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CARIBBEAN MATHEMATICS PROJECT

AN EVALUATION STUDY

BY

H. MARTYN CUNDY

1976

MINISTRY OF OVERSEAS DEVELOPMENT
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PREFACE

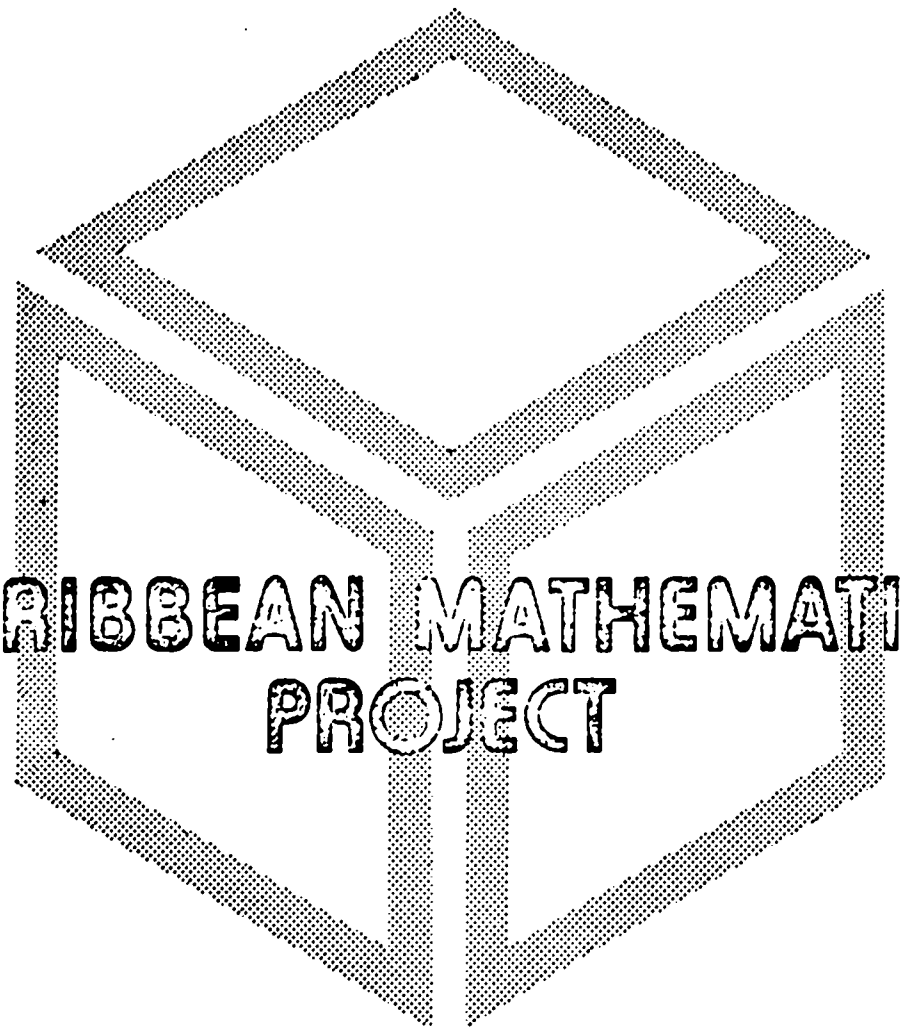
Each year the Overseas Development Administration (ODA) commissions a number of ex-post evaluation studies with two aims in mind; firstly, to assess the effectiveness of its aid activities and secondly, to learn lessons for improving the effectiveness of future aid activities.

This evaluation is one such study.

Evaluation studies are undertaken by individuals or by teams especially recruited for their particular knowledge with regard to the subject under study. Sometimes these teams will include personnel from ODA (increasingly teams are a mix of ODA and external personnel).

In all cases the reports and conclusions are attributable to the authors, who are finally responsible for their contents, and not to ODA.

Evaluation Unit
Manpower and Evaluation Department



CARIBBEAN MATHEMATICS PROJECT

AN EVALUATION STUDY

H. Martyn Cundy

To:

The Vice-Dean, School of Education,
The University of the West Indies,
Cave Hill, Bridgetown, Barbados

The Chief Education Adviser,
The Ministry of Overseas Development,
Eland House, Stag Place, London SW1

The Controller, Education and Science Division,
The British Council,
Spring Gardens, London SW1

Gentlemen,

In response to the invitation of the School of Education of the University of the West Indies and the Ministry of Overseas Development, extended to me through the British Council, for an evaluation of the Caribbean Mathematics Project, I now have pleasure in submitting my report.

I am grateful for the facilities accorded to me by the British Development Division in the Caribbean which enabled me to spend the three months from September to December 1975 in personal visits to the island territories, and to the University of Lancaster for the use of their computing laboratory in processing data during the early months of 1976. The delay in the production of this report is mainly due to pressure of business on the university's computer, largely outside my control; nevertheless I am sorry that nearly six months have passed since my return from Barbados before the report has been completed.

In conclusion may I express the hope that you will find in the reading of what follows some small part of the interest and pleasure which your evaluator has found in its collection and collation.

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Formerly Professor of Mathematics,
The University of Malawi

The Barn,
Grayrigg,
Kendal, Cumbria

ACKNOWLEDGEMENTS

So many people have helped me in the compilation of this report that it is difficult to know where to begin in expressing my thanks to them. To mention all to whom I am indebted and grateful would clearly be impossible, and also invidious because of the inevitable omissions which my imperfect memory would bring about.

Foremost in my gratitude must be Mr Nicholson and Dr Broomes and the staff of the School of Education at Cave Hill, who made my wife and myself most welcome, provided me with an office, student helpers, secretarial assistance, and constant encouragement and advice. They did their best to answer innumerable questions, disabuse me of my misconceptions, and generally to direct my operations into the most useful channels.

Then I am grateful to the British Development Division in the Caribbean, and especially to Mr Stan Wood, their Educational Adviser, and Miss Sheila Taylor, his personal assistant, who arranged all our travel and accommodation and gave us the benefits of wisdom and counsel on matters too numerous to list.

Special thanks are also due to Colin Lancaster for helpful advice and information arising from his work with the West Indies Integrated Science Project (WISCIP - now WISC) in the schools.

I am deeply indebted to many Education Officers, Project consultants and teachers, headmasters and headmistresses, College principals and tutors, who gave generously of their time for consultation, provided transport in the islands, entertained us in their homes, welcomed us into their schools, and made the whole operation into a delightful experience of friendship.

At home my thanks are due to Dr Michael Preston of Charlotte Mason College, Ambleside, who allowed me to study and make use of his M.Ed. and Ph.D. theses on evaluation of CSE pupils in South-West England, and to use part of his affective test in the survey. Also to Dr Tagg in the Mathematics Department, and to Dr Ann Trown in the Education Department at Lancaster University, for help with statistical problems: above all, to Dr Yerkess and the staff of the computing laboratory for unearthing appropriate programs, advising about organization of data, and supervising the whole processing operation. I must thank Dr A G Howson for letting me see the draft of his chapter on curriculum development in mathematics contributed to the UNESCO publication "New Trends in Mathematical Education, Volume 4".

Finally, and most especially, I am grateful to Mr Bryan Wilson of the British Council who has spent long hours briefing two newcomers to the Caribbean field, advising an inexperienced academic in the rudiments of evaluation, making available the invaluable reports of his annual visits to the Caribbean; and who has found time in a busy life to edit and polish this report, eliminating its more obvious infelicities, and making it fit to see the light of day.

Errors of fact, crudities of style and mistakes in judgment which remain in it are the responsibility of the author.

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I - HISTORY OF THE PROJECT

1.1 The Need Identified

1. The history of the Caribbean Mathematics Project has been fully documented elsewhere (1), notably in the annual reports of the CEDO visitor, Mr B J Wilson. Since however some understanding of its causation and genesis is necessary to a proper evaluation, a brief account is given here.

2. In January 1971, it was obvious to many that all was not well with the teaching of mathematics in the Eastern Caribbean territories. After the age of 11, pupils were being educated in schools of three main types: grammar schools, entry to which was selective on the basis of an examination; all-age primary schools, which retained children up to and even beyond the statutory (but non-enforceable) school-leaving age; and the new junior secondary schools which were beginning to appear in some of the territories, provided with British or Canadian aid. The inter-relation between the three types of school was and is complex, varies from island to island, and is touched on further in sections 5.1 and 8.1 of this report. Besides these schools there are many private schools of widely varying status, efficiency, and importance, but which in some islands continue to play a crucial role in the educational system. The majority of pupils however were in junior secondary or all-age primary schools and it was to conditions in these to which attention was mainly directed.

3. In his 1971 report, Mr Wilson summed up the situation in the following paragraph:

"Mathematics teaching in the all-age primary schools is generally limited to rote-learning of arid techniques, and practice ad nauseam of the "Four Rules". Chains, poles and quarters flourish, while £sd will undoubtedly make its last stand in some remote all-age Caribbean school in the later years of this century. Barren manipulation predominates; any connection between arithmetic, algebra or geometry, and life is purely accidental. The result is abysmal standards, and a widespread fear and dislike of the subject. Many children leave school barely literate or numerate after six years of "education". The vicious circle in mathematics is completed by teachers being unwilling to teach the subject, and even those who perforce have to, confine their efforts largely to arithmetic" (2).

4. There was in existence in St Lucia a primary school mathematics project, directed by Mr (now Dr) Desmond Broomes, the mathematician on the staff of the then Institute of Education (now the School of Education) at Cave Hill, Barbados. This already had produced four years of experimental materials, and a publishing programme had been initiated with Messrs Ginn as publishers.

5. In Dominica Mr R D Payne had just completed an assignment as Mathematics Adviser under Technical Assistance, funded by the British Overseas Development Administration. With the assistance of a Peace Corps volunteer, Mr Tom Schroeder, he had been able to introduce a modern approach, using SMP Book A and the Caribbean edition of the West African Joint Schools Project Book 1, to a number of teachers in the Grammar School and several of the primary schools in the island.

6. UNESCO was in process of developing an ambitious Caribbean-wide scheme (RLA 142) of cooperation with the Teachers' Colleges in the in-service training of teachers in a number of disciplines, including mathematics, with special emphasis on audio-visual media, and on the 11-14 age-group in junior secondary schools.

7. The time was therefore ripe for the setting up of a project jointly by the University of the West Indies (UWI), the Centre for Educational Development Overseas (CEDO), and the United Nations Educational Scientific and Cultural Organization (UNESCO), specifically to be concerned with the needs of the 11-14 age-group, or, better expressed, the three years of junior secondary education. (Ages differ so much

that a classification based on them is apt to be misleading. In the test administered by me supposedly to children who had had at least two years' contact with the project, their professed ages ranged from 10 to 181) Further consideration of the involvement of these three bodies in the project will be found in section 6.2.

8. Characteristically, Mr Desmond Broomes, Co-ordinator of the project from its inception, began by administering a series of diagnostic tests to the pilot classes in order to identify specific areas of need. The pilot classes themselves were chosen by the various Ministries of Education in the territories, who thus identified themselves right from the start with what has proved to be a notable example of inter-island and international cooperation. There were five tests, the design of which emerged from twin workshops held in Barbados, 16-20 August 1971, and in Antigua, 30 August - 2 September, 1971. The participants at these workshops were teachers, teachers' college tutors, and mathematics supervisors from each of the eight territories in which the project was to operate: Antigua, Barbados, Dominica, Grenada, Montserrat, St. Kitts-Nevis, St. Lucia, and St. Vincent. The workshops included sessions on curriculum development, test construction, mathematics content, teaching methods, diagnostic testing, and the formulation of objectives for junior secondary school mathematics (3). The main strategies of the project were thus drawn up at this early stage, and have remained with it ever since. This single-mindedness, which has contributed very largely to the project's success, derives principally from the exceptional perspicacity and organizational ability of its coordinator, Dr Broomes.

9. The five tests were:

1. Survey test of Arithmetic fundamentals
2. Pattern recognition test in Numbers and Spatial Figures
3. Mathematics Achievement test
4. Mathematics attitude scale
5. Questionnaire relating to pupils' and parents' education.

It would be tedious to include these tests in their entirety, but a question chosen from each will give some indication of their level.

1. Multiply 9.15 by .203
2. Fill in the blanks

X	a+b	2a+b	3a+4b		ca+b
Y	ab	a^2b	a^3b^4	a^5b^2	

3. What number does S represent if $5 + S = 2$?
4. I never seem to use mathematics out of school (answer on a 5-point scale, strongly agree, ... strongly disagree).
5. Describe your father's occupation in about two lines.

10. The results of these tests, and more particularly of test 1, which was a totally straightforward test of primary school work, proved highly traumatic to all involved. It was unmistakably demonstrated to teachers proceeding on the happy assumption that their pupils were reasonable competent in the four rules that this was very far from being the case. The following table (4) shows the reasons for their concern

Performance of pupils (aged 12-14) in all-age schools in three Caribbean territories on a mathematics test (Survey Test 1)

Topic of test item	Example with median difficulty index	Percentage of items done correctly		
		Territory 1	2	3
Number	Add: 45 + 67 + 12	58	57	44
Fractions	Add: $\frac{2}{3} + \frac{1}{9}$	18	17	7
Decimals	Add: .34 + .82	21	22	11
Measurement	Subtract: min sec 1 15 − 40	20	28	13
Application	$\frac{1}{3}$ of $\frac{1}{2}$ = ?	7	11	4

As the Senior Consultant commented: "the choice of where to begin was really no clearer. Help was needed everywhere, as shown by the table."

It is against this background, a background immediately understandable to anyone who has moved for a few sensitive minutes in an open-plan, all-age, primary school, that the achievement of the project must be assessed.

1.2 Consultants and the Round Table

1. The project chose to operate through a body of consultants with territorial responsibilities. The choice of some of these was obvious, since they had been concerned at the earliest planning stages; the others were quickly identified. This body met together as a Round Table under the chairmanship of the Vice-Dean of the School of Education at Cave Hill, Barbados, at first every month and then at more irregular intervals, but usually once every two months; at least 25 meetings have been held in the four years 1971-75. Their names are as follows:

Chairman and Area Coordinator	R M Nicholson, Vice-Dean, School of Education, U.W.I.
Project Coordinator	D R Broomes, Research Fellow, School of Education, U.W.I.
Senior Consultant	R D Payne, Technical Assistance, Ministry of Overseas Development (based in Grenada: responsible for Grenada and St Vincent)
Northern Consultant	Miss Evelyn Davis (based in Antigua: responsible for Antigua, St Kitts-Nevis, Montserrat)
Central Consultant	T L Schroeder, Peace Corps (based in Barbados: responsible for Barbados, St Lucia, Dominica)

Mr Tom Schroeder continued with the Project until August 1974, when he returned to U.S.A., and was replaced by a St Lucian, Mr George Forde, who acted vigorously as Consultant for the Central Islands until the project was wound up a year later.

2. UNESCO have not contributed personnel to the project on a permanent basis, but from time to time their experts have given considerable help, notably Dr Anil Ganguly, based in St Kitts in connection with RLA 142, who assisted at some of the early workshops, and Mr William Tenney from the Multi-media Centre in Trinidad whose assistance was invaluable in the production of materials.

3. The project has been tremendously fortunate in securing the services of so excellent a team. All of them strong personalities, they have worked harmoniously together over the whole period. While there have obviously been professional differences of opinion, agreement has always been quickly reached and team members have pulled loyally together in putting an agreed policy into practice. Regrettably I have never met Mr Schroeder, but in the course of my long conversations with each one of the others I have never heard a disloyal word or anything but the highest regard for the contributions of other members of the team.

That a team of such varied composition, no two of whom are fellow-nationals, and whose mathematical education and backgrounds cover the whole spectrum, should be welded into a company that has worked with loyalty and exhilaration for a common purpose, speaks eloquently for the skill and personal qualities of the Chairman, Mr Nicholson. Trained himself in another discipline, the kindred field of linguistics, he has given to the project leadership based on wise judgment, and has contributed to it that sense of cooperation and communality without which it could not have functioned effectively.

4. The Round Table has been the "cabinet" of the project and has taken all the important decisions. Since many of those decisions involve the administration of British money contributed through CEDO, mention should be made here of the annual visits of Mr Bryan J Wilson to the Caribbean. Quite apart from his administrative function, his contributions to the project philosophy and mathematical policy have been considerable. With his characteristic quietness and humility he has seen to it that the project is essentially a locally based affair deriving its energy from local enthusiasms and its direction from local acumen. Yet his own contribution has been no small one; in particular the initial plans for a joint project involving CEDO along with UWI and UNESCO were his, acting on an initial suggestion from Mr Stan Wood, of the British Development Division in the Caribbean. The suggestion that the Joint Schools Project materials (JSP) already in use in some of the territories should form a basis for development of local resources was also Mr Wilson's. To me as evaluator his annual reports are a fascinating and valuable source of information and continuous assessment of the growth and progress of a vigorous adolescent; his relation to the project could perhaps best be described as that of godfather who made promises at its "baptism" in 1971, has followed its progress over the years with interest, advice and concern, and can now look back with satisfaction as those promises are ratified and confirmed in 1976.

1.3 The Workshops

1. The fundamental aim of the Caribbean Mathematics Project, as stated in its publicity documents (5), is to improve the teaching and learning of mathematics. What the project leaders consider mathematics to be is an important question which we will consider further in Section 3. We are here concerned with the strategies developed to achieve this aim. These are stated to be "activities which combine aspects of: curriculum development; production of pupils' materials; and teacher training." Essentially the teacher is seen as the principal agent in each of these aspects; the teacher is to be the planner of curriculum change, the writer of new material, and teachers are to train each other by discussion, mutual criticism and interchange of ideas in the use of the new materials and the purveying of the new curriculum.

2. This strategy thus concentrates attention on one of the weakest features of the Caribbean situation as existing in 1971 - the lack of adequately trained teachers in schools of all kinds - and seeks to turn it into one of the strongest agents for development. This is probably the best way of all of improving the educational scene, and if successful, its consequences could be far-reaching. But it depends vitally on the cooperation of many participants, and we shall attempt in a later section (Section 5) to evaluate its success.

3. With this in mind the project sought the cooperation of the Teachers' Colleges. These were already linked with the School of Education through the fact that the teachers' final examinations were set and administered by the School (at that time, the Institute of Education), which inevitably had a controlling influence on the colleges' curriculum. Wherever feasible, the college mathematics tutor was invited to act as a coordinator of project activities in each island, and a most important link was thereby forged which has proved vital in the project's development.

4. Teachers themselves were directly involved from the very start, through the system of workshops. The first two workshops in Antigua and Barbados in August 1971 pointed the way ahead, for not only were they used to acquaint teachers with the philosophy and aims of the project, but also teachers were themselves used to devise tests and criticise items. These workshops were themselves critically evaluated by Dr Broomes, the evaluation being largely based on a questionnaire filled up by the participating teachers at the conclusion of the workshop. From the results of this, future policy was determined by the Round Table.

5. In view of the alarming results of the diagnostic tests (Section 1.1.10) it was realized that pupils in Junior secondary schools could not embark at once on JSP Book 1. Indeed, it has since become clear that many of them could not even read it if it were available to them. Preliminary work was necessary on fundamental topics. The Round Table therefore selected certain topics for immediate action:

Chapter 3	Counting and Measuring	Chapter 12	Mappings
Chapter 5	Primes and Sequences	Chapter 14	Area and Volume
Chapter 7	Fractions	Chapter 15	Statistics
Chapters 9-10	Decimals		

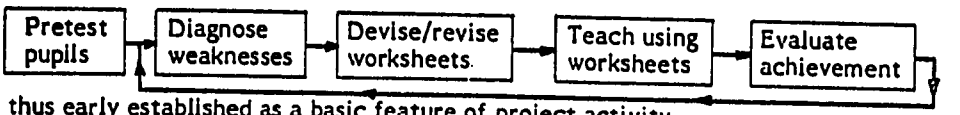
Consultants and coordinators in the various islands began to hold seminars for teachers of the designated project classes and others at which problems were identified, ideas pooled and a series of duplicated worksheets were gradually produced.

6. The workshop technique having proved its worth in these early stages, it has been continued in various forms throughout the life of the project. A full (as far as my information goes) and impressive lists of workshops conducted under project auspices is given in Section 8.3. The way in which they have developed is best described by recounting the development of the published materials to which I now turn. What follows is largely derived from a document "History: Development of the Modules" drawn up by the Senior Consultant.

1.4 Published Materials

1. The Modules. Before the project began operations, some preliminary work had been done in St Mark's Grenada in multiplication of numbers, using ideas originating with Dienes leading to the creation of "multiplication machines" and "factorizing machines" as illustrated in the diagram.

The first crude "unit of work" consisted of several duplicated worksheets along these lines, stapled together into a booklet. A sequence of worksheets was developed from this beginning, and an initial and final evaluation was included in each set. The programme



was thus early established as a basic feature of project activity.

During the academic year 1971-72, the form of the units took firmer shape. They were printed on foolscap, stated their objectives, contained an initial and final evaluation, and a set of worksheets obtained by the above programme of testing and revision. Each consultant contributed results from his own territories which were then coordinated by the Round Table. In the south, development proceeded on units which were then called Notation and Multiplication, Prime Numbers and Factors, Ordered Pairs Binary Relations and Functions. In the north, a unit called Metrication Length was being developed, and one on Decimal Notation in the Windwards. The Central consultant began work on what proved to be the most difficult unit of all, then called Fractions.

2. Mini-workshops. By Easter 1972, three units were so far developed as to be approaching their final form: Notation and Multiplication, Prime Numbers, and Mapping. The other three were less developed. It was felt that it was essential to continue to use practising teachers in the development, and to test the embryonic units with real-life classes of children, but that differences of approach and experience in the different territories were such that more than one island ought to be involved in each unit. It was too expensive to bring everyone concerned together in one grand central writing workshop; accordingly a new technique was devised, that of the so-called "mini-workshop." These were to be held on one of the islands and would involve the teachers in that island. All consultants would be present and usually one or two coordinators or interested teachers from other islands. They should get to work immediately on the remaining units.

Five mini-workshops were held eventually; the wisdom of the original decision and its success may be judged by the fact that, even with the project's usual self-critical evaluation, their format changed very little. The Senior Consultant outlines this format as follows:

Stage 1

1. Choose a unit with which the territory has been closely involved from the beginning.

2. Select a school (preferably junior secondary) in that territory.

3. Request permission to use all the first year classes for one week for two periods of one hour per day.

4. Select 16 to 20 teachers, not all of whom need be project teachers, but including all teachers who have worked on previous testing of the material.

Stage 2 (assuming 20 teachers and 4 classes)

1. Attach 5 teachers to each class and a consultant to each teacher group.

2. Rearrange furniture to split class into 5 groups, assigning one teacher to each group. Familiarise the pupils with the arrangements.

(It is worth recording that for all five workshops it was necessary to introduce the idea of grouping. No school was already using this method of teaching) (RDP's note)

(It is also worth recording that in the majority of the schools I visited in 1975 it would also be necessary to introduce the idea) (HMC's note).

Stage 3 (assuming the day has been divided into three parts for the morning session and three for the afternoon; typical times are

	Morning	Afternoon
Part 1	9 - 10	1.30 - 2
Part 2	10 - 11	2 - 3
Part 3	11 - 12	3 - 4)

Part 1
i. A consultant introduces the material to be used to the whole teacher group.
ii. Groups discuss how this will be used.
iii. Selected groups tell others how they intend to tackle the material - i.e. give dry runs of lessons.

Part 2
i. Teacher groups go to classes.
ii. One teacher presents the lesson, while each pupil group is closely watched by its teacher-leader, the consultant substituting for presenting teacher.

Part 3
i. Teachers return to their meeting room and discuss and analyse the results of the lesson.
ii. Material is confirmed as satisfactory, or revisions are suggested in the light of discoveries during the lesson.
iii. Plenary session in which consultants record teachers' comments.

Stage 4

After the school day has ended, the consultants meet to revise the material from the day and to prepare for the next day. New versions of worksheets are prepared and printed during the evening.

Stage 5

The consultant in whose territory the mini-workshop was held continues to work on the unit, and reports progress to the Round Table.

The Mini-workshop period lasted from May 1972 to March 1973. During this period workshops were conducted as in the following table:

Unit under construction	Consultant responsible	Territory and venue	Dates
Decimal Notation	R D Payne	Carriacou (Grenada) Hillsborough JSS	May 1972
Metrication Length (subsequently called Measurement of Length)	E Davis	St Kitts Cayon JSS	June 1972
Measurement of Area	R D Payne	St Vincent Barrouallie JSS	November 1972

Graphs and Statistics (subsequently called Statistics)	E Davis	Antigua Pares JSS	January 1973
Fractions (subsequently called Fractional Numbers)	T L Schroeder	St Lucia Corinth JSS	March 1973

By the end of the academic year 1972, the first five units were developed sufficiently for the final drafts to be prepared at an editing session held in Barbados in July 1972. One unit, that on Fractions, created so much controversy that it was decided to start all over again; it went through its main formative process at the St Lucia mini-workshop in March 1973.

3. Fractions. The history of this unit is so interesting that it deserves separate treatment. By good fortune, the responsible consultant, Tom Schroeder, has left a full account in the form of a monograph entitled "Growing Pains". To give more than the most summary account of this would occupy far too much space.

JSP Book 1 deals with fractions in chapter 7. Its approach is the practical one of carving up rectangles, disks, collections of dots, into parts; from this the idea of equivalent fractions is soon reached by experiment. JSP however admits in its Teachers' Guide that it assumes that "most students will be fairly proficient at dealing with fractions, having practised them thoroughly at Primary or Middle School". Experience with the Survey Tests had proved to the Caribbean teachers the falsity of this assumption in the case of their pupils. Obviously a great deal more needed to be done. In the early stages the same approach was used as JSP, but broken down into much simpler steps. All seemed to be going merrily, but at the editing workshop at Cave Hill in July 1972 the whole approach was called in question. Some participants evidently considered that it was not proper, not pedagogically wise, or both, to consider fractions first from the point of view of partitioning sets, but that they should be set in the context of the number-line and treated as "jumps"; the fraction $\frac{1}{3}$ for example being thought of as a jump such that three in succession would make a unit jump. From the point of view of the mathematician this is treating $\frac{1}{3}$ as though it were the directed number $+(\frac{1}{3})$. Obviously such an approach is radically different from that in JSP and demands a different treatment. Sharp controversy followed, and the "number-line" party prevailed. I shall give reasons in Section 3 why I consider this decision most unfortunate. I content myself here with quoting a revealing sentence in Working Paper A on Fractions presented to this workshop. "None of the work written by teachers so far has dealt adequately with the question of why we need fractions (to solve an equation such as $2x = 1$), nor showing fractions represented as numbers on the number line".

I would submit that pupils in junior secondary schools do not need fractions "to solve an equation such as $2x = 1$". This is the view of the abstract algebraist, rather than that of the practical man. It is not at all surprising that teachers had not considered it. But it is surprising that, as far as I can discover, up to this point no-one had thought that some of the pupils might already be familiar with $\frac{1}{2}$ and $\frac{1}{4}$ through using their rulers for such a practical activity as measuring the length of a piece of wood. It may of course be that rulers are so scarce that they can rarely be used in Standard 6 mathematics lessons. (In many schools this is true). But at least some of the pupils do woodwork or needlework (dignified of course with the title "Home Economics") and use rules or tape-measures to cope with $\frac{1}{2}$ inches and possibly even 5/8 inch. This would have led in naturally to the number-line approach, but even here it would have been better to deal first with the integers.

Work now proceeded along the new lines, and was taken a long way forward by the St Lucia Mini-workshop in March 1973. Working Paper No. 1 presented to this workshop

consists of a résumé of a paper by George F Green Jr in the Arithmetic Teacher for January 1973 "A model for the teaching of multiplication of fractional numbers". This looks like a last-ditch stand by the anti-number-line school (who seemed to have earned the nickname of "frangoists"), since it uses the division of rectangles into strips and points out that the repeated addition approach will not work for a/b x c/d. The battle, however, was already lost. The unit in its final form is entitled Fractional Numbers. It begins with operations with positive integers on the number-line, introduces 1/n as the jump, n of which make a jump of 1, and m/n as m such jumps. It then concedes to the frangoists several examples of partitioning of geometrical figures, and deals with equivalence and ordering. By the end of it however the pupil can neither add nor multiply fractions with different denominators. The unit thus deals very thoroughly with the concept of fractional number, as far as the basic statement, sometimes taken as an axiom, that $a/b \sim c/d \iff ad = bc$, but it needs to be supplemented with a great many practical examples on manipulation of fractions such as can be found in JSP 1, chapter 7. It is essentially remedial and introductory, and is not pedagogically closed.

4. The Printed Modules.

At a second editing workshop held at Erdiston College, Barbados in April 1973 the final drafts of the remaining modules (the new name for the "unit of work") were edited and layouts for the final versions were planned with the help of William Tenney, the UNESCO Graphics Artist attached to the Multi-media Centre in Trinidad. It was arranged that this centre should produce the first lithographically reproduced versions of all eight modules for use in the schools in 1973-74. During this academic year they began to arrive in the schools, some at once, but some not until the year was well advanced.

Since funding for the project was scheduled to cease after August 1975 it was necessary to provide for the future of the modules. The Round Table considered this matter at its meeting in September 1974 and agreed that they should be published commercially by Messrs Longman Caribbean. This has now been done, and the eight modules are available as printed booklets published by Longman at the current price of EC$1.25. each. The total cost to school or Ministry of Education for a complete pupil's set of modules is thus $10.00. In view of the fact that the books are workbooks, and therefore expendable, and that their cost has in many territories to be met from the parents' own pockets, while in others it exceeds the total allocation per pupil for teaching materials, it will be realized that their future use is in jeopardy due to financial considerations. It is difficult to see, however, what other decision the Round Table could have taken, there being no ongoing production unit in the Caribbean at the moment capable of producing them even on a non-profit-making basis at substantially lower cost.

The eight modules are:

Prime Numbers and Factors	Measurement of Length
Multiplication of Whole Numbers	Measurement of Area
Fractional Numbers	Mappings
Decimal Notation	Statistics

5. The Teachers' Guides

In the early days of the project the only help given to the teachers using the worksheets consisted of little more than a few sheets of paper containing teaching notes. It was obvious that more than this would eventually be required, and in December 1972 the Round Table outlined a scheme for the production of a set of Teachers' Guides (6). Each Guide was to have four sections distinguished by being printed on different coloured paper.

Section 1 (white) :	Mathematical Background
Section 2 (green) :	Pedagogy for the worksheets, and additional teaching material
Section 3 (yellow):	Lesson notes, including objectives, preparation, introduction, development, and conclusion for each lesson
Section 4 (pink) :	Suggestions for visual aids and instructions for making apparatus.

Responsibility for the writing of these guides was assigned to the consultants as follows:

R D Payne	Multiplication of Whole Numbers Measurement of Area Mappings
Evie Davis	Measurement of Length Prime Numbers and Factors Statistics
T Schroeder	Decimal Notation Fractional Numbers

In the event, Decimal Notation and Fractional Numbers were brought to completion by Dr Mary Robinson, and Statistics was completed by George Forde. These were not issued in their final form until April and August 1975; the remainder were released to schools in September 1974. It must be stated, however, that at the time of my visit in the autumn of 1975, very few of the Project schools had a complete set of teachers' guides and some had none of them.

The Guides were produced by the Tivoli Production Centre in Grenada (see Section 4.1) and 50 copies of each of the eight guides were produced for each territory. They were sent to the various Ministries of Education in September 1975. The originals and stencils are held at the School of Education at Cave Hill so that reprints can always be undertaken.

These guides are some of the most useful documents the project has produced. They deserve a readership outside the Caribbean. It is perhaps a pity that they are not commercially published; if the Modules prove to have a good sale, it is to be hoped that Messrs Longman will consider publishing the Teachers' Guides to be used alongside them. It seems a logical sequel.

1.5 Second and third year work

1. The modules are designed to take about three to four weeks apiece in the school teaching programme. Since they need to be supplemented by other work - the module on Fractional Numbers which we have examined is typical in this respect - a school which uses them consistently normally finds that the final modules are not completed until well into the second year. In 1972, however, the Round Table still considered that the modules would be covered in year 1, and set about considering the needs of the two succeeding junior secondary years.

2. Since its decisions have acquired critical and seminal significance in the light of future developments, I quote the relevant minutes in their entirety.

Minute VII, December 7-8, 1972.

The materials for the second year programme will take a different shape from the units produced in the first year.

The present thinking suggests that the second year material will consist of:

a. Laboratory box with sets of activities on various topics covered in the Units.

b. "Book" with "chapters" or sections using a unified approach to teaching and learning mathematics. The chapters will start with the mathematical skills and knowledge developed in the units of the first year programme. Therefore the students must have the abilities developed in the units in order to handle the ideas in the "book" - whether these abilities are acquired from the units or from other work the class has done.

The third year programme will consist of

a. Packages of work which will be developed by the individual territories to satisfy their own needs. Suggested ideas for packages are:

i. mathematics in the banana industry

ii. mathematics and cotton

iii. mathematics and sugar growing, etc.

b. Work cards.

Minute 3 (b) and (c), February 8-9, 1973

End of minute (b):

Four kinds of activities emerged as possibilities for the fourth year (i.e. of the project's activity):

1. creation of materials beyond the three years of junior secondary school, perhaps to 'O' level or some similar secondary school leaving standard;

2. creation of materials for primary schools (materials that would lead in to the junior secondary materials);

3., creation of materials for a broader range of junior secondary pupils, perhaps including the so-called 'remedial' pupils;

4. continued work on the three-year junior secondary programme, including validation testing of the materials that had already gone through developmental testing, and local (island-by-island) production of the 'weaving' units.

The meeting agreed that most of the activities would be of the type described by (4) above, and that success in generating residual skills would make substantial contributions to other types of development which would probably take place on a local, rather than regional, scale.

c. The form of materials for Years 1, 2, and 3

The discussion of this topic, begun in the December 1972 Round Table Meeting, was amplified with the following observations:

i. Year 1 materials, consisting of 8-10 modules, or units, have characteristics which are already well defined. In brief, they are designed to be used at a rate and in an order decided by the individual teacher to meet the needs of his particular pupils. The emphasis is on diagnostic evaluation and steps taken to build pupils' competence in a variety of basic areas. The teacher may decide that not all of his pupils need to use all of the units.

ii. Year 2 materials are expected to be much more explicit in defining a 'course'. A 'book' with sequenced chapters on selected topics is anticipated. The abilities, skills, and understandings required for entry would be defined as those generated by the Year 1 modules. Development of these materials would require not only clear definition of entry point but also careful planning of the scope and sequence of new materials.

iii. Year 3 materials would take an environmental approach suited to the needs of pupils about to leave school. Sound mathematics would be studied through application to such topics as local industry and commerce, tourism, etc.

3. In the event, none of the activities envisaged under minute (b) 1,2, and 3 have taken place; all subsequent activity was concentrated on getting the year 1 materials into production, and developing an outline of the 'book' envised under (c)(ii). Possible reasons for this are discussed elsewhere. Production of the "box" was abandoned because a somewhat ambitious view was taken of its possible contents, and the project lapsed on the grounds of expense. The consultants however got down to the question of producing the 'book', and in the academic year 1974-75, during which the Project Coordinator was away on secondment to the University of Guyana, the Senior Consultant compiled a document entitled "Scope and Sequence" in accordance with minute (c)(ii) above. The contents of this were thrashed out in a number of seminars or workshops and then explained to the participating teachers.

4. Scope and Sequence in its final form bears the names of 15 writers, consisting of the consultants and island coordinators with a few additional people, mostly teachers' college tutors. It does not claim to be the 'book', to whose production it looks forward, as also to that of the 'box'. Since neither of these have materialized, it is actually the final production of the project.

Its contents are discussed Section 3.2. 14 topics are listed for Year 2 work, with a suggested lesson chart and some brief mathematical notes. The booklet runs to 53 pages in all, and was produced by the duplicating facilities of the Tivoli Production Centre. It contributes only a list of possible topics (under the heading "Arithmetic") to the environmental mathematics envisaged under minute (c)(iii) above.

5. This completes this outline of the history of the project as far as its published materials are concerned. It should be evident from the story already told that the influence of the project goes far beyond that of its printed products; to consider the varied strands of its operation in the educational tapestry of the Caribbean we now turn.

II OPERATION OF THE PROJECT

2.1 The Schools

1. The project was brought into being initially with the declared object of improving mathematics teaching in the newly emerging junior secondary schools throughout the Eastern Caribbean islands. These schools were being built with British and Canadian aid in order to assist the educational program by siphoning off from the all-age primary schools those pupils who remained in the upper classes after the selection of the abler pupils for grammar-school entry. The situation varied from island to island, but the problem of the education between the ages of 11-12 and 14-15 of pupils of this type was a general one.

2. Since part of the project's declared intention was to supply free textbooks to the schools selected to participate, some control was necessary over the designation of project schools and classes. A rough quota of pupils was allocated to the various territories, and the eight Ministries of Education were asked to collaborate with the consultants in selecting the schools and the classes to be involved. Two islands in particular, St Kitts and St Lucia, wished to include all their junior secondary pupils in the scheme; it was indicated that extensions beyond the envisaged pilot scheme could be undertaken only at local government expense. This initial period of "bargaining" with the Round Table holding the trump cards in the shape of promises of free text-books was no doubt very helpful in establishing the atmosphere of cooperation between the eight independent Ministries and the Institute of Education in the administration of the project.

3. It was proposed at a very early stage to include the British Virgin Islands and the Turks and Caicos Islands in the project. Many teachers in these islands were keen to participate, but in view of their remoteness from the other islands in the lesser Antillean chain, their generally higher costs of living and the cost of transport to and from the established centres in Barbados and Antigua, the proposal was very wisely dropped. It would have meant much dilution of funds without adequate return.

4. In the final count, a total of 39 schools, involving 267 classes, 122 teachers, and 8987 ~~8807~~ pupils (7) were considered to be participating in the project. Full details are given in Section 8.2, but the distribution by territories is given here for its interest (early 1974).

Territory	Schools	Classes	Teachers	Pupils
ANTIGUA	1P+2G+4J	50	16	1619
BARBADOS	5 comp	21	14	772
DOMINICA	3P + 2G	21	15	740
GRENADA	2P+1G+2J	24	15	870
MONTSERRAT	1G + 1J	10	4	230
ST KITTS	5 J	67	27	2219
ST LUCIA	6 J	61	22	1975
ST VINCENT	2P + 2J	10	9	382
TOTAL	39	267	122	~~8807~~ 8987

P = primary G = grammar (selective) J = junior secondary

5. It will immediately be noticed that not all the schools are junior secondaries. The distinction in the case of Barbados is one of name only; the so-called "comprehensive" schools are in reality multi-lateral, as will be many of the junior secondary schools in other territories when their technical and commercial facilities are completed. Territories whose Junior Secondary programmes were not far advanced, or had not started, were encouraged to include the senior classes in all-age primary schools in the project. Special considerations influenced the entry of the grammar schools. Of more note are the high figures in three territories whose governments wished to involve all their junior secondary pupils in the project. Consultative and coordinating facilities in Antigua and St Lucia could be thought to justify this, but in St Kitts the inclusion of over 800 pupils from 25 classes in one single school should probably be considered unwise, even though the Teachers' College is in the same complex of buildings. Inevitably many teachers are involved who cannot give their first loyalty to the project, as attendances at workshops in this island seem to show.

6. The project classes in these schools were supplied with JSP texts, and turned over to a modern programme of mathematics teaching. In them the worksheets that became the modules were developed; their teachers were asked to attend the workshops and had the constant help and advice of the island coordinators and the project consultants. I myself have tried to visit as many as possible of those who remained in service in 1975. They were of course selected initially with an eye to the teachers involved.

7. In the early stages this system worked very well, but as the years passed a number of difficulties became apparent.

a. The extreme impermanence of the teaching force in any one school meant that frequently a project class moving up to a higher year found no project teacher available to teach it. This situation was to some extent unfortunately aggravated by the project itself; the selected teachers, already outstanding, were given further impetus by the project work, and found themselves able to depart for training at teachers' college, or at the university, or overseas. If they then returned to teaching, or will ultimately return, the project's temporary loss will ultimately turn to gain in the form of the additional skills and competence they have acquired in the process.

b. JSP workbooks are ipso facto expendable, and traditionally in most of the islands textbooks, where they exist, are supplied by the pupils and remain their property. Unless the school takes steps to retain the freely issued texts and to make clear that they are only on loan to the pupils, it finds the stock rapidly depleted until it becomes impossible to issue texts to the new classes.

c. Many schools found that only their upper streams could read the JSP texts and workbooks. Hitherto textbooks, if used, had contained only collections of exercises with very little reading matter by way of explanation; this had been left to the teacher in class instruction. The project asked that pupils use their own workbooks and suggested that they might work in groups on their own. This threw considerable and unusual onus on them to read and understand written material; in many cases it proved too great for them to bear.

d. Some schools, especially the Grammar schools geared to an 'O' level scheme, felt that the project materials were too simple and that they delayed progress with the 'O' level syllabus.

e. Physical conditions in many schools militated against the project's ideal of a varied use of teaching methods, including teaching in small groups or pairs of children working on their own. When all classes in a year are taught in a large hall separated only by folding screens of blackboards, the lack of space and the level of background noise makes such methods difficult to operate.

1. It was constantly necessary for project teachers to confer with their colleagues on the new materials, to instruct newcomers, and to be open to considerable inroads on their time if the project was to be made to work. These demands proved too great for many of them, although the overall response has been remarkable and that of a few teachers, not necessarily the most gifted, quite outstanding by any standards.

2.2 The Teachers' Colleges

1. Teachers for primary and junior secondary schools in the islands of the Eastern Caribbean are trained in seven teachers' colleges:

Leeward Islands Teachers' Training College, Antigua

Erdiston College, Barbados

Teachers' College, Roseau, Dominica

Teachers' College, Tanteen, Grenada

Teachers' College, Basseterre, St Kitts

Teachers' College, Morne Fortune, St Lucia

Teachers' College, Arnos Vale, St Vincent.

2. It must not be thought, however, that all teachers in the primary and junior secondary schools have been through one or other of these colleges. Many of these teachers have had no professional training at all; some of them do not even have any 'O' level passes. A few teachers in junior secondary schools have entered the teaching profession immediately after taking one or two subjects at 'A' level in a grammar school, but for the most part the entrants have two or three passes at 'O' level. After teaching for a few years and acquiring four passes at 'O' level, which may be in any subjects, so long as English Language is included, they may enter the training college for a two year course, after which they are normally bonded to teach for a further three years, but do not always do so, either because they are transferred to other posts in the educational service, or because they move away, emigrate, proceed to the U.W.I. or overseas for further training, or simply defect. The situation differs very much from island to island, and I was not able to elicit all the information needed, but out of the teachers in the project schools which I visited, originally a carefully selected group, about half were professionally trained.

3. The teachers' colleges thus play an important role in educational reform in the territories, but not so vital a role as they would play if they constituted the incircumventable route of admission to the profession. For the same reason there is no short-cut to indoctrination of teachers in new approaches through the teachers' college curriculum. In the best of systems the older teachers cannot be reached in this way, but in the Caribbean it would also fail to touch the new entrants to teaching in their first, formative, years.

4. The project, therefore, in seeking the support of the teachers' colleges, needed to enlist their cooperation in two areas: in the college mathematics curriculum, and in the supervision and in-service training which they gave to teachers in the schools. We have seen in our review of the workshop programme something of the way in which this second area was explored by the project. Wherever possible, the help of the college mathematics tutor was sought by the consultants when meeting teachers, staffing the workshops, and initiating the writing programme. But not all colleges were accustomed to undertake such supervision, apart of course from the normal requirements of teaching practice. Their mathematics tutor might be an expatriate to whom the outlook and methods of the project were quite unfamiliar. The junior secondary schools were new, and some colleges had no tradition of taking much notice of what went on in them, feeling it to be outside their terms of reference.

5. For the most part, the project changed all that. In nearly all the islands the college mathematics tutors have played a leading part in disseminating the project's philosophy, advising its teachers, and criticising its materials. Some of them became island coordinators for the project and many shared in the writing of its teachers' guides. The project succeeded in mobilising them in the interests of curriculum reform.

6. The other area, the colleges' own curriculum, must now be examined. Here the part played by the University of the West Indies is a vital one. The U.W.I. through its School of Education administers the final examination and awards the teachers' certificates. It does not however control the syllabus. All eight Ministries of Education contribute financially to the U.W.I., and the School of Education is deeply sensitive to this fact. It insists that the responsibility for the curriculum of the teachers' colleges, and even for the syllabus to be examined, rests with each individual Ministry. In practice the colleges devise their own curriculum in the light of experience. A powerful influence has been exerted in the formation of this experience by a conference of mathematics tutors and principals from the seven teachers' colleges held in St Lucia in 1966 under the guidance of the then Institute of Education at Cave Hill and energized by the enthusiasm of (then Mr) Desmond Broomes. The effect of the report of this conference is considered later in Section 3. The colleges submit items to the School of Education which are used in the construction of the final examination papers. This system is obviously fragile, but it works and has turned out to be advantageous to the project largely because the project coordinator is also the mathematician at the School of Education and the inspiring genius of the St Lucia Conference. It also has its dangers, some of which will appear later.

7. The U.W.I. also controls the entry to the teachers' colleges by reason of its certificate requirements. It will only award certificates to those with four 'O' level passes, of which English Language must be one. In some cases these become the entry requirements to the college; in others the college feels that it could not fill its vacant places or adequately serve the needs of its territory's teaching force if it insisted on them. Certain students with only two passes have therefore been admitted, on the understanding that they cannot obtain a university teaching certificate unless they obtain the extra 'O' level passes needed before their final examination. Some colleges run pre-training 'O' level courses for serving teachers on a part-time basis, often with the help of the Extra-mural services of the U.W.I.

8. The colleges offer a two-year course. LITTC and Dominica tried a one-year course for a time, but both have dropped them in favour of a two-year course. St Kitts operates a scheme of its own lasting four years: two years in-service training on a part-time basis, followed by a year full-time in college, with a final "internship" year, when the students are back in the schools, but supervised by the college staff. This system brings the teachers' college staff forcibly into contact with the situation in the schools continuously, and not merely during the weeks of teaching practice; it has much to commend it.

9. Students can usually choose whether to specialize in training for teaching Infants and Lower Juniors, or for teaching Upper Juniors and Seniors; roughly ages 5-9 or 10-14. Those who choose the second option do not know in advance whether they will be assigned to a primary or a junior secondary school. They can also choose one out of four "academic options": Science, Social Studies (that is for the most part History and Geography), French/Spanish, Art/Craft/Music. This list differs somewhat from island to island, but in no case is a specialization possible in Mathematics. The system is based on the primary school situation where all teachers are form teachers and are required to teach English and Mathematics; basic training in these two subjects is therefore given to all, and there is no further provision for the needs of junior secondary school teachers.

10. The project made no attempt to impinge directly on this configuration. Indeed, given local autonomy, it would have been difficult to do so. What it did was to enlist the support and cooperation of the tutors, and allow the colleges to change with changing needs. It started with the incalculable advantage that the colleges and the Institute of Education were already geared to a modern outlook and that a joint "manifesto" about mathematics was already in circulation. The difficulty was thus not the usual one of battling against the reaction of traditionalists. It was the more subtle one which at first they might not even have been aware of, that the "modern" mathematics espoused by some people in the colleges was not precisely the "modern" approach which the consultants fervently desired.

2.3 The Administrations

1. To make progress, the project had to have the backing and cooperation of the eight independent Ministries of Education in the eight territories with which it was concerned. The eight governments, understandably jealous of their independence and rights of autonomous action, are themselves subject to the effects of democratic processes and political change. Where these changes have been more severe, the project has suffered along with other institutions. But by and large, over the years, administrators have welcomed the project, supported its consultants, and have at times waxed eloquent in its praise.

2. As already noted, the project started with the advantage that the eight Ministries were already cooperating in the financing and administration of U.W.I., they accepted and used its extra-mural centres, and welcomed its advisory role in the teachers' colleges. There have been disagreements at times and causes of friction, but the project would not appear to have been directly involved in any of them. On the contrary, the project seems to have been an important component in cementing good relations, especially in its later stages.

3. The Ministries' assistance has been required in a hundred-and-one ways; designating schools for experiments, releasing teachers for workshops, providing accommodation and transport, allowing tests to be administered, organizing the flow of textbooks, workbooks and other materials into the schools. More significantly, they have been asked to take the needs of the project into account in making appointments, in taking up offers of "scholarships" for overseas training, in the design of syllabuses and curricula. They have welcomed with kindness and cordiality the annual visits of Mr Bryan Wilson, not to mention my own necessarily rather inquisitive visitations. They have freely opened themselves and their institutions to the penetrating eye of the film camera. I believe they are proud of their project.

4. The actual terms of the initial agreement between the project and the territorial Ministries were as follows:

> 1. That a coordinator would be identified who would supervise project activities between consultant visits and be the channel for communication for the project.
>
> 2. That certain schools would be identified as project schools, within which a certain class (or classes) would be project classes.
>
> 3. That the teachers attached to these classes would be project teachers.
>
> 4. That these teachers would be released, by prior arrangements, to attend workshops or seminars arranged by the project.
>
> 5. That arrangements, physical and financial, to get these teachers to seminars/workshops would be made by the Ministry.
>
> 6. That internal transport would be provided for the consultant's visits.

The project agreed to provide materials for the project classes at no cost to the Ministry for a period of three years. These materials were to be:

1. JSP Books 1, 2 and 3 as required, on a scale of one textbook to two pupils.

2. JSP workbooks 1, 2 and 3 as required, on a scale of 1 per pupil.

3. Additional workbooks as required by the intake and promotion of pupils in 1972-73 and 1973-74.

4. Replacements of textbooks up to 10%.

5. Supply of modules at one per pupil.

5. It is interesting to see how far the terms of this agreement have been carried out. On the project's side, we have already seen that it has amply fulfilled its obligations, apart from inevitable delays in the supply of published books over which the project usually had no control. On the side of the administrations in the islands, the record is more chequered. The simple fact seems to be that the Ministries did not always realize the magnitude of the financial burden to which they were committing themselves. The economies of the islands are in varying degree precarious, and there have been times when it has obviously been difficult, if not impossible, for the Ministries to fulfil their obligations. They are not to be blamed for this, but in any assessment of the project's achievements the facts must be taken into account. I will look at the items seriatim.

6. Co-ordinators.

a. Since the northern consultant was resident in Antigua, a coordinator was never appointed.

b. In St Kitts, since the teachers' college was charged already with supervision in the schools, the mathematics tutor was the obvious choice for coordinator. This has been a satisfactory appointment, but latterly, in view of the very large numbers involved (see Section 2.14 above), there would seem to be a need for a second tutor, or a full-time project coordinator.

c. Montserrat with its small size has managed very well without a coordinator, but with the full and enthusiastic backing of its CEOs.

d. Dominica's teachers' college only opened in September 1973, and it has never appointed a coordinator.

e. St Lucia appointed a coordinator who was already so fully occupied with the St Lucia (primary) Mathematics Project that he was quite unable to give this project any time or attention.

f. Barbados did not appoint a coordinator for some time; the one they ultimately appointed was an outstanding teacher who has served the project well, but who found after his appointment that his portfolio included too many items outside the work of the project that coordination of project activity could not be given the priority it deserved.

g. St Vincent found an excellent teacher, seconded her to the teachers' college, gave her a light time-table and allowed her to devote most of her time to project work which she has continued to coordinate and foster with great success up to the present moment. She is now Adviser in Mathematics, and since there is also a full-time mathematics tutor in the teachers' college, herself trained in project work, the coordinator is able to devote her whole time and energy to helping teachers and to curriculum development.

h. Grenada identified the tutor at the teachers' college as coordinator who functioned well for the first two years of the project's life. First study leave and then his ultimate emigration during the political troubles of 1974 left Grenada without a coordinator and the teachers' college without a mathematics tutor; a deplorable situation which continues to this day. The fact that the Senior consultant lived in Grenada mitigated considerably the effects of this deficiency, but now that he has departed to work in St Lucia the prospect for further development of curriculum reform in mathematics must be considered bleak.

7. Project schools and classes. Antigua and St Kitts designated all their secondary schools to take part in the project, though not of course all the classes contained in them. St Lucia designated all its junior secondary schools, but not its senior secondary or grammar schools. All might have been well if adequate coordinating facilities had been provided to match this all-embracing designation; difficulties which have arisen might be considered to be directly traceable to this lack of accordance between demand and supply. Barbados at first wished to include some of its grammar schools, but it soon became clear that they did not feel they needed to be included. In the end six of the comprehensive schools were designated. In the other islands there were few problems about the designation; a full list of designated schools is given in Section 8.2. Only two originally designated schools subsequently withdrew from the project.

More difficult was the question of project classes and teachers. In the first place we have seen that the upper streams in junior secondary schools were usually chosen, partly because to them were usually assigned the most progressive teachers, and also because some of the lower streams would be unable to read much of the written texts. But after the first year, the irregular movement of children (arising partly from the examination system, of which more anon) and still more the movement of teachers made it almost impossible in many cases to maintain continuity of a project class with its own teacher throughout. Data for the early years are difficult to obtain, but it is on record that only two teachers in Antigua and only one in Montserrat have been with the project for all its four years; of the 122 teachers listed above in Section 2.1 as being with the project in early 1974, only 44 were still in project schools in late 1975, two academic years later. This provides a serious brake on the speed and effectiveness of any curriculum development.

The senior consultant has put it on record that in Grenada and St Vincent most of the pupils in the topmost project class (in 1975) have been in a project class for their whole project school life. This has meant the drawing in of many new teachers into project activities, through the workshops and the activities of the consultant and coordinator, and has thus extended the project's usefulness over a wider field. Grenada and St Vincent have a better record than most for continuity of teaching; in other islands, notably those such as St Kitts and St Lucia which asked for overall coverage, it has been difficult to maintain continuity, the turnover of teachers has been much greater and the use of project methods and materials has tended to lapse.

8. Logistics. Arrangements for the release of teachers, their transport and accommodation, and for the movements of consultants, seem on the whole to have been good. Head teachers and principals of schools have with very rare excepions been cooperative and enthusiastic. A generally light-hearted approach to punctuality and the exactness of a time-table is characteristic of the Caribbean and is not specifically a project problem, though some consultants and organziers of workshops have commented on it. There have been difficulties over teachers getting subsistence and refunds of fares, but from my own observation there is obviously another side to this; the best use is not always made of the transport provided, and some teachers are less than ready to use their private journeys for official business and professional contacts, even when it would hardly inconvenience them to do so. When resources are limited, those who are enthusiastically committed do what they can for the cause without asking too many questions or making too many demands.

There have sometimes been serious delays in the transmission of books and materials to the schools who need them, and occasionally these seem to have arisen through the slow progression of the bureaucratic machinery. In fairness however it should be said that this is only one of many causes which have contributed to such mishaps. Anyone who has travelled around the islands by air or within them by road knows the sense of gratitude with which he safely arrives.

9. Examinations One factor which has exerted a profound influence on the schools and their curricula is the complexity of the examination system in some of the territories. I shall consider this in more detail in Section 5, but it should be noted here as a matter for the concern of the Ministries of Education. Many of them are seriously concerned about it. The problem is a very real one when some junior secondary schools are confronted with no less than four examinations which their pupils are expected to take: a selective examination for entry to the junior secondary school itself; a selective examination for transfer to a grammar or comprehensive (multi-lateral) school for those pupils still young enough to be allowed to sit it; a selective examination for entry to a senior secondary school; the secondary school leaving examination; a possible 'O' level examination for those who remain for the extra two years to take it. No school is I think faced with all five of these, but many schools are confronted with four of them. When a school has been designated as a project school and the majority of its upper classes at least have been engaged on project work in mathematics, sufficient consideration has not always been given to this fact by those bodies devising the various examinations. It may be that the project promoters did not make sufficiently clear to the various Ministries in the early stages that changing the mathematics curriculum would have consequences for those required to take examinations alongside pupils who had pursued more traditional courses. But the fault does not rest entirely with the project; at least two of the examinations mentioned above were not envisaged at all when the project began and indeed it seemed likely that many junior secondary school pupils would not be subjected to any external examinations at all.

2.4 The University of the West Indies.

1. The School of Education, Cave Hill: Without the School of Education of U.W.I. there would be no Caribbean Mathematics Project. To begin with, with its permanent staff of three academics and a very limited budget, it is a powerhouse of activity in servicing the educational system of the Eastern Caribbean. The meagre extent of its resources, both in manpower and funds, is, in the words of Mr B J Wilson (8), completely derisory. "With only three professional staff, they have to service eight countries, six teachers' colleges (now seven) and all subjects, as well as student work at Cave Hill itself. From such derisory resources of both men and money, the School is contributing a disproportionate amount of both staff time and finance to the project. Two of the three members of staff are actively involved in it, the Vice-Dean being overall Director and Area Coordinator, and Dr D R Broomes being editor of all the published materials and a powerhouse of creative ideas and initiatives in every aspect of the project's work. The School is the venue for the regular project staff meetings, while two of the consultants are provided with offices, and secretarial and duplicating facilities, at the School's expense". To this I could add my own appreciation of the office, secretarial help, duplicating facilities, etc., freely offered to me. From my experience of similar institutions in other developing countries, I am amazed at the sheer volume of work which the School of Education gets through in comparison with its size. It is obvious that it has a devoted and highly competent secretarial staff. The contribution of all of them, professional and secretarial alike, to the project over the years has been quite beyond praise.

2. The In-service Diploma Course, Lazaretto. Half-a-mile away from the School of Education and in a separate complex of buildings, are the offices of the In-Service Diploma Course. This provides courses, mainly part-time, for teachers in Barbados. It is separate from the main work of the school and separately staffed; its geographical separation is unfortunate. The mathematics tutor is sympathetic with the work of the project, but comes himself from teaching in a grammar school not associated with the project. Since the project did not take root very deeply in the educational system of

Barbados, the In-Service Diploma has not contributed directly to it to any great extent. Teachers are however given courses with a modern approach which are excellent nourishment for their work with the syllabuses in use in Barbadian schools. The unit possesses an excellent library of school texts and teaching aids for mathematics - an area in which the main university library at Cave Hill is rather poorly stocked.

3. The Faculty of Mathematics at Cave Hill offers undergraduate courses in pure and applied mathematics. There are no specifically educational courses and there is no B.Ed. degree or a post-graduate certificate in Education at Cave Hill. (The School of Education does not give courses to students beyond the In-Service Diploma courses already mentioned. The old name of Institute of Education would seem really more appropriate.)

Estimates of the percentage of students who go into teaching after graduation vary considerably; the School of Education consider it to be high, while the Head of Department in mathematics considers it to be quite low. From talking with the students themselves I would estimate that well over half of those taking mathematics have been teachers; that of course does not mean that they will continue to teach after graduation, although in many cases they intend to do so.

In view of the fact that many of the original project teachers are now at Cave Hill reading mathematics, and have indeed been sent there with the specific hope that they will return better qualified to teach modern mathematics in the schools, it is disappointing to find that there is no course offered on mathematical foundations, or other topics which would be specially helpful for their future work in schools. Indeed, even when such relevant areas as linear algebra, calculus, statistics are being covered, it would seem that little attention is given to any pedagogical implications, so that students can find little or no relevance to their needs as schoolteachers.

I was able to talk with the Head of Department about this problem; he was sympathetic, but could not easily be persuaded that more than a very small number of his students were interested in teaching. It may well be true that, as he claimed, the demand for mathematicians in Barbados is mainly in the fields of banking, economics and computing. But what the other islands need far more, and certainly what they are hoping to get in much larger numbers, is better qualified and more widely capable teachers.

4. The B.Ed. at the Mona campus, Jamaica, also concerns the project, since some of its teachers have gone to Jamaica to read for this degree. So far as I can discover, the courses are mainly concerned with educational theory and not with methodology. Apparently an option in mathematics education was offered as part of the degree course, but failed to attract sufficient applicants and was dropped. If this is true, one must reluctantly conclude that there is no course at degree level at the University of the West Indies which will give teachers the mathematics or the methodology they need for developing modern courses in the schools.

5. Another deficiency was pointed out to me by a member of the staff of the School of Education, not himself directly concerned with the project. He was regretting the departure of teachers to overseas institutions in order to obtain higher qualifications, and pointed out that the University of the West Indies had no qualification which it could offer to teachers who had proved themselves capable of original work in developing project materials, conducting workshops, and the like. Backed up by suitable course work in such areas as abstract algebra, transformation geometry or statistics, project work of this kind well merits a suitable diploma. In his own words, "In the U.S.A., masters' degrees are given for less!"

2.5 This, then, is a brief account of the history of the project's development, and of the institutions and administrations with which it has been concerned. Many details have of necessity been omitted. The project is exceptionally well documented, having been almost pathologically self-conscious and self-critical, with the result that this outline can be readily filled in from its published and privately issued materials. A list of the more significant of these is given in Section 8.5. of this report.

I now turn to a consideration of the mathematics which the project has been developing as its response to the situation confronting it in the schools.

III - MATHEMATICS OF THE PROJECT

3.1 The Modules and Teachers' Guides

1. We have seen that the project was never conceived as aiming to produce a syllabus of work, but as encouraging teachers to plan their own curriculum. It therefore did not begin with a preconceived body of mathematics to be covered. Instead it derived its primary direction from the needs of the children, which were identified through the diagnostic tests outlined in Section 1.1.10. These disclosed weaknesses in many areas, but notably in fractions and decimals, matters which the first six standards in primary schools could be presumed to have covered. Ineeed, they were presumed to have covered them, for there is evidence that the weakness of pupils in this area came as a surprise to a number of teachers and administrators. One of the surprising features revealed by these early diagnostic investigations is that teachers repeatedly over-estimated the knowledge of their pupils, which suggests inadequate correction of written work - a human failing whose continuing presence is disclosed by direct observation.

2. These weaknesses were traced to two basic causes: inadequate understanding of positional notation and confusion about multiplication and division. Much early work was directed to elucidating these topics, as a preliminary to a frontal assault on fractions and decimals themselves. The treatment given in JSP Book 1 was quite rightly judged to make too many assumptions and to demand too much previous experience for the average Caribbean 12-year-old.

3. As already explained in Section 1.4. the series of eight modules and their accompanying teachers' guides have been produced by successive applications of the process: diagnosis, prescription, clinical testing, revision, consultation, publication; their final form can therefore be considered as a sort of quintessential distillation of the project's thinking about first year secondary mathematics. As such, it deserves careful study.

4. The Project Coordinator, Dr Broomes, has put on record, in a paper read to the Mathematical Association of Nigeria in August 1973 (9), his view of the mathematics strategies of the Caribbean Mathematics Project. He says "For the project, mathematics is a way of thinking. In his daily activities the student encounters situations which may be given meaning through a set of activities which constitute, in our metaphor, mathematical thinking. These activities include analysing the situations into their components, putting them into categories and summarizing. Such activities allow the project to regard mathematics as a structure of relationships - the discovery of these relationships and their expression in symbolic form, that is, in words, in numbers, by diagrams, and by graphs.

"The following statements help to define the nature of mathematics.

> a. Mathematics contains a set of concepts, facts and operations that every layman as well as scientist should know how to use.
>
> b. Mathematics is concerned with searching for patterns and relationships among different entities, with developing generalizations, and with expressing generalizations in mathematical symbols.
>
> c. Mathematics consists of making deductions in an axiomatic system; and this requires identifying, and clearly stating, assumptions within which conclusions hold.

By conceptualizing the nature of mathematics as above, the teaching of mathematics provides opportunity for all pupils to create mathematics for themselves at their own unsophisticated levels with familiar sense-data".

5. I have quoted this statement at length because I consider it important to an understanding of what the project has achieved. This importance derives from the fact, acknowledged by the senior consultant himself, that the distinctive mathematics of the project, as distinct from its methodology and the pedagogic structure of the modules, was mainly contributed by the project coordinator. In a situation where few teaching participants have university training in the relevant mathematics (partly explained by my comments in Section 2.4), this is perhaps inevitable, but it has tended to give the mathematics a slightly idiosyncratic stamp. I myself find this a somewhat idealistic view of mathematics - even an "ivory-tower" view of the subject. I note that the scientist is expected to know how to use mathematical concepts, but the fact that many of those concepts are derived from scientific observation, and have been developed and refined because of their practical scientific importance, is not mentioned. The three statements labelled a. b. and c. above correspond very roughly to what have usually been called Stages B, A and C in English secondary education - in that order. b. seems to be the stage A exploration, suitable for the years up to around 12-13; a. corresponds to the stage of codification and conceptualization usually thought appropriate to the ages of 13-16; while c. corresponds to stage C, that of rigorous deduction and axiomatization, which does not usually take place in English schools at all except possibly in the sixth form with the brightest pupils. Yet there seems to be an expectation in the last sentence that all pupils will be able to make some progress at all three levels, an expectation which experience leads me to doubt. In any case, he who would know mathematics as queen, must I think first know her as servant.

6. The project at first recommended wholeheartedly the adoption of the JSP texts for junior secondary school classes, pending the development of its own materials. These texts adopt what might be described as a humanely modern approach to the processes of arithmetic, avoiding both the crudities of a traditional dogmatism and the meticulous niceties of an axiomatic development. Their closest counterparts in the English system are probably the SMP letter series; in fact their thinking was considerably influenced by the original SMP texts. To me this approach is congenial and commendable, but it was obviously necessary for the Caribbean schools to depart from it, as we have seen. Sometimes however the departure seems not to have been in the direction of simplification, but in another direction which is best shown by considering specific examples.

7. Multiplication. My first example may look very trivial. Is 3 x 4 read as "three times four" or as "three multiplied by four"? This problem is not I think explicitly resolved, but from the usage of the modules one can deduce that "three times four" is expected. Both the teachers' guide and JSP Book 1 p.62 say that 3 x 4 means three lots of four, or 4 + 4 + 4. Of course it does not really matter, but some fuss is made about commutativity in the materials and some teachers are certainly confused. One even wished to make a distinction between "three ☐ times four" and "three times ☐ four", where the ☐ means a silent gap in speaking! The teachers' guide points out that this means that multiplication behaves differently from the other three rules; 3 + 4 means "take three and add another four"; 4 - 3 means "take 4 and take away 3"; 6 ÷ 3 means "take 6 and divide it by 3". In each case the operation involves the second number. Logically we ought to say that 3 x 4 means "take 3 and multiply it by 4", which is the opposite of what is recommended. Could this be the reason why many children think that 2 ÷ 6 means "divide 2 into 6", as revealed by some of the project's diagnostic tests?

The place for establishment of commutativity of multiplication is surely early in the primary school with actual counters. o o o o can be regarded as three rows of four or four columns of three,

o o o o
o o o o
o o o o

and that's an end of it. But in one Form 2 lesson which I watched it was insisted that the proper picture for 3 x 4 was

o o o o (three rows of four),
o o o o
o o o o

and to establish that it was equal to 4 x 3

we must actually rotate the rectangle into the position
o o o
o o o .
o o o
o o o
At this stage surely this is a fuss about nothing, and a waste of time. Every child in the class knows that $3 \times 4 = 4 \times 3$, and that applies to all products, even though they do not know the ritual response "by the commutative law for multiplication". As Morris Kline points out in his book "Why Johnny can't add" (10), we know that $3 \times 4 = 4 \times 3$ because (with concrete objects) they are both 12, and we postulate the commutative law for x because of this fact, i.e. because counting of physical objects behaves in this way, not the other way round. My sympathies are with the teacher in another school, who, in the course of a very similar lesson, called 3×4 "three by four", said it was obvious you could draw the rectangles whichever way you liked, and went on to something more interesting.

This same point is substantiated by an experience of Dr Broomes in 1973 (11). Observing a form 1 class in a project school in St Lucia who were being given a lesson on the commutative property of multiplication, he wrote on the board:

'a. Is this statement true or false: $3 \times 6 = 6 \times 3$?

b. Why is this statement true (or false)?'

Results: a. all 23 pupils wrote "true"; b. all pupils wrote statements such as "because of the commutative property of whole numbers"; one pupil added "and both sides equal 18". Later he posed the same questions to a Form 1 class in a project school in Antigua after a lesson on a different topic. 33 out of 35 answered "true" to question a; in answering b. about 17 out of 35 wrote statements such as "both sides name the number 18". This seems to bear out my contention that almost all children know at this stage that $3 \times 6 = 6 \times 3$, and that they know it because both sides are equal to 18, but that after suitable conditioning they can be taught to respond "because of the commutative property of multiplication". (That 17 children wrote "both sides name the number 18" I do not believe; this is the language of the observer, but not I think the natural language of the child. I return to this point later).

8. Ones and Units. This is another small matter, but like the tip of an iceberg, there may be more to it than meets the eye. In all accounts of the place-system of numeration both in the project, and I think in JSP, the values of the places are called . . . hundreds, tens, ones. In England the traditional name has certainly been "units". The difference would be a trivial matter, but for the explanation given for its adoption by the project authors. It is explained fully in the teachers' guide to Decimal Notation, section 8.0. The point is made that if we record (for example) a length as 2.00 m, this means we have measured in cm to the nearest cm (agreed). But it is then stated that in this case the "units" - i.e. the units of measurement - are centimetres, but the "ones" are metres. In fairness I should add that the author of the teachers' guide on Measurement of Length adopts a different terminology; to him the centimetre in this example is the "unit of precision" and the metre is the unit in which the measurement is recorded. I find this clear and acceptable. But now here comes the point of my concern. Concurrently with the CMP there is a science project running in most of the project schools, the WISC Integrated Science project. When I pointed out this usage in the CMP (whereby centimetres would be described as the unit in a measurement of 2.35 m) to the coordinator of WISC, he was predictably concerned about this departure from normal scientific usage, of which he was not previously aware. It is of course possible that it had been discussed with his predecessor, but from this straw in the wind and from teachers' replies to questionnaires I get the feeling that there has been little contact between the framers of the two curricula. The attitude of the project framers seems to have been subconsciously that which was unwittingly expressed in 4 a. above. They have not been unconscious of the needs of science - after all, some teachers teach both in CMP and WISC - but they do not find it natural to confer, even less to ask the scientists "what would you like us to teach?". In this of course they are not alone; it has been a weakness of mathematical projects the world over.

But the fact is that no scientist or representative of WISC seems ever to have been asked in that capacity to attend a CMP workshop. In this particular instance I think that if the mathematicians call the units centimetres in a recorded measurement of 2.35 m they will make the task of the science teacher much more difficult, since science is greatly concerned with consistency of units, and all scientists would (I think) agree to a man that in a length described as 2.35 m the units are metres.

A very similar difficulty arises in Fractional Numbers (worksheet 5) where we are asked to consider how many times the "unit 1/5" must be used to find 1; the teachers' guide however calls the "one" the "whole or unit" in discussing the same worksheet. Quis custodiet ipsos custodes? Here it would surely have been better to stick to the word "part" as the teachers' guide does. "How many parts, each 1/5, make one whole?"

9. Fractional Numbers. We reach here a major field of controversy within the project itself, as I have already explained in Section 1.4. The problems here are both mathematical and pedagogical. To begin with, a distinction is made, most clearly in the glossary on pp 12-13 of the teachers' guide to Fractional Numbers, between fractions, fractional numbers, and rational numbers. I am not sure if I have got this right, but I think the fractional numbers are the non-negative rationals, while a fraction is merely a symbol for a fractional number. If so, I question whether we really need the term "fractional number" at all. Part of the reason for it seems to be the project's insistence on the distinction between signs and things signified, discussed in the next paragraph. But the deeper reason for the change was the desire to treat fractions as rational numbers without having previously dealt with the integers.

The more usual teaching order, which is the order adopted by JSP, corresponds in this instance to the natural mathematical order of setting up the rational numbers Q. This is (1) the counting numbers, N, which can include O if desired, in answer for example to the question (which had better be asked by a male teacher) "How many girls in this class are over 30?" Then (2) the fractions, as partitions of counted sets; next (3) the integers, as shifts along the number-line. Finally we arrive at (4) the rational numbers, by combining the properties of (2) and (3). It is of course useful to introduce the number-line at stage (1); but the numbers here are mere marks or locations on the line; they can for example be cards hung on the wall. The order is invariate, but not the spacing between them. There is at this stage no reason why they should be at equal distances apart. We only need this when we reach stage (3), by which time we are, mathematically speaking, discussing a one-dimensional vector-space (actually, a module). This is, I think, what the project calls the "frangoist" approach. The word is presumably coined by a Latinist from "frango" = I break, the root of the word "fraction". It is possible to take (3) before (2), in which case a number-line treatment of fractions is possible. What the project has done is to give this number-line treatment without an adequate exploration of the difference between (1) and (3). Let us examine the pedagogical consequences.

The change was made at the St Lucia Mini-workshop in March 1973. The result of the first test administered to the experimental classes was shattering. To quote from the hand-out given to the workshop participants: "The concept of fractional numbers as points on a number line is less familiar that the concept of fractions as parts of a whole. A Unit on Fractional Numbers is being developed with 1st year Jn. Sec. pupils. The first of the proposed worksheets deals with showing whole number operations on the number line. The difficulties encountered seemed enormous; the pupils just did not seem to understand how the operations were represented by the teacher's actions and what relationship there was between these actions and a number sentence that described them". Faced with this, the project machinery went into highly commendable action. Three tests were devised: on multiplication facts, an oral test on simple problems involving the four rules and requiring the appropriate operation to be identified, and a test on understanding of the meaning of the symbols + - x ÷. All involved counting operations only. Most tests showed adequate understanding, except for widespread failure to detect the errors in $5 \div 15 = 3$ and $4 - 8 = 4$. I have suggested

a possible contributory cause for this in a earlier paragraph. But what I consider to have been the real difficulty, the switch from counting numbers to directed numbers along a number-line, was not uncovered by these tests. It did however emerge later, because the Module on Fractional Numbers as finally constructed includes several worksheets on whole-number shifts along the number-line (positive only) before discussing fractions at all. Nevertheless the difficulty still remains, as is obvious from the teachers' guide. This repeatedly warns the teacher that pupils are apt to count the marks on the number-line instead of the spaces between them (misleadingly called "units", see above). Clearly this has been found difficult in practice, and I feel it is because the module attempts to do two things at once: to show that $^{-}1 \times \frac{1}{3} = 1$, and that $3 \times {}^{+}\frac{1}{3} = {}^{+}1$.

I would suggest therefore, with some diffidence, that the decision taken before the St Lucia Mini-workshop was the wrong one. The workshop itself surely shows that clearly. The decision was arrived at, I think, through an over-indulged desire to establish the logical structure of the rational number-system as soon as possible. This diagnosis is supported by the content of the finished module. It proceeds as far as showing that two fractions a/b and c/d are equivalent if and only if ad = bc (of course in numerical cases only, not in these terms!) but it does not introduce any technique either for the addition or the multiplication of fractional numbers. It would I think have been better to have followed JSP's lead more closely; to develop fractions by cutting up rectangles etc as is done in the module, establishing equivalence and then going on to addition and multiplication as in George Green's paper referred to in Section 1.4. There should then be a module on integers, which at the moment are treated only in Scope and Sequence. Here the jumps on the number-line could be introduced to explain why ${}^{+}3 - {}^{+}5 = {}^{-}2$, and so on. After this, fractions can be reviewed and linked with the number-line, showing how $3 \times {}^{+}\frac{1}{3} = {}^{+}1$, $3 \times {}^{+}\frac{2}{3} = {}^{+}2$, and indeed $3 \times {}^{-}\frac{2}{3} = {}^{-}2$, using the same "jump" technique as in the existing module. Experience has shown that if the two extensions of the natural numbers to integers and to the positive rationals are undertaken separately, there is not much trouble to get pupils to see how to combine them using "both ends" of the number line; but there can be confusion if we attempt to do both at once. Only high-flying mathematicians can go straight from N1 to the fields over Q-bridge without using the Ring-road.

10. Signs and things signified. The discussion in the previous section has also brought out another feature which occasionally crops up in the project materials - the insistence on distinct words for symbols and the objects they symbolize. Consider the statement I have already referred to, that 3 x 6 and 6 x 3 are two names for the same number, 18. "3 x 6" is, I admit, a somewhat roundabout name for 18, but surely 3 x 6 = 18. I agree that "The Duke of Edinburgh" and "The Queen's husband" are two names for the same person, but why is it thought to be preferable to say this, rather than to say (with the man on the Clapham omnibus) that 'the Duke of Edinburgh is the Queen's husband'? The linguist needs to make the distinction between the reference to a word and the use of it, and he usually manages this with inverted commas; thus

' "The box" contains two vowels'

is a meaningful and true sentence,

whereas 'The box contains two vowels'

is nonsense.

We do occasionally need to make this distinction in mathematics. Thus "12" contains two digits or numerals, but 12 = seven in base 5 and 12 = twelve in base ten. (Incidentally, since we have an accepted symbol for the number seven, I can see no objection to a child writing $4 + 3 = 7 = 12_{five}$, though the author of the teachers' guide to Measurement of Area (p.61) seems to have one. He says '7 does not exist in base five', but he means ' "7" is not used in base five'. The child who wrote $7 = 12_{five}$

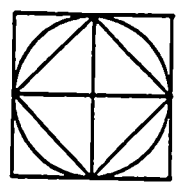
is using the symbol 7, not referring to it). It does therefore seem to be occasionally necessary to distinguish the numeral "7" from the number 7. But when we say "1/3" is a numeral for a rational number, that is to say, a fraction is a symbol for a rational number, we are laying emphasis in the wrong place. When we say 1/3 = 2/6, we are not just saying that these are two names for the same number which happen to use different symbols. Are the 1, 3, 2, 6 in this statement numerals? Clearly they are not; we are using the symbols to talk about numbers. We are saying that there is a connexion between the number-pairs (1,3) (2,6), namely 1 x 6 = 3 x 2, and it is this fact about numbers which makes it reasonable to say that "1/3" and "2/6" name the same number. The truth is that we can define an equivalence class of pairs of integers ((1,3), (2,6), (3,9), . . .) and this class is the rational number. We choose the first and simplest pair to name it, so we call it "the rational number 1/3", and we don't really need a name for the name!

The attitude of JSP to all this is much more robust (Book 1, p.54). They say "The numeral for three-quarters is 3/4 .... These numbers 1/4, . . 3/4, . . are called fractions. ... 2/5, 4/10 represent the same amount; we say they are equal fractions, and we write 2/5 = 4/10". In other words, having christened the child they proceed to use the name to talk about the child, not to go on discussing the name.

Two points seem to emerge from this discussion. (a) It is very difficult to be absolutely precise and consistent if distinctions such as that between numeral and number are to be made. (b) It is pointless to do so, because it is unintelligible to the pupils and diverts attention from the mathematics involved to disputes about verbiage. Bluntly, it is a waste of precious time. The pupil needs to learn practically that 1/3, 2/6, 3/9, ... mean the same thing; the concept of ratio or rational number lying behind these fractions comes gradually, and the formal expression of the equivalence is best left to the university.

11. Geometry. Most of the geometrical work in the modules occurs in Measurement of Area. The teachers' guide to this is a very thorough introduction to most of the figures and concepts of elementary geometry; its care in explaining the treatment of area and outlining a sequence of lessons ranks it in my estimation as one of the best pieces of work that the project has produced. I am sorry to have to draw attention to some minor blemishes.

In regard to the main topic there is an unfortunate statement on p.17; "all geometric figures can be transformed into rectangles". The context shows that what is intended is "all rectilinear geometric figures can be dissected into parts which can be rearranged as rectangles". "Transformation" is too vague a word to be serviceable here (but see my comment below on the definition of congruence). The author seems not quite clear himself that the statement is only true for figures bounded by straight lines, for he states that "the transformation is more complex for circles"! Indeed it is; it is impossible. The limiting process here involved is rightly glossed over for pupils, but it might have been helpful to have established that for a circle (a) Area is proportional to r^2; (b) if A/r^2 is defined as π, then the accompanying figure demonstrates that $2 < \pi < 4$, and that π is a little over 3. Incidentally, an estimate for π is more easily obtained by wrapping a long thread several times round a bottle or can than by the methods suggested. It is even better if calipers are available to measure the diameter (another example of lack of cooperation with science lessons?).



My chief criticism of this guide, however, is directed to the strangeness and looseness of some of its definitions. "A square is a rhombus, but the term is reserved for quadrilaterals the angles of which are not right angles" is surely self-contradictory. It seems to mean that a square is a rhombus but we mustn't say so. Again "The diagonals of a rectangle bisect each other, but not at right angles" contradicts the previous

sentence which states that "all squares are rectangles". We need of course "... not necessarily at right angles". Pupils who are going to illustrate set-theory by classifying quadrilaterals according to their symmetry need clear guidance here.

The use of the word "regular" is very strange. Regular polygons have both all their sides equal and all their angles equal, not one or the other as stated and illustrated on p.10. I have never heard conics described as "regular curved figures", and "one-sided" as applied to the boundary of an ellipse or leaf, as distinct from the "two-sided" boundary of a semicircle + diameter seems to me an undecidable distinction as well as a confusing one to a pupil who may later meet a one-sided surface such as a Moebius strip (p.11; the whole section 5 seems to me to be misguided).

The definition of congruent (p.22) is misleading in the extreme. I quote it verbatim and in toto. "Congruent. The identification of one geometric figure with another by a transformation which yields a one-one correspondence. Two geometric figures which coincide exactly with one another are congruent". There are of course infinitely many transformations which are one-one, including many that are not even bicontinuous, between non-congruent geometric figures, and two geometric figures which coincide exactly are surely identical (and indistinguishable!). So this mass of verbiage tells us precisely nothing.

More indicative of trouble is the definition of angle. Here two incompatible definitions are simply placed side by side. "Angle. The union of two rays having a common endpoint. The measure of the rotation of a ray about an endpoint". Now, to use a relevant Caribbean illustration, we may peg our currency to the U.S. dollar or to the British pound, but in these floating days we cannot do both. Here the first definition is a set of points; the second is a number. What is more, that number is in no sense a measure of the first set. The first definition is of course very common in U.S. texts. Since its introduction by (I think) SMSG it seems to have become almost an article of faith to be accepted quite uncritically. I find this very surprising, and I speak here as a mathematician, not as a chauvinistic Englishman. For if an angle is a union of two rays, then it is a set of points, and in the diagram, the segment PQ is a part or subset of the angle AOB.

Further, there is no way of distinguishing angle AOB from reflex angle AOB; there cannot be, because the definition does not really refer to either of them.

This is certainly not what most people mean by angle. There is a case for defining an angle as an ordered pair of two rays, though this is rather sophisticated. From the point of view of pedagogy, once again this is focussing attention on the wrong things. For these and other reasons SMP, JSP, and most British treatments have rejected this definition of angle and substituted the second, informal definition (which in fact can be made quite respectable mathematically, if required). To JSP and others, an angle is defined practically in terms of a physical operation called a turn. By recommending the use of popsicle sticks to measure and transfer angles - a simple device which bears the hallmark of genius - the project is really saying the same thing. But it keeps on making confusing concessions to the axiomatists. There is a very full treatment of this issue, written from a U.S. point of view but endorsing the comments I have made here, in the 36th yearbook of the N.C.T.M. (1973) by Henry van Engen (13). The whole volume repays careful reading, but I could not find a single copy in the library of any teachers' college in the Caribbean.

12. Mappings. This same point is more forcibly brought out by the complete module on Mapping. JSP has a chapter (12) on mapping in Book 1; it does not introduce sets until book 2. But the project wants to have the purist's definition of mapping as a set of ordered pairs, so in this unit the pupils are introduced to sets, ordered pairs, and Cartesian product. I am not surprised that my visits to schools have revealed that very few teachers are using this module; I suspect that, coming late in the series, it did not receive the same critical appraisal accorded to the others. For JSP adopts no such approach.

Why do we need mappings, that is, functions, in school mathematics? Because everywhere we are concerned in practice with the connexion between different quantities - to use traditional language for a moment, with the values of variables. This is a fundamental part of the application of mathematics; in real life we find that measurable quantities which change from time to time, or from place to place, are connected. The ideal way to show this is by a graph, or in simple cases by a formula. Yet the module does not really reach graphs at all; it ends at the plotting of points from two coordinates. The JSP chapter goes further, of course; it can devote the time saved by not considering sets, ordered pairs and Cartesian products to get further with the practical plotting of straight line graphs. Does the project module help the pupil who cannot yet cope with the JSP treatment to find his way into it? I cannot think that it does. Once again, the treatment of so basic a topic differs in different countries, and it could be argued that Cartesian products are needed for probability. But I suspect that once again the purist's definition of a function as a set of ordered pairs with certain properties has unduly influenced the framers of the project material, to the detriment of the immediate practical needs of the pupils in science, geography, and elsewhere.

3.2 Mathematics of Scope and Sequence.

1. I have discussed in Section 1.5 the relation of Scope and Sequence to the project as a whole, but it is well to recall that it is the work of a group of sixteen people: the Project Coordinator, the three consultants, one consultant-designate, eight teachers' college tutors or local coordinators, and three teachers. The 'balance of power' has clearly moved away from the teachers' workshops responsible for the modules, and this may be felt to indicate that the ordinary teachers already feel themselves less competent to contribute or criticize at this level of mathematics. "Scope and Sequence" distils the project's thinking about second and third year work. In it we find an outline sketch, more detailed in some areas than others, of the following 14 topics:

1. Numerals and other symbols (3)
2. Integers (3)
3. Rational numbers (3)
4. Reals (2)
5. Number theory (5)
6. Geometry (5)
7. Geometric transformations (2)
8. Mathematical sentences (2)
9. Algebraic expressions and processes (3)
10. Relations and functions (2)
11. Probability (2)
12. Sets (3)
13. Groups (2)
14. Arithmetic (1)

The figures in brackets give the number of pages allocated to each topic. This is preceded by a sequence table and chart with a lesson scheme for a year of 245 lessons (some optional); 108 of these are devoted to the number-system (topics 1 - 5), 71 to geometry (topics 6-7), 34 to algebra (topics 8-10) and 32 to the remainder (topics 11-14). Practical arithmetic (which looks very much like an afterthought) is tacked on to the end of the allocations to probability and geometry. Very little guidance is given to the teacher in developing this important topic beyond a list of possible applications; thus, section 2.0 Ratio and Proportion reads

2.1 Fertilisers

2.2 Allocating costs, sharing profits

2.3 Recipes, formulae for concrete, etc.

2.4 Map scales, e.g., 1:25 000

By contrast, and also because I would like to comment on it, I quote Section 3.0 of topic 9, Algebraic expressions and processes.

3.0 The Balance Principles and their Application

3.1 Inverse Operators

3.1.1 ^{+}a is the inverse of ^{-}a

3.1.2 ^{-}a is the inverse of ^{+}a

3.1.3 a x is the inverse of $\div$ a

3.1.4 $\div$ a is the inverse of a x

3.2 The balance principles: if A, B, Y are algebraic expressions and A = B, then,

3.2.1 $A + Y = B + Y$ and $Y + A = Y + B$

3.2.2 $A - Y = B - Y$ and $Y - A = Y - B$

3.2.3 $A \times Y = B \times Y$ and $Y \times A = Y \times B$

3.2.4 $A \div Y = B \div Y$ and $Y \div A = Y \div B$

3.3 Using the balance principles and an inverse operator to solve equations in any of the following forms:

3.3.1 $x + a = b$, and $a + x = b$

3.3.2 $x - a = b$, and $a - x = b$

3.3.3 $ax = b$, and $xa = b$

3.3.4 $x \div a = b$, and $a \div x = b$

3.3.5 $ax + b = c$

3.4 Using the balance principles and inverse operators to change the subjects of formulae, e.g.,

$C = \pi d$, solve for d

$A = p + l$, solve for p, l

$P = \frac{F}{A}$, solve for F, A

$D = rt$, solve for r, t

2. First, two immediate comments about detail. The curious inversion of order in 3.1.3 and 3.1.4 sticks out like a sore thumb; it is of course dictated by the reading of a x as "a times"; " multiply by a " would be clearer, surely. There is a slight confusion in 3.1.1 and 3.1.2. It is true that ^{+}a and ^{-}a are additive inverses, but the context shows that we are talking about operators, not about numbers; what is meant is that " subtract a " is the inverse of " add a ". An important distinction has been missed while attention is being diverted to trivial ones. This whole section would be better treated by writing the operations out in words in boxes; this is the treatment given to it in JSP Book 2, chapter 7. Once again I have to confess that I find the JSP treatment preferable to what the project has substituted for it, and I query why the substitution has been made. Here it certainly does not make things easier for the pupil, rather the reverse.

But more seriously, we seem to have lost our sense of proportion here. Section 5.0 of the notes on this same topic 9 reads, in toto,

"5.0 Solution of verbal problems using linear equations."

No subheadings, no guidance. Now first of all any experienced teacher concerned about the motivation of his pupils for mathematics would begin the work on linear

equations with "verbal problems", or rather with real-life situations which would indicate why we need to bother with linear equations at all, after which we need to discuss ways of unravelling the equation, not the other way round. The inexperienced teacher (for whom presumably these notes were written) needs to be given this hint, and also some help about how to start in on a real-life situation. Even a "think-of-a-number" game would be better than nothing. But I am terribly afraid (and remember, no text-book goes with "Scope and Sequence") that an inexperienced teacher may begin to hand out to pupils the contents of these notes, even that "the balance principles" may get learnt by heart in the bad old way.

While we are discussing this section, there is one more item on which I feel a comment to be called for. This is

> "4.6 (optional) solution of simultaneous equations using lattices, open sentences and truth sets, e.g.,
>
> $\square + \triangle = 5$ $\qquad\qquad$ $\square - \triangle = 1$
>
> (the intersection of the two sets solves the equations)". Since throughout the section we seem to have been operating freely with letters, and this is an extra optional topic, surely we are allowed to say $x + y = 5$, $x - y = 1$? When we have got to form 2, we can put away childish things. But why have we got to do this on a lattice? These equations happen to have integral solutions, but most do not, and before we get to this stage we ought I think to know that $\{(x,y): x - y = 1\}$ is a straight line; if we don't, then this topic ought to have been substituted for the one under consideration. Has this strange omission been actuated by the idea that no-one ought to be allowed to draw a continuous graph until he has mastered the real number-system? If so, it is like the now mercifully dying American view that no-one ought to be allowed to differentiate until he has a thorough grasp of limits and continuity, or like saying that no-one should be allowed to use an electronic pocket calculator until he has mastered its internal logical structure. If this were true, over 99% of our secondary school pupils would never draw any graphs at all.

3. The imbalance of Scope and Sequence appears again when we consider its contents alongside those of JSP Book 2. In practice it is usually taken in conjunction with JSP Book 2; teachers, if they use it at all, select from JSP 2 those topics which occur in Scope and Sequence. The following list shows how the two books compare in their contents:

In S and S but not in JSP 2	In JSP 2 but not in S and S
Sets: cardinality, complement, intersection	Flow diagrams and inverse flow
Ordered pairs and cartesian product	Graphs and applications
Square roots and irrationals, reals	Vectors
Groups	Perspective drawing
Probability (as distinct from frequency)	Topology
"Business arithmetic"	

Graphs get only a casual mention (for $y = kx$ only) in Scope and Sequence; some statistics topics in JSP 2 are in the Statistics module.

4. There seems to be sufficient cumulative evidence here, borne out by a closer examination, to establish the following general statements:

Scope and Sequence

a. shows a greater interest in abstract field structure

b. shows less interest in graphs and applicable mathematics

c. has been less influenced by teachers and classroom experience

d. has been more influenced by (American) "new math".

5. It is a pleasure to turn from these somewhat adverse criticisms to look at the other major component of Scope and Sequence, the Geometry. For here we seem to be moving in a different world. We start by "observing cuboids" and we end by " pouring sand". We fold paper, thread straws, swing weights, find widths of streams, experiment with mirrors and make endless drawings. Theory is not neglected, but is practically motivated and approached. It includes angle-sums of polygons, angle properties of the circle, the 3:4:5 triangle. A good account is given of transformations - of course only in outline - as far as the combination of two reflections (but not of two rotations). My only regret about this section is that it has no bibliography. My experience shows that teachers need help here, especially in regard to the transformation geometry which is new to them, and a guide to further reading would have been helpful. This criticism applies to Scope and Sequence as a whole; it contains no book-list and no references to text-books in common use, such as JSP, SMP, and the Scottish SMG.

6. The questions we now need to ask, and if possible to answer, are two:

a. The JSP material has always been advocated for 'O' level classes. Is the "Scope and Sequence" material more easily assimilated by the non-academic streams for which it has been ostensibly devised?

b. Is this material suitable for the educational needs of these pupils?

Evidence from the schools would appear to be indecisive on the first question. This evidence is considered more fully in Section 5 of this report, but the facts are that some teachers seem to be using the practical geometry with the lower streams, some are selecting a few topics from JSP 2 which coincide with those in Scope and Sequence, but the vast majority are reverting to traditional material, often "commercial arithmetic". How one interprets these facts is largely a matter of personal bias, but my own feeling is that the academic imbalance of the Scope and Sequence scheme has something to do with it.

Our answer to the second question depends on what we consider the educational needs of these pupils to be. In replying to the questionnaire (see below, Section 8.6) teachers have given their answer fairly clearly: their main need is to cope with the arithmetic of everyday life. Judged by this criterion, Scope and Sequence is found wanting. For this is just the area to which it has devoted least attention. It could be argued that teachers can cope with this anyway, and that what was wanted was a viable and more mathematical alternative. But this is a false assumption; the mathematics of "commercial arithmetic" with its stereotyped methods and mummified text-books is a poor preparation for everyday life, even for modern commercial practice. The alternative could and should contain sounder and more open-ended mathematics, but such an alternative has not, in my view, (except in the case of the geometry) been found. Sufficient attention has not yet been given to the real needs of the less academic children in Caribbean secondary schools.

3.3 The project in the general curriculum

1. JSP. The project recommended the JSP books from the outset as a course which could be used while its own materials were being developed. As it progressed, it became clear that the project materials could never replace a class text-book, where this was appropriate; indeed, it is doubtful whether such replacement was ever intended. It was hoped that the project modules could be used in conjunction with any modern textbook; this hope has largely been realized, but they do remain more closely linked with JSP than with any other course. The present complex situation is the subject of

Section 5, but the fact is that the supply of free JSP textbooks has resulted in the project being so identified with JSP that in some schools the project which I was announced as evaluating was immediately taken to be JSP. I do not believe there is a better O level course for Caribbean schools than JSP, so it is a matter for congratulation that the project has acted as agent for its introduction; the fact remains however that it is an 'O' level course and not entirely suited for junior secondary schools in their lower streams.

The modules can act very well as an introduction to the more difficult topics in JSP 1; the relation of Scope and Sequence to JSP 2 is more ambiguous, with unfortunate results in practice.

2. Remedial work. The junior secondary schools receive in their first year many pupils whose knowledge of mathematics is very limited and whose standard of reading is low. The modules, or some of them, seem to have proved their usefulness for the more literate of such pupils, and could probably be used more widely.

3. Science. This deserves a separate study, which has not, to my knowledge, been undertaken, and which I am in no position to undertake. The impact of Integrated Science programmes has been to reduce the mathematical needs of science courses in the junior secondary years, and the tendency of the project has been to move away from the applied side of mathematical education, so that the two subjects have drifted apart. I regard this as a great pity, but perhaps inevitable.

4. Technical subjects. The treatment of geometry in Scope and Sequence is excellent for pupils involved in technical studies, including girls concerned with design and needlework. This aspect deserves more development than it has received. A skilled and imaginative teacher can do a great deal, but help is needed with specific illustrative material.

5. "New Math". If in some islands the project is identified with JSP, in others, especially the more northerly ones, it is identified in the minds of teachers with what is referred to as "New Math". That is, in the minds of head teachers for the most part; project teachers are usually more precise. The terminology used of course betrays the origin of the confusion, for the term originates in the U.S.A. and its area of prevalence coincides pretty much with that of the former employment of Peace Corps personnel to supplement the local teaching force. It should be clear to the perceptive reader that the project's mathematics, though modern in flavour, is considerably removed from the "New Math" for example of SMSG or the Entebbe materials (African Education Program). If this were only a matter of the use of a convenient name, it would be unimportant, but in fact there is some justification for the confusion. Part stems from the unfortunate tendencies already noted in Scope and Sequence to displays of axiomatics. More is revealed when one examines the libraries of the teachers' colleges and the reference books available to teachers in schools. Many and in some cases almost all of these books are found to be U.S. or Canadian texts of the 1965 era, dating,that is to say, from the first flush of "New Math" in America. This is not the place to go into the nature of the mathematics they contain, but it is well-known that much of it was university generated, on logical axiomatic foundations, and was comparatively untried in the classroom. There have been many second thoughts about such material in America and elsewhere and a famous letter deploring the then current tendencies was published as long ago as 1962 in the American Mathematical Monthly over the signatures of 75 leading university mathematicians in U.S.A. Since then there has been a considerable swing away from such an approach to school mathematics - a fact which may in itself account for the presence of these textbooks in the Caribbean. Here, I suspect, is the probable origin of much that I have criticized in the project materials; preoccupation with set theory and the axiomatic structure of the real number system was one of the foibles of New Math. The student of mathematics can only gain any meaningful understanding of this structure when he is in a position (a) to look back and contemplate a number of examples which he knows on other grounds to

possess this structure, and (b) to have experience of systems which do not possess it, so that it becomes something meaningful and worth talking about. Transformation operators and matrices are probably the first example of such systems. A discussion of this kind is therefore best undertaken by 'O' level classes in the fourth or fifth year of their course, not before; this to me indicates that it is better, for example, to demonstrate through concrete models that 5 times 1/3 is the same as a third of 5, rather than to invoke the "commutative law" to justify it. For at this stage the commutative law is no law at all, merely an observation of consistency.

Prof. Morris Kline puts all this much better than I can, so I let him speak for me (14). Prof Kline has been a leading critic of New Math since the early days, and in this his latest book ("Why Johnny can't add") he certainly but most entertainingly overstates his case; nevertheless in the two quotations that follow I am sure he is basically right.

On the proliferation of symbols:

"The symbols of mathematics, like the notes of music, are in themselves merely an artificial, intrinsically meaningless script. They will convey life, meaning, richness of thought and beauty only if the ideas and the thinking which the symbols merely record are taught with as little use of symbolism as possible".

And on the application of mathematics:

"Mathematics exists primarily to help man understand and master the physical world and, to some extent, the economic and social worlds. Mathematics serves ends and purposes. If the subject did not have these values it would not get any place at all in the school program. These values should be reflected in the curriculum".

Here is a book which should be in every teachers' college library in the Caribbean; it will certainly provoke creative thought and discussion. But I found it in only one of them.

6. The St Lucia Mathematics Project. This is a project which has been operating in primary schools in St Lucia since 1966. To date Messrs Ginn have published the books (workbooks and teachers' guides) for the first three years; materials for years four and five are being tested out, and those for the sixth year (Standard 3) are in draft form. It is hoped that the materials will have wide circulation throughout the Caribbean, and the name has now been changed to Caribbean Primary Mathematics. Confusion with the Caribbean Mathematics Project has not been entirely avoided.

There is very considerable overlap with the project modules. In the year 6 draft, for example, topics appear which the modules have not yet reached: there are 18 lessons on fractions which get as far as LCMs, addition and subtraction, which as we have seen are omitted from the modules. This of course is all to the good, if these topics are taught effectively in primary schools. Coordinates appear, as do tallies and pictograms. One topic which we shall meet elsewhere in reviewing project work elucidated for me a mysterious term; I am not sure if it is a local coinage. The method also seems a little bizarre. Here is the problem, and the solution given.

"4 packets of dog-chow feed a dog for 7 days. How long will 12 packets feed him?

Solution: $\frac{4 \text{ packets}}{7 \text{ days}} : : \frac{12 \text{ packets}}{n \text{ days}}$

$\frac{3 \times 4}{3 \times 7} : : \frac{12}{\square}$

Thus $\square = 3 \times 7 = 21$. Answer: 21 days".

This is called the "rate-pair" method; not a term I had met previously, though I can see how it arises. But why the four dots, instead of a plain = ? The use of them in 3:5 : : 6:10 was dead and buried about 30 years ago; the usage shown above is entirely new to me, and is surely quite unnecessary? But is the method natural to a primary school child? As it is only in draft, one should not criticize, but dare one say that the traditional way of looking at a problem like this is surely easier:

"What do we have to multiply 4 by to get 12? 3. So we have three times as many packets, and they will last three times as many days. 3 x 7 = 21 days". If a formal statement is needed, then let it be

$$\frac{\square \text{ days}}{7 \text{ days}} = \frac{12 \text{ packets}}{4 \text{ packets}} = 3$$

so $\square$ days (why not "the time asked for"?) = 3 x 7 days = 21 days.

We are in danger here of substituting a new formalism for an intelligent approach.

If the St Lucia Mathematics Project makes headway in primary schools, then the project modules will in many cases need modification. But also many more teachers in primary schools will have had experience with practical discovery methods, and with an outlook which is not too different from that of the CMP. What is important is that primary and junior secondary school teachers should continue to talk to each other and to discuss the curriculum together.

7. The needs of the lower streams. I shall return to this theme in Section 7.2 after a closer look at the current situation. Here I would raise the question whether the mathematics of the project materials is really suitable for the lower B and C streams in the junior secondary schools, or their equivalent.

"Scope and Sequence" (p.4) says that

> "Good, sound mathematics can be taught to all pupils, regardless of ability level, if the correct approach is used".

But this obviously does not mean that any good sound mathematics can be so taught - try teaching tensor calculus to ten-year-olds - and leaves totally untouched the much more urgent question as to what mathematics (assumed to be good and sound) ought to be taught to junior secondary school pupils. Also while the sentence quoted does not actually say, it could be thought to suggest that soundness guarantees teachability. Precision, alas, is not the same as communication; if it were, legal documents might become best-selling paperbacks.

What sort of mathematics then ought we to be giving the pupils in Caribbean junior secondary schools? To answer this thoroughly requires a hard look at the social milieu into which they will be thrust after leaving school; the employment opportunities open to them; even a peering into the crystal ball to divine what may be required of them in the very different world they will face in their maturity. Meanwhile some memorable words of Dr Broomes himself will provide us with an answer to be going on with (15): "We are interested in the kind of mathematics needed in buying fish, in building a house, in making an economic plan". Is this the sort of mathematics offered by the project's published materials?

If we judge this by the response of the teachers and pupils of the lower streams, then by their actions they have voted in the negative. For the impact of the project on B streams is marginal, and on C streams minimal, as we shall see. But it would be quite wrong to ascribe this negative result simply to the inappropriateness of the mathematics offered. The problem is more subtle than that. There is quite enough material published by the project to enable a good programme to be put into action for

the B and C streams by a capable and determined teacher. Such a teacher needs to be selective, and there could have been more material suitable to his needs if the project had not succumbed to some of the temptations I have tried to outline. But the pressures of the educational system, of parental ambition, of sheer physical conditions in the schools, have exerted a more potent effect, eroding the teachers' determination and smothering their capabilities. The School of Education, the staff of teachers' colleges, the project organizers, adminstrators, teachers, parents, employers, should be insistently asking "What sort of mathematics do the middle 50% of our school population really need?". This was the question the project set out to answer; in recent years I do not think it has asked it insistently enough. Instead it has tended to ask "What sort of mathematics are the pupils in our pilot classes capable of absorbing?". And that is, in two subtle ways, a quite different question.

IV BY-PRODUCTS

4.1 Production of materials

1. One of the encouraging features of the working of the project has been the number of by-products: developments not directly related to mathematics, or to its original objectives, which it has engendered. The most important of these is the development of skills and facilities for the local production of materials.

2. In all but two of the islands (Barbados and Montserrat) at the present the government does not provide textbooks or stationery for pupils in school. These are provided by the pupils at parental expense. Since nearly all schools contain some very poor pupils, there is a natural desire to keep the demand for parental expenditure on books and stationery to the minimum; in some cases this is zero, and in many it amounts only to exercise books, usually plain ruled and without squared pages. "Chequered" exercise books with pages ruled in quarter-inch squares are usually little more expensive, if at all, but schools have not always realized the advantages of using them and many bookshops that supply school texts and materials do not stock them. Many primary schools manage with a total absence of textbooks, except perhaps for a few readers, and those often unsuitable because of foreign origin reflecting a different culture; it may take as long to explain the meaning of the words and activities illustrated in the pictures as it does to teach the children to read them.

3. The project, with its emphasis on worksheets and diagnostic methods, found it necessary to produce materials quickly and cheaply for each child to use. The obvious method was duplicating (mimeographing). Most schools possess duplicating machines, but not all are in working order. Cost of shipping centrally produced materials to the various islands needing them is expensive and increasing. Local production is therefore obviously desirable. The Caribbean is not a mainland with easy surface communications; it is a chain of islands with tens if not hundreds of miles of sea between them. The only reliable means of communication and transport is by air; transport by sea often takes a long time and is subject to the movements of trading vessels.

4. In many of the islands the Ministry of Education or the Teachers' College provided the necessary facilities for duplication, but in Grenada the Senior Consultant went into action on a do-it-yourself basis with characteristic vigour. The results are best told in his own words (16).
He says

"What became immediately apparent was the need for duplicating facilities under the direct control of the project. The consultants in Barbados and Antigua had what might be defined as "equal right facilities" with others to the use of the duplicating machines at Cave Hill and the UWI centre in St John's. The consultant in Grenada had only second strike facilities, taking his place after the Ministry's needs. In both Antigua and Grenada no proper maintenance was carried out on the machines, and the quality of the work was poor.

The first by-product of the project was the acquisition by R D Payne and T L Schroeder of maintenance skills on the Gestetner duplicators. Instruction was given to operators, and the cleaning and adjusting of duplicators became a part of the consultants' activities.

5. In 1972 the consultant in Grenada was equipped with his own Gestetner 400 machine to supply the increasing demand for test versions of the earlier modules. The continual improvement in the quality of the printed work was due to the increasing skills of the consultants in using the proper stencils and stencilling equipment. The second by-product of the project was the development in teachers of stencil-cutting skills and this became part of the mini-workshops.

6. In 1973 a definitive document An Introduction to Graphics and Lettering for Teachers was produced by William Tenney, then UNESCO Graphics Artist in Trinidad. This document has had a wide circulation and considerable impact. It is easily possible to date duplicated project materials from their appearance, as "BT" (before Tenney) or "AT" (after Tenney).

7. Extra-modular Booklets. So far progress in duplicating facilities could be regarded as directly concerned with the work of the project. But from now on the payoff began to be seen in a myriad of other activities emanating from the village of Tivoli in Grenada, to which the Senior Consultant moved in April 1973. Once again I quote from his own account.

"From the beginning of 1973, additional teachers were being identified as associates with the project. This identification was done in an ad hoc fashion, largely through interested teachers following up the content of seminars on their own initiative: "Seek and ye shall find". In 1973, one of these teachers, Rudolph Charles of Tivoli RC School, Grenada, wrote the draft of a small booklet, Profit and Loss. This was intended for use in his own class to suit his own methods and the special requirements of his pupils. The booklet was printed by the project's facilities at Tivoli. Other booklets by the same author followed and by the end of that term a new concept of "mini-module" for use in individual classes had emerged. The booklets were sold to pupils for the cost of materials only: at that time, 5 cents each.

8. Involvement of local businesses. In September 1973 a group of seven teachers, identified as the Grenville Group, met regularly each week in a local dance hall to develop more of these booklets. One of them, Making Change, developed the concept of sets using the Easter Caribbean Currency coins. This booklet was extensively tested and frequently revised, with the intention that it should be of use in a number of schools. The scale of printing was envisaged as exceeding 1,000 copies, and this would put a strain on project funds, even to capitalize the edition with the hope of recovering costs later through sale to pupils. Barclays International Limited were approached to sponsor the booklets. They were sufficiently interested to grant £500 (EC$2 400) and this enabled the booklets to be produced in Grenada, St Vincent, St Lucia and Dominica.

In 1974, Bottlers (St Vincent) Ltd sponsored about 4,000 copies of a booklet, Bottlers Cup 1974, based on the Bottlers Cup Cricket Series. Since then sponsorship has been obtained for other booklets.

From September 1974, Waltham Junior Secondary School in Grenada, which has a Gestetner 400 and a typewriter, decided to produce its own classroom teaching materials. These have covered a wide range of reading, social studies (in an English milieu I had perhaps better explain that this usually means History and Geography) and science topics. They have obtained sponsorship from Y. de Lima, Carib Insurance and Central Sales in Grenada. This has been in the form of supplies of paper and stencils and the booklets produced are sold to pupils for 10c or 15c. The income is re-invested in more paper, ink and stencils.

9. The Tivoli Production Centre. The booklets produced by the Grenville Group were all mathematical, but individual teachers, notably in Tivoli RC School, had been experimenting with booklets on other topics. Pupils at Tivoli had written and illustrated Stories from Tivoli and a history book, Stories of my Island had been produced. A local hotel proprietor, Miss Palme Buxo, wrote a booklet I am a Tourist too, and this was sponsored by the Hotel Association.

It was becoming more necessary that teachers should be fully trained in the use of reprographic equipment. This equipment had been increased in May 1974 with the addition of a Gestetner 420 and a Roneotronic 300S Stencil Cutter to the Tivoli facilities. Consequently, with the help of local people, a workbench was erected in a garage space and additional shelving built. Teachers were seconded by their principals

for training on this equipment during 1974. Other territories expressed interest and since then courses of varying duration from one to three weeks have been given in Carriacou, St Vincent, St Lucia and St Kitts.

By early 1975 the number of titles of booklets passed 100 and included the topics of Music, Cookery, Spanish, Reading, Geography, History, Science, Social Studies. Stencils of these booklets were kept on file for the use of any teacher prepared to use the duplicating machines. The output of booklets had passed the consultant's ability to do it alone.

The booklets printed at the Centre are sold to the pupils at cost. This varies from 8c to 15c depending on the size of the booklet. The largest booklets are 22 pages, 165mm x 203mm. The income from these booklets was used to buy more stencils and paper to produce the trial versions of new booklets. Where sponsorship was available for larger runs of booklets, the cost of labour was included and there was then no charge to project funds. In 1975, before the Centre closed down, the cost of 500 copies of a 6 sheet (22 page) booklet, including all labour and other overheads, was 14.6 cents per copy: in sterling, less than 4p.

10. Local enterprise. Outside working hours, but using project equipment, a young man from Tivoli using his existing skill as a typist, produced a fortnightly newspaper, New Dimensions. This paper appeared regularly from June to December 1974, selling about 500 copies of each edition. This paper has now been absorbed into a monthly publication by the Grenada Association of Youth. As the demand for booklets increased further, the young newspaper proprietor Kenneth Budhlall was employed by the project for routine runs of booklets. As his skill increased, he became able to lay out and produce the master originals required for the electronic stencil cutter. By mid-1975 almost all the printed material from Tivoli became the joint effort of teachers and Mr Budhlall, with the consultant in an advisory capacity only.

At the end of 1974, a Peace Corps Dental Hygienist, Miss Judy Skelton, began to develop a programme of Dental Health. Using the teachers trained by the project, the Grenville Group activities, and the Tivoli Production Centre, she first produced a teachers' guide and then a series of 4 booklets: Tooth House, Our Teeth, Teeth Thieves, and Susan learns about Teeth. These four booklets cover the Upper Infant, Lower Junior, Upper Junior and Senior age ranges. A grant from Colgate-Palmolive paid for the production of 13,600 of these booklets, sufficient to supply every school in Grenada with 50 copies of each booklet free. The production was carried out at Tivoli in 14 working days, without any assistance by the consultant or project funds.

The latest (June 1975) production by the Centre and completely unsupported by the project, has been a 40 page book of recipes from Barbados. This book had been developed by the people of Dalkeith Village in St Michael. A commercial printer quoted $700 to produce 200 copies; the Centre produced the 200 copies for $70.

11. In summary, the work of the Tivoli Production Centre has shown that

a. It is possible to produce high quality duplicated material with simple equipment

b. This production can be decentralized down to junior secondary school level. Each junior secondary school can be used as a resource centre for its contributory primary schools.

c. Local personnel can be trained to the standard required for high quality work.

d. School materials can be produced on a self-supporting basis. The recycling of funds from a limited capital can sustain a programme producing up to 1,000

booklets per day from one centre.

e. No business will want its name associated with poor quality. The project's efforts have shown that there is no such reluctance when the product is good, and thus sponsorship is a strong possibility.

f. There is no heavy financial handicap in producing limited runs of material".

12. Thus far, I have been quoting Mr Payne's account. I would add only the briefest of my own comments.

First, the record of the Tivoli Production Centre would be impressive in any developed country of the West. It is doubly so when considered in relation to the Caribbean background outlined at the opening of this Section. The project may be proud of its consultant's achievements and this unforeseen spin-off of the skills it sought to develop. Nor is the story fully told, as we shall see in the next section.

Secondly, it is terribly sad that the whole of the Tivoli Centre closed down at the end of the Project and its machinery was dispersed. The senior consultant, his work with the project completed, is now in St Lucia; the other trained operator left Grenada, and the Grenville Group no longer meets as such. The skills developed in these and other teachers have of course not left them, and it is to be hoped that the good work begun at Tivoli will be continued elsewhere. Postscript: as this report goes to press, news has come that the Centre has been re-established by the Ministry of Education at Tanteen, under the professional management of Mr Budhlall. This is most heartening news, as it must also be for the teachers who made such excellent use of the facilities at Tivoli.

4.2 Teaching of Reading

1. Another by-product of the project's activities has been closely linked with the work of the Tivoli Production Centre, and is conveniently considered next. When the project first began to introduce duplicated worksheets into the junior secondary schools, it was found that many children could not read them. When the material in the worksheets was read to them, they could do the mathematics involved, but they could not read and understand the English instructions. To appreciate this, it is necessary to remember that in many of the islands, especially those with some history of French occupation in the past - often the remote past - what is spoken in the homes of most of the people is not English but a patois which is probably more readily intelligible to speakers of Provencal French than to English speakers. Even in the islands where this is not so, the English spoken is a dialect considerably removed from either the Queen's English or that of the President of the U.S.A. The head of one school in a thoroughly English island explained to me that the top streams in his first year did two foreign languages, Spanish and French; the second streams one foreign language, usually Spanish; while the lowest streams also did one foreign language, English. In all islands teachers have repeatedly told me that it is no use giving the project modules to C streams because they cannot understand them; some teachers have been willing to confess that even the A streams have difficulty with their science textbooks or JSP, largely because they do not understand, or, worse, misunderstand, the English. Realization of this encouraged the wife of the senior project consultant, Mrs Barbara Payne, to initiate a major testing programme of reading ability in the schools of Grenada. The results, financed by CEDO and produced by the Tivoli Centre in 1973, appeared in a booklet entitled "Even so are the young children". This very competent investigation of some 1,200 children in 7 schools, both urban and rural, showed clearly that only 4% of the children had reading ages at or above their chronological ages; that the retardation in reading age for 9 year-olds averaged 3 years, while for fifty children in the first year B stream of a four-stream junior secondary school, the mean chronological age was 13.4 and the mean reading age 7.7. Standard Schonell tests were used with words in common use in the Caribbean culture.

One immediate consequence of this was that the Ministry of Education in Grenada was alerted to a very real need, and Mrs Payne was asked to give a 40 hour course of instruction in the teaching of reading at St Patrick's RC School at Sauteurs in Grenada. Reading books suitable for use with primary school children were produced by the Centre, some being written by junior secondary school children themselves. The story of "My hose is leaking" by R Edgar has been told elsewhere (17).

4.3 Diagnostic expertise.

Since the project throughout has employed a diagnostic-prescriptive philosophy, and teachers have been introduced to the use of diagnostic tests in the workshops, it is to be expected that teachers will have become more familiar with the formulation of objectives and the construction of items to test their attainment. One example of this is the testing programme for reading ability outlined above, but also teachers have shown themselves able to submit acceptable items from which examination questions at various levels can be selected. In most schools it is probably true to say that the progress of pupils has been more thoroughly tested since the introduction of project methods than it was before. What is not so clear is whether the teachers are also able to devise suitable teaching programmes to overcome the difficulties of pupils as revealed by the testing procedures. To pursue the medical metaphor, diagnosis may be better, but treatment may not have improved pari passu. Certainly in some cases it has. A weakness in division of fractions diagnosed in a small rural school in Dominica led the teacher concerned to devise a mini-module on the topic for his own pupils; experience however suggests that practical results of this kind are not very common, and a higher level of skill is required.

4.4 'O' level courses

One effect of the project which was probably not originally envisaged has been its influence on the 'O' level courses offered in the schools. This is dealt with more fully in Section 5, but here it can be said that a number of schools which have been introduced to the project materials are entering their upper streams in the later years for 'O' levels, and also giving 'O' level teaching courses in the earlier years to pupils who will not in fact be ultimately entered for the examination. Where the JSP textbooks issued by the project have been extensively used, the result has been to induce schools to offer the Cambridge C syllabus for 'O' level, in place of the B syllabus, or even the A syllabus which has been prevalent hitherto. This change has of course been accelerated by the announcement of the withdrawal of the A syllabus from 1977 onwards; school administrations have thus been forced to reconsider their attitude to "modern" teaching syllabuses and examination syllabuses in mathematics. Project teachers have naturally tended to press for a more modern syllabuses, and it is gratifying to note a tendency in almost all the islands to change over gradually to Cambridge C syllabus for their O level entries. It is not easy to assess how much of this is to be reckoned to the credit of the project and how much is simply the changing climate of opinion, but I believe the project has played a not inconsiderable part in influencing the change.

4.5 The Film and Filmstrips

1. The idea of an audio-visual record of the project's activities appears first in the Round Table minutes of 8-9 February, 1973 in connection with the forthcoming (and fateful) St Lucia Mini-workshop. It was hoped at first that the UNESCO centre in Trinidad would be able to undertake this, but this was found not to be possible in view of the number of experts supposedly required and the consequent inroads into the UNESCO budget for regional activities. Exploration of possible commercial production of a 16mm colour film of the project again produced prohibitively expensive quotations. Eventually the Department of Drama and Audio-Visual Aids of the University of Bristol offered the services of a team of four, free of charge, for the work of filming the project's activities.

2. This offer was accepted gratefully by UWI and CEDO, with the result that a first-rate film, plus four filmstrips with taped commentary, was eventually produced at a cost, including the travel costs of the Bristol team, of less than £6000, which was borne by CEDO funds. This was a whole order of magnitude lower than the estimate for a commercial production of similar length. The project is deeply indebted and correspondingly grateful to the University of Bristol for this cooperative enterprise.

3. The film-crew of four consisted of

D. Ponting	Director
Miss M. Coombes	Continuity and Graphics Arts
N. Sanderson	Cameraman
P. Shears	Sound

The team spent three weeks in the Caribbean, and were accompanied by Mr B. J. Wilson from CEDO and a CEDO photographer, Mr John Hunter, who took the stills for the filmstrips. The whole operation owes its success to the devotion of all concerned including excellent preparatory staff-work on the ground by the consultants, who alerted government officers, head teachers and schools and obtained the enthusiastic cooperation of all.

4. The film is entitled "Mathematics - a way of looking". It is 16mm sound, in colour, 1080ft in length, and 30 copies have been made. It develops the philosophy of the project that mathematics is a way of looking at quite everyday things; a matchbox, for example, can be looked at in many different ways - artistically, chemically, economically, sociologically, and also mathematically from the point of view of its geometry and construction. This theme is developed in relation to many everyday objects; bottle-tops, popsicle (lollipop) sticks, concrete blocks, aircraft, navigational aids, and so on. It shows the project about its normal business: Round Table, mini-workshop, classroom activity, module production. It emphasizes that in a rapidly changing world pupils must be equipped with basic understanding, combined with flexibility in application.

5. The film is technically first-class, and the Bristol team are to be congratulated on a superlative piece of work. As a piece of propaganda for a modern approach to the teaching of mathematics - not chanting of tables, but group discovery work - it moves rather fast, and leaves a great deal to be inferred from the pictures which is not spelt out in the sound-track. This rather sophisticated technique is effective when presenting material that is reasonably familiar to the audience, but here it could be less than immediately communicative to the non-mathematical layman for whom it is intended. It should certainly be shown twice to any audience. To me it communicates the value of awareness of the environment, but the interaction seems mainly one-way. It shows how the environment facilitates and illustrates the formation of mathematical concepts, but it is less effective in showing how mathematics is used and applied in shaping the environment. For that of course we really need another film. "Mathematics - a way of looking" - is one side of the coin; we also need "mathematics - a way of planning and creating".

6. The film has been widely used. Within the Caribbean it has been made available to each of the Ministries of Education, and it has been used by nearly all of them for showing to parents and teachers on suitable occasions to show what the project is all about. The usual pattern is a showing of the film, followed by questions and discussion, followed by a second showing. Wherever if has been shown it seems to have attracted large audiences and has been very well received. Outside the Caribbean it has been used extensively by the British Council in various countries, to illustrate the strategies of curriculum development and to generate enthusiasm for in-service education of teachers of mathematics. Among the countries in which it has been shown may be listed Sierra Leone, Ghana, Kenya, Swaziland, India and Sri Lanka, besides showings at the National Film Theatre and by Institutes of Education in England.

7. The Filmstrips/tapes. There are four of these, entitled

1. Strategies of curriculum development
2. How a unit of work is produced
3. Teachers write booklets
4. New methods in the classroom.

Each unit (called "Series", though it is not very clear why; possibly because each contains a series of pictures) consists of a strip of about 60 frames with a commentary on tape, together with a complete script of the commentary for the operator's benefit. There is no indication on the tapes when the frames should be changed.

8. Series 1 is the most important of these, and one of the longest. It outlines two methods of curriculum development, called "central dissemination" and "periphery" models; in the first the project team writes the materials, which are sent out to schools for testing and returned for revision, whereas in the second the teachers write the materials, singly or in groups, the project team merely advising, and collating the results into a unity. The claim is made that the Caribbean Mathematics Project has followed the second method, with consequent development of writing and development skills in the teachers, with in-service training needed mainly for teachers not involved in the formative stages. I shall discuss the validity of this claim in the next Section, but I would say here that I consider it fully justified up to about August 1973, but that thereafter I consider that the project found the "periphery" model unworkable, ought to have reverted to the "dissemination" model, was reluctant to do so, and progress suffered in consequence.

9. Series 2 shows the sequence of operations through which a unit passes on the way to final publication: teachers writing, worksheets produced for a mini-workshop, class testing, teachers conferring, revising, duplicating further drafts, further testing, editing, graphics and drafting, until the final (UNESCO Trinidad) version is produced. Series 3 is a short sequence devoted to the work of the Tivoli Production Centre; Series 4 shows the project's ideal of group work and the use of apparatus in the classroom.

10. The photography is usually very clear and communicates the points made very well. Some shots are a little harsh and hues are diluted, probably because fill-in flash was used alongside daylight with flash on the camera. If the four series are viewed one after the other (which of course is not likely to happen in normal use) some scenes become very familiar, as do some grins designed to signify the joy of teaching or learning mathematics the new way! The tapes record the commentary with Caribbean voices, but the English is perfectly clear and intelligible to anyone whether or not they are familiar with the accents. Opinions differ as to whether they would be improved with an aural signal for changing frames. As it is, the operator must have light to follow the commentary in the manual.

11. The series are intended mainly for use in teacher training, for which they are eminently suitable. They have been so used in the teachers' colleges in the islands, but as far as I can discover, not very extensively. This is most probably due to the difficulty of assembling an operative film-strip projector and tape-recorder at the same time and place. Where these are readily available and kept in working order, the four series should find ready use, and would make a valuable contribution to the training of Caribbean teachers. They have been used in India and in Nigeria, and would not be amiss in teacher training in this country, at least as a basis for discussion.

12. This concludes my account of the history of the project, its strategies, procedures, materials and by-products. It should be clear that the project has proceeded by essentially diagnostic-prescriptive methods, actuated by certain

educational theories, and in particular by a specific theory of curriculum and curriculum development. Throughout it has been self-conscious and publicity-conscious, so that a further by-product has been a number of monographs and articles contributed to educational journals. Since I cannot pretend to mastery of the language in which educational theories are expressed or educational research conducted, I can best give the flavour of this material by quoting the introduction and conclusion of one such paper, and so bring this section of the report to a fitting close.

4.6 Mathematics, Curriculum and Evaluation

This is the title of a paper by Broomes, Schroeder and Payne, published in Educational Development International in April 1974, pp 67-73. (18).
I quote from its introduction:

"The first concern of a mathematics programme should be to help children organize in a meaningful way the concepts, facts, and principles they learn. A second concern should be to help teachers use, understand, and devise teaching strategies and materials that could prove very effective in assisting children organize their knowledge.

The focus of this paper is on certain features of the Caribbean Mathematics Project which show how teachers in secondary schools devised teaching strategies and built appropriate materials which have proved very effective in helping their pupils organize mathematical knowledge so that the knowledge is incorporated in a non-arbitrary substantive fashion to what the learner already knows".

The paper goes on to give an account of the strategies of the project and its evaluation procedures: initial, formative, and summative. It concludes with an account of two incidents at the St Lucia Mini-workshop in February 1974: the first, when a geometric vocabulary test was being administered, and to save time the test was broken up, each item being given to three children chosen at random in a class of 30 instead of giving the whole test to the whole class; the second incident describes the activities of a group of pupils testing equality of angles in the equilateral triangle and the square using figures made with drinking-straws, and angle-measurers made from popsicle-sticks. The article concludes as follows:

"Summary

Of these two workshop experiences, the first emphasized that evaluation activities were at the heart of the Caribbean Mathematics Project. The teachers as they planned their programmes and as they taught, needed to make decisions all along the way. By evaluation (initial, formative and summative) they sought to collect and order the evidence systematically in order to facilitate their decision-making. The experience in particular showed the economies in time and effort that could be effected by using a small sample without impairing the usefulness of the data collected in the initial evaluation.

The second experience helped to make the point that mathematics is a way of thinking. In their daily activities, pupils encounter situations which may be given meaning through mental operations such as: (a) analysing each situation into its components, (b) putting the components into categories and (c) summarizing. These mental operations constitute, in our metaphor, mathematical thinking. Therefore by conceptualizing the nature of mathematics as a structure of relationships, the discovery of these relationships and their expression in different forms, the teacher in the Caribbean Mathematics Project could provide opportunity for all pupils to create mathematics for themselves at their own unsophosticated levels with familiar sense-data.

We have focused on teachers teaching their pupils. That we did not describe the pupils' materials rested on the sincere belief that curriculum is what each teacher does, as

teacher, in his classroom. However, it seems not difficult for the reader to infer that the material produced for the Caribbean Mathematics Project would have some distinctive feature which would help children organize mathematics in a meaningful way".

Perhaps the Caribbean teachers, after reading this account of themselves feel like the man who discovered that he had been speaking prose all his life without knowing it. But the proof of the pudding is in the eating; so I now turn from the printed menu, and the account of the activities of the cooks, to the experiences of the consumers.

V - PRESENT STATUS OF THE PROJECT

5.1 The situation in the schools

1. In order to evaluate the present status of the project, I visited the Caribbean from mid-September to mid-December, 1975. During these three months I was based in Barbados, but was able to spend between two and elght days in each of the other islands involved in the project; regrettably, I did not visit Barbuda or Carriacou. One problem of such a tour is that many of the schools are remote from the administrative centres or the airports of the various territories; furthermore they often cease work for the day at 1.30, or even 12.30. Since I was usually provided most generously with transport by the Ministry of Education - in fact, I was usually driven in person by the project coordinator or an education officer responsible for mathematics - their commitments and working hours precluded an early start. It was therefore difficult to spend very much time in the more outlying rural schools; on one occasion we actually arrived to find the children going home. In spite of these limitations I managed to visit 40 schools: 35 of the 38 project schools, and 5 others more loosely connected with project work. In all of these I was able to talk with the principal or his deputy, and in most of them I spoke to all the project teachers and discussed the situation with them. In some cases I was asked to address all the teachers. There was not always time adequately to observe classes, but I was able to observe 26, usually for a full period. In one or two cases where, through an oversight, the school had not been notified of my visit, it took a little time to establish a happy rapport; but with these trivial and understandable exceptions, everywhere I was given a most friendly welcome, a generous allocation of school time, and an attention which revealed a genuine concern for the mathematical education of the pupils.

2. Principals (This is not always the correct term, but, being unisex, it is convenient, and I do not pretend to the accuracy of a St Luke in dealing with the titles of officialdom). Almost without exception I found principals of schools appreciative of, and indeed often enthusiastic for the project. The work of the consultants was everywhere highly praised; the servicing and logistics of the project were often compared favourably with those of similar educational projects in other fields. They seemed able and indeed eager to speak their mind freely to me, especially when we were alone; I am grateful for their frankness. Their criticisms of the project were usually trivial matters about the non-delivery of materials, especially the teachers' guides, which was usually not the fault of the project itself. They were more concerned about the cessation of the project without its getting to grips with the urgent problems of the examination structure, and the lack of syllabuses, or the confusion caused by the demands of various examination schemes on their timetable and curriculum. The more perceptive of them realized than an international body like the project was not really in a position to unravel these essentially domestic tangles.

The turnover of principals is sometimes high, and a new principal does not always realize the importance of maintaining contact between project teachers and project classes. The turnover of teachers is however even higher, and this ideal cannot always be achieved. I felt for all that, that sometimes a principal could have exerted more influence to ensure continuity in a mathematics syllabus and the choice of accompanying textbooks. There were too many cases where classes, started on a JSP course, for example, had reverted to a much less suitable diet because they had come under a teacher who was unwilling to master new material, or because some old textbooks happened to be lying around. A strong principal with a definite well-thought-out policy, and who is willing to inform new teachers what he expects them to do, seems to be something of a rarity. In the schools where such exist, help has always been forthcoming. Consultants, coordinators, or simply an able established teacher, have set up tutorials for the teachers who, knowing clearly what is expected of them, have set about acquiring the necessary knowledge and skills.

3. Teachers.

Since, as we have seen, the project has laid great stress upon the part played by the teacher in curriculum development, and in constructing its materials, it is disappointing to have to record that, of the 122 teachers listed as " project teachers" in the 1974 survey, only 44 are now teaching in project schools. Information about the remainder was not always obtainable; but I would estimate that about a quarter of them have been transferred to other schools, a quarter are in training, and half have left teaching altogether. Some schools have almost all their original project teachers, but in the majority there is a mixed teaching force, many of whom have had little or no experience of project methods (apart from training college) and no part in the construction of its materials. Out of 44 teachers who returned the questionnaire (see Section 8.6), only 12 stated that they had helped in the construction of project materials; there were a great many others who are quite new to project work who did not return the questionnaire at all. The pupils who answered the test papers were asked how many mathematics teachers they had had in the last three years. The question was open to misunderstanding; some pupils did not count the teachers in another school if they had transferred during the last three years; others did not count a form teacher who taught all subjects as a "mathematics teacher". An average of these figures is therefore not very meaningful, but the majority gave answers ranging from 2 to 4 with some as high as 7. The 36 teachers who answered the question "How long have you been teaching C.M.P.?" gave answers averaging less than two years. If we assume, usually correctly, that the answer for the others is zero, the average if 4.4 terms.

The answers given to the questions relating to teaching are of some interest. These were as follows:

	Question	Answers			
		Yes	Qualified yes	Question unanswered	No
A	Have you enjoyed the project work?	30	9	5	0
B	Do you think your pupils have liked doing it?	31	6	7	0
C	Has their maths helped them to cope with everyday problems?	18	10	13	3
D	Has it helped their learning in other ways?	28	5	10	1
E	Has it helped them with other subjects?	28	4	10	2
F	Do you find your teaching methods have changed?	32	3	7	2
G	Do you think you yourself understand maths better as a result of the project work?	36	1	6	1

A few teachers specified subjects under question E: 3 specified Science, 2 Physics, 1 Technical subjects, and 1 Art. One specified "with their English and Geography" under D.

Undue weight should not be attached to these figures, because the response was very uneven. It was difficult to recover the questionnaires unless I called back to collect them, or stood by while they were answered. In the light of experience I would have framed many of the questions quite differently, but to have sent out a further revised questionnaire by post would have prouced an almost nil response. Nevertheless the figures are of some interest. Even when due allowance is made for the desire to please in answering, there seems evidence that the project has been enjoyable for teachers and pupils alike. Some amplified their answer by saying "Yes, far more than the traditional work". The more guarded answers to question C reflect, I feel, a little misgiving as to the practical value of the kind of mathematics being studied. There were two outspoken comments relating to this: one reported the remark of a colleague that "modern maths is a waste of time" and another revealingly complained that "JSP hides what is trying to be taught in problems which the children can't understand". This points partly to difficulties with understanding English, but also to the detachment from practical application already noted. Since the school from which this comment emanated uses neither workbooks nor the modules, the comment is perhaps not surprising. The large affirmative response to question G is encouraging - four even wrote "very much so" or the equivalent. It seems to indicate that the project analysis and thoroughness has been of great value to teachers, even though they may not have been able as yet to pass on much of its benefits to their pupils.

It has to be realized that, apart from a few fortunate schools where all their mathematics teachers are involved with modern mathematics along project lines, the project-trained teachers are diluted in most schools with a great many others who are untrained, or traditionally trained; while the newer teachers coming in to the schools find themselves with so much work and so much to learn that their ardour for a more modern approach tends to evaporate. Sometimes even worse occurs. I visited one school with a mathematics staff of four; one with an A level in mathematics, but no professional training, two training college trained, and one who had just graduated in mathematics (B.Sc) from Cave Hill, but of course with no educational training. The former head of department, herself trained in the teacher's college, and the main support of project activities in the school, had been transferred to Home Economics in favour of the newly-fledged graduate. The bureaucratic rules may well have been such that the principal had no option. The results could not have been more disastrous. The new head of department announced that he was quite untrained to teach modern maths, knew nothing about it, and could only teach as he himself has been traditionally taught. The school was desperately short of textbooks and needed to order new ones; it was obvious that these would not now be JSP texts or anything involving untraditional methods. The new young teachers were keen to do otherwise but were given no say in the matter. Even if they were moved to attempt group teaching and the use of workbooks in the first year, the size of the classes (more than 40) would be against them. I left the school in a very sad frame of mind. Yet not more than eight miles away is another school that has its two original project teachers, who have trained five more newcomers, are holding regular evening classes for the teachers at their feeder primary schools, and have all four classes (35 each) in each year using workbooks, even getting all the first year children to contribute equally so that everybody can have a share in a module. The leader of all this good work is still working for an 'A' level in mathematics. The Caribbean certainly sharpens one's appreciation of the inequalities of life.

4. Teaching methods and classes.

While it was difficult for reasons that I have explained to get enought time to observe very much at the remoter schools, I took every opportunity to sit in on actual lessons, and was able to observe 26 teachers at work. This was very helpful for the purposes of evaluating the work of the project, though it proved to be a rather disheartening experience in some cases. Certain recurring features need to be mentioned.

a. Overcrowding. In the all-age primary schools, overcrowding could almost be said to be the rule. If the school is also in a single hall, as some are, the senior classes are usually at the front or squeezed into the available space on the dais; classes are separated from one another only by folding blackboards. In the newer junior secondary schools, each class usually has its own room, but here there is often a shortage of chairs and desks; three children in a desk meant for two; children sitting on chairs designed for much younger pupils; these are common sights. In one school, located in an old estate house that would make a good setting for "The Haunted Grange", even a senior class was so restricted that one boy had to sit on the rim of his upturned drawing-board; teacher and learner were equally in a well-worn groove. Unfortunately, when overcrowding is severe, the lower streams are often the first to suffer, being relegated to the school hall, where they are taught in open plan as in the primary schools which the junior secondaries were built to replace. In these circumstances it is not surprising to find that any teaching method other than the traditional "chalk-and-talk" is difficult to carry out, and class chanting is at least an effective method of securing attention and audibility.

b. Absenteeism. Classes are noticeably emptier at the end of the week than at the beginning; the demands of marketing and other home activities prove too pressing. If this were reduced, overcrowding would be worse than it is.

c. Punctuality. Mid-morning changes of class usually take place punctually, but many things happen to delay the start of the first lesson in the morning; the classroom gradually fills as the lesson proceeds.

d. Apparatus. Some schools suffer so much from vandalism that it is impossible to preserve such things as posters fixed to the walls, or charts on display; apparatus has perforce to be locked away in storerooms or in the principals office for safety's sake, and therefore an extra effort is required to get it out and use it.

It is against such a background that my experiences should be viewed; criticism must be tempered with sympathy and understanding. It is one thing to teach a demonstration class at college or at a project workshop, and quite another to be confronted with a class of 40 in an overcrowded hall.

I saw 12 lessons on the number system in some form or other; 6 on geometry, and others on a variety of topics, but only one involving any application of mathematics. That was the senior (form 5) lesson which included the boy on his drawing board; it was a very traditional treatment, of latitude and longitude, without the use of globes or any visual aid. Not even a football was pressed into service. In only three classes were the pupils organized in pairs or groups; in one of these they rearranged themselves in pairs for an activity which involved sharing of books and apparatus with an obviously well-trained efficiency. In several lessons there was active pupil participation and pupils were asked to come and write on the board. In one school work-cards were in use, but in only one lesson was any practical activity going on: this was paper folding and cutting in a lesson on area which was handled extremely well. By way of contrast, in another lesson on measurement where pieces of string were obviously needed, none were forthcoming; all the girls were wearing (non-functional) belts as part of their uniform which could have been used for the purpose, but no-one thought of it.

In spite of conditions which were often extremely adverse, I saw no real misbehaviour; one expatriate teacher who complained that she was untrained for that particular age-group was obviously having some disciplinary problems - the mathematics was also very strange to her - but this was exceptional. But I saw a good deal of inattention, which comes easily in the heat of the Caribbean day. I must confess that a project lesson on commutativity does not seem to have very much to do with the world outside. But, as both the teachers' questionnaire and the affective test (see 8.6) indicate, the

level of commitment to mathematics and general enjoyment of it is high. Of course I did not see, neither was the test administered to, the lowest streams.

5. Project Classes. The project came officially to an end in July 1975. The flow of free JSP books and modules then ceased; some of the free issues before that date had not yet been brought into use in the schools and are therefore still available, but schools who wish to continue to use project materials will have to pay for them. In all but two of the islands this means that the pupils or their parents willl have to pay.

It is not now possible in most schools to identify a "project class" though there are some who have had project teachers and have preserved their identity throughout. These are now for the most part working on a JSP course, so that the old project pilot classes have become "modern maths" classes. But in many cases they have been split up and resetted, so that while all of a given class have usually reached the same level in the JSP course, not all the class will have covered all the modules, even if it is a third-year class. In most cases the school directs the pupils to buy (or the government provides) the appropriate JSP textbook; they cannot afford the workbook as well, and I only met one school that actually chose to provide the workbook rather than the textbook. In other cases stocks of some workbooks and modules still exist to enable perhaps one class - usually the top one - to be provided with them. The lower streams, who really need the modules most, do not get them, but a wise teacher can use module materials without issuing the books. Shortage of paper and the lack of efficient duplicating facilities tend to restrict the possibility of reproducing worksheets in duplicated form, though some schools are trying to do so.

A further difficulty arises from the lack of trained teachers who are able and willing to teach JSP material. This problem becomes acute in the third year, because it is then that the content of JSP begins to depart more widely both from the traditional course and also from anything that can be found in US or Canadian textbooks which are often around in the schools.

6. Statistics and Transformation Geometry. These are the topics which present teachers with the most difficulties in the JSP course. Up to this point the material was either traditionally familiar, or at least appeared in the American "new math" which had penetrated the teachers' colleges even before the project appeared on the scene. Teachers could therefore make an attempt to teach JSP1 and most of JSP2 without extra training, but with the arrival of statistics, and more especially the transformation Geometry in the course, teachers are at sea. For these are peculiarly British topics which have come into JSP. They do not appear in the majority of resource books and reference books in teachers' college libraries, or in such libraries as the schools may have. The project included them in Scope and Sequence, and there is actually a module on Statistics, but it rather sanguinely hoped that teachers would develop their treatment of these topics along the same successful lines as the mini-workshop had done in the past. Unfortunately this came too late; the decision taken in 1973-4 to continue testing and validating the project materials meant that there was neither time nor resources to develop the treatment of these newer topics before the project came to an end.

The only real attempt to grapple with this was made by George Forde, who most commendably ran a series of workshops on Barbados and Dominica in which he stressed content rather than diagnosis, particularly in these areas of weakness (19). In his account of this, "The Dominica Experience", he makes the point as follows:

"The consultant believes that ideally every workshop should be run according to the needs and abilities of those involved. Whereas it is desirable for teachers to play a major role in curriculum development, it is ridiculous to imagine that every group of teachers is ready to develop suitable curriculum material in mathematics, or that every group of teachers is ready and has the ability to define their needs with respect to mathematics. Nor is a group enthusiastic about learning from peers when each

participant is fully aware of his own acute limitations and those of the other members of his group . . . . The problem has been intensified in the past few years with the introduction of almost totally new topics and techniques in the field of mathematics. If workshops are to be successful with groups like these, they must recognize and deal with this important psychological need. Teachers must feel at the end of a workshop that they have achieved; that they are returning with a lot more; and that, whether we like it or not, is measured basically in terms of what they get from the persons conducting the workshop".

It is a great pity that the distinctive and realistic contribution of George Forde to the project did not come earlier in its development. It is possible that if he had been present at the critical Round Table meeting in February 1973, the subsequent development of the project might have been entirely different.

The fact is, as I see it, that the project's methods succeeded with the number theory and the simpler geometry because these topics were already familiar - perhaps dangerously familiar - through the influence of "new math" in the Caribbean. The danger was that the mathematical content was apt not to be subjected to adequate critical appraisal, as I have already discussed. On the other hand, the statistics and the transformation geometry, and later on the vectors and matrices, were totally unfamiliar to the majority of teachers, as George Forde has stressed. The project's original methods, then, could not hope to be successful with this material. Vectors and matrices do not even get a look in in Scope and Sequence. But they are one of the main reasons for doing transformation geometry.

The result is that there is a noticeable falling off of enthusiasm in the schools by the time the third year of JSP work has been reached, and a shortage of teachers equipped to teach, or even to discuss, the later material. I must leave to a later chapter any discussion of the question as to how far this is junior secondary school work.

7. Examinations. I now come to a complicated but much more serious problem which affects the junior secondary school curriculum, that of the system of examinations with which they are confronted. These form a varied collection, which I now describe in order.

a. Common Entrance Examination. This is the usual title of the examination taken between the ages of 11 and 15 on which the selection for entry to Grammar schools (selective secondary schools) is based. In about half the islands the age for this examination is limited to one year, so that only one attempt is allowed for any given child; in the others, the permitted age covers a spread of years, and in some cases a child may have three attempts. Where this is the case, parental pressure is such that the attempts have to be provided for, and the lower forms of junior secondary schools contain a number of children who are still preparing for it. Success in this examination is a much coveted prize; those who score highest are awarded scholarships by which their full fees and textbooks are paid for for five or more years at a grammar school; in Barbados they gain admission to a select group of ancient foundation schools of considerable prestige. The next level of attainment is rewarded with bursaries, which offer entry to grammar schools but provide only partial financial help with fees. Then there is often a further group who may enter a grammar school if the fees are paid. The remainder either stay in an all-age primary school or proceed to a junior secondary school, if one exists in their particular parish or area.

b. Junior Secondary School Entrance Examination. In many islands there is pressure for junior secondary pupils to stay on until they can sit an 'O' level examination; if they are unable to, there is a tendency to feel that the school is failing. In St Lucia pressures have been such that it was felt that some children in junior secondary schools should not really be there - partly because some of the junior secondary schools were expected to act as feeders for a senior secondary school which has ceased to offer courses below the third year. As a

result, junior secondary schools had their own entrance examination in which a uniform pass-mark was demanded. This affected them very unevenly, some schools having quite small first years while their neighbouring all-age primaries were bursting at the seams.

c. School Leaving Examination. This is an examination administered by the Ministry of Education in all the islands. It was originally a primary school leaving examination taken at the official school leaving age, and continues as such in Grenada and St Vincent where there is not a full complement of junior secondary schools. It is written usually at age 14 in junior secondary schools, though sometimes only the upper streams are expected to take it. In many cases entry to form 4 is conditional on a good mark in this examination. There is often no published syllabus, though teachers may be encouraged to send in items from which questions can be selected for inclusion in the papers.

d. Senior Secondary Entrance Examination. In some territories there is an opportunity for pupils from junior secondary schools to transfer to a grammar or technical school after form 3; in many cases this selection is made on the results of the school leaving examination (c), but in Montserrat and maybe elsewhere the Technical School has its own entrance examination. Again in St Lucia, the one Senior Secondary School sets its own entrance examination at form 3 level on a syllabus which suits its own 'O' level requirements.

e. 'O' Level General Certificate of Education. This examination, usually the Cambridge Overseas G.C.E., was formerly confined to grammar schools. But except in St Lucia all junior secondaries now have fifth and even sixth year classes who hope to sit for it. Certainly in mathematics, the number of passes obtained is very small, but it exerts an influence out of all proportion to the success achieved. Because the word "secondary" occurs in the school's name, every junior secondary school pupil tends to be thought of as a potential 'O' level candidate. Those who are obviously not destined to reach this coveted prize tend to be treated as second class citizens and relegated to a programme which is largely unplanned.

f. London Chamber of Commerce, College of Preceptors, et al. There is very naturally a tendency to demand that pupils who have spent two years in a junior secondary school beyond the statutory school leaving age in the hopes of gaining an 'O' level shall emerge with some piece of paper as a reward for their achievement. If the school realizes that an 'O' level is unlikely to be reached, it will often substitute a course leading to one of the qualifications offered by other bodies such as those listed. The mathematics involved : usually commercial arithmetic of a very traditional kind, with even more traditional textbooks; little is hoped for beyond memorization of techniques and formulae. The syllabus is usually quite unsuitable for the Caribbean context.

It must be emphasized that these examinations are all distinct, though fortunately they do not all occur in any given school. Except for e. and f. there is usually no precise syllabus, though the requirements for a. and c. are fairly well established. I have however met with repeated complaints in the junior secondary schools that the papers set in a., c. and especially d. are out of touch with the work of the project -even when all the schools concerned have been permeated with project activities. The fault of course may not all be on one side; those who set the examination may, for example, feel that they want to induce the project schools to take a rather more practical view of mathematics. But the sheer diversity of the examination system, if indeed it can be called a system, condemns itself. This is private enterprise and professional independence taken to extremes. It is perhaps too much to hope for a uniform system over all eight independent territories, but a start has been made by the Caribbean Examinations Council to localize and rationalize e. and f. The C.S.E. system in use in this country is being seriously considered. This is important, but from the point of

view of the project it is more important that the local examinations, a. - d., be rationalized. In my view, a. needs modification, b. is unjustifiable, and c. and d. if unfortunately necessary, should at least be combined and set on a syllabus devised by the junior secondary schools in consultation. The broader issues are further discussed in Section 7.3.

8. Curriculum. In response to these various pressures, what actually happens in a junior secondary school? The best way to answer this seems to be to try to give what is I hope a typical, though necessarily a composite, picture of the situation as I found it. No particular school is being described.

St Symphorian's Junior Secondary School was built in 1965. Because of the scarcity of available land, the school is on the outskirts of the village on a cliff-top. The road to it is unmetalled and pot-holed. The buildings have not survived very well; the louvered windows have many missing panes, and others are broken. Hardboard screens have holes in them, and the right-angled corners are worn into interesting curves. The principal's office contains, in addition to the principal, a typist-secretary, a duplicating machine, shelves of books and papers, including a stack of project modules (old style) in a corner, and a large display of silver trophies for sporting activities of various kinds. The room where the typist-secretary would normally be expected to be has been pressed into service as a store for stocks of text-books; among the mathematics books are 100 bright new copies of a book of tables, which prove on inspection to be of an archaic type with an unfamiliar layout, in which all the log sines begin with a 9.

Entering a classroom, which is open to the corridor and fully visible to anyone passing, we find a class of children looking very smart in their school uniform. There will probably be far more girls than boys. The wall in front of them is filled with a blackboard, but otherwise there is nothing whatever on the walls. They are sitting three to a desk made for two, and some are on chairs which are much too small for them. They are happy and cheerful. They have exercise books, but no textbooks. A few of them have rulers. They are learning about ranking fractions in order of size; they are having trouble with the LCM's. Their teacher is in command of the situation and is patiently showing them how to list multiples. When she asks an easy question the answer to which they all know, they chant it out in a chorus. When she indicates that this is not what is wanted, and asks a more difficult question, the boy who can answer it stands up, gives the answer and remains standing. Others who can contribute to the answer also stand up and respond, until there is quite a squad of children standing, when they are all told to sit down. A girl comes forward and writes all the multiples of 6 up to 30 on the board, likewise the multiples of 5; since 30 is common to the two lists, it is the LCM. One suspects that she knows this already, but this is the modern method; in any case, not everybody knows it. A boy is bored, or feels somnolent. He gets up, walks over to the window. The view from it is superb, but maybe that is not the reason for his exhilaration. He returns to his seat; nobody takes any notice of the interruption, indeed, it is not felt to be an interruption. Suddenly there is a heavy shower of rain; since the roof is corrugated iron, teaching immediately ceases because of the noise of the waterspouts. A group of children remember that this is the day the dentist comes and troop off to be inspected; the lesson comes to a somewhat indeterminate end.

In the first year at St Symphorian's the top two streams are doing "modern maths"; they are taught by two college-trained teachers, one of whom has had three years experience of the project; the other is in her first term of teaching and her colleague is helping her along. The experienced teacher has the top class; there are enough JSP Book 1 workbooks left for them to have one between two, so they use them from time to time. They have been asked to buy the textbook (JSP1) but the school forgot to advise the local bookshop in good time that copies would be wanted, so stocks are short and not every pupil has a copy. The second year class did not complete JSP1 last year, so they have retained the free copies of the book which were issued to the school by the project; whoever was responsible for notifying the bookshop forgot that this would happen. The second stream do not have workbooks, and have to be content with such

textbooks as can be mustered. There are no copies of the early modules in sight; a thorough search would disclose the pile in the corner of the principal's office, but they are used copies of an early draft version, and they have been partially assimilated by mice.

The third stream are taught by an untrained teacher with an 'O' level pass in mathematics; they are doing arithmetic only, using a traditional text-book. The fourth stream also have an untrained teacher, and are doing "remedial work"; there is no syllabus, and they do whatever comes into the teacher's mind from day to day. Since many of them cannot read, and the others only read very slowly and haltingly, a textbook is useless. Although this is a project school, their teacher is new and has never heard of the modules; in any case, modern maths is for the brighter pupils only.

In the second year, the pattern is much the same, but the Statistics module is now in use with the top stream; the copies have just arrived and the project teacher proposes to use them. Only certain parts of JSP2 will be covered; the teachers are frightened of the geometry, and in any case the top stream has to sit for the entrance examination set by Nouvelle Anse Technical School, and they have never heard of transformation geometry.

By the time we get to the third year, the threat of future examinations becomes serious. The top stream will try for Nouvelle Anse, but experience shows that almost none of them will get in; however, a number will stay on and try for O level; these continue with JSP 3, as fortunately there is a VSO teacher who can take them on to a modern 'O' level. The project teacher has a full time-table, and the new teacher has her work cut out with the first two years, so there is nobody to take the second stream. In any case it is easier for pupils who have done traditional mathematics to get good grades in the school leaving examination. So the second stream is doing a course for a traditional 'O' level, using a textbook with plenty of drill exercises which the competent and experienced teacher who takes them has used since it first came out in 1947. The third stream are continuing with their commercial arithmetic, and the fourth stream are looking forward, as is their teacher, to the day when they are 15 and can decently leave.

The fourth year classes are small, but the position is complicated by a small intake of late developers from an all-age primary school whom it is thought might be able to take an 'O' level after all. The top stream should by now be well set for JSP O level, but JSP books 4 and 5 have not been published in a Caribbean edition, and the school is unaware of the existence of the original West African edition. The local bookshop has, however, copies of SMP Book 3T which some previous expatriate teacher found helpful, so Form 4A is instructed to obtain these, as did their predecessors last year. The VSO is sufficiently alert to ensure that the bookshop does not foist its obsolete non-metric stocks on the guileless pupils. Meanwhile form 5A are using SMP Book 4; both these forms are finding the language of their new text-book a little difficult to follow, and it does not fit very squarely on to their previous JSP course. The perceptive reader will also realize that the pupils are being prepared for the Cambridge syllabus 'C' - it is too much to expect the school to realize that they could ask for the actual SMP papers if they so wished - but this mismatch is not very serious. He will also realize that there are five books in the SMP course, so that the pupils are entered for 'O' level without having completed the full course. This, however, is more an apparent difficulty than a real one. Few pupils in 5A pass 'O' level maths, but there is a form 5R which takes pupils who are repeating the fifth year, and they have a better chance of success, though still the pass rates in St Symphorian's have not been very good. Forms 4B and 5B meanwhile are working at the traditional textbook for Cambridge syllabus 'A', whose demise, fortunately for St Symphorian's, is not due until 1977. If form 4B ever get into form 5R there will of course be trouble, because by that time they will have to take the 'B' syllabus, but St Symphorian's does not cross its bridges until it gets to them.

It may be thought that this account is too highly coloured to be true; in fact every item in it is drawn from my experiences; it is sober truth, not fiction, though there is no such school as St Symphorian's and mercifully everything does not happen just like this in one and the same school. But it could, and I do not think the picture is unfairly drawn. In particular, the textbook confusion is, if anything, rather worse than this. No school is using JSP 4 and 5, and this is certainly due to lack of proper information. Some schools are using JSP 4S, which is intended for the first year of a two-year course which includes additional mathematics. The reason given for this is that they have been told that JSP 4 and 5 are not sufficient for the Cambridge syllabus C 'O' level. Strictly, this is true, but the missing topics are so few, and the coverage of the syllabus incomplete in any case, that the lacuna would be quite insignificant. One school is using JSP 1, 2, part of 3, followed by SMP 3T, followed by SMP X, Y, and Z. The reason given was that the bookshop had them in stock. In a region where the ordering and delivery of books may take a whole school year, we should not be too hasty to condemn this haphazardness. A changing population of teachers, in this and other schools in the island, had asked the bookshop to order the texts which suited best their own immediate needs. In actual fact, the use of SMP X, Y, and Z is a good choice, especially if preceded, as they should be, by the earlier SMP lettered series. Very few schools are using them, but those that are speak highly of them. It is a pity that the choice more frequently falls on SMP Books 1-5, because it is thought that they are the proper 'O' level course; there is always difficulty with the rather sophosticated English contained in them. This choice is really unnecessary, because only about 25% of the pupils who start on this course will sit their 'O' levels, and only about 10% will pass. These could well be moved on to X,Y, and Z in their final years; the majority could use SMP Books A-H, which are much more suitable for them.

9. Where is the project in all this? This is a question I often asked. The facts are that the project has succeeded in introducing JSP to some 30 of the 39 project schools, and most of them will continue to use the textbooks after the free copies have been expended; the modules can be found in some 20 schools, though sometimes only the newer ones such as Statistics and Mappings; the earlier ones have been expended and not replaced. At a cost of $12 a set, I do not think the commercial versions will find a ready market. The most disappointing feature is the scarcity of teachers' guides. Although each island has received 50 copies of each of the eight guides, it is rare to find them in the hands of the teachers who need them. The simple answer seems to be that they arrived too late; by the time they reached the islands, the modules they referred to had already been expended. The teachers, not knowing what they were missing, did not demand them; they lie unused on some shelf. They do, however, exist, with their modules, in the teachers' colleges, and here is a point of growth for future development.

10. 'O' level courses. The position with regard to 'O' levels has been briefly summarized in Section 4.4. Apart from Antigua Grammar School and Basseterre Junior High School in St Kitts, which feed their own Senior Schools, and the St Lucia schools which feed the Comprehensive School and the Vieux Fort Senior School, all the junior secondary schools have fourth and fifth year classes and enter candidates for 'O' level. The pass rate is very low; one school principal told me that his school had never had a candidate who passed. Even so, the wisdom of the procedure seems never to be questioned, such is the pressure of parental and social ambition. The desire for whitecollar jobs, with the elevation of social status which they bring, coupled with the unwillingness of employers, including the civil service and the police, to take on school leavers without a GCE of some kind, even in just one subject, results in a spurious importance being attached to an 'O' level pass. It is interesting that the proposal of the Cambridge Examination Board to issue certificates to all candidates, recording their grades, even when those are all failing grades, has caused consternation and public outcry in a number of territories. In Barbados, the Advocate News carried an article by E.L.C., their leading columnist, headed "Further debasement of the education coinage", in the course of which he says: "The fact that one chap, taking five subjects, did brilliantly, gaining an A grade in every subject, will be disregarded; it will pass over the heads of employers not accustomed to make such educational

judgments. The lad with one B, two C's, a D, and E, and the rest F's, flourishing his imposing list of subjects sat, will get the job every time". He concludes: "Education has become an exercise, not for developing the talents of each individual child to their fullest extent, but for churning out Huxleyan epsilons, all cast in the same intellectual mould". One would expect that even the employers caricatured in this article would soon learn to recognize the worthlessness of a piece of paper entirely filled with F's. But the underlying assumption that examinations exist to stratify society puts a high premium on the value to a school of its 'O' level class.

Statistics of GCE 'O' level results are available for Antigua, Barbados and Dominica, and are given in Section 8.1. Unfortunately the Antigua figures are incomplete, and there are no junior secondary schools in Dominica, so that only the Barbados figures are relevant and they are untypical of the Caribbean as a whole. But it can be said that

a. In Antigua, in all schools, including the selective ones, 545 candidates were entered for 'O' level, taking on average 4 subjects; of these, 195 sat for mathematics, and 32 passed; this is 16.4% of the mathematics entry and 5.9% of the whole.

b. In Barbados, 6 of the 10 comprehensive (newer secondary) schools entered candidates for 'O' level in mathematics; their total entry was 76 candidates, of whom 10 passed - 13%. All took a "traditional" syllabus, probably Cambridge syllabus 'A'. By contrast, in the 10 fee-paying "older secondary schools", the figures are:

Syllabus	sat	passed	%pass
A or B	138	56	41
C	443	224	51

My information is that in 1976 or at the latest 1977, all the 5 project (comprehensive) schools will enter candidates for mathematics at 'O' level and the great majority of these will be in syllabus C. Bearing in mind that over 3000 candidates from the schools of Barbados sit for 'O' level annually, it will be realized that the total of 345 passes in mathematics is less than impressive. (The remaining passes are from private schools). But when one reflects that the pass rate is 1.38 per thousand of the whole population in Barbados, and 0.49 per thousand in Antigua, the problem is seen in a better perspective. It is not so much that the pass rate is too low as that the entry is too high. Far too many children are being trained to race over hurdles that are too high for them. It can be a disheartening experience.

More often, junior secondary schools enter their fifth year pupils, not for 'O' level, but for LCC, RSA, or COP examinations. The only justification for this is the inflated estimation of a piece of paper from an outside body; the syllabus, textbooks, and examination are to my mind quite unsuited for the Caribbean child. They fit him neither for the present nor for the future.

11. Libraries. In as many project schools as possible, I asked to see the library, or the books available for teachers or pupils. The results were no less depressing for being not entirely unexpected. It can be said at once that of pupils' libraries, in the sense that would be acceptable in a developed country, there are none. Often there is no space available, and it is imprudent to keep books on open shelves. Some schools who have a reasonably secure room are taking steps to keep a stock of books available to pupils at certain hours, but these are rare. As conditions improve and buildings are extended, better facilities may be offered. A number of schools are enjoying the benefits of a programme which is providing them with a block of rooms for laboratory and technical work; usually two science labs, a typewriter room, a room provided with cookers and sewing machines for Home Economics, a woodwork shop and possibly a

metal shop. Where there is a keen member of staff and a sympathetic principal, it is sometimes possible to designate one of these rooms as a library, or a mathematics room where at least mathematics books and visual aids, models, etc can be kept.

Where books are status symbols, they are subject not only to purloining, but also to worship. Such bibliolatry induces the preservation of all books, no matter how ancient, inappropriate, or even decayed. The space occupied by collections of obsolete textbooks thus preserved by the faithful in school stores is often far more valuable than the books. They need not always be ancient. In one island, several schools had a shelf-ful of new copies of the misleading tables already referred to; no doubt a recent gift, unwisely accepted. Unused books, usually of American origin, were often to be seen, but they were seldom of recent publication. There was a great dearth of British texts, even of the courses which were relevant to the needs of the mathematics being taught: the Scottish series (SMG), SMP Books A - H, the ATM topic books, or even the New Mathematics series by Snell and Morgan. In fact nearly all the British mathematics texts in the schools, apart from project materials, seemed to come from one publishing house. This shows commendable commercial enterprise, but a sad limitation of knowledge. I was able to supply each school with a list of suitable texts which might be obtained if they so wished in course of time through the British Book Presentation Programme.

Teachers' libraries were usually kept in the staff-room or the school office. These were often better equipped, though they tended to show the same discontinuity of spectrum noted above. In view of the difficulties experienced by teachers in dealing with topics such as statistics, matrices and transformation geometry, as I have previously noted, the absence of any books on these topics is especially noticeable. There were few books on visual aids, and standard teachers' handbooks such as the NCTM yearbooks, the Mathematical Association reports , the ATM Primary School report, were nowhere to be seen. In these circumstances it is not surprising that teachers are limited as far as resource books are concerned; a few well-used textbooks, perhaps those from which they themselves were taught at school; a few books given to the school in some aid programme, consisting not of what the school needed, nor of what it officially requested, but of what the donor agency found convenient to supply. (These are usually three different things). The mathematical consequences of this I have already discussed.

5.2 The situation in the teachers' colleges

1. In addition to visiting schools, I was able to visit all the seven teachers' colleges, and to talk with the mathematics tutors - except, of course, in Grenada, where there is no mathematics tutor. I have already outlined the position of the teachers' colleges in relation to the project (in Section 2.2), but here it is appropriate to comment on the conditions actually found in them today.

2. In assessing the value of the teachers' college courses, it is necessary to remember that very few students come to the colleges direct from secondary school; as explained, most have some years of teaching experience in a primary school before they arrive. The course and final certificate qualifies them to teach in a primary or junior secondary school; to teach in a selective secondary school a university degree is normally expected, but many teachers can be found in such schools who have only a training college certificate and some whose only qualification is a couple of A level passes. In any case, as I have already indicated, a university degree in mathematics from U.W.I. is unfortunately of limited value as a training for a secondary school teacher. It will be realized thererefore that the course given in mathematics in the two years at teachers' college - reduced as it is by 9 or 10 weeks of teaching practice - cannot do much more than cover the ground of a modern 'O' level syllabus with some additional emphasis on the foundations of primary school arithmetic and the appropriate methodology. The fact that students do not know whether the administration will send them to primary or to junior secondary schools means that it is impossible to separate out the junior secondary trainees in order to give them a

deeper understanding of the mathematics they will be required to teach. While junior secondary schools continue to be regarded as upper extensions of primary schools, and not educational institutions sui generis, needing courses devised specially for their needs and teachers trained to conduct them, these difficulties seem likely to remain. Turning the upper classes of junior secondary schools into 'O' level classes with their own specialist (often expatriate) teachers is surely the wrong way forward.

3. The teachers' colleges for the most part have welcomed the project and make good use of its materials. Such criticisms as I have heard of its activities and its mathematical content have been few and unimportant; there have been criticisms of some of the workshops and of demands on the time of teachers in training, but they should not be taken very seriously. It is otherwise, however, with the criticisms that I heard in some colleges about the project's overall strategy; there are, I believe, some substantial points here of which the project should take note.

Those who engaged in training others for definite tasks need above all things to know where the lines are drawn, even if, for example they are only instructors in a driving school. Such will try to know not only the Highway Code but also the routes beloved of the driving test examiners, the corners that examinees will be asked to back round, the hills they will start on, and where their three-point turns will be done. So those who train teachers can reasonably ask what the teachers are going to teach, and more especially, on what they are going to be examined. They will and do complain if the project is not particularly clear about the answers to either of these questions. Now the project's strategy has been that the teachers should devise the curriculum in the light of their classroom experiences, and that the teachers' colleges should devise their training courses in the light of the needs of their individual territories; only after this has been done should they submit items to the School of Education for inclusion in the examination. I have already commented on the fragility of this policy; my conversations with teachers' college tutors indicate that more definitive syllabuses are really needed.

4. The roots of this problem seem to antedate the project by several years. I have already mentioned the study conference on mathematics in teachers' colleges held in St Lucia in December 1966. (20). The colleges for a long time relied on the report of this conference, which appeared in two volumes. It merits a little attention.

Volume I (Goals in mathematics for teachers' colleges) opens with two general chapters: "A strategy for curriculum change in mathematics", written by (then Mr) Desmond Broomes, and "Goals of teachers' colleges and the implications for the mathematics curriculum" written by Mr Sylvester Lorde. The first of these reveals the seminal thinking of the project coordinator which has borne fruit throughout the whole of the project's history. Already, over four years before the project began, we find outlined "Three major tactics in the strategy of curriculum changes":

> 1. A study of the curriculum at a specified period of time in order to identify the weaknesses and strengths of the programme at that time and to diagnose the problems.
>
> 2. The induction of changes in the behaviours of the key persons (in this instance mathematics tutors at teachers' colleges) who are responsible for maintaining the equilibrium of the curriculum at that specified period of time, by providing an atmosphere conductive to producing new skills without loss of status; by causing them to share in the shaping of objectives to be attained, in selecting and defining the content of the syllabuses and in constructing tests.
>
> 3. The control of the changes in the behaviours of the key persons by
>
> a. providing a supportive atmosphere in each college; and

b. allowing each college under the leadership of its mathematics tutor to draw up its mathematics syllabus out of the materials and his experience of the conference".

Chapter 2 lists the five major tasks of a mathematics programme in a teachers' college: "to equip the students to

1. appreciate and use the scientific method;

2. establish criteria for determining objectives and content of mathematics curriculum;

3. acquire the spirit and extent of mathematics;

4. develop techniques for evaluating the mathematics programme;

5. apply the language and concepts of mathematics to the study of other subjects".

It will be seen that both these expositions of policy are deeply imbued with the presuppositions of behavioural psychology - direct your attention to producing testable behaviours and you will produce the mental changes you desire. Here is the characteristic emphasis of the project on formulation, testing, modification of objectives and the shift of responsibility for content to the evaluator of the educational experiment in the classroom. Chapter 1, it will be noted, shifts responsibility for syllabus formation from the administrator to the teachers' college tutor, and chapter 2 shifts it further from there to the student, presumably only to be exercised fully when he returns to active teaching.

The three college tutors who were most articulate in their criticisms of these strategies regarded the project as responsible for them, although at least one of them was present at the 1966 conference. The burden of their complaint was that this does not make contact with the real needs of the teachers, and that the students' weakness in mathematics demands that a much more specific attention is necessary to content; bluntly, students cannot develop a curriculum in mathematics which they do not know. Not having been made aware of the 1967 report until after my interviews with the tutors concerned I was unable to discuss its statements with them directly. Had I been so able, I might have been tempted to say that they had opportunity to voice these opinions in 1966 and therefore they should not blame the project for the line it had taken. But it would have been unfair, because only one of them could then have been present, and she was then comparatively inexperienced. As it is, I completely concur in this criticism, though I hesitate to pin the responsibility on anyone or even on any group of people; there has been insufficient attention to the drawing up of a definite syllabus, either for junior secondary schools, or for teachers' college courses in mathematics. JSP is the syllabus de facto, but teachers are not yet sufficiently well-versed in its content. For the weaker pupils, slow learners, or what you will, no syllabus is yet in sight.

5. It is perhaps worth pursuing the description of the 1967 report a little further. Chapter 3 of Volume I lists specific objectives for "suggested topics" and chapter 4, which comprises over two-thirds of the book, gives the mathematical background of these topics. They fall naturally into three groups:

1. Sets, numeration systems, real numbers, algebraic expressions and operations, equations and inequalities

2. Plane and space figures, Cartesian plane and space, symmetry and transformation

3. Measures of central tendency, dispersion, relationship; statistical estimation, measurement.

Business arithmetic and graphs appear in chapter 3, but are not treated in chapter 4, perhaps because it was felt that they were already adequately covered elsewhere. But the suspicion arises that the notable absence of these two important and practical topics from the project's activities and published materials is not unconnected with the absence of any treatment of them in this document. On the other hand, the treatment of the number system is very full, starting with the natural numbers N (undefined and not established in terms of sets) and developed axiomatically, even "=" being considered undefined. Postulate 1 states that for all a N, a = a ! This proceeds as far as an excellent treatment of the integers Z, missing from project material, but there is no development of Q (where the axioms of equivalence really do mean something, and relate to actual classroom needs) and no discussion whatever of R in spite of the heading "The Real Numbers". As an example of the style of this chapter I cannot resist quoting this gem:

"It is part of the decision-making process to check all the values of the solution set to verify the truth of the open sentence". In other words, when solving equations, check your answers.

Volume 2 is mainly concerned with a very detailed syllabus for the content of a teachers' college course on these listed topics. A full bibliography follows; of the 142 items included in it, 106 are of American origin.

I was not able to discover how far this syllabus has actually been used in the last ten years. Some colleges refer to it when asked what the syllabus is, but I do not think much has ever been done about measures of relationship (presumably, correlation), Cartesian space, geometrical transformations. Reluctance on the part of college-trained teachers to introduce these topics into the schools seems to bear this out. In other colleges the book is merely a forgotten archive, difficult to locate. If the project had not stimulated the selection and development of certain of these areas, the report and syllabus might well have become a dead letter. In all but two of the seven colleges - St Lucia, and Erdiston College, Barbados, the college tutor has been closely associated with project work, if not the official island coordinator. Even in the two exceptions, the tutors have by no means remained detached from the project, although their syllabuses and procedures have not been as much controlled by the project's needs.

5. In short, the colleges have not implemented the syllabus in volume 2 of the 1967 report, and now feel the need of a definitive syllabus for their mathematics courses; the reasons I believe to be among the following:

a. The 1967 syllabus was far too long for a two-year course with students whose background is tenuous.

b. Adequate literature in support of sections of this syllabus, notably business arithmetic, geometrical transformations, and statistics, was not readily available.

c. The project workshops concentrated (necessarily) on less than half of the syllabus.

d. When the syllabus was formulated, junior secondary schools were only just coming into existence, and there was no very clear idea of their requirements.

6. We may come nearer to an evaluation of the present-day mathematics curriculum in the teachers' colleges by looking at the latest (June 1975) final examination papers set by the School of Education for college students. There are four papers, taken by all candidates. Part I, 1½ hours, contains 58 items, multiple choice or short answer type. Part II, ¾ hour, contains 7 longer problem-type questions, each in a number of parts. Question 1 (on a statistical experiment) is compulsory, and one

question must be attempted out of the other six. Part IIIA, ½ hour, contains 25 multiple-choice items relating to testing procedures and teaching strategies, as well as specifically mathematical questions on the structure of the number-system. Part IIIB, 1 hour, contains 12 questions of an essay type on teaching methods, of which 3 are to be attempted.

Paper I is roughly of the standard of JSP Book 3; it does not contain questions on Scope and Sequence material (e.g., groups, ordered pairs) which are not in JSP. There are some questions which would cause the average English teacher some hesitation in interpreting: e.g. "Write 480.699 .... (b) in expanded exponential notation "(i.e., as a sum of positive and negative powers of ten); "(c) in scientific notation" (i.e., in standard form). Again "The rate-pair (3,5) compares the sizes of two numbers" seems a very odd way of saying "Two numbers are in the ratio 3:5". The preoccupation with the distinction between the sign and the thing signified reappears in this remarkable question:

Which of the following is the correct meaning of km?

a. The abbreviation for a kilometre
b. The abbreviation for kilometre and kilometres
c. The symbol for kilometre
d. The symbol for kilometre and kilometres".

I think my vote goes for D, but does it matter?

Paper II is easy 'O' level material, apart from the compulsory statistical question (on comparing two means), which is distinctly more difficult, but only one other question has to be done.

The main thrust of the rest of the examination appears to be directed towards making the teacher into a curriculum researcher, and thus accords with one of the main objectives of the project. It is obvious that the philosophy behind the project has strongly influenced the training programme implied by this examination with its emphasis on structure in the part concerned with content, and on continuous assessment in the part concerned with methodology.

7. In many teachers' colleges the project modules now form part of the curriculum; now that the teachers' guides have been completed it is to be hoped that they themselves will be used as texts for both content and methodology. The lesson notes which they incorporate lay considerable stress on the use of apparatus and practical aids, whose almost total absence in school classrooms has been a disturbing feature of my investigations. It is too early to say whether these guides will find extensive use, but one would hope that every college student could possess a personal copy of each of them; I fear though that the cost of production and the problems of distribution would make this ideal unattainable.

8. The relation of the college mathematics tutor to the project differs from island to island. In some cases they owe their training and postion to it. The project, with its emphasis on teacher participation, was able to identify teachers with mathematical competence and powers of leadership, to introduce them to opportunities of further training, to bring them to the notice of their Ministries of Education, and now reaps the benefit of seeing them in key positions in the teachers' colleges.

9. In some cases the mathematics tutor in the teachers' college is officially charged with responsibility for curriculum development in the schools; even where this is not so, he may have a good deal of influence in a small island where he may be one of very few people who have any tertiary mathematical training. It is therefore gratifying to be able to report that the tutors are committed to the project and have welcomed it into their system. Even when they are critical, it is the welcome criticism of friends, not the destructive criticism of outsiders which they offer. Conscious of the project's

weaknesses, they want to make it better; in no case do they regard it as an intruder whose influence they wish to destroy. In some cases they have been critical of the methods of an individual consultant or coordinator; it would indeed have been suspicious if it were otherwise. But I have always felt that they regard it as "our project"; the fact that the project has gained this cooperation and affection in the insular society of the Caribbean deserves the highest praise.

5.3 Curriculum development.

1. The project's view of curriculum development has already been referred to a number of times. It has been expounded by Broomes in papers already quoted, in references (9) and (18). In this last paper, responsibility for curriculum development is spread across three "clusters of activities"; that of the classroom teacher, the teachers' college, and the curriculum unit. The activities are three, forming a repetitive loop:

1. Identifying and formulating principles underlying classroom learning

2. Designing lessons and units based on principles identified or created

3. Testing units and lessons and their effect on pupils and teachers

Once again we notice the emphasis on the learning process, and the absence of any reference to identifying the mathematics to be taught. But our immediate task is to discover whether the project is achieving its stated objectives; is the curriculum developing?

2. Of the three clusters of activity, that of the curriculum unit has now ceased. The teachers' colleges are too concerned with the overriding need to provide their students with a minimum knowledge and understanding of basic mathematics to have much time for new designs; but the potential is there when need and opportunity arises. What of the teachers?

In some areas good work is being done in the development of new material. In Antigua a booklet on probability experiments is in production; one school in St Lucia is devising practical activities in geometry for C streams; a remote primary school in Dominica has produced a small booklet on multiplication and division of fractions. But teachers in isolation find it difficult to do very much. Wherever I went, I found the need expressed for conference, collaboration, conversation with other teachers facing similar problems. Isolation and insularity are the great enemies of progress; the project was able to offer means of overcoming them, but the Ministries are reluctant to do much about it, especially where finance is involved. Teachers need the stimulus of meeting together to discuss their problems; the warmth of the welcome accorded to my wife and myself seemed to be generated by more than mere politeness.

3. The activities of the Caribbean Examinations Council, of which I shall say more in Section 7.3, are encouraging teachers to re-assess the needs of their pupils, and to press for new methods of examining which could be more suited to their capabilities. Wherever possible I tried to encourage the view that the function of an examination is to register the achievements of candidates rather than demonstrate their failures; that an examination in which over 80% of the candidates failed provides little information beyond that of its own unsuitability, and that the C.S.E. method of examining and the inclusion of project work in the assessment was at least worthy of consideration. One island, indeed, not in the project area, has already introduced a C.S.E. examination linked with a U.K. examining board, and it seems likely that other territories will follow suit. It is obvious that this will throw considerable responsibility on local

teachers in the framing of syllabuses and assessment procedures, especially if the Mode 2 or Mode 3 examining schemes are chosen.

4. A possible forum for discussion and the generation of ideas for curriculum development is the professional association. To the best of my knowledge, only in Barbados does any professional association of mathematics teachers exist. The Mathematical Association of Barbados has been recently revived and is already showing signs of vigorous life. It holds monthly meetings, publishes a journal, and has a growing membership. So far it is largely confined to the more conservative section of the educational system, but a number of primary teachers participate and it holds considerable potential for the future. Part of its work is unobtrusive assistance to teachers with the content of unfamiliar portions of the modern mathematics syllabus; part again with practical lesson organization. Given wise and imaginative leadership, it could do much to bring teachers together in a creative community. I hope that such associations will spring up of their own accord in other territories; it is useless to attempt officially to engineer them.

5. When all is said, however, there remains with me a feeling that a clear sense of direction is lacking. It is partly that general educational policies vacillate too freely with changing political administrations. But at least some contribution has been made by the project's own strategy. In designing a course for the University of Southampton on "Mathematical Curriculum Studies", Griffiths and Howson (21) stated their view that "a rather rigidly formal curriculum must first be designed even if there are gifted teachers available who can develop their own classroom methods of treating the material. Some such teachers refuse adamantly to use printed textbooks but nevertheless they surely need some kind of blueprint before they can actually go into action". Realities in the Caribbean situation force me to assent to this view. The gifted teachers are there; the lack of textbooks is often a matter not of choice but of economic necessity; but the blueprints are tentative and incomplete. Scope and Sequence is only partly successful as a blueprint for second and third year work in junior secondary schools; JSP itself is a better one for the upper streams, while for the lower streams Scope and Sequence has diverged in the wrong direction, teachers are not using it, and even a tentative experimental blueprint has not really been devised. Everywhere there is a cry for help. From whence shall help be found?

6. Any approach to an answer must be made in the context of the whole educational system, not solely in the realm of mathematics teaching. This is a major enquiry which I am not competent to undertake, but perhaps a few guidelines may be suggested here. First, a negative answer from within the Caribbean itself.

Every year there takes place the Eastern Caribbean Standing Conference on Teacher Education. This is a most valuable conference of education officers from the various Ministries, principals of teachers colleges, and the staff of the School of Education of U.W.I. The Conference for 1975 was held in Grenada in April and its report has just been issued. One of the papers was read by Dr R V Goodridge from the In-Service Diploma course staff at Cave Hill, and concerned "The teacher training component of the curriculum development strategy" (22). In it he says, inter alia, "very few teachers in initial training can be turned into curriculum developers or even be brought to perceive themselves as having the freedom in their schools to effect meaningful change". I agree with this judgment. Indeed, in an African territory with which I am familiar, a very similar attempt at curriculum development in mathematics failed, no doubt largely because the political regime was unfavourable towards so-called "progressive" developments in education, but also at least in part because undue hopes were placed in the renewing powers of the graduates emerging from the college of education, and too little attention was paid to the need for securing the cooperation and sympathy and developing the latent expertise of the older established teaching force in the schools. Enthusiastic new teachers are a stimulus to any educational system, but salvation will not come by these alone.

The second negative answer seems to be that a too rapid attempt to change teaching methods is also doomed to fail. Perhaps the project expected too much in this

direction. In their book already referred, Griffiths and Howson warn (23): "The real reasons which underlie the non-acceptance of discovery methods are constraints within the educational system - external examinations, and the lack of suitably qualified teachers. Discovery methods make considerably greater demands upon teachers than do conventional ones. The teacher is no longer the director of the classroom situation, proceeding along well-worn paths, but is now the manager of an educational enterprise which will never work in exactly the same way two years running. Not only are the recurrent demands upon the teacher greater, but he will require different and more extensive initial training to ensure that he is capable of becoming the master rather than the victim of the method. No wonder that past attempts to encourage such teaching techniques have often failed. The constraint of external examinations ..... still remains in secondary schools, where the difficulties of teaching by discovery methods against the schedules of the GCE examinations are too readily apparent". "The constraints of the external examinations, and the lack of suitably qualified teachers". If these operate in supposedly progressive England, they operate far more crushingly in the Eastern Caribbean. Realistic curriculum development must come to terms with these constraints. One of the most successful projects in England has been the SMP. One reason for its success was that its initial attack on the existing system was three-pronged; it sought to reform the curriculum (in the sense defined by Broomes of what the teacher does in the classroom), to devise its own examinations, and to provide in-service training of the workshop type for all participating teachers.

Dr Goodridge's paper seems to me so important that it should be studied in the original, but I would like to quote it a little further. He urges a fundamental re-examination of the approaches to curriculum development, and stresses the importance of teacher-training institutions and programmes in it. He then makes a number of conditional statements which seem to spring from past, maybe even from recently past, experiences. He says "it will be difficult to achieve this objective if Ministries take the view that they deal with real problems and teacher training institutions deal with theory, and if there is not more communication and understanding on both sides, and the maximum of feedback between Ministry curriculum supervisors or subject specialists and teachers' college staff. The situation is not helped either if Ministries expect teacher training institutions to respond to the development strategy .... (when) teacher training personnel are not involved at base level in planning curriculum projects and strategies". Then, in a self-critical vein, "Teachers' training institutions can hardly achieve a central position in the development strategy if the School of Education behaves as if the very real problems of teachers' colleges will disappear when the School of Education runs ad hoc courses for college staff. ... or if cooperation and collaboration are defined as existing only when teachers' college staff do what School of Education staff wish them to do".

Finally he advocates increased attention to in-service training, including day-release for participation in workshops of the type with which the project has made us familiar; retraining of school heads and senior personnel for the organizational changes involved; better use of experienced and overseas-trained teachers: and the establishment of teachers' libraries and resource centres.

I am convinced that this line of thinking is fundamentally sound. It is heartening to feel that in some ways the project has pointed the way. It would be tragic if for lack of funds or enthusiasm the present situation became ossified. The project has identified able and experienced people who know the problems and the needs at first hand, and should be encouraged to continue with the work of development. Give them the tools, and they will finish the job. What some of those tools might be I will suggest later.

5.4 An island-by-island survey

The islands are taken in alphabetical order, and the report on each is divided under eight heads:

a. Geography and communications
b. Secondary schools
c. Examination structure
d. Distribution of project schools
e. Relation of the administration to the project
f. Relation of the teachers' college to the project
g. Project activities in the schools
h. Results of the statistical test.

Full statistical data are given in Sections 8.1 and 8.2.

It is perhaps necessary to emphasize the subjective nature of the value-judgments in this survey, which commit no-one but myself. It can be extremely annoying when someone makes sweeping generalizations on the basis of a fleeting visit. I am all too aware of the superficial nature of my acquaintance with these fascinating territories, the brevity of my "whistle-stop" visits, and the tentative quality of my animadversions - "conclusions" is far too strong a word to attach to them - which I am very ready to withdraw if further information would show them to be erroneous.

ANTIGUA

a. Antigua has an area of 280 km^2 and a population of about 65,000. Except for a concentration of volcanic hills in its south-west corner, it is a low-lying coral island. Roads and communications are good, and no point is more than about an hour's drive from the capital, St John's.

b. There are two ancient grammar schools, Antigua Grammar School and Antigua Girls' High School. Originally single-sex, they are now both co-educational, having been combined into what is effectively a single school divided by age, the lower forms being in the Grammar School and the upper in the Girls' High School. The names, however, have not been changed. The Antigua Girls' High School boys are not very happy with this nomenclature. There is also a newer grammar school, Princess Margaret, which shares some courses with AGHS. Both are in the project. There is a technical school, and six "government secondary schools", four of which are in the project. These are nominally junior secondary schools, but some have a selective entry and some have 'O' level forms. One of the largest, Pares, outstanding also for its corporate spirit and its esteem in the local community, is developing a technical side also and is the most truly "comprehensive". In addition there are eight private secondary schools, two of which are taking the Scottish (SMG) mathematics course and enjoy a good reputation for success with it.

c. Full details of the examination structure in Antiguan schools was not available to the author at the time of compiling this report. It is clear, however, that there is great pressure on all secondary schools - including the junior secondary schools - to enter a very high proportion of their pupils for GCE 'O' Level.

d. The two (urban) grammar schools, the rural comprehensive school, and three of the junior secondary schools are in the project. One of the JSS's is on the outskirts of St John's, the rest are rural.

e. The project consultant, Miss Evie Davis, lives in Antigua and enjoys the confidence of the government administration, as is demonstrated by her recent secondment to act as headmistress of AGHS which was felt to be in need of firm control. The project has been warmly received in Antigua and continues to be valued highly. The main problem in this territory is the high prestige value attached to 'O' level and the insistence on 'O' level passes as the gateway to employment. I have given elsewhere the actual pass-rate figures in mathematics, which were greatly overestimated by the government officers with whom I spoke. It seems important to give a sense of achievement and of value to the community to a far larger proportion of the school population; the all-too conspicuous problem of vandalism seems not unconnected with this. In addition, the schools contain a disproportionate number of girls, which I was told reflects a general demographic imbalance. Antigua seems to merit sociological study.

f. In Antigua is located the Leeward Islands Teachers' Training College, which also serves Montserrat, Tortola and the Turks and Caicos Islands. The tutor, Mrs Margaret Twidale, is a Peace Corps volunteer. She has long been associated with the project, is very open to its non-American components, and is a valuable source of creative ideas. LITTC has a large number of first-year entrants who have not the standard 4 'O' level passes for entry; in particular there are 69 students taking mathematics, only 5 of whom have an 'O' level pass in the subject. This makes the tutor very conscious of the need for lectures in straight content of the mathematical syllabus, and anxious to extend the college course by at least a year. An alternative tried elsewhere might be to conduct a pre-college 'O'-level course, rather than an in-college course as at present, stiffen the entry requirements and raise the standard generally. But as the college has only this year moved to a full two-year course, this may take time. The removal of the consultant from the mathematical scene is a matter for regret, and Antigua is anxious to have a full-time mathematical coordinator appointed. Suitable persons are available. The college has a good library, is pleasantly situated on a hilltop, with a dormitory for 50 students. It would make a good centre for a teachers' vacation course, and Antigua is seeking a seminar in programme construction for the lower streams in junior secondary schools. This is a crying need, and I would strongly support the request.

g. I was able to visit all six project schools and to observe a number of lessons. They provided some of the most encouraging experiences of my whole tour, and some of the most disappointing. In over half the schools children were actually buying new copies of the project modules; JSP workbooks were in use in some, and were being bought in preference to the textbooks. In one school at least, new material has been and is being developed; I have already referred to the teacher who is holding classes every week for his colleagues. The pressure of 'O' level is as great as the results are poor; there is thus a strong tendency to play safe and revert to traditional work in all but the top streams; only one school at present is offering syllabus C, though others hope to. One school is so full that it works in shifts, and the physical condition of two others was depressing in the extreme. Demand for secondary education is high, attainment is often low, and trouble is being laid up for the future.

h. Full discussion of the statistical tests, and in particular of the difficulties associated with the affective test, must be left until section 8.7. However, it will be useful to summarize here one or two salient features of the results for particular islands, where it is possible to identify them.

Antigua's results in the cognitive test were rather disappointing, apart from the top third year class at Princess Margaret. The affective test revealed a fair degree of commitment to mathematics; while most of the responses to this test were confused and showed very low vectors (as in all the islands), it is

noteworthy that Pares and to a lesser extent Clare Hall showed an open-ended attitude to the subject, and the upper class at Pares showed a preference for its exploratory aspects.

2. BARBADOS

a. Barbados, with a population of a quarter-million packed into an area of 430 km^2, is the most densely populated of all the islands. More significantly, it is distinguished by its long history of uninterrupted British rule from 1625 to its independence in 1966, its parliament, dating from 1639, being the third oldest in the Commonwealth. Geographically considered, it is a coral island, apart from a few ancient rocks outcropping in the north-east, rising in a series of terraces to a maximum height of just over 1,000 feet. A close network of excellent, though rather narrow, roads covers the island. Buses connect all parts with Bridgetown, the capital.

b. There are 10 "older secondary" (grammar) schools, four of which have sixth forms and share some of the ancient traditions of English public schools. There are also 10 "newer secondary" schools, formerly called "comprehensive", but in reality multi-lateral; transfer to these from the primary schools is automatic in the parishes where they exist, but some parishes have none, and all-age primary schools continue. The government also assists 19 private schools, and there is a sixth-form college. There are 118 primary schools, so that there is one secondary school to every three primary schools; compared with others, the island is educationally well-equipped.

c. There is a common entrance examination, taken at age 11+, for entrance into the older secondary schools. Five of these enjoy such prestige that they have first choice of entrants, before even the other "older" secondaries. Since their classes are smaller than those in the others, this has engendered strong feelings, and the selection procedure is at present under review. A report (the Shorey report) has been privately circulated, but although its contents are widely known it has not yet been officially made public; its proposals are more equitable and therefore less popular with some privileged groups. There is also a school leaving examination at 14+ which is taken by primary schools. In the secondary schools it may be used at the discretion of the headmaster; where there is pressure on space, as in the urban schools, it is used to regulate entry into Form 4.

Comparative figures for this year's allocations to secondary schools are available and may be of interest. The Common Entrance examination is in two parts; to sit part II one must reach 45% in Part I. Either part may be taken at age 10+ or 11+.

CE Entrants:	Boys 10+	11+	Total	Girls 10+	11+	Total	Grand Total
Part I	2917	2406	5323	2882	2232	5114	10437
Part II	647	724	1371	918	1190	2108	3479

Two noteworthy features are: (a) only one-third of the candidates achieve the qualifying level of 45%; (b) the girls are 1.53 times as successful as the boys - a difference which is highly significant. But there are actually fewer places for girls than for boys in the older secondary schools.

The figures for allocations to these schools in 1975 were as follows:

Boys 10+	11+	Total	Girls 10+	11+	Total	Grand Total
383	78	461	273	63	336	797

In addition, about 400 bursaries were given to independent secondary schools, and the total entry to the newer secondary was 3,359. Summarizing, about 18% of the school population in any year get into a "grammar" school at 10; the rest try again a year later, and a further 3% succeed; about 60% go to the newer secondary schools, and the remaining 20% either go to independent secondary schools, or remain in the all-age primary schools. Of the grammar school scholars or bursars, about 70% sit 'O' level maths and about 40% of these pass in it; that is, about 6% of the whole year-group. 76 in all sat from the newer secondary schools, and only 10 passed; a tiny trickle. These are the Cambridge GCE figures; it is possible that a few of the newer secondary schools take the London examination, but it cannot be very many. It is obvious that once again the needs of 'O' level courses should not be allowed to influence the newer secondary schools' curriculum. Apart from a radical change of policy, which is at present unlikely, they are not, and cannot be, truly comprehensive schools.

d. The schools selected for the project originally included one selective girls' school and one boys' school, but they quickly withdrew. The project was planned to operate in five of the newer secondary schools; two single-sex urban schools, a co-educational urban school, and two mixed rural schools.

e. Rightly or wrongly, the administration in Barbados has felt that the project was less than essential in the educational system. Many of the schools were already working to a modern syllabus in mathematics, using either the Scottish (SMG) texts, or the series first devised for use in English preparatory schools by Clayton and Straker. It seems not to have been properly explained that the project might have been helpful with the lower streams in the newer secondary schools, whose diet was arithmetic only. Barbados of course is not alone in this. Instead, the materials were tried in the upper streams and thought to be too easy. Two workshops planned to take place in Barbados during the construction stage had to be cancelled at the last minute, owing to administrative difficulties. When an island coordinator for the project was appointed, he found his time too fully taken up with the needs of primary schools. One gets the impression that the special needs of the newer secondary schools have not always been appreciated.

f. The teachers' college, Erdiston College, was founded in 1948, and thus antedates by many years the Institute of Education at Cave Hill. By the time the project came along, its traditions were well established, and later developments seem to suggest that it did not find it easy to accommodate the newcomer. Its tutors were associated with the writing of draft modules as in other islands, but there seems to have been insufficient coordination between the college and the schools. The college tutors are not responsible for any supervision of work in the schools, and their contacts seem to be limited to teaching practice. Since the educational system is more sophisticated than in other islands, the project pilot classes may well have been unadvisedly chosen; what actually happened was that they found the draft materials unsuitable - they considered them too easy, I was told - and in many cases the designated project teachers were not teaching the allocated pilot classes. It is perhaps also unfortunate that it was the fated "Fractions" module which was to have been developed in Barbados. Many factors seem to have contributed to the result that the college has only had the most tenuous links with the project's work in the schools. At the present time, the college tutors use only the later modules on statistics and mappings, and there does not seem to be any intention to use the teachers' guides as part of the curriculum. On the other hand, they have made good use of the film and the filmstrips, and interest in the project is not lacking. The need is recognized to teach students the content of the JSP course, and similar courses which they will meet in the schools.

g. The project modules are in use for remedial work in one or two of the original project schools. The government now provides for textbooks to be issued free to pupils in all secondary schools; unfortunately this announcement was made after schools had placed their orders for this year, so it was not possible to see what books they would choose with their new freedom from financial constraints. JSP, SMG, Clayton and Straker are popular textbooks for the upper streams; the lower streams seem always to do only arithmetic. It is possible that some modules may be ordered, but they are not well-known in some of the schools. Since I was based in Barbados, I was able to visit and to spend some time in each of the project schools and to observe many lessons. Most of these were of a very formal kind, and I received an impression that teachers were rather less in touch with their pupils than in some of the smaller islands. One teacher, conscious of this herself, suggested as a possible reason the large turnover of teachers arising from the fact that many of them are simultaneously taking training courses or waiting to get into the teachers' college. I do not think this is worse than elsewhere. The schools are very large, classes are large, and personal relationships are difficult in consequence, especially for inexperienced teachers.

The Ministry of Education is in process of "installing" syllabuses into the primary and newer secondary schools. These have been devised by committees and are subject to revision. But it seems unfortunate that the majority of teachers have not been involved in producing them: with this "central dissemination" mode of curriculum development, much in-service training will be necessary. The primary syllabus is unashamedly modern, and indeed calls itself "new mathematics". It also says that it is for A and B streams only; once again the lower streams are passed over. The secondary syllabus follows much the same lines as the project modules, and has obviously profited from experience of them. It is in many ways an improvement on them; it treats integers before decimals, and fractions last of all, emphasizes graphs, and has many practical suggestions. Since the former project coordinator is involved in helping teachers to use this syllabus, and will presumably also be concerned with its revision, something good could come out of all this. Dare one hope that the Mathematical Association of Barbados might one day produce its own "Mathematics eleven to sixteen"? There is plenty of talent; what is needed is co-operation.

h. Results on the cognitive test were good, with a distinct gradient downwards from the urban to the more rural schools, as was to be expected. Commitment to the subject is very varied and is not correlated with cognitive ability; the highest level of commitment was found at West St Joseph, where there is also a healthy professional regard for the subject. Scores on the other vectors were uniformly low, probably betraying a casual attitude to the questions and possibly a misunderstanding of their meaning. This was one of the islands where it was possible to attempt a comparative study of project and non-project classes; no great difference is detectible, but the best results seem to occur in those classes who have combined project work with another more conventional approach.

3. DOMINICA

a. Dominica is the most sparsely populated of the Islands; its population of about 70,000 is spread over 750 km^2. It consists of a range of volcanic mountains falling steeply to the sea, intersected by deep valleys, some of which contain sizeable rivers. Roads are poor, and in their untarred portions subject to erosion and the hazards of fallen rocks. Communication is therefore difficult and it may take all day to get from the capital, Roseau, to one rural school and back again. It has proved next to impossible to get teachers together in one centre for a workshop, and there have usually been two centres, one at Roseau and one at Portsmouth in the north.

b. There are 2 government and 3 private "grammar" schools, a small sixth-form college and a technical school. There are 55 primary schools; this seems a large number for a small population, but it is because of the very scattered distribution of the villages and the poorness of communications. There are no junior secondary schools as such. Portsmouth was built as a junior secondary, but has become selective. Five primary schools have been designated as junior secondaries, but the change is at present one of name only. None of them is linked with the project.

c. The Common Entrance examination for selective schools is taken between the ages of 11 and 13; many children sit it twice. There is no set syllabus. The school-leaving age is 15, and there is the usual school leaving examination; once again there is no syllabus for this. When I enquired about this from the Ministry of Education, the answer was given that the syllabus was "the work developed by Mr Payne"; the embodiment of this in Scope and Sequence was felt to be sufficient. The schools however seemed unaware of this; copies of Scope and Sequence were not available even in some of the project schools, and some were devising schemes of work on their own based on experience of past papers. The selective schools are geared to Cambridge or London 'O' level. They contain 2,300 pupils; the total 'O' level GCE entry in June 1975 was 830, and the number of subjects passed was 1,026, an average of 1.25 per candidate. This however includes teachers, private candidates, and the sixth-form college; 715 subject passes are recorded for secondary schools, but the total entries are not given; they can be estimated as approximately 600. The total passes in mathematics were 40 from the secondary schools, 4 from the sixth-form college, and 8 private candidates, mostly teachers. This is only about 2% of the year-group. These figures are profoundly disturbing.

d. The project has been operating in the government grammar school in Roseau, the selective secondary school in Portsmouth, a private (Roman Catholic) primary school in Roseau, and two rural all-age primary schools. They are all on the western side of the island, and can be reached by the main road along the leeward coast; but even this, after heavy rain, is no mean undertaking.

e. The Ministry of Education has great faith in the project, and has depended on it for guidance in its post-primary mathematical education. Consultants' visits have always been welcomed and workshops encouraged. George Forde was able to hold two series of workshops for teachers in all primary schools, not merely those designated as project schools, by special request from the Chief Education Officer. In addition he reports (24): "On the average each of the 47 teachers who have been attending workshops meet about five other teachers at least five times a term for an average period of two hours. This means that at least 200 teachers from all parts of the island do come into contact with the ideas and strategies of the workshops". But now that the funding of such activities by the project has ceased, the Ministry's budget for education is so restricted that they are unable to provide a coordinator for mathematics in the schools, and it is doubtful how much will continue on its own momentum.

f. The teachers' college has been in existence for two years. It has an enthusiastic principal, and is occupying pleasant and efficiently designed new buildings. The mathematics tutor was formerly teaching, and acting principal, at one of the project schools. The college runs an 'O' level course for teachers before they can enter the professional courses; this is a one-year course to 'O' level in which Cambridge syllabus C is offered and SMP books 4 and 5 are used, as well as JSP 1-3. (Dominica is one of the islands where the existence of JSP books 4-5 is not known). There are 24 students in the professional course of two years; 18 have an 'O' level pass in mathematics. The one-year pre-professional course is thus paying dividends. Owing to problems in distribution,

the college had not yet seen the projects teachers' guides, but intended to use the modules; both tutor and the two-year course were new at the time of my visit. The library is still small but has been very judiciously stocked - better so than many larger ones. With its capable staff and manageable numbers, the college has great potential.

8. The schools are all so different that they must be considered separately.

1. Dominica Grammar School in Roseau is a school of nearly 600 (three-stream) with a predominance of boys. The project materials are not now used in the school. It has two main problems in regard to mathematics: an over-loaded curriculum (two foreign languages and three different "social studies" components in Form 1, for example) results in only 140 minutes per week being devoted to the subject; and a confusion of textbooks (both JSP 1-3 and SMP 1-3; SMP 3T, SMP Y and Z) makes for lack of proper continuity. The acting headmaster is concerned about both these matters, but most of the teaching load in the upper classes is carried by one VSO and there is a lack of trained staff in the early stages.

2. Portsmouth Secondary School has 345 pupils and runs courses up to Cambridge 'O' level; it offers syllabus C for mathematics. The school uses JSP 1-3 and 4s; both JSP workbooks and project modules are in use. It has three mathematics teachers with A levels. Its past record has not been very good (it had no 'O' level passes last year in mathematics) and it suffers from its remoteness; for example, the top class travel by bus to Roseau every Saturday to do their Science practicals, since Portsmouth has no properly equipped laboratory. Its new principal and his staff are alike enthusiastic; once again, the school has potential, as yet not fully developed.

3. St Martin's Primary School. This is interesting, because it is the only private primary school in the project. Mathematics is in the charge of a teacher with no professional training, but an 'O' level pass in mathematics. I was privileged to see her teaching; the children were sharing modules, working on their own in pairs. In the course of the lesson they had to change groups and did so at a word with complete and well-practised efficiency. The whole lesson was a model of what a project lesson ought to be. This same teacher coordinates a team of six who devise their own schemes of work. This school will try to buy the printed modules; given continuity of staff, the future for project work seems assured. O si sic omnes!

4. Colihaut Primary School is a village school with about 280 pupils; all its teachers come from the village. There are less than 50 children in its "senior" classes. There are no textbooks, and no modules. Copies of Mappings and Statistics were on a shelf, unused; they are obviously too advanced for a school such as this. Regrettably the school seems to have reverted to a traditional programme; but it is a happy place, and the village is proud of it.

5. Paix Bouche Primary School is about the same size, but much more remote; it is perched in the mountains with a breathtaking view. The Principal is a mathematician. He arranges for school to end early one day a week so that he can conduct a workshop for teachers. Work-cards and new materials are still being produced here; classes work in groups, and modules are used, in spite of the fact that the copies have at some time been nibbled by mice (as have most of the modules in the island, obviously while lying around awaiting distribution). The walls are decorated with charts and children's work. The project's seed fell on good ground here and has brought forth fruit a hundredfold.

Dominica then, though hampered by the difficulties of its terrain, and the meagreness

of its resources, has considerable undeveloped potential. Junior secondary schools are still at the drawing-board stage. I was honoured with an invitation to address the committee met to consider them; I emphasised the dangers of regarding them as "grammar-schools manqués" and of a mere truncated 'O' level curriculum; I urged the need to consider the lower streams and the local and practical aspects of education; that it was better to proceed slowly, ensuring a body of suitably trained teachers who would have some security of tenure in the new schools and could build up the essential esprit de corps. I was given a very sympathetic hearing.

h. The statistical results, which only came to hand after the previous sections were written, tend strongly to confirm the impressions there recorded. Dominica's achievement on the cognitive test is very moderate; a good average score was recorded from Portsmouth, with its selective entry, and low scores from the rural primary schools. St Martin's is not outstanding, but quite commendable for an all-age primary school. But it is the affective test which is most interesting; both St Martin's and Portsmouth show a high level of commitment, but they also show high scores in the other vectors. Questions have been answered thoughtfully and consistently and each school contains a majority of pupils in the sampled classes who prefer an open-ended discovery approach to mathematics rather than an emphasis on mere technique. Scores in the rural schools are low, but it is perhaps significant that the one with the higher B vector (tendency to experimental methods) has also a higher level of commitment and a higher score on the cognitive test.

4. GRENADA.

a. Grenada, the most southerly island of the Antillean chain, has an area of 310 km^2 and a population of close on 100,000, which makes it the second densest in the group. It is another mountainous, volcanic island, and, like Dominica, its airport is across the mountains from the capital, on the flatter land bordering the east coast. Vegetation is dense, and the air spice-laden and languorous; nutmegs are a principal export. Communications are not good, though better than Dominica; roads are tarred, but often full of potholes.

b. There is a boys' secondary grammar school, over 100 years old, in St George's; one junior secondary school, and for the rest the territory relies heavily on independent church schools, mostly Roman Catholic and Anglican. There is a junior secondary school in the dependent island, Carriacou, which I was unable to visit.

c. The Common Entrance examination may be taken between the ages of 11 and 14; it therefore occupies the work of some streams in the junior secondary school and the senior classes in the primaries. Syllabuses were drawn up for the school leaving examination some time ago, but it was stated that those who now set the papers were out of touch with the activities and materials of the project. On the other hand the junior secondary schools seem not greatly affected by 'O' level pressures.

d. The project has operated in the Grammar School (Grenada Boys' Secondary), the two junior secondaries, and one Roman Catholic all-age primary school. In addition, under the influence of the project's senior consultant, who lived in one of the villages, a group of teachers from primary schools near the small town of Grenville began to use and, indeed, to write, project materials in their schools. In particular, two primary schools, Tivoli R.C., and Belair, formerly Presbyterian, but now under the Ministry of Education, can really be counted as project schools and were tested as part of the statistical survey.

e. The administration in Grenada has been hampered by political upheavals and its attitude to the project is somewhat ambiguous. In the past the Senior Consultant has reported that while no difficulties were put in his way, full financial support has not always been forthcoming. At the moment there is no mathematics tutor at the training college and there seems to be no officer specifically charged with supervision of mathematics in the schools. Until conditions are more settled in Grenada the situation is unlikely to improve.

f. The teachers' college has supported the project wholeheartedly in the past and its mathematics tutor was island coordinator. Since his departure from the island, the college has had no mathematics tutor and is now able to do very little. Some teaching of content is undertaken by a teacher from the technical college, but there is little that can be done in the way of specific project-style methodology. The library also seemed to be very poorly equipped.

Teacher training is an urgent need in Grenada, and teaching needs to be made a more attractive career. With so few government secondary schools there is little inducement for teachers to better themselves professionally, and in the private schools there is often no guaranteed pension, so that teachers try to move on elsewhere.

g. Against this rather sombre background the project schools for the most part scintillate with activity. The effect of the Senior Consultant's long residence in the island, and the work of the Tivoli Production Centre, is still obvious and excellent work is continuing in all the project's primary schools; modules, JSP workbooks and other readers are still in use, and the staff are enthusiastic about what the project has done for them, though pessimistic about their ability to continue at the same level in the future. The grammar school is changing to Cambridge syllabus "C" and phasing out its syllabus "A" work; it is using the JSP texts, although the first book is found to be difficult for its intake. The one junior secondary school on the main island, however, has found reading ability in the main too low to use JSP books, and is also conscious that its upper streams are taking the Common Entrance examination for the second or third time, so that project activities have come to an end, and the modules have all been expended.

h. Though the general level of achievement in Grenada on the tests was low, the project seems to have achieved a relative measure of success, in that the two rural primary schools which have been fully committed to it have done as well as their urban non-project counterpart. By contrast the results from the rural junior secondary school which has not fully used the project's materials and methods are disappointing. Level of commitment is low, and, apart from St John's which shows a slight preference for experimental teaching, there is insufficient evidence to draw any further conclusions. Probably many of the questions were not understood.

5. MONTSERRAT

a. Montserrat is a small island of area 100 km^2 and a population of just over 12,000. It is volcanic in origin, but its contours are smoother than those of the Windward group and there is much open grassland. Its rainfall is high and the resulting greenness has earned it the well-merited title of the Emerald Isle. Communications are reasonably good; as usual, the airport is on the opposite side of the island to the capital, flat land for a runway and sheltered harbours being incompatible requirements. Landing is an adventure, because the runway is on a spit of land below rugged cliffs and a last-minute turn is necessary to reach it. Montserrat has the distinction of being the only territory in the group remaining as a British colony, and, at present, content to remain so.

b. The island has only two secondary schools; a selective entry school at Plymouth, the capital, and a junior secondary school just over two miles away at Salem. There is also a technical school.

c. There is the usual Secondary entrance examination taken between the ages of 10 and 12; three attempts are thus allowed. Entry to the junior secondary school is automatic, from its catchment area, at 12; the upper streams sit the school leaving examination at 14+ on which a further selection is made for the Plymouth secondary school; in addition there is a separate examination for entrance to the technical school which pupils can choose to sit. Only 8 children out of 50 at the junior secondary school passed the school leaving examination in 1975. This complicated system is in obvious need of re-examination and modification.

d. Both secondary schools are in the project.

e. The project is thoroughly naturalized in Montserrat, with the full backing of a most helpful administration. The whole situation gives the impression of peace and stability. Montserrat is of course no bigger than a small English country town with its villages in a semicircle of about 5 miles radius.

f. There is no teachers' college in Montserrat; it is served by the Leeward Island Teachers' Training College in Antigua. Miss Evie Davis in Antigua has always exercised pastoral oversight over the project work in Montserrat, and has been welcome there.

g. The project is operative throughout the first four years of the Plymouth Secondary School, and next year the 'O' level form will take syllabus C, with JSP in use throughout. The government provides the pupils' textbooks at this school, though funds are limited. Supplies in this island are difficult; they have to be obtained through a circuitous route and take a long time. Such things as graph paper are in short supply. The project modules are popular, especially those on Area, Mappings and Statistics, as might be expected in a selective school. The published versions of the modules will almost certainly be used in Montserrat; Salem JSS proposes to charge a loan charge for them and reuse them to save expense. Salem uses JSP 1-2 only; this occupies most of their time, and there is always the school leaving examination to think about. The transformation geometry is unfamiliar, and there is a tendency for the St Lucia - trained teacher to revert to the more formal American geometry. The most highly qualified teacher is a U.W.I. graduate in Biology and Chemistry, who admits that she has had no training to teach mathematics. Some continuation of seminars on project work would be helpful here.

h. Plymouth has the second highest score in the sampled classes on the cognitive test, and Salem has quite a respectable score for a rural school. Yet the class sampled at Plymouth was a B class, and its level of commitment is low. Salem shows a moderate value for the B vector, indicating preference for a more experimental approach. As far as can be judged from so small a sample, the project would appear to be making effective progress here.

6. ST KITTS

a. The two islands of St Kitts and Nevis are separated at The Narrows by only two miles of sea, but the ferry voyage from Basseterre to Charlestown is almost 14 miles. The area of St Kitts is about 170 km^2 and of Nevis about 90 km^2, with populations of 23,000 and 12,000 respectively. Nevis is a simple conical island with a perimeter road; land is broken up into smallholdings, much of it is derelict and roads are bad. Much is expected of tourism, but the basic agricultural economy needs cooperative effort. Apart from its tongue of wild and roadless

hills extending towards Nevis, St Kitts is similar, but with a central range of mountains with several peaks. The slopes are given over to sugar cane for the most part; communications are better than on Nevis. The capital, Basseterre, is the only sizeable town.

b. There are no selective schools in the islands, and apart from a few continuing all-age primaries, all secondary schools are comprehensive. There is streaming however in all the schools, and in Basseterre the O-level classes are in a separate "Senior" school, while in Charlestown, Nevis, the "remedial" streams are in a separate building some distance from the main school. There are three secondary schools in St Kitts, and two on Nevis.

c. Transfer to secondary schools is automatic at age 11+, apart from the remoter areas where all-age primaries persist. There is a school leaving examination taken at 14+, which does not seem to be used to select those who remain to take 'O' level. There was general agreement that the syllabus for this examination, which was indeed unknown to some schools altogether, is old and in urgent need of revision. 'O' level is for the most part Cambridge syllabus C, though some schools have still classes taking syllabus A, and in some cases the pupils have the choice. Long-established teachers are reluctant to change to the new syllabus, though it is recognized that by 1977 some change must be made.

d. The project operates in all the secondary schools, though in Basseterre it is confined to the junior high school, and in Charlestown to the "academic" half of the school.

e. The administration has cooperated well with the project, as evidenced by the fact that it has asked it to operate in all the secondary schools. It has relied rather heavily on expatriate volunteers to staff the academic sections of its schools, but this is becoming less necessary as more local teachers are trained. A pressing problem is the need for adequate help and supervision for the many young teachers. It would be helpful if an appointment could be made for this purpose distinct from the tutorship at the teachers' college. A suitable person is available, but the Ministry is not convinced of the value of creating such a post. There is a possibility that they may request a teachers' vacation course for help with the later parts of the JSP course with which their own teachers are unfamiliar; they are also conscious of the unsatisfactory state of the curriculum for the upper forms in secondary schools who do not proceed into the "O" level streams; with the imminent possibility of the school leaving age being raised to 16, this is a question of some urgency.

f. The mathematics tutor at the teachers' college has herself been trained by the project, and has completed her training in England last year. The college is completely committed to the project, and will give its methods and materials every encouragement. Under the training arrangement in St Kitts, teachers do a two-year pre-college part-time course while still teaching, and a further internship year in the schools after their year in college. This excellent arrangement brings the tutor into regular contact with schools and enables her to give advice and supervision throughout. It also places a heavy burden upon her, as already noted.

g. JSP is in use in all the schools, up to book 4S for the O level forms; again, books 4 and 5 are not known. The project modules are well used, and some schools have already ordered copies of the commercially published edition. In some ways the rural schools seem to be making better progress than the urban ones; perhaps because they contain the younger teachers. Some teachers, wrongly identifying JSP with "new math", are reluctant to change over to it. On the other hand one of the most interesting practical lessons in transformation geometry that I saw was in the rural secondary school on Nevis. The chief handicap to progress seemed to be the mixed nature of the teaching force; some

excellent and fully committed teachers are a great asset and need encouragement, while others, maybe anxious to escape after their bonded period, showed little interest either in teaching or in mathematics. The lower streams have great difficulty, even with spoken English, and make little headway.

h. With two notable exceptions, the pattern of test scores is very similar to that of the other islands. The general level of commitment, as registered by Vector C on the affective test, is low, almost as low as Grenada. But the results from the sampled class at Basseterre Junior High School proved to be far and away the best in the whole Caribbean. A number of papers scored very highly, but the patterns of their replies showed sufficient divergence to remove any suspicions of collusion; the overall performance of the class reached nearly 60%. The other notable exception was Charlestown, who achieved the highest negative score on the A vector in the affective test; more than any other school they seem to be devoted to the proposition that mathematics consists in memorizing stereotyped methods. By contrast, Basseterre had a moderate positive score on this vector; they lean to a more exploratory outlook.

7. ST LUCIA

a. St Lucia is a large island with an area of 616 km^2; its population of just over 100,000 makes it the second in the group. It is divided into two parts by a range of volcanic mountains: the area around Castries, the capital, in the north, and that around Vieux Fort in the south; communication between the two is difficult, though the east coast road is being improved. Most inaccessible of all is Soufriere, superbly situated under the Pitons, which can only be reached by steep and tortuous roads through the mountains. There are two airports; that at Castries can only take small aircraft but is the most used. The new international airport at Hewanorra, near Vieux Fort in the south, is little used, and a two-hour drive (in comfort, or 1½ hours in acute distress) awaits the visitor to Castries who lands there. Schools are scattered and isolated in consequence.

b. St Lucia has three grammar schools: two Roman Catholic, with a confusing trans-sexual dedication - St Mary's College (boys), and St Joseph's Convent School (girls) - and one Seventh-day Adventist; also a Senior Secondary School at Vieux Fort, and a Sixth Form College on Morne Fortune. There is also a new "Comprehensive" school in Castries, provided by Canadian money. The role of this school in the educational system seems not to have been fully worked out. At present it is selective on entry, and again at the end of the first year, but it receives a new intake after three years in junior secondary school. Its facilities for metalwork and woodwork are lavish in the extreme, such as would make many English technical schools envious; yet it has no library. The mathematics curriculum for its academic section is directed towards a traditional 'O' level; the staff would prefer a more practical approach.

There are seven junior secondary schools; one is new this year. The three southern schools - Micoud, Choiseul and Vieux Fort, act as feeders to the senior school at Vieux Fort, which has a selective entry at Form 3. Soufriere is under pressure to run its own 'O' level classes because of the lack of boarding accommodation in Castries and the difficulty of transport to and from the grammar schools. The two urban schools are normal junior secondaries.

c. As I have already hinted, the examination structure is confusing in the extreme. Because of the shortage of secondary school places, the primary school leaving examination is used to select entrants for JSS's after the grammar school entry has been siphoned off by the Common Entrance examination. The pass mark demanded this year was too high; some JSS's were not full, and adjustments had to be made. The three southern schools then face a selection examination after two years, set by Vieux Fort to suit its own requirements, which are

independent of the School Leaving Examination. This is taken after three years at age 14+; it is at two levels to suit the A and B streams; the C streams are not considered examinable. The mathematics syllabus takes the project work as a basis and is set by the former consultant. I was able to see some of the marked scripts; some calculations asked for appeared to me rather involved, and candidates often failed through lack of sufficient stamina to carry the work through to get the answer, rather than through ignorance of the techniques. It was noticeable that candidates were unhappy with metric units: in a question on metric area, there seemed to be no answer given in the correct cm^2; most omitted all reference to units, and those who gave any put cm instead of cm^2.

The 'O' level taken by the grammar schools in the island is usually the traditional Cambridge syllabus 'A'; some have changed to 'B', and the Senior School at Vieux Fort was thought to be intending to change to 'C'.

d. All the junior secondary schools were selected to participate in the project, and have continued to do so; the one new JSS of course does not.

e. The ministry of Education has always supported the project. St Lucia has its own Primary Mathematics Project which antedates the C.M.P. which is its logical sequel. Energies which might have been put into C.M.P. activities have at times been diverted to the Primary Project, but the C.M.P. has always been regarded as the officially blessed scheme for JSS's. The difficulty appears to have been that, where the CMP has come into contact with 'O' level programmes there has been reluctance to make any recommendations which would cause modifications in an entrenched conservatism. The unconformity of the examination levels is a symptom of this.

f. The teachers' college has been actively associated with project activities through its mathematics tutor and through the consultant who is now on the staff of the sixth form college in the same educational complex on Morne Fortune. It would appear to be happy with the project's philosophy, but critical of its methods. I found it difficult to locate these points of disagreement precisely, but among them it is possible to identify the following:

1. The project made a mistake in giving guidelines only, such as are contained in Scope and Sequence, when there was urgent need for a syllabus.

2. The project was also unwise to have produced only expendable modules; instead it should have grappled with the problem of producing local textbooks.

3. The project did not sufficiently explain the philosophy behind JSP before advocating its use in schools; as a result some of the workshops were less effective than they might have been, because less motivated.

4. The project did not really listen to the wishes of staff and parents or understand the real needs of the St Lucia system.

While the last of these complaints sounds rather like the traditional plea "My wife doesn't really understand me" in a marriage which is foundering for other reasons, nevertheless these criticisms have substance and some of them are to my mind quite justifiable. In this connexion it is worth remarking that St Lucia held a Maths Fair in 1974 and issued a booklet for parents entitled "What's new in mathematics?". This was mainly concerned with the St Lucia (Primary) Mathematics Project, but there is a section on C.M.P. Here it is stated, inter alia, that "preparation of Form 2 books is well on the way. This aspect of CMP will be presented in one text book which will contain all topics suitable at the

form two level. Already the syllabus for Form Three has been seriously considered. CMP will ensure that at that stage pupils are going to be involved in solid mathematical activities which will prepare them for admission into the broad outside world of trade and industry". It will be seen that it is impossible to pretend that any of these expectations have been satisfied.

The college is a large one, with a full-time staff of 13, including two teaching mathematics, and a student enrolment of 116. The second mathematics tutor was an ex-Peace Corps volunteer, keen on the project work, but using a Canadian text which included a rigorous treatment of transformation geometry; expectedly he was not happy with this, but seemed unaware of suitable alternatives other than school textbook series which were too broken up for adult teachers. The English series "Pattern and Power in Mathematics" was however in use for in-service training courses. The college has a good library, so that a readiness to compare and discuss the philosophies of, e.g. JSP and the Ontario Mathematics Programme would probably be stimulating, and might help to resolve some of the problems in the mind both of staff and students.

g. It is only to be expected that, with the complexities of the examination system, and the lack of clear guidance as to their role, the JSS' s would be in some confusion. This indeed I found to be the case. Of the two urban schools, one has only two members left of its former "project" staff, and the other has none. In these circumstances it is not surprising that the project materials are hardly used, though I was able to observe two very competent lessons taken by new teachers on project work. Soufriere also has a young new staff, having lost all its project teachers; project modules and JSP 1-2 were in use, but not issued to pupils because they were in very short supply and expendable; once the stock is exhausted pupils will have to buy the texts and that they will be unable to do. I was unfortunately too late in arriving at one of the three southern schools to visit it, but in the other two I found some excellent work being done. In each school an enterprising member of staff was working out a scheme of practical work for the C streams; one school was making use of a class set of SMG; the other uses JSP 1-2. Both complained of the pressure imposed by the Senior School entrance examination, and its incompatibility with their syllabus; also of the lack of coordination between JSS's about their schemes of work, and the school leaving examination. At Vieux Fort a new block had just been completed to provide laboratory and technical facilities; it was hoped to use one room for a mathematics laboratory and library.

h. The tests revealed a gratifyingly high level of commitment to mathematics, and also showed that the rural schools sampled did better on the cognitive test than the urban sample; this is unusual, and may reflect the fact that the urban school is no longer fully committed to the project. Apart from this, the data are too indefinite to draw any conclusions.

8. ST VINCENT

a. St Vincent has an area of 345 km^2 and a population of 90,000. Like Dominica, its centre is an impenetrable range of mountains; the northern tip is almost inaccessible, and the population is confined to the southern perimeter. Kingstown, the capital, is close to the airport, and communications are good within this restricted area.

b. There are 9 independent grammar schools, two government grammar schools and three junior secondary schools, with two others just coming into use. None of these are in Kingstown, which relies on all-age primary schools.

c. There is the usual 11+ examination on the results of which the government awards scholarships to the fee-paying independent grammar schools. There is a

common syllabus and examination for the three senior years in the all-age primaries and the three years in junior secondaries; the examination is set on project material by the former project coordinator. The two JSS's have small traditional 'O' level classes; they may well change to a modern syllabus, but as in other islands the teachers are afraid to venture into the new material such as transformation geometry.

d. All the original JSS's were allocated to the project - that is, two rural schools. In addition two denominational all-age primaries in Kingstown have participated throughout: one Methodist in town, and an Anglican school about three miles out.

e. The administration are enthusiastic about the project, its philosophy, its activities, and the servicing of its schools. They have appointed one of its leading teachers to be mathematics tutor at the teachers' college, and another, the island coordinator, to supervise the work in the schools. One could hardly ask for a better and more understanding provision for the project's needs. In addition, there is a mathematics consultant for work in primary schools.

f. The teachers' college has two mathematics tutors, both sympathetic to project activities, and keen to extend the workshop system if funds can be found to continue it.

g. The two all-age primary schools are overcrowded and conditions militate against effective teaching; nevertheless good work is being done in them. The two rural junior secondary schools use JSP books as far as they can, but they experience difficulties because of the children's lack of reading ability which hinders their understanding of the texts and workbooks. But in both there is enthusiasm for the project and what it has achieved.

My visit to this island was rather hurried, since it was only intended to be a preliminary visit, and I planned to return for a more leisurely survey at a later date. Unfortunately a six weeks' teachers' strike closed the schools, so that, while it was possible to get the tests administered on their return, it was then too late to pay a worth-while second visit to the island, and I had to be content with such information as I had already collected. This was singularly regrettable in so promising a territory for the future continuation of project-style activities.

h. Regrettably, the tests had to be administered in St Vincent at the end of a teachers' strike when the schools had been closed for over a month. It is hardly surprising to find that the results are very poor. With one exception (a non-project rural primary school!) scores on the cognitive test are very low, and the answers to the affective test show a tendency to agree (or to disagree) with everything quite regardless of the question asked - in other words, to complete the test with the minimum of thought in the least possible time. The best thing is, therefore, to ignore them. This was particularly unfortunate in that St Vincent was one of the islands in which it was possible to set up control groups, and from which it was hoped to obtain some useful information.

VI - ACHIEVEMENTS OF THE PROJECT

6.1 The overall strategy

In this section I attempt to summarize in as succinct a form as possible the diffuse comments of earlier sections. I do not wish to appear oracular, but Delphic ambiguity is even more abhorrent. I have taken the view that it is better to state one's mind clearly, so that one can, if necessary, be proved wrong, rather than to cover one's tracks with such a layer of qualifying clauses that one has said nothing identifiable. Where the project has in my opinion had defects, I shall say so; but I must emphasize that they are not the defects of weakness, but rather the defects of its qualities.

1. The development programme

As appears very clearly in the filmstrip (4.5.8), the project had to choose between the "central dissemination" model of curriculum development and the "periphery" model, and it chose the second.

In beginning from the discovered needs of the children, and by involving practising teachers at all stages of the development, the project has achieved a high level of success in producing materials in tune with the needs of the pupils in the selected classes.

2. Method of Use

By laying emphasis on diagnosis of pupils' difficulties, and by producing workbooks incorporating the guided discovery of mathematical principles, the project has succeeded in changing the attitude of many teachers towards their teaching methods. Nevertheless the methods and materials have been less successful with pupils whose comprehension of English is inadequate, or whose intellectual curiosity is insufficient for them to follow where they are being led.

3. Quality control

The design of any curriculum development programme and the quality of its products can be controlled in many ways, of which there are four main types: (a) by academic university mathematicians concerned with the needs of education - for example, SMSG, and many US programmes; (b) by academically competent practising teachers - for example, SMP, and many British programmes; (c) by mathematically competent educators and psychologists - for example, the "Understanding Mathematics" series in England; (d) by administrators, mathematical inspectors of schools and the like - for example, SMG in Scotland. For a discussion of these various methods, see, for example, Griffiths and Howson (25). The project attempted to combine (b) and (c).

In its Round Table, whose members all were or had been practising teachers, while some were well-versed in educational theory, the project possessed a nearly ideal instrument of control, which operated with commendable harmony and unity of purpose.

By failing to enlist the support of academic mathematicians, the project lacked disinterested advice on the mathematical content of its materials, but more seriously, lost the opportunity of influencing the educational content of the mathematical courses in the university.

In the multi-national situation of the Eastern Caribbean, the Round Table was unable to attach to itself a representative body of administrators without becoming impossibly large. It acted very wisely in not doing so, but its ears could have been more sensitive to administrators' pleas.

4. Localization

No curriculum development project operates in vacuo, but in an ongoing educational system with established procedures and textbooks. It may have to begin by importing a workable programme, while local materials are being devised. The project imported the Joint Schools Project materials, already being produced in a Caribbean edition.

> The JSP course is probably the most suitable course devised elsewhere for the upper streams in Caribbean secondary schools. It has been found unsuitable for the lower streams in junior secondary schools. But the project was completely justified in introducing it and financing its adoption.

By doing so, the project was faced with a dual task; that of producing local materials for those not ready to undertake the JSP course and for those who would never aspire to it; and that of training teachers in the use of the introduced material with those pupils who could profit from it.

> The project has succeeded admirably in producing local materials which are introductory to the JSP course. It has not yet produced any local alternative to JSP for those pupils who cannot master the JSP texts.
>
> The project ought to have recognized the impossibility, with the resources available, of producing de novo a complete Caribbean mathematics course for secondary schools. Accepting the JSP as an acceptable norm for the more academic streams, it could have concentrated in its later years on
>
> a. advancing the production of a Caribbean edition of JSP books 4 and 5;
>
> b. developing practically based materials for use in the lower streams of the upper secondary years;
>
> c. training teachers in the unfamiliar sections of the JSP course.

To implement (b) would necessitate broader collaboration with teachers of science and technical subjects; to implement (c) would involve the return to central dissemination.

5. Collaboration

> The project tended to regard mathematics as a self-contained, self-justifying and self-motivated discipline. It could with profit have incorporated more teachers of science and technical subjects into its councils and workshops.

6. Decentralization

> The devolution of responsibility for production of materials in draft form to the various territories, and the decentralization of activity through the mini-workshops, were highly successful and commendable features of the overall strategy, producing better work at less expense.
>
> While it would have necessitated much repetition, more time could have been spent at workshops in explaining the mathematical philosophy of the project and in direct instruction in the less familiar parts of the JSP syllabus.

7. Market research

In the first two or three years of its life the project concentrated on the production of the modules in response to the needs of the new entrants to junior secondary schools, as evinced by the diagnostic tests. The needs of the teachers revealed in the workshops led to the teachers' guides. Thereafter it would appear that insufficient attention was paid to the needs of the market, and in particular to its economic constraints.

By direct and extensive experimentation, the project was able to match its modules closely with the needs of junior secondary entrants. The accompanying teachers' guides are a valuable compendium of educational wisdom.

Because they are workbooks and not textbooks, the modules are educationally superior. But they are expendable, and costly to replace annually. In a more affluent community, they would be ideal, but their expendability restricts their usefulness in the Caribbean.

The production of Scope and Sequence was probably a mistake. It is motivated more by educational theory than the needs of the market Its place could well have been taken by the JSP Teachers' guides. Instead there could have been produced, with no more effort, a teachers' book of detailed guidelines for applications of arithmetic, practical work in geometry and design, activities with mathematical implications, suitable for use with C streams in years two and three.

8. Flexibility

The Round Table meeting of 8-9 February 1973 was an important one. Among many items in its minutes, three are seen in retrospect to have been crucial ones. The first was the acceptance of a point of policy sent to the participants before the meeting in a memorandum by Dr Broomes: "the project's emphasis is not on production of materials, but rather on how to generate curriculum skills among participants". The second was the decision taken "to continue work on the three-year junior secondary programme, including validation testing of the materials", in preference to "creation of materials for a broader range of junior secondary pupils, perhaps including the so-called 'remedial' pupils". The third was the statement that "the accepted facts, concepts and principles of this topic (Fractions) will be used to generate a unit for trial at the St Lucia mini-workshop".

At this point of time the project was about halfway through its life. It was conscious of this because it expected to end in August 1974. Nevertheless I feel that it displayed a lack of flexibility at this juncture.

It is difficult to generate curriculum skills in an area of subject-matter with which teachers are not familiar. They first need familiarization, even direct instruction, in content. It is to the credit of the new Central consultant in 1974 that he recognized this, but the project should have realized it earlier.

Though it is usually a virtue to be tenax propositi, it becomes a vice if an underprivileged section of the community suffers in consequence. By this time the needs of the "C" streams were becoming increasingly insistent, and the project should have given them more serious consideration.

9. Examinations

I have been told that when the project started it was not intended that the junior

secondary schools would be concerned in any examinations. The project quite rightly ignored such considerations. But when under mounting pressures various examinations, as we have seen, entered these schools, it became necessary to take action.

When it became obvious that some form of final examination was inevitable, it would have been helpful if the project had been able to offer some form of agreed mathematics syllabus for the three junior secondary years; the administrations would I believe have welcomed it, and some of the worst anomalies might have been avoided.

10. Teaching aids

In 1973 the Round Table proposed to do three things: to produce a "Book" of guidelines for second and third year work, which became Scope and Sequence; to produce a "Mathematics Letter" or journal of the project, which failed for lack of an editor; and to produce "Box": a collection of teaching aids for use in project classrooms. While the idea of actually producing a physical box was probably doomed to failure, more attention could have been given to helping teachers to see the importance of visual aids whose absence in the schools I have already deplored. May be it was not realized that the quotation from Bruner which has been paraphrased in Scope and Sequence:
"Every subject can be taught effectively and in an intellectually honest form to any child at any stage of development", was actually itself a quotation from Bärbel Inhelder, who added, in the case of mathematical topics, "provided they are divorced from their mathematical expression and studied through material that the child can handle himself" (from H. Freudenthal, in Developments in Mathematical Education, Report of the ICME Congress, p.113 (27)).

The project has attempted, but with only limited success, to urge upon teachers the importance of visual and tactile material in the teaching of mathematics, and the use of graphical and geometrical illustration alongside the more abstract numerical work.

6.2 International Co-operation

Aided by the already existing international role of the School of Education, right from the start the project sought and enjoyed the cooperation of the eight independent territories which comprise the Eastern Caribbean group of islands. The Round Table comprised a Jamaican, a Guyanese, an Antiguan, a St Lucian, an Englishman and an American; I have already commented on the consonance achieved in its work. I would imagine the project to be unique among educational experiments for the extent of this cooperation, not merely in a large conference discussing educational theory, but in the everyday rough and tumble of work with teachers and schools. It was also international in its genesis and funding, combining as it did resources derived from the University of the West Indies, UNESCO, and the British Centre for Educational Development Overseas (now merged with the British Council). The eight separate Ministries of Education all gave it their blessing and support, and the seven independent teachers' colleges incorporated its methods and often also its personnel into their system. It integrated education theories originating in the U.S.A. with Canadian ideas of school structure, a British examination system, and a West African series of texts. To complete the picture, its annual visitor from CEDO was a former teacher in Uganda and its evaluator a former professor in Malawi. UNESCO contributed an Asian as one of its early coordinators. One would have to stretch matters to go much further afield, but I have no doubt its meetings were often refreshed with tea from India or China, wine from France and coffee from Brazil. The world of mathematics is one world.

6.3 Cost effectiveness

1. One aspect of the international nature of the project has been the method of its funding. No less than thirteen different sources have contributed financially to its organization and running expenses:

8 territorial ministries:

Ministry of Education

Antigua
Barbados
Dominica
Grenada
Montserrat
St Christopher-Nevis-Anguilla
St Lucia
St Vincent

These have released teachers and paid their travel expenses, provided transport for the consultants (and for the evaluator) within their territories, made schools available for workshops, releasing teachers and classes from their normal school programmes for the purpose, allowed mathematics tutors from the training colleges to devote time and energy to writing and editing materials, besides assisting the project in other ways too numerous to mention.

The University of the West Indies

This through its School of Education has regularly hosted the meetings of the Round Table, and provided office accommodation and secretarial help. It has allowed both the academic staff and the secretarial staff of the School of Education to devote a large portion of their time to project work.

UNESCO

Through its Multi-media Centre in Trinidad help has been given to the project in the production of the draft editions of its modules, and through the personal services of, among others, its Graphics Expert, Mr William Tenney, much very valuable help and advice has been given to consultants and teachers concerning the drafting of effective publicity and booklets of all kinds.

CEDO

Besides providing the annual visits of Mr B J Wilson, through whose splendid work in the field of public relations much of this international cooperation has been achieved, CEDO has paid the salary and expenses of a West Indian consultant, the inter-island travel of others, and has supplied the JSP texts and project modules free of charge to the project schools.

The Ministry of Overseas Development, through the British Development Division in the Caribbean, has provided the salary and expenses of the Senior Consultant and the capital outlay for the establishment of the Tivoli Production Centre.

The Peace Corps provided the salary of Mr Schroeder during his time as consultant with the project.

2. The total cost to the British government over the four years of the project's life, from 1971 to 1975, amounted to less than £75,000. When this is compared, for example, with the cost of educational projects in this country sponsored by the Schools Council, it will be realized that this is money well spent. Quite apart from the transformation it has effected in the teaching of mathematics and in the attitudes of

teachers and children in the classrooms of junior secondary schools throughout the Eastern Caribbean, with an unpremeditated bonus in the shape of the various by-products I have examined in Section IV, the effect in the field of international cooperation is incalculable. Anyone who is familiar with the Caribbean will know that the great need of all the islands, both internally and in their mutual relations, is mutual trust and cooperation. The words quoted by G Hunte (28) are still true:

I am a West Indian patriot;
I believe in the West Indies.
But
I believe that my island
Comes first in the West Indies
Always.

In these circumstances to have brought together an international team of this kind and to have carried such an international enterprise to a successful conclusion is no mean achievement; its value cannot be measured in hard cash but in the intangible worth of peace and goodwill amongst men.

6.4 Observable effects

In this section I attempt to summarize the findings of the statistical enquiry, the full documentation of which is given in section 8.7.

The project has made mathematics a subject of concern rather than complacency, and has pin-pointed the areas of special weakness.

A high level of interest in mathematics has been maintained in the project schools, and mathematics lessons appear to be enjoyed by a majority of pupils in the upper streams.

There is a possible tendency for schools who have combined the use of project materials with that of more traditional courses to have succeeded slightly better than those who have done exclusively project and JSP work or exclusively traditional work, but the figures are capable of more than one interpretation.

The sampled classes have achieved a reasonable standard of accuracy in arithmetical techniques. They did not do well in questions which require an understanding of those techniques or of simple set theory.

The classes showed deficiencies in geometrical understanding and experience, and in the application of mathematics to practical affairs.

It was difficult to compare schools which had used project materials with those which had not, but where such comparision was possible, for example in Barbados, the differences were slight. A much more extensive investigation would be needed to establish any firm conclusions, and it would be difficult to ensure comparability and lack of bias between project and control groups. Indeed, one could say that there is now no such thing as a pure project class, and, contrariwise, few that have been wholly uninfluenced by it.

Some general conclusions, not specifically related to the project, which emerge from the enquiry, are of interest.

Boys scored slightly higher overall than girls, but the difference of 1.4% is only just significant at the 5% level. There is no evidence that girls are significantly less interested in mathematics, and this compares favourably with a comparable situation in south-west England where the difference is much greater.

There is a very marked difference between urban and rural schools in achievement on the test, though rural junior secondary schools achieved a slightly higher level than urban all-age primaries. There is also a larger turnover of teachers in rural schools, and in one, two children stated that they had had as many as 9 different mathematics teachers in the last three years.

6.5 Potentialities for the future

1. Personnel. There is now, in almost every island of the Eastern Caribbean, at least one person with adequate training and experience to guide the future development of the mathematics curriculum in their territories. If they can meet together regularly as a team with help, where necessary, from university staff and administrators, they could do much to maintain progress while ensuring that what is demanded of teachers is realistic and that the genuine needs of children are being met.

There is also a body of teachers trained in project methods, which although much reduced from its former strength is still sufficiently large to enable experimental workshops to continue and simple materials to be written. There are also many gifted teachers who have not had much experience of the project whose help could well be sought in constructing the much needed materials for the less gifted children. It should not be a matter of either "new math" or "trad math"; a proper synthesis is possible, and given goodwill on both sides, could be devised in the classrooms where it is needed.

There are also in every island adminstrators whose eyes have been opened by the project to the possibility of great improvements in mathematics teaching and curriculum, but who are hamstrung by tight educational budgets and by the transitory nature of the teaching force.

2. Materials. Copies of project materials in a usable condition are not always physically present even in project schools, for reasons that have been sufficiently explained. The modules are of course now commercially available, but their cost will militate against their widespread adoption. The teachers' guides deserve much wider use and dissemination than they have as yet received. In all the project schools that have applied for them, as well as in many others, there are physically present copies of the Joint Schools Project books 1-3 (but not the accompanying workbooks) which can be used with some of their upper classes. Materials suitable for the lower classes are inadequate in supply, unimaginative in content, and uninviting in appearance.

JSP Books 4 and 5 should be produced in a Caribbean edition, and when this is done the needs of pupils who are to be candidates for the new examinations of the Caribbean Examinations Council should be adequately met. To produce an independent series of textbooks on a local basis worthy to be compared with JSP demands a higher level of cooperation between the available resources over the whole Caribbean - not just the Eastern sector with which the project has been concerned - than seems at present feasible.

Nothing has as yet been done towards meeting the needs of the less academic pupils.

The materials of the St Lucia Mathematics Project go some way towards meeting the needs of primary schools, but they are incomplete, and contain some idiosyncracies which need to be subjected to a process of extensive testing and revision outside St Lucia before they could be recommended for general adoption. Nevertheless a commendable start has been made which could be used as a basis for a serious international effort.

Some experiments have been made in the production of individualized workcards in schools where conditions are suitable for their use, but at present there are many obstacles to their successful introduction. Classroom conditions, curriculum structure,

duplicating facilities, and the set patterns of teachers' thinking would all need extensive refurbishing before such methods could be used on a wide scale. Their judicious introduction is to be encouraged but, to my mind, a deliberate advocacy of mixed-ability groupings with reliance on individualized materials would, in the Caribbean situation, almost certainly produce negative results.

3. Resources for Learning. By setting a high standard in its own productions, by using experts in graphics, and by training teachers in effective use of graphics in their own materials, the project has done a great service to the whole educational field in the Caribbean. Assets for the future lie in certain specialized equipment, but more important, in the expertise of trained personnel.

It is gratifying to know that, while this report was being written, news has come to hand that the Ministry of Education in Grenada has installed Mr Kenneth Budhlall in a new Teaching Materials Production Centre which has inherited the equipment of the Tivoli Production Centre, and is thus making use of the expertise which Mr Budhlall gained under the project's senior consultant.

The former senior consultant has himself moved to St Lucia where he is being employed by the Ministry of Education to set up a similar educational resources centre. It is to be hoped that such reproduction by fission will be encouraged as skills are acquired and reputations built up, until ultimately every island will have a fully operative centre of this kind. The project is to be congratulated on showing the way.

4. Teacher-training. The project has established an esprit-de-corps in the teachers' colleges which permits a gradual rise in standards of entry and of qualification requirements. A start has been made in building up a body of teachers who are playing a responsible part in curriculum development, and if this can be continued it may help to enhance the standing of the teaching profession and to encourage an increasing sense of vocation in teachers of mathematics. The University School of Education, with its control of the qualifying examination, will play a crucial role in this. The more direct the contact that can be fostered between the School and serving teachers - or, even more desirably, between the University faculty of mathematics and serving teachers - the less danger there will be of teacher training becoming too involved in doctrinaire exposition of educational theory and too little concerned with the real problems of teaching relevant and applicable mathematics in the classroom situation as it actually is. "What is the best way of representing division on the number-line?" should take its place alongside "Where can a knowledge of division help the housewife when she goes to the supermarket to do her shopping?" Perhaps the newly revived Barbados Mathematical Association can point the way here; it could form a valuable link between the university faculty and school teachers in the island where the university campus is situated. Each group has much to learn from the other.

5. Inter-island co-operation. Financed from outside, the project was able to do much to bring teachers from the various islands together. It would be a pity if this habit of conference and collaboration were lost. There exists of course the annual conference of heads of training colleges, but more than this is needed; ideally a hundred-strong annual conference of mathematics teachers could achieve a very great deal. But this is economically impossible with inter-island distances, rising transport costs and impoverished budgets; but two fifty-strong conferences might be more possible with some outside help. However it is organized, in-service training on a regular basis - or better, in-service refreshment and renewal - is an indispensable part of curriculum development and should have the highest priority in all planning for the future. For, to quote again a favourite dictum of the project, curriculum is what the teacher actually does in the classroom, and that can only be influenced by changing the motivation, attitudes and capabilities of the teacher. He must be given new awareness, new knowledge, and new skills; his imagination must be stimulated, his sense of responsibility increased, his confidence built up. These things the project has sought to do with some measure of success, and their future continuation is vital. In the final reckoning, better teachers are more important than better diagnosis, better

methods, better content, better working conditions, better materials, visual aids, equipment, name what you will. For the teacher is a creative force in the educational process from whom all these other things ultimately spring. "Unless you show yourselves far better men than the Pharisees and doctors of the law, you can never enter the kingdom of heaven".

VII - FUTURE PROBLEMS

7.1 Formulation of Syllabuses

Since, as we have seen, the project has deliberately eschewed the laying down of any specific syllabus for Junior Secondary schools, it has left the various island administrations with an unresolved problem. This they have tackled in various ways. Barbados, for example, has set up a committee to formulate a syllabus, and it has already proposed overall objectives and topics for the first year; these are:

Number systems	Measurement
Number patterns	Solids
Integers	Foundations of Geometry
Decimals, Fractions, Percentages	Statistics

Their stated objectives include making mathematics relevant to the interest and experience of children, and cultivating the ability to apply mathematical knowledge to the solution of problems of social value. Grenada is concerned more particularly with the pressure for pupils to remain in Junior Secondary schools for a fourth year, and again emphasizes the need to relate mathematics to pupils' experience: eg home economics, carpentry, agriculture, business. St Lucia has some draft syllabuses dating from 1971-72 which are very abstract in tendency and are admitted to be in urgent need of revision; St Kitts' syllabuses are even older.

Since the project included most of the experienced mathematics teachers in the islands, it could in my opinion have been more active in helping with the construction of syllabuses without appearing dictatorial. As it is, the problem is being tackled piecemeal, and island by island. Where JSP is well established, its scaffolding will not be lightly dispensed with, but it is not suitable per se for the general run of JSS pupils and needs modification in the direction of more practical mathematics.

> A Caribbean-wide seminar on the construction of an acceptable programme for the less academic children in the upper years of the junior secondary schools is a matter of some urgency, and should include teachers of science and technical subjects as well as experts with this kind of background from other developing countries.

7.2 Needs of the lower streams

The whole education of the lowest 25% in the streaming system is seriously deficient. Many of these children arrive in junior secondary schools unable to read, and even with very limited comprehension of spoken English. They have endured for many years the treadmill of mechanical arithmetical exercises in the name of remedial treatment without ever gaining mastery. They are often given to the least experienced teachers, and grouped in the largest classes which are then assigned to the least suitable accommodation. There are some notable exceptions, and certainly there are many teachers who care desperately about their plight, but are helpless in face of the magnitude of the problem. Inevitably the C stream children are the first victims of every stringency or shortage. There is a great wastage here of human potential, to put it no higher. I am certainly more dedicated to the proposition that all men are different than to the proposition that all men are equal, if the latter is to be interpreted to mean that these children should be given the same educational diet as their more academic fellows; but at present they are often not receiving simple justice, and their principals have been the first to tell me so. Yet one school told me that most of their artists came from this stream, another showed me some skilful wood-carving that they had done, and a third found them interested and adept in the construction of geometrical models. But the project has passed them by.

There is a crying need for rethinking the educational programme offered to low achievers in Caribbean schools. It should include an effort to identify, train and encourage teachers specially gifted and dedicated to help children of retarded reading ability, and to devise practical and project work in which success could enhance their motivation.

7.3 Examinations and the Caribbean Examinations Council.

It is my belief that the complexities of the selective and school-leaving examination system, and the disproportionate importance attached to an 'O' level pass, exercise a baleful influence on the curriculum of junior secondary schools. I am not alone in this. The committee appointed in Grenada to report on a suggested fourth year programme for JSS's said, in the course of their report (29), "The committee question the practice of having students of the junior secondary school write the same examinations - under 14, and school leaving - as students of the all-age schools as a basis of entry into Senior secondary schools, Domestic Arts Institute, Technical College and Technical Centre. The committee is of the opinion that this system encourages the Junior Secondary School to 'prepare' students for these examinations". Their proposed solution of yet another examination to be specially set for this purpose at the end of the third year in JSS does not seem to me to solve the problem, unless it were backed up by a definite decision that pupils in JSS's would not be allowed to take any external examinations until the end of their third year. It is possible that this is what they intended, but they have not said so.

The Caribbean Examinations Council is a body set up in January 1973 by the governments of fifteen territories and consists of no less than 40 members. It is charged with the administration of examinations as requested by any or all of these governments, and also permitted to conduct examinations and award certificates as it thinks fit, or to invite any other examining body to do so (30). It is not at present thought desirable to do either of these things. The present climate of opinion is that the CXC should not ask for sponsorship from any outside body, but that the various governments should cooperate through a series of national committees in the production of a totally West Indian set of curricula, syllabuses and examinations. The Registrar, Major Rudolph Daniel, based in Barbados, is an able and experienced administrator, with whom I had a long and helpful interview. In view of the desire to be independent of outside sponsorship, it is not expected that the first examinations can actually be set earlier than 1979. Meanwhile discussions continue. The teachers' representatives on the Council and committees are for the most part urging that examinations be set at a number of different levels to suit the needs of a wide spectrum of candidates. I found myself urging the consideration of a CSE type of examination with much more emphasis on local project work and school-devised syllabuses of the Mode 3 type; the difficulty of course is to ensure comparability and acceptability of the certificates awarded in so varied a region. It is my firm belief that the purpose of an examination is to pass candidates, not to act as a criterion for employability, but to record and measure achievement.

Future upward development of the work begun by the project in mathematics must be coupled not only with the provision of suitable syllabuses, but also with a method of examining which will enable the achievements of pupils to be adequately rewarded. Careful consideration should be given to CSE syllabuses, especially those in Domestic and Commercial options, and which give due weight to environmental studies and socially related project work in mathematics. An examination should be regarded as a failure if less than 60% of the candidates receive recognition of success.

7.4 Stimulation and encouragement of teachers.

"The training of good teachers is far more important than the curriculum. Such teachers can do wonders with any curriculum: witness the number of good

mathematicians we have trained under the traditional curriculum, which is decidedly unsatisfactory". (Morris Kline, 31).

It is obvious that a reform can go no further than the teachers will take it. It is obvious that teachers themselves, however enthusiastic, are subject to constraints; in the Caribbean, these constraints arise from the physical conditions in which they work and the cognitive equipment they themselves possess. New methods are difficult to put into effect in crowded and poorly equipped classrooms; but we have seen examples where ingenuity has overcome these disabilities - where there's a will, there's a way. Again, new topics are not easy to teach when your own background is limited and your grasp of the new material marginal. It is easy to say that you can always read it up, but this is difficult when there is no library that has any relevant books and books ordered out of your meagre income may take six months to arrive. Repeatedly in conversation and in their answers to the questionnaire teachers have asked for continuation of the project workshops, or something akin to them; the workshops were the corner-stone of the C.M.P. edifice and deserve perpetuation.

> Every encouragement should be given to the establishment of regular teachers' centres, or at the least, periodic seminars, where teachers can discuss their problems together, consult an adequate library, borrow resource materials, and pool their expertise and experiences.

Teachers also require instruction and encouragement in their work; they need to have new material explained to them, and to be trained in the use of it. In-service training is one of the most desperate needs of the Caribbean system, because so many teachers are totally untrained without even 'O' level passes to their credit in fundamental subjects. Administrators are all aware of this; but one problem is the unattractiveness of teaching as a profession to many: the conscientious teacher in front of his class has a far more exacting job than a bureaucrat on the same salary level sitting at his desk, and he deserves to be appropriately encouraged and rewarded.

> Attention needs to be given to the salary structure of the teaching profession, including the provision of incentives for those who devote their time to development work, writing, and helping their colleagues with new materials. This could take the form of provision of sustenance and transport to enable them to attend regular workshops in their own or neighbouring territories.
>
> There should be a mathematics supervisor for the 11-16 age-group in every territory, whose brief should include in-service training of this kind. This post should not be held in plurality with a full-time teaching appointment at the teachers' college or elsewhere; it is a responsible and demanding assignment in which the right incumbent can make a valuable contribution to the educational system.
>
> A teachers' vacation seminar would be appropriate on an inter-territorial basis for instruction in the content, methods of teaching, and the place in the school curriculum of transformation goemetry, vectors and matrices, and statistics. More than one would be needed if all three of these topics were to be adequately covered.

The needs of teachers in training at teachers' colleges also merit re-examination. In many cases this is also in-service and not pre-service training. If it were possible to separate those who were destined to teach in junior secondary schools from their primary-oriented colleagues, it might be possible to give those who showed aptitude more mathematics than at present.

> A specialization equivalent to that existing for science teachers should be available for prospective mathematics teachers.
>
> In preparing the curriculum a due balance should be maintained between the

numerical and the spatial aspects of mathematics, and between its intrinsic structure and its applications.

The annual conference of Caribbean teachers' colleges could well reach agreement on a common mathematics syllabus for all the colleges, taking into account syllabuses now under discussion for junior secondary schools.

It is ideally desirable that a pass in mathematics on a modern syllabus at 'O' level should be a minimum pre-requisite for admission to a specialized training-college option in mathematics, and that a pass in such an option should be a normal requirement for a teacher of mathematics in a junior secondary school.

7.5 Metrication

1. Metrication has been in the air since the early days of the project, but nowhere has it yet seriously arrived. Mr B J Wilson in his report of February 1975 could say "There is marked increase in concern in the region over problems of metrication compared with my previous visits", and I am unable to add much to this. The concern is still there, but the islands await any action or pronouncements. Increasingly goods in the shops are packaged in litres and kilograms, but petrol (or rather, gasoline) is still sold in gallons, and U.S. gallons at that. An excellent set of notes on metrication for teachers was produced for workshops in Dominica by the Central area consultant, and the Tivoli Production Centre produced a booklet on Going Metric written by a Grenadian teacher. Further action is not in the project's hands, but it is needed; to quote Mr Wilson again: "a much larger scale and systematic programme is needed, and it is needed on a regional basis". These words are as true today as they were a year ago. I do not know of a primary school which has ceased to teach imperial units; what is worse, in one primary lesson I observed, the children were dealing with the full gamut km hm dam m dm cm mm in exactly the same way as they would have dealt with miles, furlongs, chains, yards, feet and inches.

2. As Mr Wilson himself recommended, the experiences of other English-speaking countries could and should be made available to the Caribbean territories, and they would be welcomed. Meanwhile, every effort should be made in primary schools to "think metric"; to handle kilogram masses, to measure with metric tapes, to drink water by the half-litre. In the statistical test, most respondents knew that one would measure the length of the island in km, but they were far less certain that you would measure the area of the classroom in m^2. Yet a metre stick is easily cut from any bit of bamboo.

3. It is worth repeating Mr Wilson's recommendation that a tour of the Caribbean should be arranged by a team of two; a member of the British Metrication Board and a member of the appropriate Jamaican committee. These could then confer with representatives of administrative, commercial, industrial and educational interests and joint action throughout the region could be expected to follow on their report.

7.6 Mathematics in the curriculum and in society

1. The school curriculum

I have given some evidence to show that the curriculum in the average Caribbean school tends to be overloaded - a feature common to schools in many countries, but exacerbated by the multi-racial and multi-cultural nature of Caribbean society. In the field of the humanities, West Indian history, European history, geography, social studies (which usually denotes a sort of local human ecology) are all clamouring for a place in the sun. They have strong claims in islands which have a history of long struggles between european colonizing powers written large upon their terrain, their language, and their social structures. In the field of linguistics, English, French and

Spanish all have legitimate claims. In the sciences there is a welcome move to integrate biology, chemistry and physics through the West Indian Integrated Science project (WISC). But the result is that mathematics often gets a much smaller share in the time-table than it would in a corresponding English school. Options do not begin to appear until years 4 and 5 of the secondary course - that is, until after the school leaving examination has been safely put behind the pupil.

> It is difficult to develop a worth-while mathematics syllabus for junior secondary schools on an allocation of less than five 40-minute periods per week, and this should be regarded as the absolute minimum.

There is also the problem created by the fact that the Caribbean lies in the intersection of British and American 'spheres of influence'. This shows itself in all kinds of amusing ways; some infant classes contain "students" while some sixth forms contain "pupils". (In passing, I may say that in this report I have tried to use "pupil" for all undergoing primary or secondary education, reserving "student" for those in tertiary education or in-service training. There is nothing to my mind derogatory about the term "pupil"; after all, Oxbridge undergraduates are "in statu pupillari"). Some schools have chalk-boards, and some have blackboards; while some have greying hardboards which are written on with crayons. Some children study modern mathematics while others are exposed to new math. But here the difference may be not only a matter of name, but also of substance.

> There is not really room in the limited school curriculum for a full diet of American-inspired study of mathematical structure combined with a full diet of British-inspired applications. It is my opinion that the project has erred too much on the side of the former, but the basic question has still be be answered: what kind of mathematics is best suited to the needs of the Caribbean junior secondary school child?

Another somewhat neglected field has been the interaction between the mathematics component of the school curriculum and the sciences, including geography. This I have already mentioned.

> In designing the content of the mathematics syllabus for the upper forms of junior secondary schools especially, the needs of the sciences, including geography, for specific mathematical knowledge and techniques should be taken into account.

2. The social milieu

It is of course impossible to predict what sort of mathematical equipment will be beneficial to the present Caribbean child in his future years of maturity. In a rapidly changing world, and a rapidly developing society, all we can do is to hazard guesses. But we ought not to solve this problem by evasion, inaction, or conformity to current mathematical and pedagogical fashions. I have the feeling that the project has given too little attention to this problem in its understandable enthusiasm for improving the methods of teaching an accepted body of materials, and for breaking it up into teachable units leading to the mastery of one concept at a time. I have given reasons to show that this may lead to a somewhat introspective attitude to mathematics. On the other hand the answers given by the teachers to the questionnaire reveal that employers of school leavers have scarcely ever made any comments on the changes brought about by the project in the school curriculum; it is probably too early to expect this. But one could suggest that facility in basic arithmetic will always be required; measurement, estimation and approximation will remain useful skills; increasing importance will attach to statistics, graphical display of information, intelligent use of maps, charts, plans and elevations; and there will presumably be an increasing demand for data processing and computer programming. Flowcharting, and

the logical organization of operations and schemata seem natural introductions to this type of thinking.

> Any future development of mathematics in the Caribbean needs to take seriously into account the employment prospects of school leavers, their mathematical needs in relation to the social milieu, and the uses of mathematics in the media of communication, mastery of which will be necessary to enable them to play an intelligent part as citizens, not only of their immediate territories, but of the world of humanity.

VIII - STATISTICAL DATA

8.1 GENERAL EDUCATIONAL DATA

1. Some basic statistics for each island

Island	Area km^2	Popn. 000	Density km^{-2}	Schools: Primary	Jun. Sec.	Govt Grmr	Pvt Grmr	Text-Books free	CE ages	School leaving age
ANTIGUA	280	65	230		6	1	3	-		
BARBADOS	430	250	580	118	10	10	19	✓	10-12	15 (17)
DOMINICA	750	70	90	55	0	2	3	-	11-13	15
GRENADA	310	96	310		1	1		-	11-14	
MONTSERRAT	100	12.3	120		2	0		✓	10-12	14
ST KITTS	168	23	135		3	1		-	11	14 (16)
NEVIS	93	12	130		2	0		-	11	14 (16)
ST LUCIA	616	101	162	74	7	4	1	-	11	14
ST VINCENT	345	90	260	60	3	2	9	-	11-13	15

2. June 1975 Teachers' College Examination results

(1975 results in brackets)

College		LITTC	ERDISTON	DOMINICA	GRENADA	ST KITTS	ST LUCIA	ST VINCENT
Number of candidates		17	132	34	49	23	56	57
Paper I (100)	(Mean	44.0 (34.5)	35.7 (36.8)	47.8 (32.4)	46.4 (37.1)	55.3 (50.1)	39.6 (39.0)	55.6 (45.2)
	(S.D.	10.4 (7.8)	14.0 (13.0)	13.0 (11.8)	15.6 (10.2)	14.4 (11.1)	11.1 (12.9)	10.2 (17.4)
II (30)	(Mean	18.3 (7.3)	13.8 (9.1)	16.5 (7.0)	12.5 (8.6)	19.6 (12.6)	12.3 (9.0)	18.5 (9.2)
	(S.D.	4.4 (6.0)	6.0 (5.6)	5.2 (4.2)	5.6 (5.7)	4.2 (5.8)	4.4 (4.6)	5.0 (6.8)
IIIA (25)	(Mean	8.5 (12.0)	10.2 (15.9)	10.4 (10.1)	10.8 (14.3)	13.4 (17.6)	10.8 (13.7)	11.6 (12.7)
	(S.D.	3.1 (2.4)	3.0 (3.9)	2.3 (3.1)	2.8 (3.9)	2.7 (3.1)	3.0 (3.9)	3.0 (2.7)
IIIB (30)	(Mean	16.5 (17.5)	14.2 (15.5)	16.2 (13.1)	18.5 (13.0)	18.3 (16.9)	16.9 (14.7)	15.9 (16.8)
	(S.D.	4.2 (3.0)	3.7 (3.7)	4.4 (4.6)	4.2 (3.7)	3.1 (3.2)	4.0 (4.2)	4.6 (3.4)

3. Data for teachers' colleges for year 1974-1975

College	LITTC	ERDISTON	DOMINICA	GRENADA	ST KITTS	ST LUCIA	ST VINCENT
Principal	Miss James	H Bayne	Mrs Harris	C Glean	Mrs Richardson	J Leonce	Mrs Providence
Teaching staff Full time	7	22	4	5	10	13	10
Part time	6	4	10	8	2	7	7
Students year 1	85	121	36	33	28	61	50
" " 2	17	103	--	50	32*	55	59
Maths tutors	1	3	1	0	1	2	2
Mins/week Maths	150	100/150	310	120/210	225	225	160

* Year following the full-time in-College year

4. O LEVEL RESULTS

Results of the June 1975 G.C.E. 'O' level examinations are available for three of the islands: Antigua (in part), Barbados and Dominica. They are in somewhat different forms for the three islands.

ANTIGUA

Total number of candidates entered: 545

Average number of subjects for which each candidate entered:

Number passing	0 subjects	223
	1 subject	144
	2 subjects	76
	more than 2	102

Average number of subjects passed per candidate entered: 1.3

Subject	Number entered	Number passed	% pass of subject entry	% Pass of 1 candidates
English Language	453	182	40.2	33.4
Mathematics	195	32	16.4	5.9
Biology	213	30	14.1	5.5
Chemistry	69	10	14.5	1.8
Physics	25	6	24.0	1.1

BARBADOS

Total number of candidates entered: 4658

Average number of subjects for which each candidate entered: 3.3

Average number of subjects passed per candidate entered: 1.3

Results for different types of school:

School type	Number of candidates	Number of subjects sat	Number of passes	Average subjects sat	% pass
Government	2135	8378	4079	3.93	48.8
Independent	1156	4104	1444	3.56	35.2
Total school	3291	12482	5523	3.80	44.3
Private cands.	1367	2760	512	2.02	18.5
Grand total	4658	15242	6035	3.3	39.7

Mathematics results:

School type	Syllabus A/B			Syllabus C		
	Number of candidates	Number passed	% pass	Number of candidates	Number passed	% pass
Older secondary	138	56	40.6	443	224	50.6
Newer secondary	0	0		76	10	13.1
Assisted Independent	112	24	21.4	55	16	34.4
Independent	14	1	7.1	15	4	26.7
Total	264	81	30.7	589	254	43.2

DOMINICA

Total number of candidates entered: 830

Total number of subject passes: schools 715
sixth-form college 96
private candidates 215
Total: 1026

Average number of subjects passed per candidate entered: 1.24

Subject passes (numbers entered for each subject are not known)

Subject	Number of passes			Percentage pass of all candidates
	Schools	SFC + Pvt	Total	
Agricultural Science	23	2	25	3.0
Biology	57	12	69	8.3
Chemistry	30	10	40	4.8
Commerce	22	18	40	4.8
English Language	145	76	221	26.8
English Literature	98	16	114	13.7
French	60	7	67	8.1
Geography	25	12	37	4.5
History	99	54	153	18.4
Mathematics	40	12	52	6.3
Physics	35	17	52	6.3
Religious Studies	42	8	50	6.0

15 other subjects figure in the lists, all with less than 20 school candidates.

It will be seen that two figures remain fairly constant in the wide variety of data shown by these three islands:

Average number of subjects passed by each candidate is about 1.3.

Percentage of total entry who pass in mathematics is about 6%

It is obvious that far too many candidates are entered for this examination who have no reasonable expectation of passing. These figures give no grounds for complacency. It is also noteworthy that the position of mathematics is not significantly different from that of the other sciences.

5. TEACHER TRAINING

Data relating to the seven teachers' colleges, 1974-75

College	Teaching Staff		First-year enrolment				
	Full-time	Part-time	Men	Women	Total	Under 26	Over 25
Dominica	4	10	12	24	36	2	34
Erdiston	22	4	35	86	121	109	12
Grenada	5	8	16	17	33	26	7
LITTC	7	6	12	73	85	62	23
St Kitts	10	2	9	15	24*	22	2
St Lucia	13	7	23	38	61	53	8
St Vincent	10	7	20	30	50	36	14
Total:	71	44	127	283	410	310	100

*Full-time year (third of four)

First-year intake is taken as the fairest basis of comparison, since some colleges had just started or just changed from one-year to two-year courses.

Data relating to training of 60 teachers of mathamatics in service in 13 junior secondary schools for which full data were available:

Untrained	Teachers' college	A level Maths Pass	A level Maths Fail	University Graduate	University Withdrawn	VSO etc
16	25	3	2	3	4	7

8.2 DATA ON SCHOOLS

1. SCHOOLS AND TEACHERS IN CARIBBEAN MATHEMATICS PROJECT

(Position as of May 1974)

Territory	School	No. Classes, No. Pupils Year 1	Year 2	Year 3	Teachers
Antigua	Antigua Grammar	3/134	3/139	1/36	R Wright, B Thomas E Thompson
	Clare Hall Jr. Secondary	3/100	2/83	3/106	B Soames, C Yates C O'Reilly
	Princess Margaret	3/119	3/95	1/43	F Baley, G Byam
	All Saints Secondary	3/95	3/91	3/110	M Josiah, L Sutton G Roberts
	Jennings Secondary	2/77	3/84	1/37	R Simon, R Matthew
	Pares Secondary	3/105	3/105	3/105	E Baltimore, H Francis
	Holy Trinity (Barbuda)	2/26	1/23	1/6	L Webber
Barbados	St Leonard's Boys' Comprehensive	2/7 5	2/75	-	D Thompson, Mr Cadogan
	St Leonard's Girls' Comprehensive	2/75	2/75	-	P Franklin, H Lythcott J Benn, L Harris
	Ellerslie Comprehensive	2/75	2/75	-	V Browne, E Cadogan Codrington
	West St Joseph Comprehensive	3/97	2/75	-	B Sahadath, A Collymore
	Princess Margaret	2/75	2/75	-	V Atwell, C Alleyne P Zaleski

Territory	School	No. Classes, No. Pupils Year 1	Year 2	Year 3	Teachers
Dominica	Dominica Grammar School	3/105	3/100	2/65	Mr Paul, Mr Richards, A James, Mr Shillingford, Mr Christian
	St Martin School	2/85	-	-	J Rene, L Bernard
	Colihaut Government School	1/30	1/30	-	Mrs Corriette Miss Shillingford
	Portsmouth Secondary School	2/75	2/70	2/65	C Stevenson, J Murphy H Green
	Palx Bouche Government School	2/70	1/25	-	J Alexis, Miss Bannis H Leslie
Grenada	St. Patrick's R.C. School	3/136	-	-	E Alexander
	Waltham Junior Secondary School	3/105	2/60+	-	Miss David
	St Paul's Govt.	1/56	-	-	R Street
	Hillsborough Jr Secondary (Carriacou)	3/99+	3/97+	3/107	J Ergen, Mr Benjamin D Bales, Miss Joseph
	Grenada Boys' Sec	2/70	2/70	2/70	Mr Fell
	The Grenville Group	-	-	-	R Charles, O Nyack, B Antoine, E George, M Belfon, F Davis T Calliste
Montserrat	Montserrat Secondary	2/63	2/50	2/35	E Fergus, R Snowden
	Salem Jr Secondary	2/52	5/130	-	G Irish, M Virelli

Territory	School	No. Classes, No. Pupils			Teachers
		Year 1	Year 2	Year 3	
St Kitts	Basseterre Jr.High	15/463	10/355	-	E Tyrell, M Warner E Nisbet, W Taylor, I Sweeney, J Lloyd L Twells, D Duncan, W Roberts, S Crossman
	Sandy Point High	5/150	4/115	3/90	L Lenski, R Halliday C Williams, L Benjamin
	Cayon High School	4/160	4/160	5/150	J Caines, A Parker, A Hamilton, J Percy
	Charlestown Secondary (Nevis)	4/146	4/141	3/109	P Nisbet, A Walters, J Neale, S Fahie, V Liburd
	Gingerland High (Nevis)	3/90	3/90	-	D Gilfillan, D Blum V Woodley, E Curtiss
St Lucia	Entrepot Jr Secondary	3/105	3/105	3/105	S Boyce, Miss Blanchard, J Anius
	Corinth Jr Secondary	3/105	4/140	3/105	A Harris, M Cenac, K Smith, P Felix
	Micoud Jr Secondary	5/160	4/120	6/175	L Labin, E Serrieux M Augustine, G Charles
	Vieux Fort Jr Secondary	3/105	3/100	3/100	P Stevens, S Backley H Regis, C Tertallien
	La Fargue Jr Secondary	3/110	4/120	-	E Joseph, D Allen K Francis, L Constantine
	Soufriere Jr Secondary	4/110	3/100	4/110	A Cenac, N Handkinson R Fuchs
St Vincent	Bourallie Jr Secondary	3/92	2/60	-	L Richardson, B Marksman
	Calliaqua Government	1/50	-	-	Mrs Jones, O Nanton
	Biabou Jr Secondary	3/120	-	-	R Sherpelz, E George F Ollvierre
	Kingstown Methodist	1/60	-	-	B Jackson, Mrs Walker

2. SCHOOLS IN THE CARIBBEAN MATHEMATICS PROJECT, THE TEACHING OF MATHEMATICS AS OF NOVEMBER 1975

Territory	School	Type	Selective Entry: Form 1	Form 3	Feeds Senior Sch	Principal	Project Mathematics Teachers	Total Numbers	Project/JSP Classes	Total Number	Mean Test Score	In-site Modules	Work-sets	Other Tests in use: Modern	Traditional	Observations	Classroom programme
ANTIGUA	Antigua Grammar School	US	/	—	AGHS	Mrs Lewis	Miss J Braithwaite Miss R Wright VSO C Bird	2/8 B126 G233	4 1G7 4/118 4/141	31	41.1		/	—	Harcourt Clarke	—	JSP Years 1, 2 Traditional in Year 2	
	Princess Margaret	UE	/	/	Joint classes with AGHS	Mrs Edwards	Mrs G Beam G Braithwaite C Hughes			32 33	49.7 42.3	/		—		B/C	Traditional	
	Clare Hall	UJ	/		Senior afternoon shift	Mr Downs	Miss Seamen Miss Dyett S Lee	307 morning	2/60 2/60 2/60	34	42.0	/	/	—		—	Arithmetic	
	Parea	RJ	—	—	—	Mr Cornwall J King	H Francis Mr E Belmmore	700	2/70 2/70 2/70 2/70 2/70	35 36	37.7 31.1			—		C	Traditional	
	All Saints	RJ	—	/	—	Mr V Benjamin	Mrs Joseph C Joseph G Roberts L Sutton	c 650	3/123 2/75 2 62 — —			/	—			A/C	Traditional	
	Jennings	RJ	/	/	—	Mr Samuels	Mr Francis Miss Anthony Miss Turner Mrs Ennett Miss Simon Home Econ	453	3/104 2/65 2/62 12/721 13/821			—	—	—		A	Arithmetic	Reverting to trad Maths.
BARBADOS	St Leonard's Boys	UJ	—	—	—	Mr Dowd	Mr Crichlow D Joseph Mr Barker	1801	4/145 3/119 3/98 13/1151 13/911	90 91	49.4 44.8	/	—	SMG	Chauncey & McLeish Smith NCA	A/C	B Trad C Arith.	No JSP
	St Leonard's Girls	UJ	—	—	—	Miss Watts	Miss L Harris Miss P Franklin Miss H Lysherst Mrs Cenac	1434	2/88 2/68 1/34 (1441) (1811)	07 93	46.9 46.3	—	—	Clayton & Sinclair	Schofield & Sims NCA	B/C	B Beta Maths C Arith.	Canadian 1964 tests in use
	Ellerslie	UJ	—	—	—	C W Braithwaite	Mr Brown Miss E Codrington Miss P Barrow Mrs Marten	1863	6/214 6/213 6/220 (237) (2841)			—	—	SMG (A) Clayton & Sinclair (B)	Walker & Miller NCA	B/C	Arithmetic	No JSP
	Princess Margaret	RJ	—	—	—	Mr Edey	V Atwell C Taylor Miss C Alleyne	1401 8696 G709	3/100 4/120 3/100 (2221) 11808	94	42.0	?	-					
	West St Joseph	RJ	—	—	—	Lloyd Austin	Mr Ray Mr Harris Mr Burke Mrs Johnson Mr Holder	1025	3/80 3/80 2/60 (2141 11811	95 96	45.4 38.8	/	—	Clayton & Sinclair		B/C	Arithmetic + Scottish Comprehension.	

Territory	School	Type	Selective Entry Form 1	Selective Entry Form 3	Fees Senior Sch	Principal	Physics Mathematics Teachers	Total Numbers	Present/ISP Classes/pupils	Test Number	Mean Test Score	In use Modules	In use Work Sht	Other Terms in use Western	Other Terms in use Traditional	Science syllabus	Classroom programming	
DOMINICA	Dominica Grammar School	US	/		Tech	Mr Alexander	Mr Goldsberry VSO Mr Richards R Brumey F Jones J Lockyer O Severin	568 8383 G206	3/121 4/154 3/113 3/82 3/107			Some	—	SMP 1 – 3 3Y YZ		B/C		Little JSP — Skills-mats in use "
	St Martin's	UP	—	—	/	Sister Ann Clement	Mrs R Barnard Mrs Delaney Mrs Tongue Mrs Solomon Miss Wilson Miss L Shakespeare		3/135 2/90 1/33	51	40.8	/	/			—		
	Portsmouth Secondary	US	/	—	—	Mr Bellamy	E Loblane F Watson Mr Abraham	345	2/90 3/90 2/50 1/20 1/20	52	48.4			SMP 1 – 6		C		
	Col-Aust	RP	—	—	/	R F J Sebastian	Rainbow Sebastian Miss Shakespeare	279 8136 G143	11/201 11/181 11/101	53	37.8	—	—		Waterford 1965	—	Hill domain syllabus	Now trad.
	Pere Beuche	RP	—	—	/	J Alexis	H Lasne	311	1/ 1/12 1/10	54	36.4	/	/	Worksheets in use		—	Devising own units	
GRENADA	Grenada Boys Secondary School	US	/	/	—	V Francis	Mr Chevalier Mr Lendore	c 530	3/90 3/90 5/120 2/40 3/72			—	—			A/C		
	Waltham Junior Secondary School	RJ	—	—		Mrs Ferguson (acting)	Mrs L Williams		3/85 2/56 3/90	81 82	26.3 22.8	—	—					No JSP tests
	St Patrick's RC Seniors	RP	—	—	/	Carlyle John	R Gumpet	1000				/	/			—		
	Tivoli RC Primary	RP	—	—	/	Mrs Joseph	R Charles Macdonald George G Ferguson		2/80 1/33 1/28	83	40.8	/				—		
	Belair Primary	RP	—	—	/	Lennox John	E George E Murray E Dore		2/48 2/50 2/38	84	36.9	/	/	Canadian 1984 tests		—		
MONTSERRAT	Plymouth Secondary	US	/	/	Tech	W Hoppie	Mrs Forgus G Terry VSO P White Mrs A Cassell	333	3/81 3/80 3/62 1/29	41	50.8	/	/			B/C		
	Salem Junior Secondary	RJ	—	—	/	A L Thomas (acting)	Miss C Meade Miss C Mason Miss C Ryan		2/46 3/80 2/53	42	40.3	/	/	US Geometry		—		

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Territory	School	Type	Selective Entry Form 1	Selective Entry Form 3	Feeds Senior Sch.	Principal	Present Mathematics Teachers	Total Numbers	Present/JSP Classes (numbers)	Test Number	Mean Test Score	In use [illegible]	In use [illegible]	Other Texts in use: Modern	Other Texts in use: Traditional	O-level syllabus	Curriculum programme
ST KITTS	Basseterre Junior High	UJ			/	Mr Richardson	Mrs M Warner Miss E Nisbet L Tuwits Miss A Martin W Roberts Mrs Lloyd A Dorre Mr Bridgewater	1276	14/412 14-400 8/250 4/150	11	50.7						
	Sandy Point Junior Secondary	RJ			—	Joseph Halliday	J Adolphus Halliday Mrs Rose Halliday Miss Purks PC Miss J Brown L Benjamin A Fahie	400	3/100 3/100 3/100 2/60 1/25	12	42 2	/		Hult & Marjoram		C	RSA
	Cayon Junior Secondary	RJ			—	Sydney Osborne	Miss E Fahie Miss J Camps A Jones VSO Miss A Hamilton Mr Cinaman	779	3/90 3/90 3/90 2/50 1/29	13	37.7	/				C	
NEVIS	Charlestown Secondary	US	/	—	—	Mrs R Amory	P Nisbett Miss V Daniel Mrs Stevens Mrs Rafters Miss M Hanley	761	4/131 4/130 2/48 1/21 2/38	21	38.6			JSP 45	Walker & Miller	C/A	Traditional
	Gingerland High	RJ	—	—	—	Mr Kirton	Mrs Weekley O Gilliam B Kelshi Miss B Coomes VSO	463	2/60 1/30 1/30 —			/	/		Walker & Miller	A	
ST LUCIA	Corinth Junior Secondary	UJ	/	—	Comp	Vern Gill	Mrs Conez Mrs Blackman P Fabin		2/34 3/99 4/107	61 62	42.9 29.4	—				—	
	Entrepot Junior Secondary	UJ	/	—	Comp	Rev. R Basdl	Miss Lebrun Miss Pascal	c.1100	2/40 2/ 5/			/				—	
	Soufriere Junior Secondary	RJ	/	—	/	Mr Chammagne	Miss C Farrar Miss G Augustine H Moses	376	3/96 4/130 4/150			—	—			—	
	Micoud Junior Secondary	RJ	/	—	VF SS	Arsenne James	Miss Lubin L George G James	386	4/97 4/108 5/180	63 64	46.4 37.1	—	—	SMG	Channon & McLeish Smith	—	Some geometry
	Vieux Fort Junior Secondary	RJ	/	—	VF SS	Watson Louis	Mrs P Sayers H Amadee M Williams	411	5/147 3/100 5/164	65 66	51.7 40.9	/	/		Channon & McLeish Smith	—	Devising programme
	Choiseul Junior Secondary (La Fargue)	RJ	✓	—	VF SS	Mr King Isgangi	J Francois Miss H Smith	1030	(11/375) (11/383) (7/252)							—	

Territory	School	Type	Selective Entry Form 1	Selective Entry Form 3	Feeds Senior Sch	Principal	Project Mathematics Teachers	Total Numbers	Project/JSP Classes/Pupils	Test Number	Mean Test Score	In use Modern	In use Work Bks	Other Tests in use Modern	Other Tests in use Traditional	O level syllabus	C'scream programme	
ST VINCENT	Barrouallie Junior Secondary	RJ	—	—	—	Mr Bayley	L Richardson Mr Schlosser PC Mr Jessop	280	3/90 2/60 2/80 (1/15) 11/81						Harwood Clarke	B		Revert to Trad. after Year 3
	Adelphi Junior Secondary School (Bilateral)	RJ	—	—	—	Mr Henry	J Bacchus L George Mrs Rodrigues PC	231	1/40 1/29 (3/83)	71	24.3				Hall & Severn	B		Revert to Trad. after Year 2
	Kingstown Methodist Primary	UP	—	—	—	Mr Morris	B Jackson Mrs de Silva	768	2/86 1/43 1/25	72	28.0	/				—		
	Calliaqua Anglican Primary	RP	—	—	—	Mr Mendonsella	Mrs Jones O Nanton	556	1/31 1/24 1/21	73	26.3					—		

School Types: U = Urban; S = Selective; P = Primary; R = Rural; J = Junior Secondary

Numbers of classes/pupils are based on order of senior years 1 – 5
Numbers in brackets are not (or not wholly) doing modern mathematics
Under O-level B/C means that at present syllabus B is taken, but next year's candidates will offer syllabus C.

No information is available for Holy Trinity J S S, Barbuda or Hillsborough J S S, Carriacou
St Paul's Government School, Grenada seceded from the project.

8.3 Calendar of Project activities

CARIBBEAN MATHEMATICS PROJECT WORKSHOPS

DATE	PLACE	TOPIC	LEADERS	NUMBERS
1971				
16-20 August	BDS	Induction	RDP, TLS, ED	20
30 Aug-3 Sept	ANT	Induction	RDP, TLS, ED	
Oct - Dec (fortnightly)	ANT	Number system	ED	8
19 Nov.	LUC	JSS Syllabus	TLS	
10 Dec.	LUC	Fractions	TLS	
14 Dec.	BDS	Fractions	TLS	
1972				
14 Jan.	BDS	Fractions	VM	10
14 Jan.	LUC	Fractions	TLS	
4 Feb.	BDS	Fractions	TLS	10
11 Feb.	LUC	Syllabus, fractions	TLS	
3 March	BDS	Mappings	TLS	10
10 March	LUC	Mappings	TLS	
17 March	BDS	Fractions	TLS	10
20-21 March	CAR	Fractions	RDP	
22-24 March	VIN	Fractions	RDP	9
22-24 March	KIT	Decimals	ED, AG	10?
5-7 April	ANT	Length	ED,TLS	8
17-19 April	KIT	Decimals	AG	
17-19 April	MST	Mass and capacity	ED	4
24-28 April	ANT	Primary, 4 rules	ED, AG	13
15-19 May	CAR	Decimals	RDP, ED	19
26 May	BDS	Test review	TLS	7
2 June	VIN	Prime Factors	RDP	14
12-16 June	KIT	Metric measurement	ED, AG	18
10-14 July	BDS	Writing Session	TLS	
31 July-4 Aug.	GRE	Ordered pairs	RDP	26
11 October	ANT	Length	ED	
25 Oct.	ANT	Area	ED	
27 Oct.	MST	Measurement	ED	8
27 Nov-1 Dec.	VIN	Area	RDP	21
1973				
Jan.	ANT	Graphs & statistics	ED	17
19-23 March	LUC	Fractions	TLS	19
5 - 6 April	CAR	Evaluation	RDP, IT	29
April	BDS	Editing Session	DB, WT	
7 - 8 May	GRE	Graphics	RDP, WT	43
11 May	GRE	Prime Factors	RDP	
18-22 June	ANT	Primary Mathematics	ED	8+
9-13 July	BDS	Teachers' Guides	DB	10
Frequently	GRE	Scope and Sequence	RDP	

DATE	PLACE	TOPIC	LEADERS	NUMBERS
1974				
4 - 8 Feb.	LUC	Box, geometry	TLS	22
17 Feb.	CAR	Metrication	RDP	c.25
March	ANT	Box	ED	4
1 - 5 April	KIT	Number bases	ED, JT	25
May	MST	Plane figures	ED	
20-24 May	VIN	Production	RDP	25
29 July-2 Aug.	DOM	Mappings, statistics	TLS	16
23-27 Sept.	CAR	Production	RDP	16
8 - 9 Oct.	MST	Metrication	ED	4
22 Oct.	ANT	Probability	ED	4
November	KIT	Vectors, flowcharts, transformations	ED	
18-20 Nov.	GRE	Scope & Sequence	RDP	36
18-22 Nov)	DOM	Scope & Sequence	GF	37
25-29 Nov)				
25-29 Nov	LUC	Production	RDP	16
1975				
January	ANT	Probability	ED	
14-17 Jan.	VIN	Scope & Sequence	RDP	
22-24 Jan.	GRE	Scope & Sequence	RDP	
30-31 Jan.	MST	Metric length	ED	
6 Feb.	BDS	Geometry	GF	c.10
11 Feb.	KIT	Geometry, integers	ED	
17-21 Feb.)	DOM	Geometry, mappings	GF	35
24-28 Feb.)				
26 Feb.	ANT	Film	ED	100
March	KIT	Integers	ED, RDP	
6-7 March	ANT	Production	RDP, ED	715
March	MST	Metrication	ED	
1-4 April	BDS	Statistics, transformations, film	GF	17
7 April	KIT	Mini-booklets	RDP, ED	20
7 April	KIT	Mappings, film	GF	8
14-28 April	LUC	Metrication	ED	
21-24 April	KIT	Statistics & Probability Film	GF	c.35
26-30 May	DOM	Diagnostic testing	RDP	
8-11 July	VIN	Statistics, Geometry	GF	c.35
August	DOM			

KEY:				
ANT	Antigua	DB	Desmond Broomes
BDS	Barbados	ED	Elvie Davis
CAR	Carriacou	GF	George Forde
DOM	Dominica	AG	Anil Ganguly
GRE	Grenada	VM	Victor Matthews
KIT	St. Kitts	RDP	Reg Payne
LUC	St. Lucia	TLS	Tom Schroeder
MST	Montserrat	IT	Isaiah Thomas
VIN	St. Vincent	JT	Jacqueline Taylor
		WT	William Tenney

8.4 List of Project Personnel

Project co-ordinator		Desmond R Broomes, Research Fellow, School of Education, U.W.I.
Chairman of Round Table		R M Nicholson, Vice-Dean, School of Education, U.W.I.
Senior Consultant		Reginald D Payne, Ministry of Overseas Development, Technical Assistance
Area Consultants		Miss Evelyn Davis, based in Antigua
		George Forde (from 1974), based in St Lucia
		Tom L Schroeder (to 1974), Peace Corps, based in Barbados
UNESCO Representatives		Anil K Ganguly (1972-1973), based in St Kitts
		E Himes (to 1972), Mathematics consultant based in Jamaica
		A C Collins (from 1973), based in Jamaica
		William Tenney, Graphics Arts Specialist, based at Multi-Media Production Centre, Trinidad
		A B Williams, Curriculum Adviser, based in Barbados
		J Hendry, Chief Technical Adviser, RLA 142, based in Jamaica
British Development Division		Stan Wood, Education Adviser, based in Barbados
CEDO/ British Council Representative		Bryan J Wilson, annual visitor
Island co-ordinators and associates		
	ANTIGUA	Morris Henry, S.E.O.
	BARBADOS	Vere Archer, E.O./Mathematics
	DOMINICA	Belgrave O Robinson, C.E.O.
	GRENADA	F Isaiah Thomas, Mathematics tutor, Teachers' College (to 1974)
	MONTSERRAT	Mrs E White Samuels, Ag C.E.O.
	ST KITTS	Mrs Jacqueline Taylor, Mathematics tutor, Teachers' College, and UNESCO counterpart in mathematics
	ST LUCIA	Miss Agatha James, Ag Mathematics supervisor, Ministry of Education
		Mrs Marjorie Thomas, Mathematics tutor, Teachers' College
	ST VINCENT	Mrs Winifred King, Mathematics tutor, Teachers' College
		Mrs Annette Liverpool, Mathematics Advisor, Ministry of Education

8.5 List of published material

1. Eight modules:

Prime Numbers and Factors	Measurement of Length
Multiplication of whole numbers	Measurement of area
Fractional numbers	Mappings
Decimal notation	Statistics

All the above are now published by Longman Caribbean Limited

2. Teachers' Guides to the above modules

published by U.W.I. School of Education, Cave Hill, Barbados and printed by Tivoli Production Centre, Grenada

3. Monographs

Growing Pains T L Schroeder

Defining teaching strategies for mathematics in developing territories D R Broomes

(Paper read to the annual conference of Mathematical Association of Nigeria, August 1973)

Mathematics, curriculum and evaluation: Caribbean experiences

D R Broomes, T L Schroeder, R D Payne
(Educational Development International, April 1974)

Some observations on the mathematics being taught in secondary schools in Antigua, St Lucia, Dominica, St Kitts and Montserrat, under the UWI-UNESCO-CEDO mathematics project. D R Broomes, November 1973.

Questions about the Caribbean Mathematics Project - a publicity folder of various items, March 1974.

The Dominica experience George Forde August 1975

The Box: a form and shape of the second-year mathematics materials for secondary schools D R Broomes

Scope and Sequence

Some data on Broomes' Survey test of arithmetic fundamentals R D Payne, 1975

Publicity folder produced in April 1974, containing:

Questions about the Caribbean Mathematics Project

A brief history of C.M.P.

Strategies of C.M.P.

Philosophy of C.M.P.

Film and filmstrips, C.M.P.

Schools and teachers in C.M.P.

The role of the Round Table in C.M.P. UWI, July 1975

Pedagogy of C.M.P. materials

Evaluation of Workshop, Barbados, August 1971 D R Broomes

Evaluation of Workshop, Antigua, September 1971 D R Broomes

A mathematical version of the parable of the sower
R D Payne and D R Broomes

UWI-UNESCO-CEDO Maths Project "About the project"
UWI December 1971

Eastern Caribbean Standing Conference report, 1973

An introduction to graphics for teachers Barbados, April 1973

Visuals Round Table, April/May 1974

Memorandum - Curriculum development and production centre: R D Payne

4. Materials produced for this evaluation, July 1975

History: Development of the modules

Operations in the field

The Mini-workshop

By-products of the project

5. Tivoli Production Centre publications include:

Even so are the young children	Mrs B Payne
Report on Curriculum development and material production - Windward Islands, Sept - Dec 1974	R D Payne
Profit and Loss	R Charles
Making Change	Grenville Group, sponsored by Barclays International Ltd.
Bottlers Cup, 1974	Sponsored by Bottlers (St Vincent) Ltd.
Getting on in business	Sponsored by Messrs Ramdhani
I am a tourist, too	Miss P Buxo, sponsored by Hotel Assn.
Stories from Tivoli	Tivoli RC Primary school
Stories from my island	" " " "
My hose is leaking	R Edgar
Tooth House, Our Teeth, Teeth thieves, Susan learns about teeth	Miss J Skelton, sponsored by Colgate-Palmolive Ltd.
Joy to Sorrow	Tivoli RC School
The search for "three and a bit"	" " "
Multiplication of Fractions	Chantimelle School
Handle with care	Tivoli RC School
Do metric	Waltham JSS

Going metric	Ruth Wright, A.G.S. Antigua
The people Columbus met here	Carriacou
Probability experiment using Bagatelle	Ruth Wright, Antigua
Planning to save	Ruth Wright, Antigua

A total of well over 100 titles were published in all.

6. 16 mm Colour Sound Film — "A way of looking", directed by D Ponting, University of Bristol, 1974

7. Four tape/filmstrip sequences — British Council for UWI: B J Wilson, John Hunter

1. Strategies of curriculum development
2. How a unit of work is produced
3. Teachers write booklets
4. Changing methods in the classroom

1. Cognitive test and intended to provide

CARIBBEAN MATHEMATICS PROJECT EVALUATION

First fill in your name, age, sex, school and class on your answer sheet.

This is not a formal examination.

Work straight through the paper.

Don't spend too long on any one question; if you can't see how to do it, go on to the next. Nobody expects you to be able to answer all the questions.

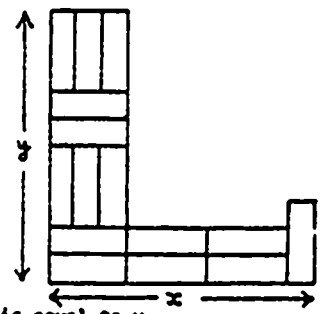
Most of the questions have four possible answers suggested; on your answer sheet put a ring round the letter which gives the right answer.

Example: 3 + 4 = ? a. 5 b. 6 (c.) 7 d. 8

YOU HAVE 80 MINUTES TO DO THIS PAPER

---

1. In the diagram, all the blocks are the same size - (congruent). Which is true?

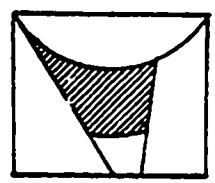


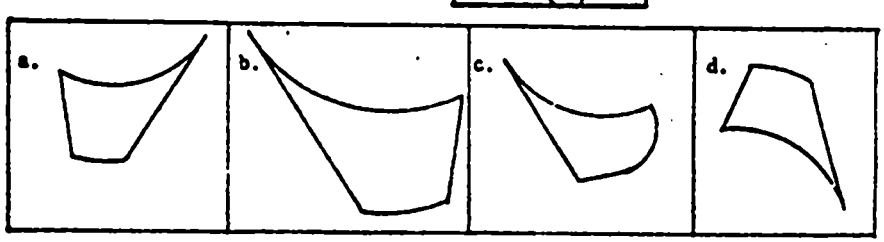
a. x is longer than y b. x is equal to y

c. x is shorter than y d. you can't tell

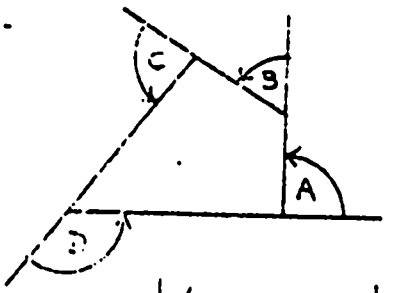
---

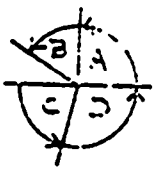
2. Which piece fits the missing (shaded) space?

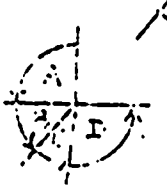


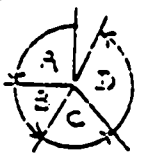


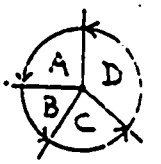
3. The four angles marked can be fitted together in one of these ways: Which?



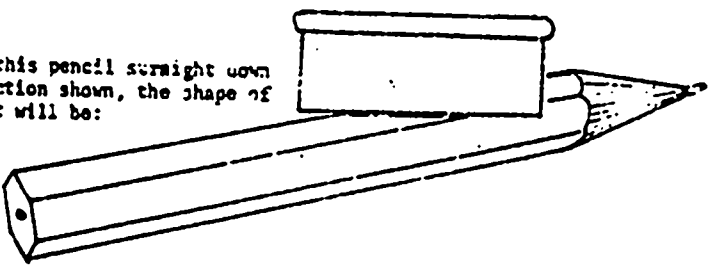
a. 

b. 

c. 

d. 

4. If you cut this pencil straight down in the direction shown, the shape of the cut part will be:



a. 

b. 

c. 

d. 

5. Which of these shows 28 written as a product of prime factors?

a. (1+2+4+7+14) b. (2+3+5+7+11) c. (2x2x7) d. 4 x 7

6. $\frac{4}{5} - \frac{3}{4} =$ a. $\frac{3}{5}$ b. $\frac{31}{20}$ c. $\frac{1}{1}$

d. $\frac{1}{20}$

7. What units would you use to measure

(1) the length of the island on which you live?

a. km b. m c. cm d. mm

(2) the area of your classroom floor?

a. km^2 b. m^2 c. cm^2 d. hectares

(3) the volume of a matchbox?

a. km^3 b. m^3 c. cm^3 d. litres

8. 19 x 31 is nearly equal to

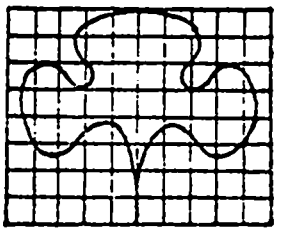
a. 100 b. 300 c. 600 d. 1000

---

9. Each square in the drawing represents 1 cm^2. The area of the leaf is about

a. 80 cm^2 b. 40 cm^2

c. 30 cm^2 d. 30 cm



---

10. Look at this table of a simple mapping.

1	2	3	4
5	7	9	

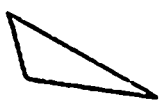
The missing number is most likely to be

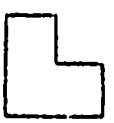
a. 10 b. 11 c. 12 d. 16

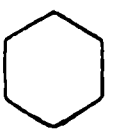
Can you be sure?

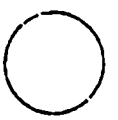
---

11. <u>One</u> of these figures will not tesselate the plane. Which is it?

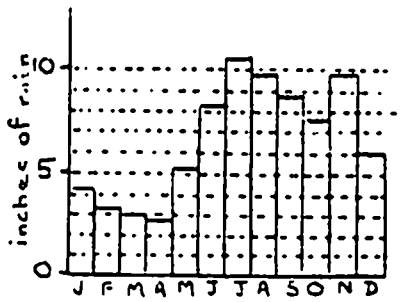
a. 

b. 

c. 

d. 

12. This diagram shows the average monthly rainfall in Dominica.



(i) Which is the wettest month?

a. June b. July c. August
d. November

(ii) How much more rain falls in the last 6 months of the year (July - December) than in the first 6 months (January - June)?

a. Over 75 ins b. Over 50 ins c. Between 25 and 30 ins
d. Under 20 ins

---

13. □ and △ stand for numbers and □ + △ = 5

(i) If □ > 2, then △ must be

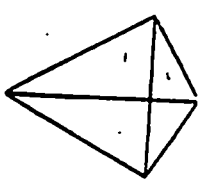
a. less than 3 b. more than 3 c. less than 5
d. either 3 or smaller

(ii) What is the value of 3 x □ + 3 x △ ?

a. 3 b. 6 c. 15 d. you can't tell

---

14. How many triangles are there in this figure?



a. 4 b. 6 c. 8 d. 9

---

15. To multiply 19.6 by 4.5, Michelle first multiplies 196 by 45 and gets (correctly) 8820.

(i) This answer is

a. 100 times the correct answer

b. 10 times the correct answer

c. $\frac{1}{10}$ times the correct answer

d. $\frac{1}{100}$ times the correct answer

(ii) The correct answer is

a. 882 b. 88.2 c. 8.82 d. 0.882

(iii) How much would I pay for 9 lbs pork at $1.96 per lb?

a. $8.82 b. $88.2 c. $176.4 d. $17.64

(iv) How long would it take to travel 88.2 miles in a boat which can travel at 19.6 miles per hour?

a. $4\frac{1}{2}$ hours b. 9 hours c. 45 hours d. 1700 hours

---

16. Which of the numbers

a. 15% b. $\frac{3}{10}$ c. 0.21 d. $\frac{1}{8}$

is the smallest?

---

17. A supermarket sells different brands of orange juice in cans. They are marked as follows:

	Brand	Capacity (ml)	Price
a.	Sunglo	500	$3.50
b.	O C!	400	$2.90
c.	Kool	700	$4.20
d.	Fullovit	1000	$6.80

Which seems the best value for money?

---

18. John used a stick 1 metre long to measure a rectangular piece of ground. He said that its length was 8m to the nearest metre, and its width was 5m, also to the nearest metre.

(1) Its real length could have been as little as

a. 8.5m b. 7.9m c. 7.6m d. 7.5m

(2) Its width was between

a. 450 and 550 cm b. 45 and 55 cm

c. 495 and 505 cm d. 400 and 600 cm

(3) The <u>smallest</u> area it could have had is

a. $28m^2$ b. $33.75m^2$ c. $39.5m^2$ d. $40m^2$

---

19. In the diagram on your answer sheet write down

(a) in circle A, numbers which are less than 40 and multiples of 6

(b) in circle B, numbers which are less than 40 and multiples of 9
(The lists have been started for you)

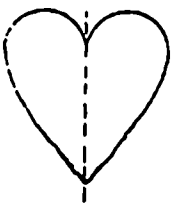
(c) If another circle C contained all the perfect squares, would any numbers be in all three circles?

---

20. Several figures are drawn on your answer sheet.

a. Underline the figures that can be drawn using just <u>four</u> straight strokes without lifting the pencil off the paper.

b. Put a ring round the figures that have a line of symmetry - that is, they can be folded about a line like this and the two halves will fit.



Mark the line of symmetry in the figures you have ringed.

In the space provided draw <u>another</u> figure, different from those above, which

a. can be drawn in 4 straight strokes <u>and</u>

b. has a line of symmetry.

CARIBBEAN MATHEMATICS PROJECT EVALUATION

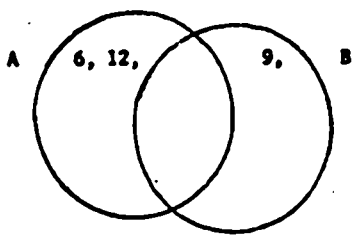
ANSWER SHEET

Name----------Age:----------Yrs.----------mths.

Sex: boy/girl School:----------Class----------

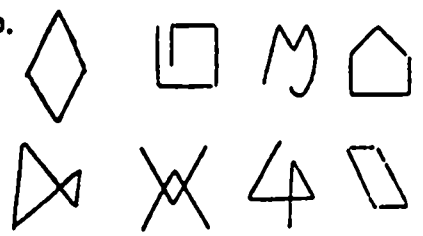
Question Number	Answer	Question Number	Answer
1	a b c d	12 (i)	a b c d
2.	a b c d	12 (ii)	a b c d
3.	a b c d	13 (i)	a b c d
4.	a b c d	13 (ii)	a b c d
5.	a b c d	14	a b c d
6.	a b c d	15 (i)	a b c d
7.(i)	a b c d	15 (ii)	a b c d
7.(ii)	a b c d	15 (iii)	a b c d
7.(iii)	a b c d	15 (iv)	a b c d
8.	a b c d	16	a b c d
9.	a b c d	17	a b c d
10. (i)	a b c d	18 (i)	a b c d
10. (ii)	yes No	18 (ii)	a b c d
11.	a b c d	18 (iii)	a b c d

19.



Numbers in all three circles

20.



Draw your own figure here

2. Affective test administered to schools.

The last column shows the factors (after Preston) to which the items were expected to contribute positively or negatively. (See next section)

WHAT DO YOU THINK ABOUT MATHEMATICS?

This is NOT an examination.

We would like to know what you think about your Mathematics classes; how you like to be taught; what you enjoy and what you find difficult, and so on. To help us, try to answer the questions as honestly as you can. Don't spend too long over a question, or check back to see if there was another question like it - just go straight through. You have HALF AN HOUR.

FIRST, fill in the details below.

NAME: ..... AGE: .....YRS .....mths.....

SEX: boy/girl SCHOOL: ..... Class.....

How many Mathematics teachers have you had in the last 3 years? .....

How many external examinations have you taken in the last 3 years? .....

Now mark with a / in the space opposite each statement the sentence which best describes what you feel about it.

	I entirely agree	I incline to agree	I am not sure	I do not agree	I strongly disagree	
1. Doing mathematics is like working a machine; there is only one right way.						A+
2. I prefer my teacher to teach the class as a whole						B-
3. I like doing as much mathematics as I can.						C+
4. The best way to learn mathematics is to find out for yourself.						B+
5. Mathematics is so different from other subjects, it should be taught entirely on its own.						B-
6. Learning mathematics is really just remembering what teacher says.						A-

	I entirely agree	I incline to agree	I am not sure	I do not agree	I strongly disagree	
7. My mathematics lessons have not been much use.						C-
8. In mathematics you need only apply the rules to get the right answer.						A+
9. Mathematics is very boring if you have to do a lot of exercises all alike.						A-
10. Mathematics helps you to sort out lots of different problems.						C+
11. The best way to learn mathematics is for the teacher to work examples and then for me to practice.						B-
12. Mathematics is like science, you need to learn it practically.						C+
13. Only people who can do mathematics should have to study it.						C-
14. The best thing about mathematics is when you can do a lot of sums which are similar.						A+
15. I enjoy doing practical experiments in mathematics.						B+
16. Time passes quickly when I do Mathematics.						C+
17. Mathematics is interesting because there are so many ways of doing things.						A-
18. I do better in mathematics when I work in a small group.						B+

	I entirely agree	I incline to agree	I am not sure	I do not agree	I strongly disagree	
19. Mathematics problems can often be done in many different ways.						A-
20. The rules of mathematics are just something you have to learn.						A+
21. I work hard at mathematics because it's an important subject.						C+
22. I don't like having to do things in mathematics which we haven't been shown how to do.						B-
23. Mathematics was necessary up to Standard 5 but not now.						C-
24. Mathematics is useful because it helps in everyday life.						C+
25. A good way to learn mathematics is to use it in other subjects.						B+
26. In mathematics you can sometimes make up your own rules.						A-
27. The most interesting part of the mathematics course is when you can try things out for yourself.						B+
28. Mathematics helps you understand things in science and geography.						B+
29. I don't really understand mathematics.						C-
30. Mathematics means solving problems by following the proper rules.						A+

3. QUESTIONS FOR TEACHERS.

Name School Class

1. How long have you been teaching CMP?
2. How long has this class been doing CMP?
3. Does all the school do CMP?
4. How long do you spend over the modules?
5. What have you done after the modules are finished?
6. Have you used JSP texts?
7. Have you enjoyed the Project work?
8. Have you helped in producing any of it?
9. Do you think your pupils have liked doing it?
10. What sort of Maths will your pupils have to cope with when they leave?
11. Has their Maths helped them to cope with everyday problems?
12. Has it helped their learning in other ways?
13. Has it helped them with other subjects?
14. Do you find your teaching methods have changed?
15. Do you think you yourself understand Maths better as a result of the project work?
16. Have teachers of other subjects made any comments?
17. Have parents made any comments?
18. Have employers made any comments?
19. Do you feel you need any more textbooks than you have?
20. Are textbooks provided for the children?
21. Have you held any examinations on the work?
22. If so, how have the children succeeded?
23. Is there a school leaving examination in Maths?
24. What do you think ought to be done next, now the project has come to an end?

4. Questionnaire on Teachers' Objectives

CARIBBEAN MATHEMATICS PROJECT EVALUATION

OBJECTIVES FOR MATHEMATICS TEACHING

There are various reasons for teaching mathematics to children aged 11-15; the following are some of those that have been put forward. It would be interesting and helpful for future development of the curriculum in mathematics if you could try to rank these in what you feel to be their order of importance, putting the most important first. Thank you.

NAME: SCHOOL:

a. To enable pupils to cope with the arithmetic of everyday life.

b. To help pupils learn other subjects, especially science.

c. To encourage pupils to reason objectively and logically, without emotional bias.

d. To enable pupils to communicate and discuss ideas involving quantitative and spatial relations.

e. To give pupils opportunity for creative design and organization.

f. To help pupils to use mathematical ideas in business, industry, and technology.

g. To enable pupils to enjoy an achievement of the human mind.

Order of importance

1	2	3	4	5	6	7	8

RESULTS OF THE QUESTIONNAIRE FOR TEACHERS

1. Ranking of seven objectives

Island	Number of rankings	Sum of ranks given to objectives a	b	c	d	e	f	g	Combined ranking order for island
ANT	10	29	53	36	35	49	34	44	a f d c g e b
BAR	9	23	49	24	33	47	29	47	a c f d e/g b
DOM	9	20	43	31	38	53	25	42	a f c d g b e
KIT	5	18	22	7	23	26	20	24	c a f b d g e
NEV	3	4	12	5	14	17	11	21	a c f b d e g
LUC	7	15	32	16	21	36	33	43	a c d b f e g
MST	8	19	29	13	41	37	36	49	c a b f e d g
TOTAL	51	128	240	132	205	265	188	270	a c f d b e g

For these 51 rankings the coefficient of concordance

$$W = 12\ \Sigma(x_i - m)^2/\{N^2n(n^2-1)\} \text{ with } m = 204,\ N = 51,\ n = 7$$

$$= 20590/\{51^2,28\} = 0.28,$$

which is significant at a level of less than 1%.

It is clear that consistently high priority is given to objectives a and c, and low priority to objectives e and g.

High priority objectives:

a To enable pupils to cope with the arithmetic of everyday life

c To encourage pupils to reason objectively and logically, without emotional bias.

Low priority objectives:

e To give pupils opportunity for creative design and organization

g To enable pupils to enjoy an achievement of the human mind.

It is also interesting to observe the two islands which placed at the bottom of the list

b To help pupils learn other subjects, especially science.

2. The general questionnaire

The results of this were rather disappointing for a number of reasons:

a. Unless I was able to contact teachers twice personally, it was not easy to get the replies returned to me.

b. In the light of experience, it would have been useful to send out a second improved questionnaire, but, because of (a), the response seemed likely to be small, so I did not do it.

c. Some questions were misleading and others ambiguous. For example, question 4, "how long do you spend over the modules?", envisaged that the modules would be used continuously at the start of secondary school, so expecting answers like "just over a year". As in fact scarcely any school uses modules in this way, the question was usually interpreted as "how long on the average do you spend over each module?". Again, question 5, "what do you after the modules are finished?", having the same pattern in mind, expected answers such as "turn to JSP Book 1", which did sometimes occur, but also provoked responses like "keep them in a cupboard"! Few teachers realized that to answer the question (17) "have parents made any comments?" with a bald "yes" was unhelpful, unless the comments were quoted; the question should clearly have been more specific. Question 19, "do you feel you need any more textbooks than you have?" was almost invariably answered with "yes", but in many cases it was clear from additional comments that what was meant was "we need more copies of the textbooks we are using". Still, some information was certainly obtained from the responses, even though it was mainly of this negative kind.

The answers are summarized, as best I can, below.

44 teachers responded to the questionnaire, apart from those who merely returned the sheet with the comment "I do not teach CMP" or similar.

Question

1. Answers ranged from 0 to 4 years, average 4.5 terms.
2. A pointless question; it depends what you mean by "this class".
3. In all but 6 cases, no; even in those 6, CMP was taken to include JSP.
4. An average of 3 weeks per module; even so, few finish the modules in the first year, because they are always supplemented.
5. Commonest answer "make up more exercises", because question misunderstood.
6. All but 7 answered yes.
7. 3 did not answer; 9 doubtful, 31 yes, 1 "very much so".
8. 12 answered yes.
9. 7 did not answer; 6 said "some of it"; rest "yes".
10. Most answered "practical arithmetic" or equivalent.
11. 18 yes, 10 some, 13 no answer, 3 no.
12. 28 yes, 5 doubtful, 10 no answer, 1 no.
13. 28 yes, 4 "a bit", 10 no answer, 2 no.
14. 32 yes, 3 "a bit", 7 no answer, 2 no.
15. 36 yes, 1 doubtful, 6 no answer, 1 no.
16. Many said "yes", but only one gave an instance: "modern maths is a waste of time".
17. 13 answered "yes", but only two gave instances: "parents are worried", "because they can't help their children".
18. 8 "yes"; no instances given.

19. Almost unanimous "yes"; but the only textbook specified was "something for the slow learners". See my comment above.

20. Often misunderstood.

21. Yes in all but four cases.

22. Not a very sensible question, but most teachers regard the examination results as encouraging.

23. Invariably "yes".

24. The most common suggestions were for syllabuses produced at local level; for subsidised teachers' meetings to continue; for seminars in the content of the new material. Some asked for things such as workbooks to accompany the JSP texts, and teachers' guides, which already exist and have been supplied by the project but have not reached the schools where these teachers are working.

There is often considerable ignorance about teaching aids which are already available, as there is about textbooks which are thought not to exist, because no publicity has been given to materials for which no money is available to purchase. The following suggestions are made in an attempt to alleviate this lack of information.

SUGGESTED BOOK-LIST

FOR

MATHEMATICS LIBRARIES

The following are suggested as suitable books for the libraries of Teachers' Colleges and Secondary Schools, where they are not already on the shelves. They are mainly British; I am not so familiar with U.S. and Canadian books, but in any case many libraries are already well stocked with these.

School Texts (courses)

School Mathematics Project	Books A - H, X, Y, Z Teachers' Editions	Cambridge
	Books 1 - 5 and Teachers' Guides	"
	Additional Mathematics Books 1 - 2 and Teachers' Guide	"
Scottish Mathematics Group	Books 1 - 8 and Teachers' Guides	Blackie
Joint Schools Project	Textbooks 1 - 5, Workbooks 1 - 5 Books 4S, 5S and Teachers' Guides	Longman
New Mathematics for Secondary Schools	Books 1 - 5	Snell & Morgan, Cambridge
Pattern and Power of Mathematics		Neill, Moakes Macmillan
Contemporary School Mathematics	Sherlock, Bailey	Edward Arnold
Mathematics for the Majority	(7 units)	Chatto & Windus

Topic Books

Caribbean Mathematics Project	8 units	Longman
Mathematical Topics for Modern Schools	James	Oxford
Making Mathematics	Paling, Banwell & Saunders	Oxford
Topics from Mathematics (series)	D Fielker & J Mold	Cambridge
Experiments in Mathematics Further Experiments in Mathematics	Pearcy & K Lewis	Longman
Machines, Mechanisms & Mathematics	Bolt & Wardle	Chatto & Windus
We Built our own Computers	Bolt	Cambridge

Teaching, Reports

Mathematics Eleven to Sixteen	Maths Association	1974	Bell
Primary Mathematics, a Further Report	" "	1970	"
Mathematical Laboratories in Schools	" "	1968	"
The Same but Different	Quadling		"
Notes on Mathematics in Primary Schools	A.T.M.		Cambridge
Primary Mathematics Today	Williams & Shuard		Longman
Mathematics for Older Children	Biggs		Macmillan
Mathematics for Younger Children	"		"

National Council of Teachers of Mathematics, Yearbooks, especially 18th Multi-sensory aids
24th Growth of Mathematical Ideas
26th Evaluation

28th Enrichment Mathematics for High School
29th Enrichment Mathematics for Grades
32nd History of Mathematical Education in USA and Canada
34th Instructional Aids in Mathematics
35th The Slow Learner in Mathematics
36th Geometry in the School Curriculum

Schools Council Examinations Bulletins (Methuen),
especially 23 Common System of Examining at 16+
25 CSE Mode I examinations in Mathematics

Examinations and Assessment ATM

General

Modern Mathematics and the Teacher	Lucienne Felix	Cambridge
Mathematics, Society and Curricula	Griffiths & Howson	"
Some Lessons in Mathematics	Fletcher et al	"
Mathematical Reflections	"	"
The Language of Mathematics	F W Land	Murray
What is Mathematics?	Courant & Robbins	Oxford
Modern Mathematics	Fuchs Weidenfeld & Nicholson	
Vision in Elementary Mathematics	Sawyer	Penguin
Mathematician's Delight	"	"
Prelude to Mathematics	"	"
The Fascination of Groups	F J Budden	Cambridge
Transformation Geometry	Jeger	Allen & Unwin
Freedom to Learn	Biggs & MacLean	Addison Wesley

Periodicals

Mathematics Teaching (£6 p.a.)

Association of Teachers of Mathematics
Market Street Chambers, NELSON,
Lancashire BB9 7LN, England

Mathematics in School (£4.50)

Subscription Manager
Longman Group Ltd., Journals Division
43-45 Annandale Street, EDINBURGH
EH7 4AT, Scotland

Arithmetic Teacher)
Mathematics Teacher) US$11.00 membership
+ $5.00 each journal
or $13.00 each journal

National Council of Teachers of Mathematics
1906 Association Drive, RESTON
Virginia 22091, U.S.A.

8.7 Results of the statistical enquiry

Three specific instruments were used to obtain information about the progress of the project:

1. A cognitive test (Paper 1) of 35 items administered to 1260 pupils;

2. An affective test (Paper 2) of 30 items administered to the same group as paper 1;

3. A questionnaire addressed to teachers.

These are all reproduced in the preceding section, where the results of the teachers' questionnaire (instrument 3) have been discussed. We are now concerned with a detailed examination of the results of Papers 1 and 2.

1. General comments. I was only in the Caribbean for a short time, and it was not possible to do more than get a general idea of the "feel" of the situation before devising items for the various tests. Pilot experiments were ruled out by the time factor, and also it was not possible to process the data obtained locally; the enquiry was therefore very much a hit-and-miss affair. In the light of experience it would now be possible to devise more appropriate instruments of enquiry, but the difficulty of getting adequate and honest responses to questionnaires and of ensuring fair administration of large-scale testing procedures would still remain.

In the event it is greatly to the credit of the administrations and the teachers in the various islands that all the scripts in response to papers 1 and 2 were duly returned. The parcel from Grenada was delayed in the post and only reached me on the last day before I packed up to leave Barbados; the packet was therefore brought home complete, which enabled me to obtain a full factor analysis on paper 2 for this one island. Schools in St Vincent were closed for a lengthy period of five or six weeks through a teachers' strike over a pay agreement. The island coordinator very nobly administered the tests as a matter of urgency as soon as they returned to work, but in such abnormal conditions it is hardly surprising that the results were disappointing and uninformative. This was particularly regrettable in that St Vincent was one of the islands in which it had been thought possible to conduct a proper controlled experiment with parallel classes related and unrelated to the project. The same strike precluded my making a second visit to St Vincent.

2. Data processing. My thanks are due to Lancaster University for according me facilities on their computer and through their direct link with the UMRCC machine at Manchester. I am particularly indebted to Dr Yerkess for a great deal of expert advice and for organizing the whole operation; also to Dr Ann Trown for help in selection of appropriate statistical methods and interpretation of the results.

In consequence of the low priority accorded an outside investigation such as this in competition with the backlog of normal university business, the final results were considerably delayed. A few minor errors (eg a few mispunched cards, probably not more than 5 in all) were then revealed, and also some places where there was a case for a rerun of the analyses with the exclusion of certain anomalous data. However, in view of the already considerable delay, and the somewhat insecure nature of the whole experiment for the reasons stated in paragraph 1, I felt that further investigation and further delay were alike unjustified. The results are therefore submitted just as they are, but the original data are available if it is thought worth while to submit them to further analysis.

3. Paper 1

This paper proved a satisfactory instrument for discrimination and revealed a good deal that is of interest.

a. Item-by-item analysis (Table 1).

The easiest item proved to be number 15 (q.12l) - identification, from a column graph of monthly rainfall, of the wettest month; closely followed by item 22 (q.15iii) which required the multiplication of 1.96 by 9. Also giving high scores was item 10 (q.8) - estimating 19 x 31, though of course there was nothing to prevent the actual multiplication being carried out. Most difficult was item 31 (q.19iii) which required the identification of 36 as the only perfect square less than 40 which is a multiple both of 6 and 9. The low scoring rate also on item 30 suggests a mental block against regarding the overlap of two circles as the region which is inside both of them. It is noteworthy that the primary schools succeeded better on item 31 than the secondary schools - perhaps because they have more practical experience of work with Venn diagrams. All parts of question 18 (items 26-28) were poorly done, which suggests a neglect of the important concept of accuracy. Item 19, which asked for a simple count of triangles in a figure, proved surprisingly difficult, maybe because a triangle is thought of, not as a set of three points, but as an open three-sided space with nothing inside it. It is not surprising that there were few correct answers to item 13 (q.10il); maybe the question should not have been asked, because it is impossible to distinguish those who answered "no" because they realized correctly that the images of a mapping are arbitrarily assignable from those who were merely timid and would never be certain about anything.

An overall average score of just under 40% is perhaps a little disappointing. If generalizations are permissible, I would say that there is a good level of technical competence at arithmetic (though it is regrettable, in view of the project's emphasis on understanding the number system, that twice as many can get the correct answer to the decimal multiplication in question 15ii as can show that they understand why it is correct by correctly answering question 15i); but there is weakness both in application and in any question where geometrical intuition is called for. This tends to bear out my contention that the emphasis of the project has perhaps been rather lopsidedly numerical.

b. Sex-differences and different responses from different school-types.

(Table 2).

Several items show significant differences between boys and girls, the girls scoring better on items 4, 6, and 21, and the boys doing better on items 2, 7, 8, 9, 23, 27, and 32. Perhaps one could draw a general conclusion from this that boys are better at applications generally, and they certainly seem more familiar with metric units.

Schools were divided into five types:

US Urban selective - having an entrance examination or other selection procedure.

UJ Urban junior secondary - taking all comers

RJ Rural junior secondary

UP Urban all-age primary schools

RP Rural all-age primary schools

To some extent the distinction between urban and rural is subjective. There is a clear tendency for the order of overall achievement to coincide with the order of school types in the list given above; they have in fact been arranged in this order to show this - originally UP was numbered above RJ. Table 2 shows the item scores where the trend is significantly reversed; ie, where US and UJ have scored significantly below the

mean or where RJ, UP and RP have scored significantly above it. These probably reflect familiarity or otherwise with different parts of the syllabus.

c. Analysis by taxonomic groups (Table 3)

Paper 1 was constructed and balanced by allocating items on a Bruner-type taxonomic matrix by subject-matter and level of cognitive skill being tested. The grouping by cognitive level is shown in the table - admittedly subjective - each item being allocated to the group corresponding to the highest level of skill it was thought to test. Thus, most items require knowledge of some kind; group A contains those that require little else, and so on.

In order to test the effect of project work, a sub-sample consisting of the schools from Barbados, Grenada and St Vincent was previously identified as containing a cross-section of classes who had had full, partial, or no connexion with the project. These 637 scripts were subjected to a full threeway analysis of variance for each taxonomic group of items, by sex, age, and relation to the project. As already explained, the results from St Vincent were very poor, and as the island contained only classes in group P (full project classes) and group N (no connection with the project), the scores in these two groups are unduly depressed in relation to group S. Again for reasons stated, it was felt to be not worth while to repeat the analsis omitting St Vincent, but it is possible to show that for the total scores, the three groups are not significantly different. This of course is a somewhat negative conclusion. No doubt it would be possible to devise a test more closely aligned to the project modules (and jargon!) which would give greater advantage to project schools. In fairness, however, it must be said that the paper was devised to cover the ground of the project modules and the contents of JSP book 1 and the recommended part of JSP book 2; yet overall the project schools do not seem to have scored any higher than schools which have been taught entirely from traditional texts. If St Vincent is included, their scores are significantly worse. What this means in the conditions prevailing after a six-weeks closure of schools, I do not pretend to know.

Sex and age distinctions are presumably unaffected by the anomalous conditions in St Vincent. The results as shown in Table 3 do not really contain any surprises; girls are more accurate than boys at manipulative techniques, but boys are much happier in applications to everyday life. Young pupils are at a marked disadvantage on a paper which covers a wide syllabus, while those who are 15 and over and are still in form 3 are probably low achievers for whom life is a struggle to maintain the status quo. There is overall weakness at those questions which were thought (by me) to involve some measure of imagination, intuition, or inventiveness.

4. Paper 2

This paper was not satisfactory as a test of attitudes towards mathematics and different teaching methods. Its history is as follows.

The paper was based very closely on a questionnaire administered to CSE candidates in South-west England in connexion with an investigation undertaken by Dr Michael Preston, now at Charlotte Mason College, Ambleside. A full Hotelling factor-analysis of the answers to this questionnaire yielded a satisfactory identification of three principal factors:

A exploratory / algorithmic attitude to mathematics

B preference for open-ended / circumscribed teaching-learning situations

C overall commitment / apathy towards mathematics

The questionnaire was a pruned selection from a much wider set of questions in the light of a pilot experiment undertaken by Dr Preston. It would have been better to have undertaken a similar pilot experiment in the Caribbean, but the time factor, and the impossibility of processing intermediate results in the time available, prevented this being done. I therefore took the 30 items which were strongly contributory to Dr Preston's factors, positively or negatively, simplified their English where necessary, and arranged them at random to form paper 2. It was intended that six items would contribute positively and four negatively to each factor, and the answers were to be recorded on a five-point scale as shown in the paper.

For each script a three-component vector was obtained by simply adding the scores with the appropriate signs for the ten items whose main loadings had been identified by Dr Preston on the three principal factors. It soon became apparent that, in the case of factors A and B, very low values of the vectors were being obtained. This was because contradictory questions, intended to contribute with opposite signs to the vector, were being repeatedly answered similarly - ie with strong agreement with both, or with strong disagreement. It seemed as if an overall tendency to be a yes-man or a no-man was masking the more interesting attributes. It was also clear that the questions were not being intelligently considered. For example, question 9 "Mathematics is very boring if you have to do a lot of questions that are all alike", to judge by its correlation coefficients with the other questions, was often taken to mean "Mathematics is boring because you have to do a lot of questions that are all alike", or simply "Mathematics is boring".

This discovery came too late to do anything about it. Also I felt that even with a better questionnaire there was no guarantee of better results - the attitude to questionnaires on the part of the pupils being every bit as important as their attitude to mathematics. But it seems clear that there are enough differences between the children of Devon and Cornwall and of the Caribbean islands to render very doubtful any conclusions to be drawn from Paper 2.

By an accident it so happened that the Grenada scripts were delayed in the post and brought back to England for scrutiny. This made it possible to carry out a proper factor analysis on them. This was done, and the result was not very satisfactory. The Hotelling matrix showed a continuous spectrum of eigenvalues from 4.6 down to 0.25, with ten of them greater than unity. No very clear factors could therefore be identified, and the principal eigenvalue yielded a vector which was negatively loaded on all the items except the first one - ie a general tendency to disagree with everything, or of course to agree, the choice of sign being quite arbitrary. The FACTAN procedure in the UMRCC package PMMD4 finally yielded the factor matrix shown in Table 4; factor 1 seems to indicate general interest in mathematics, factor 2 interest in applications, and factor 4 a tendency to limit mathematics to useful arithmetic. Scores on all the factors increase steadily in the sequence of school-types P → S → N; since most of the loadings are positive this may indicate merely an increasing tendency to agree with everything in the more traditional schools.

Finally, the scores on the vectors A, B and C for each class are shown in Table 5. Any individual script could show a score ranging from -20 to +20 on each of the three vectors; scores of +20 on C were in fact recorded. Random answers would produce very low vectors; an answer "I strongly agree" to every question would produce A = -4, B = +4, C = +4.

It will be seen that there has been reasonable consistency in the case of vector C - overall commitment to mathematics, and levels here are probably meaningful. In the case of the other vectors, there has been confusion and a good deal of background "noise" from irresponsible answers, so that no message can be clearly distinguished. Some reasons have already been given for this; there are probably others - eg it makes little sense to ask question 18 - "I do better at mathematics when I work in a small group" - to a child in an all-age primary school with classes of 40. Experientia docet.

Even when allowance is made for children giving the kind of response they think is expected of them - eg to question 3 - it is still I believe possible to say that for the great majority of the sampled pupils mathematics is regarded as both important and interesting. Pares, Clare Hall, Portsmouth, and supremely St Martins, like an experimental approach, whereas Grenada, St Vincent and most of St Lucia tend to think of mathematics as "doing sums". Not surprisingly, a lower level of commitment to the subject tends to be associated with a preference for more traditional didactic methods. I leave it to others to discuss which is cause and which is effect! Further generalizations would seem to be hazardous.

5. Island differences

These are summarized in Table 6, and have been alluded to under section (h) in the island-by-island survey of Section 5.4. The table speaks for itself without detailed comment, but it should perhaps be emphasized that the differences between the islands are greater than those between the project and the non-project schools.

References:

M. Preston "The measurement of affective behaviour in CSE Mathematics" Ph. D. thesis, University of Leicester, 1972.

Nuttall and Skernik Examination and Item Analysis, NFER, 1969

TABLE I

PAPER I - ITEM BY ITEM ANALYSIS

Question	Item	Tax. Gp	Total √	% √	Percentage Girls	Percentage Boys	Correct B>G Sig	Responses US	UJ	RJ	UP	RP	% Significance against trend
1	1	C	864	68.6	68.8	68.3		75.9	73.6	71.9	51.9	56.6	0
2	2	D	385	30.6	28.1	33.8	• 3	40.0	38.5	27.3	28.2	16.1	
3	3	C	721	57.2	55.7	59.2		61.0	59.1	60.0	45.5	51.0	
4	4	E	468	37.1	39.8	33.6	- 2.0	23.5	31.1	40.2	53.8	37.1	0 1.0 0
5	5	B	636	50.5	50.7	50.3		39.8	54.0	51.2	46.8	56.6	0.3
6	6	B	678	53.8	58.0	48.6	- 0.1	69.0	62.2	50.2	48.7	59.0	
7I	7	A	562	44.6	38.6	52.1	• 0	46.0	59.5	33.9	57.0	35.0	0.1
7II	8	D	570	45.2	41.3	50.1	• 0.2	57.2	54.1	40.8	38.0	31.5	
7III	9	D	658	52.2	48.6	56.8	• 0.0	66.9	60.5	50.0	36.5	41.3	
8	10	B	982	77.9	78.6	76.8		88.0	85.1	74.7	71.2	69.9	
9	11	C	460	36.5	34.6	39.2		44.0	46.6	34.1	32.7	19.6	
10I	12	C	897	71.2	72.0	69.9		81.9	80.0	71.3	59.7	52.0	
10II	13	B	137	10.9	10.2	11.9		3.6	10.5	12.0	10.9	14.7	0.1
11	14	E	643	51.0	51.0	51.2		54.2	52.0	50.0	50.6	47.6	
12I	15	A	1093	86.7	87.0	86.2		94.6	94.6	85.9	70.5	81.8	
12II	16	B	460	36.5	37.0	36.0		42.8	49.3	33.5	29.5	20.3	
13I	17	D	403	32.0	31.6	32.5		36.8	31.1	28.5	41.0	30.1	1
13II	18	C	338	26.8	25.7	28.6		31.9	34.1	24.3	19.2	23.1	
14	19	A	136	10.8	11.3	10.2		10.8	12.2	13.0	4.5	7.0	3.7
15I	20	C	296	23.5	21.5	26.0	• 6.5	27.1	22.3	21.1	28.8	24.5	
15II	21	B	643	51.0	53.6	47.5	- 3.1	53.6	60.1	49.2	38.5	49.0	
15III	22	B	1066	84.6	83.8	85.5		91.0	91.9	82.9	77.6	75.5	
15Iv	23	B	537	42.6	39.9	46.2	• 2.7	53.6	51.4	40.0	33.3	30.8	
16	24	B	596	47.3	46.9	47.9		66.6	63.9	49.2	31.3	46.8	
17	25	D	200	15.9	15.4	16.5		20.5	16.2	15.1	21.2	7.0	5.4
18I	26	A	221	17.5	16.9	18.6		21.7	18.6	13.6	19.2	22.3	10
18II	27	B	148	11.7	10.1	13.7	• 4.5	13.9	15.5	9.4	8.3	13.3	
18III	28	C	104	8.3	7.1	9.6		11.4	10.5	6.8	10.3	9.1	
19I	29	A	815	64.7	65.5	63.4		75.3	76.7	63.4	61.0	61.5	
19II	30	E	106	8.4	8.8	8.0		8.4	13.8	9.0	6.4	3.5	
19III	31	D	97	7.7	8.4	6.9		4.8	7.4	4.2	17.3	13.3	0 0.8
20I	32	D	381	30.2	25.1	37.1	• 0	49.4	42.6	27.9	5.8	16.8	
20II	33	C	386	30.6	30.6	30.8		54.8	39.2	27.9	11.5	15.4	
20III	34	D	284	22.5	22.1	23.4		47.6	28.4	20.7	7.0	6.9	
20Iv	35	E	566	44.9	45.7	44.0		57.8	49.3	43.0	34.6	38.5	
TOTAL SCORE Maxi 35			13.92		13.7	14.2	• 0.1	15.8	15.8	13.4	12.0	11.8	
%			39.77		39.1	40.6		45.1	45.1	38.3	34.3	33.7	
TOTAL NUMBERS		1260			716	539		166	296	498	156	143	

TABLE 2

PAPER 1 - ABSTRACT FROM ANALYSIS BY ITEMS

SEX DIFFERENCES

The following items show significant differences between the sexes: ($p<5\%$)

Item	2	4	6	7	8	9	21	23	27	32	n
Girls % correct	28.1	39.8	58.0	38.6	41.3	48.6	53.6	39.9	10.1	25.1	716
Boys % correct	33.8	33.6	48.6	52.1	50.1	56.8	47.5	46.2	13.7	37.1	539

TYPE DIFFERENCES

The following items show significant differences between the various school types ($p < 5\%$). Differences are only recorded where they are against the overall trend for the type in question, ie when types US and UJ show deviations below the mean, and when types RJ, UP and RP show deviations above the mean.

Type	Item	1	4	5	7	13	17	19	31	n
US	% correct		23.5	39.8		3.6				166
UJ			31.1							296
RJ		71.9						13.0		498
UP			53.8		57.0		41.0		17.3	156
RP									13.3	143
Overall means		68.6	37.1	50.5	44.6	10.9	32.0	10.8	7.7	1259

TABLE 3

PAPER 1 - ANALYSIS BY TAXONOMIC GROUPS

Group A (Knowledge); Items 7, 15, 19, 26, 29

B (Technique); Items 5, 6, 10, 16, 21, 22, 24, 27

C (Comprehension); Items 1, 3, 11, 12, 18, 20, 28, 33

D (Application); Items 2, 8, 9, 17, 23, 25, 31, 32, 34

E (Invention); Items 4, 13, 14, 30, 35

Taxonomic group	Percentage correct responses		DEVIATIONS Relation to project			FROM Sex		MEAN Age group		
	Mean	s.d.	P	S	N	Girls	Boys	≤12	13,14,	≥15
A	40.6	21.2	-2.8	3.6	.6	-0.6	0.6	-6.8	1.0	-2.2
B	49.9	19.1	-1.9	2.4	1.1	1.6	-1.6	-8.4	0.8	0
C	37.8	17.8	-2.8	4.1	.0	-0.2	0.6	-8.9	1.2	-2.2
D	28.1	17.6	-4.1	2.3	0.8	-2.2	2.4	-7.1	.1	-3.3
E	29.6	10.4	-0.8	1.0	-0.4	1.2	-1.2	-3.0	1.0	-3.6
Number in sample 637			290	142	205	337	300	48	500	89

Deviations have been adjusted to remove effects of the other two factors. Boxed figures have been shown to be significant ($p<5\%$) by the F test.

The low averages of types P and N relative to type S arise from the atypical results from St Vincent. A full analysis has not been carried out on Barbados and Grenada alone, and indeed numbers are insufficient to warrant any conclusions. But examination of the total scores shows that the very low achievement of the St Vincent schools has exercised a disproportionate influence on the figures. Mean total scores are as follows:

	P	S	N
Full sample as above:			
Barbados, Grenada, St Vincent	12.3	14.2	13.3
Barbados and Grenada alone	14.8	14.2	14.2

On this reckoning the project schools have a slight (but not significant) advantage over the others.

TABLE 4

PAPER 2 - FACTOR ANALYSIS FOR GRENADA

(148 scripts)

Eigenvalues:	1	4.60	Six more eigenvalues greater than 1
	2	2.33	
	3	1.77	Smallest eigenvalue 0.25
	4	1.65	

Factor structure matrix (varimax rotated)

Item	Factor 1	2	3	4
1	-0.08	0.06	0.03	0.11
2	0.23	0.07	0.16	0.09
3	0.51	0.32	0.19	0.09
4	0.10	0.20	0.47	0.19
5	0.10	0.11	0.28	-0.00
6	0.25	0.25	0.24	0.45
7	-0.04	0.05	0.31	0.24
8	0.12	0.09	0.27	0.07
9	-0.09	-0.00	0.25	0.17
10	0.49	0.30	0.32	0.10
11	0.63	0.30	0.19	0.04
12	0.27	0.44	0.29	0.10
13	0.08	0.20	0.07	0.43
14	0.22	0.38	0.07	0.35
15	0.34	0.29	0.28	-0.05
16	0.09	0.22	0.15	0.26
17	0.59	0.44	0.21	0.07
18	0.27	0.30	0.12	0.02
19	0.47	0.36	0.30	0.08
20	0.35	0.20	0.44	0.17
21	0.53	0.20	0.21	0.02
22	0.20	0.12	0.03	0.18
23	-0.04	0.08	0.26	0.51
24	0.40	0.30	0.11	0.03
25	0.26	0.58	0.16	0.25
26	0.24	0.48	0.27	0.10
27	0.34	0.31	0.29	0.15
28	0.32	0.45	0.23	-0.07
29	-0.04	0.00	0.22	0.22
30	0.36	0.22	0.32	0.03

Mean factor scores for each type of school:

Type		1	2	3	4
P	Mean	40.92	37.75	43.73	45.55
	s.d.	24.41	35.78	26.48	17.08
P*	Mean	45.43	45.53	48.99	48.60
	s.d.	18.5	22.18	18.70	13.33
S	Mean	47.82	49.55	46.10	47.53
	s.d.	16.41	25.95	24.80	12.33
N	Mean	59.59	60.37	59.11	56.16
	s.d.	17.01	27.79	20.72	13.09

P* has been obtained from P by eliminating three scripts with high negative scores - pupils who prefer to disagree with everything.

The steady increase in scores on all factors down the table is noteworthy, but very difficult to interpret.

TABLE 5

TOTAL SCORES FOR EACH CLASS

ISLAND	SCHOOL	CLASS	No. pupils	TYPE	Relation to Project	PAPER 1 (Cognitive) Score	s.d.	%	PAPER 2 (Affective) A	B	C
ANTIGUA	Antigua GS	3B	33	US	P	14.4	3.29	41.1	-1.33	-0.25	11.2
	Princess Mgt	3A1	24	US	P	17.4	3.36	49.7	-2.41	0.38	12.5
		3A2	39	US	P	14.8	4.24	42.3	0.08	-0.85	8.9
	Clare Hall	3A	32	RJ	P	14.7	3.00	42.0	-1.28	3.12	11.5
	Pares	3F1	28	RJ	P	13.2	2.39	37.7	3.11	2.62	11.4
		3F2	22	RJ	P	10.9	2.35	31.1	-0.27	5.33	11.5
BARBADOS	St Leonards Boys	3A2	29	UJ	S	17.3	2.93	49.4	0.09	0.75	11.6
		3A3	31	UJ	S	15.6	2.73	44.6	0.47	-1.23	9.4
	St Leonards Girls	3A	34	UJ	P	16.4	3.28	46.9	0.09	-0.33	7.0
		3R1	29	UJ	S	16.2	3.31	46.3	0.07	1.31	13.4
	Princess Mgt	4	29	RJ	P	14.7	4.04	42.0	0.53	1.40	10.5
	West St Joseph	3A1	30	RJ	P	15.9	3.11	45.4	0.26	1.03	13.2
		3A2	30	RJ	P	13.5	1.96	38.6	0.20	2.04	13.0
	Parkinsons	3A1	31	UJ	N	16.9	3.57	48.3	2.32	2.23	11.1
		3A2	33	UJ	N	14.1	3.63	40.3	-0.31	1.30	7.5
		3B1	31	UJ	N	12.6	3.68	36.0	-0.16	0.17	11.2
DOMINICA	St Martins	3	31	UP	P	14.2	2.72	40.6	3.00	9.66	16.4
	Portsmouth GS	3Sc	24	US	S	17.3	4.16	49.4	5.87	6.38	16.0
	Colihaut	2+3	26	RP	P	11.4	3.75	32.6	-2.19	-0.77	9.8
	Paix Bouche	2+3	17	RP	P	12.4	3.97	35.4	-2.00	1.00	11.2
GRENADA	Waltham	3A	20	RJ	S	9.2	2.87	26.3	-1.60	-0.65	8.8
		4A	34	RJ	S	11.4	2.49	32.6	-0.03	-0.53	11.0
	Tivoli	3	24	RP	P	14.2	2.89	40.6	-2.25	0.38	8.6
	Belair	3A	20	RP	P	12.9	4.25	36.9	-1.88	-0.17	10.6
	St Johns	7A	29	UP	N	14.6	3.23	41.7	-0.82	3.28	12.5
		7B	25	UP	N	12.4	2.52	35.4	-1.12	3.20	9.3
MONTSERRAT	Plymouth	3B	30	US	P	17.7	3.54	50.6	-0.13	0	8.2
	Salem	3A	24	RJ	P	14.1	3.91	40.3	0.93	3.89	12.4
ST KITTS	Basseterre	3A	34	UJ	P	20.9	3.91	59.7	3.11	1.65	10.1
	Sandy Point	3A	35	RJ	P	14.8	3.75	42.3	0.58	1.70	12.1
	Cayon	3B	28	RJ	P	13.2	3.61	37.7	-0.52	-0.46	8.2
NEVIS	Charlestown	3B	16	US	P	13.5	2.53	38.6	-2.94	2.00	10.9
ST LUCIA	Corinth	3A	25	UJ	S	14.7	3.58	42.0	-1.52	-1.40	13.3
		3B	19	UJ	S	10.3	2.90	29.4	-1.52	-1.70	7.6
	Micoud	3A	29	RJ	P	15.9	4.19	45.4	-1.55	2.63	12.9
		3B	37	RJ	P	13.0	2.79	37.1	-0.03	0.83	11.9
	Vieux Fort	3A	34	RJ	P	18.1	4.14	51.7	1.34	1.23	14.4
		3B	30	RJ	P	14.3	2.89	40.9	-0.07	1.35	10.0
ST VINCENT	Adelphi	2+3	55	RJ	P	8.5	2.99	24.3	0	1.62	7.2
	Kingstown Meth.	2+3	35	UP	P	9.8	3.16	28.0	-1.90	0.38	7.7
	Calliaqua	3	35	RP	P	9.2	2.69	26.3	-2.78	0.69	8.3
	Dorsetshire Hill	2+3	21	RP	N	12.5	3.17	35.7	-2.40	-1.25	5.8
	Sion Hill	1+2	25	UP	N	9.7	2.44	27.7	-1.95	1.68	6.8
		3	11	UP	N	10.6	2.58	30.3	-1.50	1.30	3.6

Types: 1 US Urban selective entry
2 UJ Urban Junior Secondary
3 UP Urban all-age Primary
4 RJ Rural Junior Secondary
5 RP Rural all-age Primary

Relation to project:
P Full project class
S Semi-project (e.g. one year project followed by a year of more traditional work)
N No project work

TABLE 6

MEAN SCORES FOR EACH ISLAND

ISLAND	PAPER 1			PAPER 2			Number tested	Sig. level %
	Score	s.d.	%	A	B	C		
ANTIGUA	14.3	3.66	40.9	-0.28	1.48	11.0	179	
BARBADOS	15.3	3.54	43.7	0.35	0.85	10.7	308	0
DOMINICA	13.9	4.20	39.7	1.46	3.91	13.2	100	
GRENADA	12.5	3.35	35.7	-1.16	1.01	10.3	153	0
MONTSERRAT	16.0	4.11	45.7	0.34	1.73	10.7	55	0
ST KITTS	16.0	4.83	45.7	0.57	1.19	10.4	115	0
ST LUCIA	14.6	4.13	41.7	-0.40	0.69	12.6	175	1.8
ST VINCENT	9.6	3.10	27.4	-1.73	0.76	7.39	183	0
Overall mean	13.9	4.2	39.7	-0.22	1.23	10.6	1260	

NOTES

i The number tested refers to paper 1; the numbers for paper 2 were slightly different. The discrepancy in the total is due to a single mispunched card; the resulting error is negligible.

ii The significance level is that for the difference between the island mean and the overall mean for the score in paper 1; "0" indicates less than 0.1% probability.

iii A, B and C refer to the vectors selected for paper 2 on the basis of M Preston's tests; see explanation in the text. In view of the unsatisfactory nature of this test no significance levels were computed. Even so, it would seem obvious that the differences between Dominica, St Vincent, and the other islands on this test are real ones.

M Preston's results for Devon and Cornwall, C.S.E. candidates, 1972

	A	B	C
Girls	-1.26	-0.06	6.90
Boys	-1.00	1.46	11.06
Overall mean	-1.12	0.76	8.22

The much higher level of commitment (vector C) in the Caribbean is noteworthy; it would also appear that girls' antipathy to mathematics is a peculiarly English phenomenon. Direct comparison is however precarious, since the project classes are for the most part A streams, whereas all CSE candidates are included in the Devon and Cornwall figures.

PAPER 2

Items contributing to the Preston vectors A, B and C.

Item	Vector and sign	Item	Vector and sign
1	A -	16	C +
2	B -	17	A +
3	C +	18	B +
4	B +	19	A +
5	B -	20	A -
6	A -	21	C +
7	C -	22	B -
8	A -	23	C -
9	A +	24	C +
10	C +	25	B +
11	B -	26	A +
12	C +	28	B +
13	C -	28	B +
14	A -	29	C -
15	B +	30	A -

Vector	+ Items	- Items
A	9 17 19 26	1 6 8 14 20 30
B	4 15 18 25 27 28	2 5 11 22
C	3 10 12 16 21 24	7 13 23 29

The sign of A (which of course is arbitrary) was reversed from Preston's paper, because positive values for all three vectors then indicate attitudes which tend to be consonant with the project's stated objectives. It is then positively correlated with the other vectors - these are not orthogonal vectors.

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