with a new curriculum has two parts: in-service and pre-service training. The in-service training is often nothing more than exposure to new ideas: a notice of changes to come. It takes more than a two-week institute to train someone with a poor background to handle new mathematics curriculum. The problem is never solved if teachers graduating from the training colleges likewise are unexposed. Pre-service training is the long term solution, in-service the short term method of coping. In between lie dozens of useful schemes and ideas.

The African Mathematics Program's effort must be judged both in terms of balancing these two problems (in-service and pre-service) and in terms of the enormity of the task.

AN OVERVIEW

Leadership Personnel Training

In the opinion of this writer, which reflects other views as well, five years of experience with training mathematics tutors and supervisors in East and West Africa have revealed a number of problems relevant for consideration in future programming:

1. The plan to use tutors and field supervisors as the staff to undertake the extensive teacher training efforts badly overestimated the number of such individuals available for this kind of work in several of the countries. In Liberia and Sierra Leone in particular, and to a lesser extent in Ethiopia, people with basic qualifications in mathematics, who with additional training could become competent to train others in modern maths, simply did not exist at the onset. Instead, quotas for the training slots provided by the program were filled by promising primary school teachers. Mixing people with differing mathematics qualifications in a single training course either bored the best students or confused the least able. This was a serious problem for the trainers. The problem still exists today after five years in these same countries.

Only in Ghana in West Africa, and in Kenya in East Africa, was there sufficient personnel with basic mathematical grounding to benefit from such a course as was proposed by AMP. However, the question remains whether national commitment to introduce

modern mathematics into all primary schools is possible, given the available trained talent. All countries are making valiant efforts to overcome this handicap, although progress has been less than hoped for in 1970.

2. It had been anticipated that 400 participants could be trained in the series of ABC Institutes and correspondent courses in the five years available to the program. 200 would be trained in East Africa and another 200 in West Africa. There was no way of judging in advance what the drop-out rate would be. It was understood that re-assignments within African ministries of education were frequent. Some participants beginning the training would not be able to complete their work through reasons over which they had little control. Others might not complete for more personal reasons. In actuality, the reason for non-completion in most instances appeared to be lack of sufficient motivation. Participants were being asked to undertake training for which there was no obvious or immediate pay-off in personal terms, other than the satisfaction of obtaining a better understanding of new mathematics. For some this proved insufficient when pitted against the need to spend time and effort outside normal duties to pursue the training. In addition, the follow-up correspondence courses proved too easy for some, too difficult for others, resulting in mixed success of that part of the training.

The total training program package functioned much better in East Africa than in West Africa. Reasons for this difference

are not clear but may well be related to the closer involvement with the Ministries of Education of the participating countries in East Africa. The percentage of those completing the course was approximately double for the East African group: 80% versus 40% for West Africa. It should be pointed out, however, that experience with the Ghanaian participants was superior to other country nationals in terms of completion and certification. Sierra Leone and Liberia simply did not have sufficient manpower of the kind envisaged by the training course developers to profit from such an activity.

Meetings of Management Committees included discussion of the possibility of according university credit for the WARMP and EARMP course. It was clear that review of the content and conduct of the course would be required before credit could be offered. This was never followed up by the Management Committee, which was unfortunate.

Perhaps the most fundamental of all problems with a course of this nature had to do with its beginning assumptions; that is, planners had no choice but to assume that the kind and depth of training proposed would be sufficient to impart adequate knowledge of modern mathematics to participants who then could train others. The ability to train others in modern mathematics implies a high level of sophistication and understanding, and probably some actual experience in experimental teaching situations should have been offered. Of even greater impedance, however, was the fact that field inspectors and supervisors who were being depended upon heavily to conduct the inservicing of primary teachers, were educational generalists. For the

most part, they had neither particular training nor interest in mathematics. Experience revealed that while this was a dedicated group, it was to a large extent being asked to learn extensive and graduate level mathematics for the first time. This was beyond the ability of any short term training course to meet.

In summary, those planning for the implementation of modern mathematics in Africa were operating with two serious handicaps: first, there were insufficient numbers of people able to properly benefit from the training offered, and second, there was little experience available anywhere on which to base a training course which would be adequate to impart a teaching knowledge of modern mathematics.

C. Regional Institutional Development

1. The Challenge

Programs attempting to cater to the mathematics education needs of developing countries must recognize the variations among them. They also must deal with the continuing scarcity of trained mathematics educators, a scarcity expected for some future years.

Regionalizing education development assistance in mathematics is one mechanism for handling these realities. An indigenous regional African institution which can make possible the sharing of scarce resources across national boundaries was seen to have great potential.

A regional institution, it was hoped, might make it possible for countries to continue development of anticipated future educational needs in mathematics. Five countries actively participated in the implementation stage of the African Mathematics Program. Expectations were

that a regional institution could ultimately expand to meet the needs of countries less far along the development continuum.

2. A Resolution

As stated earlier, programming of assistance for in-country implementation efforts has been through two regional organizations. The East African and West African Regional Mathematics Programs came into being after contract signing in 1970 by Kenya and Ethiopia (EARMP) and by Liberia, Sierra Leone and Ghana (WARMP).

Structurally WARMP and EARMP each had a management committee composed of representatives of the ministries of education and the principal universities from the constituent countries, plus EDC. The management committees met semi-annually to seek solutions to on-going problems and to discuss policy issues. The venue for the meetings rotated among the countries, with the intention that the chairmanship of a session be assumed by the senior ministry official from the host government. In each instance, an appointed Program Administrator was responsible to the management committee.

It was anticipated that the management committee, together with the program administrator in the region would take major responsibility for seeking to create a more permanent Pan-African supported legal organization following the withdrawal of foreign aid. Further, it was hoped that the regional organizations could be expanded to include additional interested countries, as the accomplishments of the groups became known and understood.

3. The Reality

The anticipations for regionalism in mathematics education were

considerably at variance with reality. The experience of five years has taught a number of lessons about attempting to create viable regional organizations which might be emulated by others. These could be categorized as follows:

- i) Regional cooperation in education can be made to work in the accomplishment of short-term program goals that a single country might find difficult to do on its own. In this category were the preparation and production of textbooks in mathematics for the teacher training colleges. Books written by Regional workshops are now in widespread use. Justification for long-term regional cooperation is more difficult. Once limited objectives have been achieved, longer term benefits of cooperation between countries not accustomed to such mutual assistance are not perceived easily. Benefits are frequently seen as of insufficient importance to overcome long-standing historical and cultural barriers. (This view is more pronounced in program work in East Africa.)
- ii) The time and tempo of development of regional institutions for almost all problem areas in education are long and slow. The implications of joining regional groupings across national boundaries transcend education, and require action at a political level which takes time and diplomacy.

Without a long established history of educational cooperation between adjacent countries, there was little experience

for guidance in designing or establishing regional institutions for mathematics education development. Assumptions were made that action taken by cooperating ministries of education would be sufficient to create viable international bodies. Such assumptions proved unwarranted. Any cooperative venture across national boundaries had implications for foreign policy which meant careful review and study at the highest governmental level.

In regard to the regional mathematics programs established under this contract, governments were cautious about creating permanent institutions until specific understandings of the future roles, objectives, nature and financing of such institutions were obtained. Yet this was a dilemma, for it was difficult to fulfill these requirements when either external or internal funding for future programming was so problematical. Cooperating countries understandably were cautious about legal commitment to an organization which had, from its beginning, been financed by external sources. Ministries in those countries needed to understand the nature and extent of the commitment they were being asked to undertake for themselves.

4. Conclusions

In short, the questions involved in establishing regional organizations on a continuing legal basis were complex. They were not subject to resolution within the time constraints imposed by external funding. As a result, in all probability, no regional

organizations for the improvement of mathematics education will endure beyond the terminal date of this contract. This is clearly true for East Africa where the self-interest served by such a cooperative effort was never satisfactorily identified.

In West Africa, the situation appears brighter. WASMO, one attempt (mentioned earlier) by the governments of Liberia, Sierra Leone and Ghana, reflected considerable official interest in creating a West African School Mathematics Organization as the legal successor to WARMP. It is not known whether sufficient motive power exists following termination of this contract to formalize the necessary organizational steps.

Questions of governance in regional programs supported by foreign assistance require diplomacy. Foreign aid contractors such as EDC who are charged with the responsibility for creating such organizations at the same time are hampered in giving the decision-making power to African countries. Contractual obligations to the funding agency require careful control and scrutiny of all financial matters. This tends to inhibit the development of the "African" image of such organizations, yet that image is crucial to the ultimate African commitment to them.

D. Evaluation

1. Evaluation Schemes Employed

Evaluation serves important and diverse purposes for programs such as AMP. It serves a formative role in helping to shape and revise the nature, scope and direction of program outputs. Evaluation also has the difficult summative role of determining impact educationally on the

students for which the program was intended. The African Mathematics Program has been concerned with both aspects of the evaluation task. It also has been concerned with the development of human resources in evaluation, which could well have more long-range impact on education in Africa than any other aspect of evaluation work.

A consultant evaluator has worked closely with program planners during the entire implementation phase of AMP. Broadly speaking, his task has been to look for ways by which on-going (month-to-month, etc.) evaluation needs could be met by integrating various aspects of the task. That is, the consultant evaluator worked to establish a network of trainee evaluators in each participating country who could perform the needed tasks under professional supervision. These trainee evaluators would be working on important program work while at the same time gaining valuable experience in the techniques of evaluation. The plan called for periodic visits by the consultant evaluator to all field personnel performing evaluation tasks in order to review progress and to establish new and reasonable work targets which were consonant with more general program goals.

Trainee evaluators also attended two special courses on evaluation conducted by the International Center for Educational Evaluation at the University of Ibadan in Nigeria, in the summer, and again in December, 1972. This course was sponsored by the Science Education Programme for Africa (SEPA) through a grant made jointly to it and the University of Ibadan by the Carnegie Corporation of New York.

The task of summative evaluation inevitably proves more formidable. Such was the case with the African Mathematics Program. The fundamental problem in such evaluation efforts is the proper isolation and measurement

of variables which affect learning. Student learning is a complex result of teacher behavior and training, classroom materials, and student background, to mention only a few of many factors. To measure the impact produced only by AMP materials and teacher training is a task of monumental size and difficulty. And most importantly, to do a creditable job professionally requires financial resources beyond the capacity of curriculum development programs to handle.

Early discussion about the shape of summative evaluation efforts for AMP produced a recommendation by the contractor that a carefully limited plan designed to measure the impact of AMP materials and methods on only a small, selective number of classes be undertaken. The contractor argued that such an approach was all that was reasonably manageable within the manpower and financial constraints imposed upon the program. This approach was ultimately rejected as being insufficient to produce the generalized answers sought about the impact of program efforts.

An alternate larger scale effort at summative evaluation was then discussed in considerable detail. However, it was ultimately rejected as being too expensive in proportion to the total development effort being undertaken. The result has been that the program itself has been able to accomplish little in terms of understanding the impact of modern mathematics on children's learning. It has, however, worked over five years to create a capacity within participating countries for asking and answering such questions. This in the long run, it is felt, will prove most valuable.

Other formative evaluation efforts were conducted by organizations and persons outside the program itself. In addition to regular field

visits by USAID staff to observe and monitor progress, an intensive evaluation study was undertaken by the American Institutes of Research (AIR) in 1972 and 1973 to determine program effectiveness and to make recommendations for improvements. This effort was commissioned by USAID and involved intensive discussion with personnel in the field, as well as in the United States, who were knowledgeable about various aspects of program activities. This included both those working directly for AMP as well as African Ministry of Education officials, mathematicians and mathematics educators who had come in contact with the program in various ways.

2. Outcomes and Conclusions

In retrospect, the various facets of the evaluation component of the African Mathematics Program produced mixed results. On the one hand, those aspects which had to do with the process of feedback to the development effort seem to have worked well. Text materials for both the East and West African regions have been completed in accordance with the needs of the constituent governments. And the best evidence of the value of this work is that many of the materials are already in use. It now appears likely that all regional program materials will eventually find their way into widespread use, as countries find the resources to print and distribute them and provide the required training for the teachers expected to use them. Such results suggest that program goals with respect to materials were appropriately set and adjusted throughout the life of the program.

Formative evaluation mechanisms for ongoing assessment of various training strategies employed by the program produced some desired

changes in approach to the training task. The efficacy of mathematics educator visits to training colleges to work with tutors, in conjunction with their attendance at program sponsored courses, was quickly called into question and modified. The mini-institute program was substituted as a way to provide better follow-up to the more formal course work, and that program worked well. The correspondence course used in conjunction with the institute program proved inappropriate for the needs of those participating, and it also was modified. The course first used had been designed for an earlier program training activity. It did not sufficiently cater to the diversity of mathematical understanding experienced by the regional programs over the past five years.

On the other hand, as stated before, the problem of assessing the impact of program materials and methods on teachers and children proved too large and difficult to make measurable assessment. Such research studies still lie in the future and in all probability will need to be addressed through the conduct of large numbers of studies directed to limited aspects of the problem.

The human resource development component of AMP evaluation efforts also produced less than totally satisfactory results. Participating governments found it difficult to make time available for qualified trainees to work on program related tasks. Other priorities seemed to take precedence.

Although all participating countries eventually did select their trainee evaluator, most were unable to undertake the tasks designed by the program consultant evaluator as part of their training. As a result, the evaluator was not able to gather sufficient field data on program activities and results to be of more than marginal use. Participation

by trainee evaluators in the resident course at Ibadan was valuable. The program evaluator's report at that time remarked on the noticeable increase in understanding of the technical issues involved in evaluation which resulted from attendance.

Only in Kenya was extensive field interviewing undertaken for the purpose of determining program impact in rural areas of the country. These interviews were taped and have been transcribed and evaluated for their usefulness. In general, the interviews revealed that there was indeed widespread knowledge about the work of the East African Regional Mathematics Programme among Kenyans who were closely associated with mathematics education in the schools. Many, if not most of those interviewed, had either participated at some time in program activities or had learned about these activities through others who had participated. However, others interviewed whose connections with mathematics in the schools was not as close were generally unfamiliar with the Program. This group included headmasters, regional education officers and others with more general educational responsibilities. This suggests that the Program might well have devoted more public relations effort to keeping educational administrators apprised of program work and progress. Although there is no hard evidence, there is little reason to feel that the nature of program impact in other participating countries has been significantly different.

In summary, efforts over the past five years suggest that evaluation is first and foremost an expensive undertaking if serious progress is to be expected. Costs seem to rise exponentially with the amount of detail sought. Broad trends can be reasonably assessed, and detailed information from a small controlled situation can be obtained.

Goals, however, must be chosen carefully.

Evaluation efforts of AMP also clearly reveal the importance of using program personnel over whom a degree of control and direction can be exercised. It appears unrealistic to expect to achieve program evaluation targets through the use of personnel whose basic professional and administrative allegiance is elsewhere. In that circumstance, the Program's ability to produce meaningful work is subject to external decisions.

EAST AND WEST AFRICA

April 7, 1971 j/s

A TIME SCALE IN MONTHS

1973												1974												1975													
Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June			
Completion of Training - first batch (200): Presentation of certificate. Dec/Jan				4 Training Institutes for second batch: 2E, 2W, 50 participants each Institute Dec/Jan				On-going Correspondence Course for Institute participants Jan-Nov						Continuing Training Institute: same participants Dec/Jan						Continuing Correspondence Course: same participants Jan-Nov						Completion of Training - second batch (200): Presentation of certificate Dec/Jan											
				Visits of Educators to Tutors & Supervisors Jan-Nov										Visit of Educators to Tutors & Supervisors Jan-Nov																							
<p>WORKSHOP PRODUCTION</p> <p>Workshop Participants: Avg. 35 Africans per workshop Teacher Experimenters: 12 TTC, 18 Primary, 9 Secondary</p>																																					
Workshops: Retrials of materials 1st workshop. Pre-trial materials Vol.2 E & W, Try 364 with Mrs' Guides Secondary 1st and/or Mrs' Guide July/Aug				Completion camera copy for Vol.1 Teacher Ed. (E&W) Primary 1 & 2 (W) Secondary 1 (W) Subsidiary Math. pamphlets Nov/Dec 1972				2 Workshops: short meeting in E to review revised materials of 2nd workshop. Prepare trial materials for Primary 5&6(W) & Secondary 3 & 4 (W) & review W revisions of 2nd workshop. July/Aug						Completion camera copy for Vol.2 Teacher Ed. (E&W) Primary 3 & 4 (W) Secondary 2 (W) Nov/Dec 1973						1 workshop (W) short meeting: review revised materials from 3rd workshop. July						Completion camera copy for Primary 5 & 6 (W) Secondary 3 & 4 (W) Nov/Dec 1974											
Tryout of 2nd workshop materials. Same trial classes as before. Supervision as before. Sept-June								Tryout of 3rd workshop materials (W): same classes & same supervision as before. Sept-June																													
Trainee Evaluators attend 1 semester at Ibadan Sept-Jan				Trainee Evaluators continue evaluation tasks under guidance of Ibadan staff & consultant Evaluator: college visitations & text book use Jan-June				Trainee Editors pay experiential visit to U.S. Sept-Nov						Trainee Editors continue classroom observations and assisting Program Editors in production of finished materials. Dec-June						Trainee Evaluators take 6-week TEDRO course. Jan/Feb						Training Completed 5 Editors 5 Evaluators July						Continue working with Program Editors and Evaluators until all tasks completed. Aug-June					

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The West African Regional Mathematics Programme

October 1970 - March 1975

A Report by D.A. Brown, Administrator, WARMP

Inception and Initial Difficulties

The WARMP, which includes Ghana, Liberia and Sierra Leone, began its operations in October, 1970 under the wing of the Faculty of Education, University College of Cape Coast. It was a continuation programme to the African Mathematics Programme in which the Ministries of Education of member countries had participated with the approval of their governments. Initially it had a staff of three, an Administrator and two Mathematics Educators. The Administrator and one of the two Maths Educators, Mr. John Norris, were based at Cape Coast and the other Maths Educator, Mr. J.W. Alexander, at University College of Njala, Sierra Leone.

The Programme had three main objectives, namely:

- 1) the training of teacher-trainers, i.e. Training College Tutors and School Inspectors in modern maths (thus facilitating the pre-service training of primary school teachers in modern maths);
- 2) the preparation of materials for modern maths texts for the Primary, Secondary and Teacher Training levels of education in the participating countries;
- 3) the training of personnel, nominated by the Education Ministries of participating countries, in Editing and Evaluation.

The WARMP was sponsored by Education Development Center (EDC) of Newton, Massachusetts, U.S.A. with funds obtained from the United States Agency for International Development (USAID). Its Director was a member of the staff of EDC.

The Programme Director and Administrator spent several days in October, 1970 visiting the Education Ministries, and a few University Institutions and teacher training colleges in participating countries, introducing the Programme staff to Principal Secretaries, Chief Education Officers, Curriculum and Inspectorate Units, etc. and explaining the objectives and mode of operation of the Programme. In all three countries, as a result of the work of the African Maths Programme, a forerunner of the WARMP, a small beginning had been made in the introduction of modern maths, particularly at the Primary level.

The Programme staff were kindly received everywhere. In Sierra Leone both the Institute of Education and the Ministry of Education welcomed the Programme and readily offered assistance. It was agreed to hold the Second Institute in Sierra Leone and to invite the Minister of Education, Sierra Leone, to perform the Opening Ceremony. Liberia was no less enthusiastic. In Ghana the University College of Cape Coast welcomed the programme and agreed to its operating under the wing of the Faculty of Education. At this initial stage the only difficulty was encountered at the official level in the Ministry of Education, Ghana, where the General Education Division was, at the time, implementing a modern maths programme of its own. It had put several thousands of locally written modern maths texts into several primary schools throughout the country, and with assistance from the British Council it was training a few training college maths tutors in modern maths in Britain yearly. There was, however, no organized pre-service training of primary teachers in modern maths and the only in-service course available in the subject for the primary teachers already in the schools were one to two days briefing courses based on the texts which had been put in the schools. This was clearly 'putting the cart before the horse' and in the end wiser counsel prevailed. The Ministry confirmed its acceptance of the Programme and the first Institute was opened at the Advanced Teacher Training College, Winneba on 10th December, 1972 by the Deputy Minister on behalf of the Minister.

The First Institute was organized in a rush owing to difficulties created by the General Education Division of the Ministry of Education, Ghana. A letter issued on November 2, 1970 by the National Teacher Training Council to the Colleges, in Southern Ghana and the Volta Region informing the Maths Tutors of arrangements for the First Institute, was cancelled by the Chief Education Officer. For the next fortnight the Administrator travelled with the Programme Director to Liberia, Sierra Leone and Nigeria. Returning to Accra on November 24, the Administrator informed the Principal Secretary, Ministry of Education, that if the Programme did not get Ministry approval of the First Institute by November 29, the Institute would be cancelled. The Administrator was invited to meet the Deputy Minister, and Principal Secretary on November 30. At that meeting the Administrator was requested to submit a memorandum on the subject by the following day to enable a decision to be taken. The Administrator complied and apparently this memo put things in their true perspective and cleared doubts which the General Education Division had created. On the following day, the Minister both approved the Institute and accepted our invitation to open it on December 10, 1970 at the Advanced Teacher Training College, Winneba.

The time was too short to notify the Training Colleges by letter that the Institute would in fact be held, and it became necessary for the Administrator and the two Maths Educators to take turns at the wheel driving hundreds of miles by day and night to 35 Training Colleges in Southern Ghana and the Volta Region to confirm to Principals that the Institute would, in fact, be held and to urge the tutors to endeavour to attend in spite of the short notice. To complicate the situation further, Winneba, which was the venue for the Institute, was widely reported to be the worst hit town in the Cholera epidemic then raging in the country. In the event, however, the turn-up was quite satisfactory. Fifty-one Tutors attended out of 57 who were invited.

Institute and Correspondence Course

The first Institute, like most of the other seven Institutes held by the Programme from 1970-1973, was highly successful. The purpose of the Institutes was to prepare the ground for the correspondence course that followed. The tutors stayed two years with the Programme, attended an institute each year and did a two-year correspondence course. In the course of the two years the Maths Educators visited the Maths Tutors several times at their colleges and worked with them. Every month the Maths Educators spent three weeks on the roads and only one at base. The objective of the institute and the correspondence course was to provide good mathematics for tutors in training colleges. Both method and content were equally emphasized and class teaching as well as written work involved considerable activity and application.

The Programme planned to hold two institutes yearly, one in Ghana for Ghanaian participants only, who greatly outnumbered participants from the other two countries, and the other in Liberia or Sierra Leone for participants from all three countries. Thus the first Institute was held in Ghana for 51 Ghanaian Training College Tutors, and the second in Sierra Leone for 26 Sierra Leoneans, 15 Liberians and 20 Ghanaians. Each institute lasted two weeks and the programme bore the entire cost of board and lodging. It also paid the participants a small dislocation allowance to enable them to purchase small items such as shaving blades and postage stamps, etc. When participants travelled out of their country to attend an institute, the Programme provided the air tickets. Member countries were required to bear only the cost of in-country travel of their teachers. These terms were agreed with the Education Ministries of member countries. Nevertheless, in spite of repeated representations, the last item, i.e. 'refund of in-country travel fares to participants' remained a perennial source of complaint from participants, particularly in Ghana.

The Institutes were staffed by the Maths Educators of the Programme, who were assisted by other teachers drawn from Universities, Teacher Training Colleges and Education Ministries of member countries. The Programme paid stipends to the invited teachers and paid also all other costs of their attendance at the Institutes.

During the first phase of the Programme, 1970-1972, assignments were sent out to the participants who sent their work to the Maths Educators for correction and return. A careful record of their scores was kept by the Administrator to serve as a basis for certification at the end of the course. There were several drop-outs, mostly among the Sierra Leone participants, owing to weak background in Maths (most of them being primary school teachers) and also among the Ghanaian and Liberian teachers due to lack of perseverance. Of a total of 117 school supervisors and inspectors enrolled for the course in January 1971, 99 started, but only 50 completed the course, and of this number 33 Ghanaians, 2 Liberians, and 7 Sierra Leoneans satisfied the conditions and were awarded WARMP certificates.

In the second phase, which started with the Fifth Institutes and will terminate with the Programme in March, 1975 the assignments are based on the WARMP texts, Concepts of Mathematics, Vol. 1 and 2, copies of which

have been issued by the Programme to all the participants. The course is now more individualized than in the first phase, and also requires the participants to exhibit more originality. Owing largely to the more taxing nature of the new correspondence course, the Programme has had to resort to the use of Mini-Institutes, i.e. Institutes for about 5 to 10 participants to ensure that they get the greatest possible individual attention and help. In this way a large drop-out has been avoided and it is expected that a reasonable number of the participants will qualify for a WARMP Certificate at the end of the course.

The institutes and, in fact, the entire Programme and the Workshops which will be discussed later, provided member countries of WARMP an excellent opportunity of practising the international cooperation which their politicians had repeatedly professed but had done little about. The results are likely to be the more fruitful because this involved teachers and school inspectors who constitute in all three countries the articulate strata of their populations.

The following table gives particulars of the eight Institutes held by the Programme from December 1970 to August 1973.

<u>Inst.</u>	<u>Location</u>	<u>Dates</u>	<u>Enrolment</u>	<u>Opened by</u>
1st Inst.	Advanced Teacher Trg. College, Winneba, Ghana	Dec. 1970	51 Teacher Trg. College Tutors	Deputy Minister of Education, Ghana for Minister
2nd Inst.	Women's Training College, Port Loko, Sierra Leone	Jan. 1971	61 20 Ghanaians 26 Sierra Leoneans 15 Liberians 5 Exp Teachers	Minister of Education Sierra Leone
3rd Inst.	Ramseyer Training Institute, Abetifi Ghana	Dec. 1971	47 Ghanaians TTC Tutors	The Vice-Chancellor U.S.T. Kumasi Ghana
4th Inst.	Booker T. Washing- ton Institute, Kakata, Liberia	Jan. 1972	38 13 Ghanaians 16 S/Leoneans 9 Liberians	No formal opening due sudden illness of Secretary of Education, Liberia
5th Inst.	Women's Training College, Port Loko, Sierra Leone	Dec. 1972	61 20 Ghanaians 12 Liberians 19 S/Leoneans	Chief Education Officer Sierra Leone

<u>Inst.</u>	<u>Location</u>	<u>Dates</u>	<u>Enrolment</u>	<u>Opened by</u>
6th Inst.	University of Science & Tech- nology, Kumasi Ghana	Jan. 1973	49 Ghanaians 36 TTC Tutors 13 Math Organi- zers	Dr. S.G. Nimako General Secretary Ghana National Assoc. of Teachers
7th Inst.	University of Ghana, Legon	July 1973	62 18 Ghanaians 19 Liberians 25 S/Leoneans	<u>Discussion</u> Current problems in Maths teaching in Ghana, Liberia & Sierra Leone by participants led by Administrator
8th Inst.	University of Ghana, Legon	Aug. 1973	49 Ghanaians	<u>Discussion</u> Current problems in Maths teaching in Ghana, Liberia and Sierra Leone by par- ticipants led by Administrator

Workshops and WARMP Modern Maths Texts

The first Workshop was held at Fourah Bay College, Freetown, Sierra Leone from July 19 - August 28, 1971. In preparation for this and subsequent workshops, the Administrator had four main preliminary tasks to perform, namely:

- 1) obtain Primary, Secondary and Teacher Training modern maths syllabuses from participating countries;
- 2) nominate workshop participants;
- 3) select a suitable venue, and
- 4) procure requirements for the workshop.

Syllabuses in the modern maths were available in Sierra Leone and Ghana for the Primary and Teacher Training levels and these were obtained from the two countries. Liberia reported that it had no syllabus in modern Maths and sent, instead, syllabuses in the traditional maths for Grades 3 to 8. In both Ghana and Sierra Leone some of the Secondary schools used the West African Examinations Council syllabus in the modern maths.

The initial nominations of the participants were made by the Maths Educators, partly on the basis of performance at the first and second Institutes held in December 1970 and January 1971 respectively, and the correspondence course that followed.

The list of participants as finally approved by the Ministries of Education was as follows:

<u>Country</u>	<u>Teacher-Training</u>	<u>Primary</u>	<u>Secondary</u>
GHANA	Mr. P. Badu-Prah Tutor, Trg.College	Mr. Seth Minta Educ. Officer	Mr. J.S. Jackson Univ. of Ghana
	Mr. Y.A. Bempong Min. Education	Mr. A. Nyame Educ. Officer	Mr. B.A. Eshun Sec.School Teacher, Mfantshipim
		Mr. B.K. Addo Tutor,Trg. Coll.	Mr. J.K. Okine Headmaster
		Mrs. Lucy Tagoe* Educ. Officer	
SIERRA LEONE	Dr.Romanus Ohuche Njala University	Mr. D.S.M. Lahai Educ. Officer	Mr. J.E. Jonah Sec.School Teacher
	Mr. M.A.J. Bockarie Tutor, Trg.Coll.	Mr. S.J. Gbondo Primary Sch.Tr.	Mr. S.F. Thomas Sec.School Teacher
		Mr. T. Dugba* Method Master Trg. College	Mrs. E.H. Palmer Sec.School Teacher
		Mrs. O. Benjamin Snr.Asst. Tr.	
LIBERIA	Mr. Blamoh Snoh Tutor,Trg.Coll.	Mr. Tamu Diggs* Tr.High School	Mr. Joe L. Bettie Tr. High School
	Mr. Moses Elliott Testing Centre	Mr. J. Maximore* Teacher	Mr. Solomon Russel Univ. of Liberia
		Mr. M. Johnson Teacher	Mr. Rapus Parley* Trg. High School
		No 4th nomination, lack of suitable candidate	
WARMP	J.W. Alexander Maths Educator J.T. Norris Maths Educator		

The asterisks indicate those who did not attend for various reasons - illness, bereavement, inability to get away from work, etc. J.L. Bettie (Liberia) was switched over to the Editor/Evaluator Group as Trainee Evaluator for Liberia. Owing to short notice, only three replacements could be found, namely: A.Y. Doe (Ghana), J.B. Dennis (Liberia) for the Teacher Training group, and C.V. Kimber (Liberia) for the Primary group.

Teacher Training: 3 Ghanaians (men)
2 Liberians (men)
2 Sierra Leoneans (men)
2 Maths Educators (WARMP men)

Secondary Group: 2 Ghanaians (men)
2 Sierra Leoneans (1 man, 1 woman)
1 Liberian (man)

Editor/Evaluator
Group: 2 Liberians (men)

In addition to the above there were also the following full-time participants:

Prof. Shirley Hill of University of Missouri, Kansas City, Missouri, who was Chairman of the Primary Group.
Dr. Grace Alele Williams of College of Education, University of Lagos, who chaired the Teacher Training Group.
Prof. E.J.A. Williams of Fourah Bay College and Dr. D.K. Abbiw-Jackson of the University of Science and Technology, Kumasi who were joint chairmen of the Secondary group, and Co-chairman of the entire Workshop, and the Administrator of the Program.

Participants were comfortably housed in blocks G and M of the Men's Hall, and Group chairmen and the Workshop Co-chairmen were in University Guest Houses. By kind permission of its head, the Department of Education building was used as work centre where all group meetings were held, and where the office of the Administrator was housed. Fourah Bay College allocated a bus full-time to the Workshop and also gave participants access to the College Library. All these arrangements were kindly made for the Program by the Secretary of the Institute of Education, University of Sierra Leone, Mr. C.E.A. Noah, at the request of the Administrator.

The Workshop was opened by Prof. N.D.J. Smart, Head of the Department of Education, on behalf of the Vice-Chancellor who was then out of the country. The Workshop felt greatly reassured by the Professor's inspiring address on the value of the assignment it was about to carry out. The opening ceremony was followed by a discussion of the state of maths teaching in participating countries. In my report to EDC on the Workshop I wrote as follows:

"The Opening Ceremony was followed by a Plenary meeting at which two participants from each country spoke briefly about the position of mathematics teaching in their respective countries. As may be expected, the picture was, in general, a sombre one. For the most part mathematics was still the hated subject in the curriculum. Everywhere there was a shortage of textbooks and teachers of the subject and a woeful lack of the better quality of both.

Associations of Teachers of Mathematics were doing good work in Sierra Leone and Ghana, but there was no such association in Liberia. There had been a small degree of a breakthrough in Ghana, where Education Officers who had received training in the U.K. in Modern approaches to mathematics teaching had been appointed Maths Organizers throughout the country, and there had also been some clamour for the Modern Maths, particularly at the Primary level. But even in Ghana too, as in Sierra Leone and Liberia, the subject was still taught at the Secondary level largely by expatriates. It was clear that the WARMP was fulfilling a present need, and that the assignment before the Workshop when completed would meet a crying demand."

The position at present is almost exactly as was foreseen in 1971.

Programme of Daily Activities

Groups	..	..	..	8.30 a.m.
Tea/coffee	..	..	..	10.30 - 11.00 a.m.
Groups	..	..	..	11.00 a.m.
Lunch	..	..	..	1.00 p.m.
Groups	..	..	..	2.30 p.m.
Tea/coffee	..	..	..	5.00 p.m.
Dinner	..	..	..	7.00 p.m.

Saturday - individual assignment

The Workshops were conceived in terms of adaptation of Entebbe texts to meet the regional requirements and adequate quantities of the relevant Entebbe texts were therefore supplied by EDC for this purpose. However, it turned out that only the Primary group felt that it could meet the requirements of the participating countries by adapting the Entebbe Primary texts. Both the Teacher Training and Secondary groups found it necessary to write new materials patterned to meet school and examination requirements of participating countries, and based as much as possible on Entebbe material. The Secondary group, for example, studied existing material - J.S.P., SMP and Entebbe and then prepared a list of what the WARMP course should contain. The Teacher Training group decided that the Entebbe Basic Concepts did not meet the requirements of the West African Syllabuses and therefore sought more relevant materials from the Entebbe Secondary and Primary texts.

By the end of the Workshop the groups had completed work as follows:

Primary Group: Completed adaptation of the Entebbe Primary One and Two and revised the Primary Teachers' Handbook.

The Ministries of Education were invited early in the year to nominate candidates, who should be their employees, to be trained by the Programme as counterpart Editors and Evaluators. By July 19, when the Workshop started, only Liberia had complied. Ghana and Sierra Leone had only intimated their intention to do likewise. Accordingly the Management Committee directed that the Workshop should propose suitable persons to Ghana and Sierra Leone for appointment as Counterpart Editors/Evaluators. After protracted negotiations first Ghana appointed Seth Minta, Education Officer and E.G. Dogbe, Senior Education Officer, as counterpart Evaluator and Editor respectively, and later Sierra Leone also appointed S.F. Thomas as counterpart Editor cum Evaluator. For the first Workshop, however, the Editor/Evaluator group comprised only the Liberian team, namely Williams Momolu, Editor and J.L. Bettie, Evaluator.

Venue

The Management Committee had expressed the hope at its meeting in January that Liberia could provide a venue for the Workshop. Three offers of a venue were received from Sierra Leone early in the year, but in view of the foregoing reason, the dateline for offers was extended to give Liberia a chance. Sierra Leone's offer of Fourah Bay College was ultimately taken because Liberia could not meet the date line.

Requirements for the Workshop

Owing to the delay in deciding on a venue, large quantities of books and other items which were required for the workshop were shipped to Ghana and had to be air-freighted to Sierra Leone from there. This proved expensive both of labour and cost.

The Administrator and the Associate Director of the Program, Mr. John Joanou arrived in Freetown on July 13 and set about tying loose ends in the arrangements for the workshop. Before July 19 all the packages air-freighted from Ghana had been cleared through customs and sorted out. Also all other workshop requirements obtainable in Freetown had been procured. Prof. Williams of Fourah Bay College, a Co-chairman of the Workshop, arranged for the loan of six typewriters free of charge from a government secretarial school in Freetown, and the Programme also purchased three portable machines and a second-hand Olivetti. Orders were placed for items which were not obtainable locally, e.g. S.M.P. books, speedisets, etc.

Workshop participants from Ghana and Liberia arrived on July 17 and those from Sierra Leone on July 18. Air tickets were provided by the Programme. All other travel costs of all participants were also borne by the Programme, and all the travel arrangements for the Ghanaian and Liberians were made by the Administrator. The final numbers were as follows:

Primary Group: 3 Ghanaians (men) .
 3 Sierra Leoneans (3 men, 1 woman)
 2 Liberians (men)

Secondary Group: Completed first and second year pupils' books and Teachers' Guides partly in draft.

Teacher Training Group: Planned a course of 2 volumes and completed Volume I, some of it in draft.

It was desirable to have the same participants write the entire series, unless any of them proved unequal to the task. Thus almost all the participants at the First Workshop were invited also to the other three that followed. Throughout all the workshop only one participant was rejected and he was a Ghanaian Secondary School teacher who gate-crashed at the second workshop held at Legon in 1972 and whom the workshop Co-chairmen decided to retain on trial. Also Prof. Hardgrove of the Northern Illinois University replaced Prof. Shirley Hill for the 2nd, 3rd and 4th Workshops, because the latter had commitments which prevented her from coming.

After the First Workshop, the Maths Educators decided to strengthen the T.T. group with more University people and submitted names of three such people, one from each country, to the Administrator to invite to the second Workshop. These changes apart, the same participants were invited to all the workshops.

Editor/Evaluator Group

This comprised only two participants at the first Workshop, namely Williams Momolu, Trainee Editor, and Joe Bettie, Trainee Evaluator, both of Liberia. The coordinating Editor, Roger Hartman, dealt with development of editorial skills and preparation of materials for class trials. Dr. Bernard Shapiro of Boston University, who was consultant Evaluator to the Programme, visited for seven days, had sessions with Joe Bettie and Roger Hartman, and outlined plans for Bettie's training activities.

The difficulties encountered at the first Workshop arose largely because of inadequate arrangements for typing and the lack of various items of production equipment and materials which were not obtainable locally and should have been obtained direct from EDC in advance. Timely steps were taken to minimize or completely eliminate these difficulties at subsequent workshops.

There were four workshops in all held, one yearly, from 1971 to 1973, and they all followed the same pattern, held the same time of the year. Each workshop, like the institutes, was opened by a prominent person from Government or Education. The following table gives the date and location of the workshops, numbers of participants, work done and official opening particulars.

Workshop	Date and Place	No. of participants	Worked on	Opened by
1st	July 19 - Aug. 28 1971. Fourah Bay College, Freetown	26 plus 4 staff & 5 typists	(i) Primary 1 & 2 Pupils & Teachers' Guide. Handbook for Primary teachers. (ii) Concepts of Mathe- matics Vol.I (iii) Sec. 1 & 2 Pupils & Teachers' Guide	Prof. N.D.J. Smart, Head of Education Dept. Fourah Bay College, Freetown.
2nd	July 17 - Aug. 25 University of Ghana, Legon	25 plus 4 staff & 5 typists	(i) Primary 3 & 4 Pupils & Teachers' Guide. (ii) Secondary 2 & 3 Pupils & Teachers' Guide (iii) Concepts of Math- ematics Vol.2	Pro-Vice- Chancellor, University of Ghana on behalf of Vice-Chance- llor
3rd	July 16 - Aug. 24 University of Ghana, Legon	24 plus 4 staff & 5 typists	(i) Primary 5 & 6 Pupils & Teachers' Guide. (ii) Sec. 3 & 4 Pupils & Teachers' Guide (iii) Concepts of maths Vol.2 (review)	Commissioner for Education, Ghana
4th	July 15 - Aug. 26 University of Ghana, Legon	20 plus 4 staff & 5 typists	(i) Primary 6 & 7 Pupils & Teachers' Guide. (ii) Secondary 4 & 5 pupils	Director General of Education, Ghana. Dr. K.C. Anim

All the opening addresses stressed the importance of mathematics in the education process; the commitment of participating countries to the change-over from traditional to modern maths, and the pressing need for teacher education in the subject through in-service as well as pre-service courses.

By the end of the 4th Workshop the programme had completed its textbook writing assignment. The Workshops produced material for the following texts:

1. Primary 1, 2, 3, 4, 5, and 6 Pupil and Teachers' Guide
14 books - Primary 7 for Sierra Leone only
Primary Teachers' Handbook.
2. Concepts of Mathematics Vol. 1 and 2 for Teacher
Training (3 books). Answer book.
3. Secondary 1, 2, 3, 4 and 5 Pupil and Teachers' Guide
(10 books)

Editorial work is still in progress and is due to be completed by March 31, 1975 when the Programme terminates. All three participating countries, Ghana, Liberia and Sierra Leone have declared their intention to print and use the books with some adaptation where necessary. Already the Concept of Mathematics Vol. I has been printed for use in Ghana and the Vol. 2 has gone to the printers. Also both Ghana and Sierra Leone are printing the Primary texts and the latter has also accepted the Teacher Training Text and will print it. Liberia will follow suit when she has completed some adaptations.

When groups of intelligent and experienced people engage in work of this kind, disagreements sometimes arise with regard to procedure, selection of materials, form of presentation, level and quality of diction, etc. Such disagreements provoke lively discussions and are often necessary if the best agreements are to be reached. Discussions in all the three groups were lively, and the result was, in general, beneficial. However, by the end of the Second Workshop disagreement had become almost acrimonious in the Teacher Training group, and it became necessary to nominate what might be termed referee teams to review the T.T. Volume 2.

The Programme has achieved results in the in-service training of teacher-trainers and thereby has provided a sound basis, particularly in Ghana, for the pre-service training of primary teachers in modern maths. It has also made a contribution in the field of editing and evaluation. But it is probably by the textbooks it has produced that it will best be remembered in all three participating countries, and this has been almost entirely the work of mathematicians and mathematics teachers drawn from the Ministries of Education, schools and higher educational institutions of the participating countries themselves.

Value of the Work of WARMP over the past Four Years

WARMP tried to achieve its objectives, namely

- 1) training of teacher trainers in modern maths,
- 2) preparation of materials for modern maths texts, and
- 3) training of Evaluators and Editors - through in-service institutes and mini-institutes, correspondence courses, writing workshops and editorial and evaluation activities.

In deciding whether the first objective of WARMP was appropriate and relevant to the needs of participating countries one must consider what had happened earlier in maths teaching in the participating countries. WARMP was a continuation programme to the African Maths Programme. WARMP pre-supposed that there existed in the participating countries a nucleus of personnel trained in modern maths by the AMP, actively engaged in teaching the subject and readily available to draw upon for further work. This turned out to be only partially correct. Some trained personnel there were - particularly in Ghana and Sierra Leone and to a lesser extent in Liberia too. But so few were they in all the three countries and so heavy national demands on their time that they were not so readily available to draw upon, even in holiday time.

The WARMP institutes were planned for teacher trainers, namely primary teacher training college tutors and primary school inspectors. Again the assumption that these categories of personnel existed was only correct in respect of Ghana. In both Liberia and Sierra Leone mathematics was, and still is being taught in the teacher training colleges as in the secondary schools, also largely by expatriate staff. Throughout the four years of its work, WARMP was able to recruit only one Liberian maths tutor from Kakata Training Institute and three Sierra Leonean maths tutors, one from Port Loko Women's Training College and two from Bo Teachers College. It was only in Ghana that the right category of indigenous personnel were available for training.

It seems clear, therefore, that in all the three participating countries the training of adequate numbers of trainers of teacher trainers was an essential priority which was entirely overlooked by WARMP. Modern maths cannot be introduced into the primary schools without prior training of the vast numbers of indigenous teachers in these schools in the subject. Such large scale training is impossible without adequate numbers of indigenous teacher trainers who are completely unavailable in Liberia and Sierra Leone, and as regards quality, inadequate in numbers in Ghana. To correct this situation WARMP should, as a first step, have trained an adequate number of indigenous trainers of teacher trainers in all three countries.

The question which arises is whether the human material was available for this high level training. The answer is a definite "yes" in Ghana where, in fact, the head of the C.R.D.U. made the request which was turned down on the ground that the WARMP did not envisage such training. Even in Liberia and Sierra Leone small beginnings have now been made by the National Ministries of Education. One school inspector in Liberia, Brian Dennis, and in Sierra Leone two teacher trainers, Momo Bockarie and Mrs. Palmer are already in, or are about to proceed to, foreign institutions for this high level training.

The current situation in all three countries, namely the dilemma of modern maths texts without modern maths teachers, is an eloquent testimony of the importance of this level of training as a first priority. In all three countries the need is for the in-service training of the large numbers of teachers already in the primary schools, and the request is for trainers of teacher trainers. Merely providing maths educators can only be a stop-gap. It will not solve the problem. Counterparts must be trained both locally and overseas.

Alternatively, or perhaps concurrently, participating countries might consider increasing their supply of teacher trainers by joint opening of one specialist maths college to be staffed by USAID to train their personnel.

The second objective of WARMP, namely the preparation of materials for modern maths texts, like the first objective, was a real and pressing need in all the three participating countries. There was then no modern maths text specifically designed for primary teacher trainees in the WARMP countries. The J.S.P. and Entebbe texts were being used in a small number of Secondary schools, but proposed changes in examination requirements already pointed to the need for a new Secondary school text.

In Ghana, local effort was already trying to meet requirements of the Primary level, but some of the local material was not of the best quality and were having to be withdrawn. Therefore, in all three countries there was real and pressing need for the WARMP materials at all the three levels. The complexities of contemporary life, even in developing countries, and the lightning speed at which science and technology are advancing, make textbooks an essential educational tool. The field of selection is too vast for the teacher.

The question which arises with regard to the second objective of WARMP is, whether WARMP should have tried to sponsor each country to produce materials for its specific national needs, or whether WARMP was right in trying to solve national problems by an international approach? In answering this question, cost should not be a prime consideration because considering air transportation costs on the one hand, and possible economies which governments could have effected working on their own on the other hand, the difference in cost between a national and an international approach could not have been prohibitive.

Again, there was a wide disparity in the quality of the trainees recruited in Ghana and those available in Liberia and Sierra Leone for the Institutes and correspondence courses. Most of the former were teacher trainers, whereas the latter were mostly primary teachers. This created instructional problems which could have been avoided working separately by countries and the training could then have been tailored more profitably to the specific needs of each country.

However, the question of cost apart, most of the other facts appear to favour an international approach. For example, as noted earlier, none of the three countries had adequate trainer personnel of the required calibre for the work involved, and it was necessary to pool resources in this respect. The levels of education are similar, and all three countries belong to the West African Examinations Council. The tempo of educational change is about the same, as also are the social and cultural problems that involve mathematics. For example, the money-lender menace is a social problem in all three countries and this could be dealt with in the primary school when teaching simple interest. Ideas of length, distance and size are vague and inexact, resulting in erroneous estimates by young and old, educated and uneducated alike. Following gradual improvement in the standards of living and the gradual introduction of science and technology, weights and measures are playing a role of increasing importance in the cultural and social life of the people in both the traditional and educated sectors of the communities in all three countries.

For example, in urban areas throughout West Africa it is no longer unusual to hear a market woman or a fishmonger talk of pounds weight of this or that commodity, and the illiterate folk are as much at home with measuring tools and instruments such as gallons, and ordinary wrist watches, as the educated. Therefore there would appear to be a good case for an international, rather than a national approach to the problem of maths teaching in the WARMP countries because the problems are similar, a unifying factor is thereby created, and chances of co-operation in other spheres strengthened.

The third and last objective of WARMP was the training of Ministry personnel in editing and evaluation with a view to facilitating periodic review of the WARMP texts by individual Ministries. West Africa is experiencing rapid change in all spheres - physical and spiritual, social and cultural; and education is the pivot on which revolves the whole paraphernalia of change. In no field is this more evident than in the field of science and technology, and this underscores the importance of mathematics in the educational process.

Mathematics in one form or another is an indispensable ingredient of any advance in science and technology. It has been rightly said that mathematics is the queen and servant of the sciences. The face of West Africa is changing rapidly as a result of the impact of science and technology. If the people are to keep pace with this change, then the teaching of mathematics must be kept under constant review with respect to both content and method. In not more than five years from

now, whatever is being inherited from WARMP will have undergone a review in all three countries.

Therefore the need for editorial and evaluation activities by WARMP is firmly established, but the question which arises in this respect is whether this aspect of the Programme's work was conceived generously and carefully enough, and whether it was executed with a zeal commensurate with the size and importance of the problem. Clearly the answer cannot be in the affirmative.

First of all, the numbers proposed to participating countries, one trainee editor and one trainee evaluator per country were too small to elicit serious or enthusiastic response, in the light of the flux and very unstable nature of trained personnel in the region. Secondly, the programme of training did not seem definite and attractive enough to participating countries. Certainly the calibre of personnel released by the participating countries for editorial training could easily have coped with a more serious and wider range of training. This is no reflection on the Programme Editor, who has done an excellent job in the limited time and with the scanty facilities at his disposal.

On the whole WARMP has done a good job. Mainly through its work pre-service training of primary teachers in modern maths has become a reality in Ghana. This has not happened in Liberia and Sierra Leone because these two countries did not have adequate numbers of the right calibre of indigenous personnel for training.

WARMP has also made a contribution in the field of evaluation and editing and it has, above all, provided much needed textbooks of unquestioned quality for pre-university education in West Africa. It can safely be claimed that by its work, WARMP has set the stage for the orderly organization of mathematics teaching in Ghana, and to a lesser extent in Liberia and Sierra Leone also. It is to be hoped that some means will be devised to achieve in Liberia and Sierra Leone the same measure of success that has been achieved in Ghana in the area of personnel training.

African Mathematics Program

Contract No. afr-711

FINANCIAL STATEMENT

(6/20/70 - 5/31/75)

	Budget	Actual
	\$	(thru 5/31/75)
	\$	\$
1. Materials & Services	259,017	298,212
2. Equipment	0	861
3. Salaries & Wages, On Campus	147,724	159,483
4. Salaries & Wages, Off Campus	400,277	371,091
5. Fringe Benefits	76,347	70,802
6. Travel	475,582	411,192
7. Consultants	45,997	58,230
8. SubContracts	0	0
9. Indirect Costs	<u>161,616</u>	<u>162,672</u>
TOTAL	1,566,560	1,532,543*

*Total does not represent all expected program charges
due to time lag in reporting

African Mathematics Program

ROSTER OF PROFESSIONAL EMPLOYEES

1961 - 1975

<u>TITLE</u>	<u>LOCATION</u>	<u>NAME</u>	<u>DATES</u>
Chairman, AMP Steering Comm. & Principal Academic Consultant	Newton, Mass.	Prof. W.T. Martin	1961-1975
Acting Director	Newton, Mass.	Mr. Stephen White	1961-1963
Program Director	" "	Mr. Hugh P. Bradley	1964-1970
Program Associate	" "	Mr. Stanley D. Weinstein	1962-1966
Program Associate/ Director	" "	Mr. John Joanou	1967-1973
Program Director/ Coordinator	" "	Dr. Ralph H. Robins	1974-1975
Consultant Evaluator	" "	Prof. B.J.Shapiro	1970-1974
WARMP Administrator	Accra, Ghana	Mr. Daniel A. Brown	1970-1975
EARMP Administrator	Addis Ababa, Ethiopia	Ato Makonnen Eunatu	1970-1973
Maths Educator	Freetown, Sierra Leone	Mr. John W. Alexander, Jr.	1970-1975
Maths Educator	Nairobi, Kenya	Mr. John C. Fitzgerald	1970-1974
Maths Educator	Addis Ababa, Ethiopia	Ato Petros Habtemariam	1974
Maths Educator	Accra, Ghana	Mr. John Norris	1970-1972
Maths Educator	Kumasi, Ghana	Mr. Patrick W. Thompson	1973-1975
Maths Educator/ Editor	Addis Ababa, Ethiopia	Prof. Roy Dubisch	1971-1973
Maths Editor	Accra, Ghana	Mr. Roger R.Hartman	1970-1975

AFRICAN MANAGEMENT COMMITTEE MEMBERS - 1974

EAST AFRICAN REGIONAL MATHEMATICS PROGRAMME (EARMP)

<u>Ethiopia:</u>	Dr. Abiy Kifle	Haile Selassie I University Addis Ababa
	Ato Getachew Makuria	Ministry of Education & Fine Arts Addis Ababa
	Dr. Yohannes Menkir (deceased)	Haile Selassie I University Addis Ababa
	Dr. Ayalew Selassie	Curriculum & Mass Media Center Ministry of Education & Fine Arts Addis Ababa
<u>Kenya:</u>	Mr. Claudio Achola	University of Nairobi, Nairobi
	Mr. Isaac Hunja	Ministry of Education, Nairobi
	Mr. Gideon Kimote	Kenya Institute of Education Nairobi

WEST AFRICAN REGIONAL MATHEMATICS PROGRAMME (WARMP)

<u>Ghana:</u>	Dr. D.K. Abbiw-Jackson	University of Science & Technology Kumasi
	Prof. N.O. Anim	University of Cape Coast, Cape Coast
	Mr. A.F. Menka	Ministry of Education, Accra
<u>Liberia:</u>	Dr. A. Doris Banks-Henries	Ministry of Education, Monrovia
	Dr. Romanus Ohuche	University of Liberia, Monrovia
<u>Sierra Leone:</u>	Mr. Lemuel Forde	Institute of Education University of Sierra Leone, Freetown
	Mr. Sigismund F. Thomas	Ministry of Education, Freetown
	Dr. Awadagin Williams	Fourah Bay College University of Sierra Leone, Freetown

External Members to both Committees

<u>U.S.A.</u>	Prof. W.T. Martin	M.I.T. Cambridge, Massachusetts
	AMP Project Director	EDC, Newton