Numeracy in Papua New Guinea: an investigation with particular reference to the relationship between number skill teaching and the use of the calculator

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Numeracy in Papua New Guinea: An investigation with particular reference to the relationship between number skill teaching and the use of the calculator

By

ALLEN EDWARDS MA

A Doctoral Thesis

Submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy of the Loughborough University of Technology, April 1982

Supervisor: Professor A C Bajpai, Director of CAMET and Head of the Department of Engineering Mathematics

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ABSTRACT

Numeracy in Papua New Guinea: an investigation with particular reference to the relationship between number skill teaching and the use of the calculator

ALLEN EDMARTS

The thesis is the result of four years' work in mathematical education in Papua New Guinea. The first two years were spent in setting up a new Mathematics Education Centre at the University of Technology, Lae. A broad brief enabled the author to seek out the most crucial needs for the country and these appeared to lie in the area of basic number skills. Assessments of the situation and contributions to a changing attitude are described. This part of the thesis concludes with a critique of the role of a Mathematics Education Centre in a Third World country.

The work had led to a conclusion that one of the priorities in mathematical education for the country lay in some form of adult numeracy campaign. At the same time the Department of Commerce had identified 'numeracy' as one of the prime needs for successful business development in Papua New Guinea. The author was therefore invited to spend a further two years in seeking to resolve this problem.

The cheap long-life battery calculator became available at this point in time and provided the means for a possible solution. Its potential was appreciated and a grant was given from the Prime Minister's Non-formal Education Sectoral Fund to enable the author to research into the possibilities of adult numeracy teaching in the villages where 85% of the population lives. Detailed reports of the eighteen field tours undertaken are included in an appendix, together with some of the material specifically developed for the purpose. In this thesis the problems of organising an adult numeracy campaign in a country with poor communications and a limited budget are also considered.

The thesis concludes with an attempt to identify the new style of teaching that will be required when a realistic use of the calculator is accepted as a normal part of the post-secondary and non-formal education system. This new style is seen to include elements of the number skill teaching that was the prime concern of the first two years. References are made to the relatively few attempts to teach adult numeracy in the Third World and also to some attempts in the developed world to meet the challenge presented by the incorporation of the calculator into the formal system of education.

KEYWORDS:

Numeracy; Number Skills; Calculator; Mathematics in Papua New Guinea; Mathematics Education Centre; Non-formal Education; Adult Education; Mathematical Education
ACKNOWLEDGEMENTS

I wish to thank Professor A C Bajpai, not only for his invaluable advice and assistance in the preparation of this thesis, but more particularly because without him it would never have been written. As one of the original instigators of the Mathematics Education Centre at Lae, Professor Bajpai was already in a unique position when I was appointed to direct that Centre. It was only in the course of conversation with him that the idea of recording the work in a doctoral thesis was first suggested.

Likewise I wish to acknowledge the immense debt I owe to Bryan Wilson of The British Council who was my principal mentor and adviser while I was in Lae and who continued to give unstinting support for our subsequent work, even to the extent of participating in one of our adult numeracy training courses in Papua New Guinea.

I must also thank the Coventry Local Authority and particularly their Director of Education, Robert Aitken, for being willing to offer me secondment from their employment, and the members of my family who accepted the responsibility of caring for my ageing father. Without all of them my wife and I would never have been able to accept the challenge of the Third World for a second time in our lives.

We are indebted to far too many people in Papua New Guinea to attempt to identify them all, but particular mention must be made of Bob Roberts, Senior Curriculum Officer for Mathematics, without whose eirenic powers our work might easily have foundered.

Mary Dickie too, at that time Staff Development Officer for the Department of Commerce took the unprecedented step of urging the appointment of a mathematics teacher with no experience of commerce, to tackle a problem to which there was at the time no known solution.
Thanks are also due to the Village Development Council for a grant from the Prime Minister's Non-formal Education Sectoral Fund which enabled the field work to be carried out.

I must also mention Angela Hewitt and Patsy Taylor who, out of friendship, typed the first draft of this manuscript.

If honour were to be given where it is due my wife's name would take precedence over mine as the instigator and maintainer of the work.

But there are a whole host of others in Papua New Guinea whose help we would wish to acknowledge. The University of Technology, Laloki College, the Department of Commerce, Steamships Trading Company and our colleagues there, teachers in every type of educational institution in the country, volunteers, missionaries, contract workers, students, friends whose guests we often were, villagers, village councillors, pastors, drivers, trade store keepers, government officers in Business Development, Social Services, Agriculture, Education, Health, to all these and others not even listed here we offer our acknowledgement and our thanks.
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INTRODUCTION AND BACKGROUND

1.1 THE AUTHOR's BACKGROUND AND INTRODUCTION TO THE THESIS

1.1.1 THE AUTHOR'S EXPERIENCE IN THE U.K

For nineteen years the author was Head of Mathematics in a British Grammar School where he "lived through" the impact of "modern mathematics" and made his own contribution to it in the form of an 'O' Level text book called Mathematics - Modern Style [1]. This four volume work written in 1966-73 emphasised the application of arithmetic to a wide variety of problems. It used the slide rule to deal with realistic numbers. It also (in 1968) broke new ground in school texts by using a fully self-paced technique of teaching.

Three issues which will recur frequently in this thesis were therefore already identified:

1. the importance of number skills
2. the need for mechanical aids to computation
3. the self-paced method of teaching

The author spent the next five years helping to set up a new Community Comprehensive School in Coventry in which the majority of students were Asian while a substantial minority came from the West Indies, so a fourth issue was added to the other three:

4. the importance of cultural background

All these issues became crucial for the author in the next four years from 1978 to 1982 which he spent in Papua New Guinea (commonly referred to as "PNG"). They form the theme for this thesis.
1.1.2 THE MATHEMATICS EDUCATION CENTRE AT THE PNG UNIVERSITY OF TECHNOLOGY, LAE

In 1978 and 1979, as Director of the Mathematics Education Centre at the University of Technology, the original concern was with the self-paced system which had been set up to tackle the problem of low mathematical standards of University entrants.

In practice however it turned out that the system was working tolerably well and the staff of the Mathematics Department were well able to carry out any modifications that proved to be necessary. The Director of the Centre was therefore free to seek other avenues of service for his expertise in mathematical education.

In doing so he worked with the handful of such experts who were struggling to cope with the urgent problems which were being experienced in primary, secondary, post-secondary and adult education.

In all these areas the issue most frequently referred to was that of number skills. Chapter 2 is concerned with the evidence of and the causes and effects of poor number-skill teaching in Papua New Guinea.

1.1.3 "MAKING PAPUA NEW GUINEA NUMERATE"

Perhaps it was the request for 20 toea that made the author want to "make Papua New Guinea numerate". The currency there consists of the toea (pronounced "toyer") and the Kina (pronounced "keener") worth 100 toea or about £0.70. The bill had come to K1.20 so the author offered the waiter a K2.00 note. The waiter asked for 20 toea more. Not unnaturally it was assumed that he lacked change and he was given the extra 20 toea. He solemnly returned, not a K1.00 coin but five separate 20-toea coins. It was not that he lacked the change: it was just that he knew the change for K1.10 from K2.20 would be K1.00 and that K1.00 was five 20 toea coins. But he could not work out that the change for K1.20 from K2.00 consisted of four 20-toea coins. As this was a waiter whose job was to collect money it is possible
that the reader may question this explanation - until he has read Chapter 3.

1.1.4 ADULT NUMERACY WITH A CALCULATOR

Chapter 3 is the result of a challenge by the PNG Department of Commerce to try to solve the problem of teaching almost innumerate businessmen to carry out the minimal arithmetical processes needed to run a trade store or other income generating project efficiently.

By this time the slide rule which had been used to solve computational problems earlier was ancient history. But at this precise point in time the production of cheap hand-held calculators with Liquid Crystal Display (and consequently long battery-life) presented a possibility of universal numeracy which had never existed before.

The usual arguments against the use of the calculator were encountered and are examined in 3.1.

The Village Development Council of PNG was convinced to the extent that K17,790 (about £12,500) was provided to enable the author and his wife to investigate the possibilities of "adult numeracy with a calculator" in five provinces, together with additional visits to other areas where there were specific projects concerned with the possible involvement of women in business.

Detailed reports on the eighteen tours made possible by this grant are included in the Appendix. An analysis of the experience gained from them is given in the rest of Chapter 3.

1.1.5 THE CALCULATOR IN FORMAL EDUCATION

The use of calculators in formal education in PNG is the subject of Chapter 4. This includes a radical re-appraisal of their position in post-secondary work, the possibility of teaching calculator skills to the students who have to terminate their education at Grade 6, 8 or 10, and the first signs of their influence on the Primary School syllabus.
Chapter 3 and 4 refer frequently to the various courses written by the author during this period 1980-82 when he was Director of the Department of Commerce Numeracy Project. Chapter 5 describes these courses in some detail, tracing their development from a purely self-paced course to one that appeared to be self-paced but was not, and on to a first attempt at a class text with detailed Teacher's Manual.

1.1.6 CONTRADICTION OR RATIONALE?

Having spent two years emphasising the importance of number-skill teaching in educational institutions it may appear as a self-contradiction that the next two years should have been spent in teaching the use of the calculator. It might be thought that the calculator made it unnecessary to learn number-skills the hard way, and that anyone who had really mastered his number-skills would find the calculator no more that a useful aid in dealing with more difficult numbers. This however is far from the truth and the rationale set out in Chapter 6 suggests how a combination of number skills (particularly mental ones) together with calculator skills, may provide the essential basis on which to build "mathematics for the majority" in the future. The applications of this proposal to Papua New Guinea are considered in 6.3.

1.1.7 UNIVERSAL NUMERACY: A NEW POSSIBILITY?

Section 6.4 samples some of the millions of words that must have been written about the worldwide drop in standards of number skills which resulted from the "modern mathematics" revolution of the 60's.

By contrast section 6.6 attempts to refer to all the available literature on adult numeracy in the Third World. Could it be that the reason why there is so little of this is that unlike adult literacy, numeracy was virtually unteachable to rural adults until 1980 when the cheap Liquid Crystal Display calculator became available?
In the final section of Chapter 6 the author considers some of the literature relevant to his proposal for basing mathematics for the majority on mental arithmetic and the calculator. Evidence is adduced from Brazil, Australia, Sweden, the USA and the UK.

Chapter 7 contains recommendations that follow from the experience related in this thesis. Perhaps however in concluding this introduction the author's underlying motivation may be confessed.

In the end it is irrelevant whether significant differences in arithmetical skills result from genetic, cultural, education or economic causes. What is undeniable is that they aggravate racial and other tensions. This can be observed in parts of Africa and the South Pacific where the Indian minority is seen as a threat because of its greater business acumen. It is clear too in the story Ubiratan tells of the South American villager who spent years trying to master computational skills and was then immediately "put down" by his employer who achieved the same results so much more quickly with a calculator. (See 6.7.1)

So long as the "have's" alone have calculators, this will increase their advantages over the "have not's". Instead a worldwide cost-effective campaign to provide disadvantaged groups with the cheap LCD calculators and the skills to use them could do something to reduce the ever-growing injustice of the gap between the rich and the poor. What more can anyone do?

1.2 THE GEOGRAPHICAL/POLITICAL/CULTURAL BACKGROUND TO PAPUA NEW GUINEA

1.2.1 GEOGRAPHICAL/POLITICAL

The term New Guinea is used in a non-political sense to refer to the large island to the north of Australia. The western half was at one time controlled by the Dutch and is now part of Indonesia. The south-eastern part of the island, known as Papua became in effect an Australian colony while the north-
eastern part experienced German and Japanese rule and subsequently became the Trust Territory of New Guinea, administered by Australia.

In 1975 these two eastern parts were united to form the independent state of Papua New Guinea†. The state is strongly democratic with institutions based on those of Australia and Britain. Provincial Government since 1979 has eased the breakaway tensions that existed prior to that and the chaos some people expected has not occurred although problems do exist. Substantial aid is received from Australia and the aid agencies. Otherwise it relies on the export of commodities (coffee, cocoa, copra, gold, silver, copper etc) whose fluctuating prices make long-term planning difficult.

1.2.2 THE CULTURAL BACKGROUND TODAY

The most noticeable feature of the cultural background in Papua New Guinea is the immense number of independent languages, about 700, in a population of around 3 million. "Almost half the world's languages are on this island". [2, p.25]. The official languages are English, (Melanesian) Pidgin and Motu. Motu is only spoken in Papua, Pidgin is practically universal apart from a few areas where a single vernacular happens to be spoken by many people (eg. Huli in the Southern Highlands, see 3.4.1). Most expatriates learn enough Pidgin for basic needs. All formal education is in English.

Along with these 700 languages there used to be an estimated 250 different counting systems. These were of four main types [3, p 6]. About 12% were of Type I which is a "body parts tally system". When the parts of one man's body have been counted another man is required if the counting is to continue. About 15% belonged to Type II: in these, sticks or groups of commodities are used to form a 2, 3, 4 or 5 base system. About 40% were of Type III: these are true counting systems but most have mixed bases using 5 and 20 where for

† Strangers find the name a bit of a tongue-twister. It comes more easily if you emphasise the first syllables "Par-" and "Guin-". The -Pua then slips in without too much trouble
Woman killed with axe

A 42-year-old woman was axed to death on Saturday in Ee village, near Magarina, Southern Highlands Province.

A Port Moresby police spokesman said yesterday, Mrs Hebe Hunka was "axed" during a domestic argument.

A man has been arrested in connection with the killing.

A man died on Saturday during a soccer match in Mendi.

He was Steven Kagi, of Taripi village, near Mendi, who died instantly when he was apparently kneed in the stomach, the police spokesman said.

Two men died when about 100 men went on the rampage at Ramu Sugar, Morobe Province on Thursday night.

A police spokesman said yesterday it had not yet been established who was responsible for the deaths.

Watersiders vote to lift overtime ban

The K5000-a-day overtime ban on ships on the Port Moresby's waterfront will be lifted tomorrow.

This was decided in a lunch-time meeting yesterday by 170 workers employed by Port Services PNG Pty Ltd, who are members of the Port Moresby Waterside Workers and Seamen's Union.

The ban imposed three weeks ago because of a company order not to allow liquor at a proposed Christmas party, had forced four ships to overstay in the port.

'Point has been made'

The union's general secretary, Mr Reg McAllister, said yesterday that "in future the workers will surely get a good Christmas party".

"The point has been made to the company and the message transmitted very clearly that workers were expecting a good reception at the end of every year in future", Mr McAllister said.

Meanwhile six more ships were expected to berth by Friday.

Murders and strikes happen in Papua New Guinea as in the West although there may be some differences. A rough translation of the Pidgin in the cartoon is: "It means the cost of the strike is the same as the cost of 11,679.6 cartons of beer?!! "All right, just give me 9.6 cartons and keep the rest for a really good party next Christmas."

From the Post Courier, 5.1.82. Cartoon reproduced by permission of Grass Roots Comic Company, Port Moresby.
example the number 56 would be represented by 2 twenties, 3 fives and 1 one, or 2 men, 3 hands and a 1. There are usually only 4 discrete number words. The remaining 32% were probably of Polynesian origin and have a genuinely abstract concept of number. They use base 10. Some societies having these may still use a Type I system for special purposes.

The situation described is complex: but there is one simple fact about them all. "Virtually all Papua New Guineans are abandoning their traditional counting systems in favour of the decimal system of counting in English or Pidgin" [3, p 10]

Traditional methods of measurement in PNG have not been studied to the same extent but "there does seem to be a dearth of standardised units for measuring things" and "This doesn't mean that people don't measure things but rather that the systems for doing so are informal" [3, p 14].

By contrast an African culture such as that of the Kpelle of Liberia has basic measurements involving length, time, volume and money for which complex systems are available [4, p 62]. If only in order to express appreciation of the achievements of the older culture it would be wholly admirable to bridge the gap between traditional numbering systems and those of the West. Unfortunately in PNG the option is hardly practicable. The variety, the informality and the rapid abandonment of such traditional counting systems as exist combine to make it difficult in general even to attempt to relate western mathematical teaching to the traditional culture. Traditional counting systems can and will it is hoped continue to be used for traditional customs by the 85% or so of the population who live in rural areas and still follow a more or less traditional way of life. Once these people step beyond the boundaries of their own village however, perhaps only going as far as the next village, they need to communicate with others in some system other than their own. [5]

In such circumstances any teaching provided in the country must be related, not to the traditional but to the national system. In the case of numbers this simply means the "western" system.
1.3 THE EDUCATION BACKGROUND IN PAPUA NEW GUINEA

"The people of Papua New Guinea have been here for a long time; the technologies and the education of the West have not. Inasmuch as some areas of the nation were touched by the West only a mere thirty years ago, it is remarkable that the leap into the international community of nations has been so successful. The whole span of recorded history in Europe has been packed into a decade" [2, p.1].

Herein lies the nub of the problem: the very great advances that have been made in this brief period go to show how adaptable the Papua New Guinean really is, and how anxious he is to acquire the benefits of modern technology. It is generally assumed that these benefits will come through education, although if that does not lead to paid employment, disillusionment may follow.

1.3.1 PRIMARY EDUCATION

The first elementary school was founded by the London Missionary Society in the 1870's [2] and the missions have to a greater or lesser extent been involved in education ever since. The churches' contribution in the 1980's is principally, through teachers' colleges, schools of nursing, non-formal education and a few church-controlled schools.

In 1966 there were 5500 teachers in Primary Schools, one fifth of whom were expatriates while two fifths had less than a year's training beyond Grade 8 [6]. By 1979 about two-thirds of all seven-year olds were in school, the numbers of primary teachers had risen to 8800, all the expatriates had been replaced and the new teachers had at most Grade 10 with two years of training.

The education system was built on the teaching of English and although this is hardly ever the first language of their teachers it has for long been the only officially approved language in Government schools. This does not however appear to have resulted in a high standard of literacy and there are obvious disadvantages to it, one being the difficulty of
communication between teacher and student in the early years. This results in pupils learning not to ask questions, particularly as any outstanding merit is likely to be discouraged by their peers: the people do not yet share the West's competitive philosophy. It also makes discovery-based teaching or games-like activities very difficult.

Another effect is that Pidgin or the vernacular tend to be used for general conversation or practical activities like getting ready for class or cleaning up the school ground. The effect is to make an even greater divorce between English along with academic studies on the one hand and "real life" on the other. [7, p.87-88].

During the 1970's there was a worldwide movement (in which the author was involved) towards "Community Schools" which tried to bridge this gap between the academic and the "real" life. This had its influence in Papua New Guinea to the extent that the primary schools were renamed "Community Schools", but this made little real difference.

An early attempt to provide non-formal education by paying teachers extra money to do it was rapidly abandoned and such work, even unpaid, was then not really encouraged.

Indeed, Lancy in an essay on Education for Papua New Guinea [ 7 ] goes so far as to say "There is no evidence that Papua New Guineans want Community Schools". He tells how he observed an able and enthusiastic headmaster seeking to enlist the support of the community but finding that "They did not want school-leavers in the village and they had no use for an education system that did not lead directly to wage-employment for successful students".

It is therefore by no means a platitude when the Secretary for Education says "Children and their parents must get used to the idea that the purpose of community schools is to educate children to live in their community after they leave the community school" [ 8 ].
Another facet of the same concern was expressed in July 1982 by the then Acting Prime Minister, Iambaky Okuk, when he complained that the education system did not prepare students for manual and trade work and did not even teach them how to make better use of land for farming. He said that steps must be taken immediately to correct what he called "years of neglect in education". He went on to say "School courses must put more emphasis on learning for living". [9]

The work described in Chapters 4 and 5 is a response to this recognition of the need for "learning for living" [10]. Indeed a subsequent article in the PNG Post Courier on "Mathematics: Vital link of school and life skills" [11] claimed that the latest High School mathematics course "aims to provide students with a sound basic knowledge of the subject, taught in a practical way that is aimed to link the concepts and skills taught in schools with everyday application." It was however around this time that a school inspector quoted a villager as complaining that after six years education his son still could not give correct change in a trade store. So perhaps reality had still some way to go to catch up with intent, at the Primary level anyway.

1.3.2 SECONDARY EDUCATION

The first Secondary School was founded in 1962. In 1965 there were 7,000 students in the High Schools, by 1975 these had increased to 29,000 and by 1978 33,000 students were being taught by 700 national staff, 300 expatriates on contract and 300 expatriate volunteers. Due to the localization policy the proportion of expatriates is falling, but not nearly as quickly as was once expected.

Most students at High Schools are boarders because of the difficulties of communication in the country (see 3.2.5.4) and this further reduces the relationship between the school and the village.

Only about one third of the students in the Community Schools are selected for High Schools, the selection being partly on the basis of an examination taken at the end of Grade 6 and partly on a quota or "percentage per school" basis in
recognition of the fact that any Grade 6 examination would reflect the ability-levels of the teachers and the community rather than those of the individual students.

Approximately one third of those who start High School are "pushed out" after Grade 8: the rest leave after Grade 10.

1.3.3 THE NATIONAL HIGH SCHOOLS
There are four of these schools staffed almost entirely by expatriates. They give an intensive two years of boarding school education to about 15-20% of the Grade 10 graduates, selected on the basis of internal and external assessments and student choice.

1.3.4 POST-SECONDARY EDUCATION
This term is used locally to refer to the non-University institutions which accept Grade 10 (or 12) students. There are over 80 of these, including about 10 technical/secretarial colleges, 10 teachers colleges, 40 institutions run by more than 10 different Government Departments, and 20 run by Churches/Missions. In general these are probably about 50% staffed by nationals.

There are also the University of Papua New Guinea (UPNG) at Port Moresby and the University of Technology (UTECH) at Lae, both staffed (at lecturer level) almost entirely by expatriates.

1.3.5 NON-FORMAL EDUCATION
There are about 90 Vocational Centres giving one year of post-grade 6 vocational education. Funding is at a low level and each institution is expected to supplement its funds by its own agricultural or other efforts. There are a number of other statutory and voluntary institutions engaged in non-formal education, such as the Lutherans with their vernacular and Pidgin-speaking schools. Each Province has one Non-formal Education officer: some provinces have more than one.

Judging by the 1977-78 Budget estimates, about 0.2% of the expenditure of the Department of Education goes on non-formal
education compared with 13% on the 100 High Schools, 19% on the two Universities and 36% on the Community Schools [12, p.216].

1.4 THE MATHEMATICS EDUCATION CENTRE AT THE PAPUA NEW GUINEA University of Technology, Lae

1.4.1 ORIGINS

In 1971 Professor A C Bajpai, at the instigation of the Centre for Educational Development Overseas (since merged with the British Council) and with the support of the Nuffield Foundation, prepared a Report [13] in which a team of three full-time professionals was proposed. They would produce integrated packages for use in four centres, Goroka Teachers College, Sogeri Senior High School, the Institute of Technology (later University) at Lae and the University at Port Moresby. Four audio-visual aids centres were to cooperate with the team, one at each location.

At the time, however, the Institute at Lae was having immense difficulties with its 1st and 2nd year students and their Committee which reported on the proposal urged that (a) the problems of the 1st and 2nd year engineers should take precedence, (b) large expenditure on audio-visual technology should be delayed and (c) research should be widened to include educational psychology. [14, p.15].

1.4.2 THE MATHEMATICS LEARNING PROJECT

As a result the Mathematics Learning Project was concentrated at the University of Technology and for three years it was primarily concerned with the setting-up of a self-paced teaching system there. Its research included spatial ability, Piaget's conservation theories, classificatory ability and the vernacular counting and measuring systems. Few papers were published however between 1975 and 1978. The Resource Centre contained various pieces of educational apparatus but its most important function was printing and issuing the self-paced materials.[15]
In 1976 Bryan Wilson of the British Council, again with support from the Nuffield Foundation, reported on the work that had been done by the Project and proposed the setting-up of a Mathematics Education Centre [16].

1.4.3 THE MATHEMATICS EDUCATION CENTRE (MEC)

The aims of the MEC were to develop self-paced learning materials for use in the University of Technology and other post-secondary institutions, to disseminate information about mathematical materials, to develop resource materials in mathematical concepts and skills in Papua New Guinea students, to examine the effectiveness of mathematical materials and to foster in-service education programmes for teachers, especially those in Senior high schools. It would also continue research into aspects of cognitive development.

On taking up his post as first Director of the Centre, however, the author found that the experienced staff of the Mathematics Department were well able to cover the teaching and modification of the self-paced material which had now been in use for some years. The system itself had been stoutly defended by Alan Bishop, who visited the Centre in 1977. Other relevant research was also well underway, such as that on the teaching of mathematical terms by staff of the Language Department [17].

The Principal Research Officer of the Department of Education also felt that by this time cognitive development in PNG had had an excess of attention and more practical, school-oriented research was needed. The author recognizes that substantial research has been carried out in this field, but does not wish to pursue this aspect in this thesis.

The Director therefore chose to develop the outward-looking practical side of the Centre, seeking to provide whatever knowledge, experience and resources were available for the benefit of any agency that was prepared to use them. The peculiar situation of the Centre, being within the Educational field but not responsible to the Department of education, meant that its resources were more acceptable to those outside the Department and it was also not restricted by excessive bureau-
cracy. But it meant that it had no power to compel others to use its services. A nominally wide brief therefore was effectively restricted by the extent to which potential users requested its services.

1.4.4 BREADTH OF CONCERN

In the course of 1978 and 1979 the Centre extended its assistance over many fields. Its work with the Basic Arithmetic Test, the Basic Skills Course and the Community Schools Mathematics Materials Project will be referred to below in 2.2.1, 2.2.2, and 2.3.1.

It was also able to import and sell on a non-profit making basis mathematical aids which the Department of Education had no facility for selling. During 1979 the Centre sold K1280 worth (£900) of plastic apparatus such as is found in most schools in Britain, K6820 worth (£6000) of calculators and "Quizkids" (electronic number-fact teaching units) and K5490 (£3850) of printed materials. The Centre had also provided assistance with In-service training in a number of institutions, including Community Schools, referred to in 2.3.1.

Its latest ventures under its first Director were in non-formal education where a new field had been found for using its Basic Skills course. In particular, a course was conducted in Lae for the Department of Commerce and the idea of an Adult Numeracy Campaign began to take shape. The main lesson learnt from this however was that something vastly simpler than our current materials, 'basic' though they might appear to us to be, would be essential if we were to work in that field.

Other research undertaken by the Centre during this period included the publication of "Spatial Abilities in a Papua New Guinean context" (20) and "Developing Spatial Abilities" (21) both by Alan Bishop and "A Pilot Study into the level of comprehension of some words taken from the Papua New Guinean Community Schools Mathematics Syllabus" by Meek and Feril (22).

The flexibility of the Centre, and particularly its freedom to supply the same services to many different areas of need, meant that it was in fact a very cost-effective institution with
virtually no overlapping or duplication of effort involved.

The following table, taken from the report to the Council of the University in November 1979 [14] indicates the breadth of services that were then being provided.

**AGENCIES INVOLVED IN SOME PROJECTS OF THE MATHEMATICS EDUCATION CENTRE IN 1979**

<table>
<thead>
<tr>
<th>Agencies Involved</th>
<th>The Basic Arithmetic Test</th>
<th>The Basic Skills Course</th>
<th>Community Schools Mathematics Materials</th>
<th>Calculators and Quizkids</th>
<th>Adult Numeracy Campaign</th>
<th>In-service Training</th>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>National High Schools</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>College of Allied Health Sciences</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Primary Industry Colleges</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Goroka Teachers' College</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Community Teachers' Colleges</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Technical Colleges</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Secretarial College</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Schools of Nursing</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Regional Training Centres (PSC)</td>
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<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Business Development Centres</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vocational Centres</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Adult Education Officers</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Missionary Agencies</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Office of Village Development</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provincial Education Offices</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provincial High Schools</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
</tr>
<tr>
<td>Community Schools</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Many Govt &amp; Commercial Training</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Centres eg Elcom, BCL, Air Niugini</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
1.4.5 THE UNIVERSITY DECISION

Unfortunately (in the author's view) the University authorities did not see it in this light, and decided that in future its role would be to service only the University, the National High Schools and the Lae Technical College [23]. The University of PNG had offered to set up a Mathematics Education Unit to cover the rest of the field. Had it done so this would have provided some justification for the contraction of the Lae Centre, because UPNG was in Port Moresby and therefore in much closer touch with the Department of Education.

In fact, however, the Mathematics Education Unit at UPNG never got off the ground.

1.5 NOTE ON COMMUNICATIONS IN PAPUA NEW GUINEA

The problems of communication in a country where the aeroplane is a normal means of travel because of the lack of roads have not been sufficiently stressed in this "Background to PNG".

Perhaps it is sufficient to quote an earlier paper by the author [6] in which he says: "The service which even a dedicated (schools) inspector can give is in any case limited when, typically, he has 18 schools to visit, five of which require a total of 27 hours walking, five can only be reached by air and his main centre is a 3 hour drive from his headquarters." [47]
CHAPTER 2

NUMBER SKILLS IN PAPUA NEW GUINEA

2.1 THE PRIMARY SCHOOL SYLLABUS

In the 1960's, as explained in Chapter 1.3, about one fifth of the teachers in the Primary Schools were expatriates and it was under these conditions that it was decided to introduce a "modern mathematics" syllabus. The decision might perhaps have been different if the administration had realised that Independence would come in 1975 and with it the very rapid expansion of the teaching force, accompanied by the replacement of all the expatriates by nationals who had at most ten years of education and two years of training.

The move to "modern mathematics" was inspired by Professor Dienes who was then an educational psychologist at the University of Adelaide.

In 1967 the syllabus for the first two years was issued. By the end of the first year a group of writers was formed to extend this into a programme called TEMLAB, which assumed the provision of kits of workcards and structured aids including Dienes' Multi-based Arithmetic Blocks and attribute cards. The syllabus however was never completed along the lines Dienes laid down. Already it was realised that more work on number was needed and a "MaPS" version was produced. At this stage three different syllabuses were being taught. TEMLAB, MaPS and PMS, a South Australian text. The new syllabus, with its name changed to MaCS when Primary Schools were renamed Community Schools, was not completed until 1977 and even then only teachers guides had been issued, leaving the teachers themselves to produce their own material and worksheets. This failed to take account of the almost
Some old TEMLAB materials found in a storage box at a Community School.
complete lack of facilities in rural schools.

The course had been based too, on the belief that if a teacher slavishly followed the instructions in the guide then the children might acquire an understanding of mathematics beyond that of the teacher. [24, p.209]

A writer to produce pupil texts was not even appointed until 1981.

Coupled with the lack of consistency in the curriculum there was a serious weakness in distributing such materials as were produced. A Principal Materials Officer appointed in 1978 stated "Where materials have found their way into schools they are often not used because
a) the teachers don't know how to use them
b) the head teacher doesn't believe in them
c) the class teachers are unaware of their arrival

In other words the inservice training workshops vital to the implementation of any new syllabus have not taken place". [25]

Distribution failures between national headquarters and the Provincial Office and between the Provincial Office and the schools were also identified in a report prepared by the author in 1978 on behalf of the Superintendent for Education in Morobe Province.

2.1.1 THE MaCS COURSE

Finally, when one studies the materials themselves one is struck by the lack of balance between what might be described as theory and practice. There are five strands in the course. Logic, Relations, Number, Measurement and Geometry. Of these one could see Number and Measurement as having practical application in a village situation, whereas Logic, Relations and Geometry are relatively theoretical. But the amount of time to be spent on number and measurement was relatively small, while the guidance given to teachers
was often unclear or impracticable.

In Grade 1, the numerals 1, 2, 3 were not introduced till unit 10, out of a total of 32 units for the year. Much of the time was to be devoted to "free play" which was totally contrary to the Papua New Guinean's concept of teaching. Apparatus which was certainly not available in sufficient quantities for a normal PNG class, is required on 61 pages out of a total of 83 pages in the first volume. (Teachers Guide for Units 1-25, [26]).

In the first teachers book for Grade 2, out of 92 pages of "guidance" 59 required that the students work in "groups". It is doubtful if more than a handful of Community School teachers have succeeded in organising their classes in this way for any length of time, if only because there have never been sufficient sets of apparatus available to do so.

In Grade 3 out of a total of 47 units, only 12 are specifically concerned with number. The first four of these will be described in some detail below:

Unit 78 "One more, one less". This was taught by putting several sets of 8 stones or shells in one hoop placed on the floor, several sets of 7 in another hoop, sets of 6, 5, 4, 3, 2, 1 and 0 in other hoops, then arranging sample sets from each hoop along a line using the rule "The next one has one more member". The operation was repeated with base 5 materials showing how 10 was one more than 4 and 14 was one less than 20.

Unit 82 "Exchanging". In Unit 82, five stones were exchanged for 1 stick and 5 sticks for 1 bead in a dice game: the game was to be played using as successive bases 6, 8, 2, 4, 5, 7, 5, 6, 9. This was followed immediately by a fairly complicated board game using dice marked -2-1, 1, 2, 3, 4. Each player started with 25 toea (although toy money was not distributed until
1979). Moving counters along a track consisting of unnumbered squares the player would then be instructed to "get 20¢", "pay 25¢", "back 8 steps" etc. The first player to reach the "Bank" at the end of the trail got a 50¢ prize. Addition and subtraction of numbers totalling more than 10, however, were not taught until Unit 91.

**Unit 86** Here the students were back at exchanging 3 stones for 1 stick, 3 sticks for 1 shell, 3 shells for 1 bead. Starting with one stone and adding a stone each time they counted 1, 2, 10, 11, 12, 20, 21, 22, 100, 101. Then they used base 5, adding sticks this time and counting 10, 20, 30, 40, 100, 110, 120. Starting with 1 shell and 2 sticks they then removed them one stick at a time, exchanging the 'bead' (a misprint for 'shell') for 5 sticks when they needed to, and counting 120, 110, 100, 40, 30, 20, 10, 0. This activity was to be repeated using base 4, then again in base 5 and continuing to such exercises as "one-zero, two-zero, three-zero, four-zero, one-zero-zero, one-one-zero, one-two-zero etc."

The students were then to write their results on worksheets, first using base 5, then base 3, then base 4.

The counting then suddenly switched to base 10 with the teacher drawing 10 sets of 10 rectangles on the board and putting a tick in each one until the children had all counted to one hundred. This was to be followed by counting to 100 in 10's and back again to 10. The teacher was then to rub off the 100 rectangles from the board one at a time counting backwards from 100 to "zero" (although the actual instructions stopped at "one"). After this the students would have to "Go to your groups and count using 100 counters (forwards and backwards)."

The students then had to count as they placed one counter in each of 100 squares. Unfortunately, squared paper was not generally available so they would presumably have had to find rulers and draw their own. The operation
was repeated with toy money (also unavailable) counting by 1 toea and exchanging for 10 toea then "counting until you reach K1.00".† They then had to exchange back "if they needed to" and keep taking away 10 toea, counting backwards in 10's. Then forwards again in 10 toea and with a double exchange backwards by 1 toea. There was no instruction to use the 2t, 5t or 20t coins although the aim was "to count and recognise amounts of money to K1.00." The unit was completed by each child holding up 10 fingers in turn while the class counted in tens to 300 or more depending on the number of students and down again by 10's, presumably to zero.

Unit 89 Here they were to practise counting to over 100, backwards and forwards, using "stones, seeds or pebbles". Presumably, each child was to have his own supply, requiring up to 4000 such objects in the classroom at one time, hence the Teachers note: "Send the children out into the playground before this lesson to collect seeds and pebbles."

Each child was to be given a worksheet. These were not provided and it would have been extremely rare for any primary school to have a duplicating machine in working order, let alone the materials needed for it.

The worksheet was to show pictures of 25 pencils grouped in 2 tens and a 5, with the statement "10 + 10 + 5 Altogether 25" beside it. Then there were 33 birds, in 3 groups of 10 and 1 group of 3 with "...... + ...... + ......" beside it leaving insufficient space to fill in the intended 10 + 10 + 10 + 3. A group of 30 nicely-drawn shells had "...... + ...... + ......" beside it. Two groups of leaves, one of 10 and one of 9, completed the exercises on this worksheet which was to be copied and duplicated. It was also to be used as an example to enable the teacher to "make up more worksheets like it."

† The Kina (pronounced "Keener") is equal to 100 toea (pronounced "toyer"). Both are names of shells traditionally used for money. K1.00 is worth approximately £0.70 in 1982.
The next lesson started with the following instructions to the teacher:

"Divide the board. Draw pictures in the houses like this. Look at the rule on the board. Say the rule for exchanging:

| 5 stones | = | 1 stick |
| 5 sticks | = | 1 bead |

4 sticks were then to be 'put out' by the teacher and the sticks were to be drawn on the diagram, the figure 4 written underneath and a 0 written in the stones column. This was to be repeated with 2 sticks, 3 stones etc. Then the numbers were to be written in first and the sticks and stones 'put out' afterwards.

Then the rule was to be changed to base 3, and then to base 10. After this was the laconic instruction "Record some numbers using beads."

The next lesson used the rule in base 10 and a 'Chart of Number Words' was to be displayed, listing from 1 to 10 and by 10s from 10 to 100. 2 sticks and 3 stones were to be put out. The rule was to be read from the board. The number 23 was to be written. Then the sticks were to be changed into stones which were to be counted and the words "twenty-three" were to be written on the board. The process was to be repeated with 4 sticks and 6 stones, 2 sticks and 0 stones etc.

This work was to be consolidated with a worksheet comprising 4 examples of which one was already filled in. Another showed pictures of 4 sticks and 40 stones: the child had to fill in "... sticks ... stones", the number "40" and the word "forty". The second example had "1 stick 7 stones" from which pictures "17" and "seventeen" (although this was not in the number word
chart) had to be deduced and the last example had a picture of 6 sticks and 1 stone from which "... sticks ... stones" had to be filled in and the number "61" written: the word "sixty-one" was given. Most of the time would presumably have been spent drawing a picture of 61 stones, which the conscientious teacher would no doubt have to count and correct on each of his 40 students' worksheets, if the activity was to have any value.

The last lesson of the unit was to introduce "another way of recording numbers." This consisted of the format used in the earlier worksheet. Each child, with his own blackboard, chalk, duster, stones and sticks was to "put out sticks and stones to show 10 + 5". He was then to be told that "another way to write this was 15 (fifteen)". Each child had then to put out sticks and stones to show 10 + 10 + 2, 10 + 10 + 6, 10 + 10 + 10 + 8 and to "write the numbers in another way". Finally each child was to "Write these numbers in a different way: (i) 27, (ii) 18, (iii) 40."

This part of the Mathematics for Community Schools course has been described in some detail because the emphasis on other causes of failure has often been such that the weakness of the actual course itself has been forgotten. The above details from the Teachers Guide are all that was to be taught under the heading of "number" during the first term of the third year in the community school (pupils ages would range between 9 and 12 or so). Addition with numbers over 10 was not introduced till the next term and setting out of such addition in column format was not allowed until near the end of the year when 8 worksheets were to be produced, each with additions or subtractions of 2 or 3 digit numbers and the following bases: 3 (3 times), 4 (4 times), 5 (4 times), 6 (3 times), 7 (2 times), 8 (2 times), 9 (2 times), 10 (4 times).
2.1.2 **ASSESSMENT**

With this sort of background to the primary school teaching it was not surprising that results at the end of Grade 6 were rather poor. Few records were kept of actual achievement but a sample of 300 papers for the Grade 6 High School Selection Examination for 1977 gave a success rating of 38% in 23 questions involving number skills [27]. As these were in multiple-choice questions with only 4 alternatives offered, the proverbial load of monkeys with no skill but the ability to place a tick in one of four spaces should have scored about 25%. The 38% could have been expected to be scored by each child knowing the correct answer to 4 questions and guessing the other 19.

2.1.3 **TWO CONFERENCES**

In September 1968 the Officer in Charge of Experimental Projects, J M Humphreys, had reported to a conference on Mathematics in schools at the University of the West Indies that he had "no hesitation in saying that the Territory (now PNG) is embarking on a programme of mathematical education that is the envy of a great many developing countries."

Ten years later, another conference was held on mathematics in schools. This was a Seminar held in June 1978 by the Department of Education in Port Moresby. The following are some quotations from papers there presented:

Colin Meek, of the Mathematics Education Centre [28]
"It is agreed that

(a) Morale is low in community schools

(b) Teachers as well as students have difficulty in understanding the mathematics syllabus content

(c) Language problems, and hence communications between teacher and students, are aggravatingly acute
(d) Mathematics is the 'poor relation' on the syllabus, and is often left as an afterthought or not taught at all".

J Nou, Superintendent Inspections, Community Schools [29]

"The children in community schools are all rural dwellers most of whom are unaware of how maths is related to their everyday activities. The mathematical concepts with regard to Sets, Logic, Relations, Geometry and Number may represent a difficult idea, and this same idea may have a foreign value and understanding in the minds of PNG children".

Some questions from Northern Province teachers accompanied this paper:

"I am in isolated school and have no first and second term MaCs Text Books (meaning Teachers Guides). Is it possible for me to use PMS in my school?"

"Some teaching methods are not very clear written in MaCs. Can these be written bit more clearly for the teachers to follow?"

"How can we obtain some materials that are not around at school but are mentioned in the text books?"

"I have found out that in previous years teachers taught to tables by saying over and over, and now it has stopped. Is there any way where we can tackle this problem?"

A list of 22 schools in the Province was then given where Teachers Guides were lacking for an average of 3 Grades in each school. In 8 cases copies of the actual syllabus itself were also lacking.

Ivor Lopes, Superintendent Secondary Inspections [30]

"I find the standard of Mathematics depressingly low. On entry to Secondary, most students need remedial teaching before embarking on the course."
Murray Britt, UNESCO Mathematics Advisor [31]

"Since 1969 (and probably before) it is reasonably safe to say that almost nothing has been happening in the primary mathematics classroom. There are a variety of reasons for this:

- Several curriculum changes embodying a traditional to modern development have occurred.
- There has been almost no curriculum implementation.
- The curriculum has generally been inappropriate and too difficult both for teacher and learner.

In high schools and beyond we are presently experiencing the results of this educational bungling. We constantly hear that Grade 7 entrants are innumerate and that many students in Grades 8, 9, 10 and into university need some kind of remedial treatment in basic arithmetical skills."

2.2 SECONDARY AND POST-SECONDARY EDUCATION

In 1978 it was difficult to obtain any firm information about number skills attainment in Provincial High Schools. The final examinations were marked locally and detailed statistical information was not kept nationally. The whole high school mathematics syllabus was in any case in course of change, with student texts being prepared, so it might not have been appropriate to seek too much statistical information at this stage. As suggested above, however, some Grade 7 entrants were considered to be innumerate and many experienced high school teachers began with a substantial remedial course aimed at covering the number skills that should have been learnt in the primary school.

2.2.1 THE MEC BASIC ARITHMETIC TEST

Some assessment of these skills in the Grade 10 graduates was however obtained in 1979 by testing 2600 first year ex-Grade 10 students who were then in the first year of their post-secondary (or National High School) course.
These 2600 who completed the Basic Arithmetic Test in the first half of 1979 constituted some 42% of the cohort of Grade 10 graduates, including 55% of the most successful, ie of those who went on to post-secondary education. [32]

Of these most successful ex-Grade 10 graduates, 13% failed to divide 1900 by 10 correctly, 22% failed to multiply 0.37 by 100, 37% could not find 1/3 of 2.7, 42% failed to divide 134.8 by 10, 52% failed to add 3.7 + 1, 62% did not know which was the biggest number out of 0.5, 0.571, 0.0943 and 65% did not know what the time was 40 minutes after 10.38 am.

The weakness in number skills obviously affected the later work of post-secondary students. In the same test on a class of second-year Business Studies students at the University of Technology, 7 out of 18 failed to multiply 18.3 by 100 correctly, 5 of them giving the answer 183.00. 7 of the 18 also failed to add 3.7 + 1 correctly.

Out of a group of 13 fourth-year surveying students, expecting shortly to receive their Bachelor degrees, 5 failed to convert 8.34 m to mm, 3 of them giving the answer 834 mm.

At the other end of the post-secondary scale, in each of 8 schools of nursing over 40% failed to express 3 ÷ 100 correctly as a decimal, while in the other 8 nursing schools tested the failure rate on this question exceeded 70%

In such a situation the Post-secondary institutions found themselves being compelled to run their own remedial courses in arithmetic before they could do their normal teaching.

2.2.2 THE MEC BASIC SKILLS COURSE

The Technical Colleges were particularly hard-hit because they had just recently lost secondary-level sections that had previously been attached to them and this meant that they no longer had any specialist mathematics teachers on their staff.

A report suggesting an increase of time for mathematics to 50% of that allocated to Technology/Trade Theory was produced
by Port Moresby Technical College in 1977 [33]. Early in 1978 the newly arrived Director of the Mathematics Education Centre at Lae was asked to visit the College and advise on a remedial programme.

As a result a 22-unit 'Vocational Mathematics Course' [34] was prepared, each unit having 2 associated mastery tests. This was trialled in 1978 and replaced by a 'Basic Skills Course' [35] written in October/November 1978 for use in 1979. (see 5.1).

In an attempt to assess the situation and supplement the statistical results of the Basic Arithmetic Test referred to above, some 52 post-secondary institutions were visited and enquiries made of those responsible for the mathematics [36].

In order to summarise the information gathered a questionnaire was subsequently sent to those who had been visited and 29 were returned giving the following replies:
### Analysis of replies to questionnaire to Post-Secondary Institutions

March 1979

<table>
<thead>
<tr>
<th></th>
<th>Agree strongly</th>
<th>Agree</th>
<th>Don't know</th>
<th>Disagree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Continue to monitor the Arithmetical attainments of entrants to Post-Secondary Education</td>
<td>20</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Arrange College timetables in such a way that a substantial amount of time is made available (if necessary) for a concentrated effort at remedial arithmetic at the beginning of each course</td>
<td>14</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Provide inservice training for those who need it (a) to teach remedial arithmetic (b) to organise self-paced learning in the classroom</td>
<td>16</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Develop ad hoc course units meeting the specific needs of those teaching trade courses etc including exercises on the mathematics leading up to them</td>
<td>17</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Make appropriate educational apparatus available for sale to post-secondary institutions</td>
<td>5</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Increase the proportion of time, materials and training devoted to the teaching of basic arithmetical skills in Primary and Secondary Schools</td>
<td>17</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>
7 Arrange for ability in basic arithmetic to play a larger part than at present in selection for secondary and post-secondary education

<table>
<thead>
<tr>
<th>Agree strongly</th>
<th>Agree</th>
<th>Don't know</th>
<th>Disagree</th>
<th>Disagree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

8 Encourage the formation of Adult Education Groups to learn Basic Arithmetic wherever possible

<table>
<thead>
<tr>
<th>Agree strongly</th>
<th>Agree</th>
<th>Don't know</th>
<th>Disagree</th>
<th>Disagree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>14</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The next two years saw a plethora of remedial mathematics activity, aiming either to eliminate the incompetent by setting up an ad hoc selection test, or using various remedial courses.

Madang Teachers' College produced their own Basic Skills Course [37], the first twelve weeks forming a basis on which a satisfactory assessment was obligatory.

In 1976 the Port Moresby Teachers' College [38] had found that less than 40% of their entrants performed satisfactorily on numeration, notation of whole numbers and arithmetical calculations related to measurement. 57% showed adequate knowledge of basic addition and multiplication facts and could compare different forms of number. By contrast 76% were satisfactory on measurement skills including relationships between metric units, and 91% were considered satisfactory on the numeration and notation of fractions, decimals and percentages. As a result a Number Skills course was in use there in 1978 (Stuckey)[38].

Balob Teachers' College also had a Numerical Skills course in use in 1978 [39]. This consisted of 6 worksheets with mastery...
tests and retention tests. 90% was required for mastery, 80% for retention.

2.2.3 THE POST-SECONDARY MATHEMATICS GROUP

As a result of a Conference of Principals of Post Secondary Education and Training Institutions in June 1980, a Post Secondary Mathematics Group was set up in Port Moresby to give mutual support to those who were responsible for mathematics teaching in these institutions.

At the first two meetings, in June and August 1980, situation reports were given by each of the institutions represented [40].

1 College of Allied Health Sciences, Port Moresby.
   A remedial course was used, made up from a variety of sources including the 'Basic Skills Course' [35].

2 Goroka Teachers' College
   All students now had to pass an arithmetic skills test. Their own remedial course for it occupied 72 pages of A4 paper [41].

3 Port Moresby Teachers Inservice College
   (which had now changed from the pre-service institution it had been in 1978)
   The need for mental arithmetic was emphasised: an experiment had shown noticeable improvement in an experimental group that had received continuous reinforcement of this work, compared with a control group that had not.

4 Department of Works and Supply
   Their students mainly attended Lae Technical College for which an Upper Pass at Grade 10 was nominally sufficient, but many failed half-way through because of weakness in mathematics.
There was much difficulty with the four basic operations.

Students were normally Grade 12 or ex-University but a few did still have trouble with the basics, fractions, ratios, proportion, percentage.

They were about to revise their selection tests.

Their Grade 10 students had problems in the four basic operations, especially with decimals.

A version of the Basic Skills Course [35] was now compulsory for all Technical College students.

Their Arithmetic Improvement Programme used parts of the Basic Skills Course [35]. Potential employees were given a 1½ hours test with questions from it. Those scoring less than 50% were generally not hired. Those with 50% to 70% took the Improvement Course.

Mathematics created "terrible problems" in the teaching of nurses. They were weak in basic skills and particularly in estimating.

They used a 9-page Numeracy Test [42]. A score of 50% was required for selection. Most students needed basic skills teaching in mathematics.

They had the usual problems. There was no selection test but a test was given on entry to identify those who would have most problems.
14 Highlands Agricultural College
Their first semester was used for remedial work.

15 Vudal Agricultural College
It was believed that students must have lost many of their mathematical skills during the six months between school and college.

16 Burns Philp Training Centre
Their applicants seemed to have forgotten how to calculate percentages, manipulate decimals or use the metric system. They were developing tests for selection and diagnosis.

17 Electricity Commission Training College
This was the only college where entrants' basic skills were reported to be generally satisfactory. The Basic Skills Course [35] had however been used.

The report of the Conference of Principals of Post Secondary Education and Training Institutions [43, p.26] referred to the problems of selection and remediation:

"This year a Basic Mathematics Skills test on Grade 6 level work with decimals and measurement is being applied in the Community Teachers Colleges. If 80% on the first test is not achieved by the end of the first year, termination is recommended".

"Remedial education in Mathematics and English is needed but it is an expensive alternative to improving the skill levels reached in the High Schools".

"The Grade 10 certificate itself is not a reliable indication of the ability of the candidates".

This latter point was taken up in the second meeting of the Post-Secondary Mathematics Group when a proposal was put forward for a 'Minimum Arithmetic Test' which could be used by Post Secondary Institutions to eliminate candidates who scored below a certain level.
This was to be run on a voluntary basis by High Schools, the results of individual candidates being made available to those Post Secondary Institutions that wished to co-operate. No information was to be given to enable any sort of differentiation to be made between two candidates both of whose results exceeded the minimum level. This was to ensure that selection should not be made solely on the basis of arithmetical attainment.

Some members of the Group however felt that the proposed test would replace the present system of assessment and result in narrowing the curriculum in the High Schools. In the absence of any formal comment from the Department of Education on the scheme, the proposal was dropped.

At a subsequent meeting in March 1981 however a representative of the Assessment Unit of the Department listened sympathetically to the members of the Group and a submission was then made to the Assistant Secretary, Standards. This pointed out that the presence of students with an Upper Pass in mathematics at Grade 10 but an inadequate grasp of Grade 8 number work forced many institutions to set up highly uneconomic remedial teaching units. The Group urged that students lacking reasonable competency in these number skills should somehow be debarred from an Upper Pass grading.

The Group also noted that the only external examination, the Grade 10 Mid-year Rating Examination, was deliberately not based on the content of the syllabus. It was suggested that this must have an adverse effect on the teachers' and students' rating of the syllabus.

No doubt other representations were made and there was much sympathy with this point of view from officers in the Department. The first sign of a shift in policy came in May 1981 when it was reported [40] that the next Mid-year Rating Examination would have a higher content of arithmetic and 30% of the questions would no longer be multiple-choice.

By November 1981 additional staff had been appointed for the
Measurement (Assessment) Unit under a World Bank Project and substantial changes in the 1982 examination programme were expected.

2.3 **A CHANGING ATTITUDE**

Meanwhile various attempts had been made to get more number work done in the Community and Secondary Schools and so to tackle the problem at its root.

During 1978 the first of a series of booklets called 'Keep Mathematically Fit' was produced [44]. It was designed for use in Grade 7 and achieved a wide circulation. It contained 600 short questions, a large proportion of which practised simple number skills.

A meeting of the National High School Curriculum Committee in April 1978 had approved the production of mastery tests in core units, basic skills mastery tests and remedial units [23]. In the end however these were left to the schools themselves to produce.

A course on decimals to cover remedial work for Grade 8 was written by Morobe High School teachers during a National Inservice Training Week in 1978.

Another course on decimals for use in high schools was written by Brother Lawrence of Goroka Teachers College also in 1978.

2.3.1 **THE MATHEMATICS GROUPS**

On the initiative of the UNESCO Adviser, Murray Britt, and with the support of the Department of Education and the Mathematics Education Centre, a number of informal but influential mathematics groups were set up in 1978 which proved to be highly initiatory.

At the first meeting of the Lae group in March 1978 a unanimous resolution was passed urging the Department to arrange for the National Inservice Training Weeks for Primary and Secondary School staff to be set at different times [45]. This might
appear to be a small matter but 'NIST' week provided the major opportunity for the inservice so vitally needed. The fact that every school teacher in the country was expected to receive their training simultaneously however meant that the handful of experienced trainers available in a subject such as mathematics could not possibly reach more than a tiny proportion of their clients. Others expressed similar views, the advice was heeded and NIST week became more flexible from 1979 onwards.

In April 1978 the Lae Mathematics Group visited two rural Community Schools. As a result it was suggested that aids such as flash cards for relating sets of dots to numbers should be expanded to form a Crash Course in number skills for use in Grade 6.

"It was generally agreed that once Grade 6 was reached there was no longer time to go back to basic explanations of the meaning of addition and subtraction. The essential at this stage was that they learnt the necessary number bonds. Oral work and drill exercises on tables etc. were now rarely given because they had been officially discouraged when the 'new maths' came in, but there was general agreement that they were much needed now if the necessary learning were to be done at this stage to enable more complex concepts to be understood at a later stage."

The officers of the group also sent a personal note to the Senior Curriculum Officer strongly criticising a new "Learning Number Operations" booklet which had been drafted, on the grounds that this was entirely concerned with non-denary base work about which there was "much genuine doubt about its relevance." [46]

The Goroka Mathematics Group had agreed that an ad hoc remedial course was urgently needed for use at the beginning of Grade 9. This was warmly supported by the Lae Group in September and a proposed draft had been sent to the Department by October.

In October 1978 members of the four mathematics groups from Port Moresby, Lae, Goroka and Rabaul met at the University of
Technology. Graded exercises were written to expand those given in the Number strand of the MaCs teachers guides, and a series of exercises were also produced for the revision in Grade 9 of whole numbers, decimals and fractions. [47, 48]

An idea suggested in June 1978 came to fruition in April/May 1979 when members of the Lae group carried out in-service courses in 14 centres covering nearly all 800 primary teachers in Morobe Province. The subject taught was the addition and subtraction of whole numbers (in base 10), contrasting with "Learning Number Operations", the official publication for use during the week, entirely in multi-base arithmetic. [49, 46]

In July 1979 selection tests were requested by the Department of Health to assist them in excluding nursing candidates who lacked basic number skills. These were trialled by members of the Group. Unfortunately the Health Department found it impossible to apply the tests before selection because of logistical problems, or they might have had an immediate influence on number skill teaching in the High Schools. As it was, they were used subsequent to selection and did provide a basic for remedial work thereafter.

At the request of the Provincial Superintendent in October 1979 the Lae group produced an examination to assist in selecting Grade 8 students who would stay on to Grade 9. It contained a strong emphasis on number skills.

At the Second Workshop for Mathematics Groups the author read a paper [50] suggesting that the most fundamental need for non-mathematical students was 'number sense', i.e., having a 'feel' for the integers and decimals and the relations between them. He suggested furthermore that the most important factor for instilling a 'number sense' was Arithmetical skills. He therefore urged that an 'Arithmetic Supplement' be prepared which would specify what arithmetical skills should be practised and for how long each week.

The idea of an 'Arithmetic Supplement' had been put forward because of the apparently implacable determination that the

"Quizkids", calculator-like machines for teaching number facts on the Mathematics Education Centre stand at the Lae Show, September 1979.
syllabus itself should not be revised. This policy had been made clear at the Port Moresby seminar in May 1978 and was based, very reasonably, on the frequency with which the syllabus had been changed in the past.

The proposal for an Arithmetic Supplement was not accepted by the Goroka Workshop but an official statement did appear in the Education Gazette of October 1979 [51, p.237]. This listed number facts to be learned at different stages, such as multiplication tables for 1 to 6 and 10 in Grade 4 and for 7 to 9 in Grade 5. It also recommended that a short mental arithmetic test be given each day.

The Goroka Workshop also gave wholehearted support to another project which might help to improve the teaching of number skills by passing the following resolution:

"We consider the provision of MaCs and number skills materials to community schools to be of the utmost importance for the future of mathematics in Papua New Guinea." [52, p.22]

The Mathematics Education Centre had already distributed items which the Department of Education for one reason or another were unable to provide. At the end of 1979 the Centre found itself in a position to make a significant contribution. Large quantities of card were imported for printing and advice was obtained from the Lae Mathematics Group, particularly from the Head of Mathematics at Balob Teachers' College, Annette Ryan. Those Teachers' Colleges that were able to co-operate at short notice accepted and distributed a complete set of materials together with a 47-page guide on their use, to each of 400 graduates who were about to go to their first posts. [53,14]. Over a quarter of a million sheets were printed and distributed free of charge. It was this operation that had been specifically supported by the Goroka Workshop in the resolution quoted above.

Another sign of changing attitudes towards number skill teaching lay in the alteration made to the Grades 7-8 texts between the version that had been trialled during 1977-79 and the final version that was printed for use in 1981. [54]
There was a substantial shift towards increasing the work on number. Even so, shortly after publication, a supplementary booklet was published to provide additional practice exercises.

2.3.2 BREAKTHROUGH?

The point at which the most significant change could be recorded, however, was the Primary Mathematics Conference and Syllabus Advisory Committee meeting in July 1981.

The Committee had not met for many years, no doubt because of the belief that the country had suffered so many changes of syllabus that no more changes could be justified. Now, however, a World Bank loan had made it possible to appoint a writer to produce pupil texts for Grades 4, 5 and 6. It was therefore important that any modifications that were to be made to the syllabus should be made before the writing commenced.

The original MaCs syllabus was analysed in 5 strands and the objectives numbered. Some idea of the weight given to each strand can be associated with the number of objectives recorded:

- Number Operations 95 Objectives (42% of the total)
- Logic 48 (21%) 
- Geometry 44 (20%)
- Measurement 20 (9%)
- Relations 17 (8%)

A recommended revision had been proposed by Randall Souviney of the Indigenous Mathematics Project. It was analysed as follows:

- Number and Operations 92 Objectives (56% of the total)
- Measurement 22 (13%)
- Mathematical Language 18 (11%)
- Geometry 17 (10%)
- Problem Solving Applications 14 (9%).
This proposal was thus fairly radical particularly as it included the dropping of all multibase work, a decision which was later unanimously approved by the Committee. The proportional emphasis on number and measurement had also been increased, that on geometry had been halved while Logic and Relations strands forming 38% of the original had been replaced by Language and Problem Solving. [56]

The Conference broke into groups, one of which concentrated on number. A paper from the author was considered and its detailed recommendations modified but generally supported by the group. [57]. The final recommendations were prepared in the plenary session when the group's proposals were further modified. The net result however was certainly to accelerate the work on number compared with the original recommendations, specifying stages at which number facts should be learnt and introducing a number of applications to commerce. [58]

It is difficult to give precise comparisons because of the different ways in which objectives were expressed but the following table gives some of the recommended changes from the original MaCs syllabus, followed by a version of these that was actually approved by the Conference. The final result could certainly be described as a breakthrough for those who were concerned to increase the teaching of number skills in the primary schools, particularly when one realises that the new syllabus will be accompanied by pupil texts whereas the original had only the teacher guides which were described above (2.1.1)
<table>
<thead>
<tr>
<th>Grade 1</th>
<th>Original MaCs</th>
<th>Recommended</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchanging for 1 toea coins</td>
<td>Match a 5 toea coin to five 1 toea coins</td>
<td>Count money up to 10 toea</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 2</th>
<th>Original MaCs</th>
<th>Recommended</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making number patterns with additions</td>
<td>Able concretely to add any two numbers whose sum is 18 or less</td>
<td>Give quickly the result of adding two numbers whose sum is 20 or less</td>
<td></td>
</tr>
<tr>
<td>Exchanging K2 note for coins</td>
<td>Form sets of 1, 2, 5, 10, 20 toea coins equivalent to 25 toea</td>
<td>Form sets of 1, 2, 5, 10, 20 toea coins equivalent to 50 toea</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 3</th>
<th>Original MaCs</th>
<th>Recommended</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counting to 100</td>
<td>Concretely add any two numbers whose sum is less than 100 and record results in place-value tables</td>
<td>Concretely add any two numbers whose sum is less than 1000 and record results in place-value tables</td>
<td></td>
</tr>
<tr>
<td>Measure in metres</td>
<td>Measure in traditional units and metres</td>
<td>Measure in metres, to the nearest metre or centimetre</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 4</th>
<th>Original MaCs</th>
<th>Recommended</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplication with exchanging</td>
<td>Demonstrate the repeated addition concept of multiplication using objects</td>
<td>Give quickly the result of multiplying together any two numbers up to 10</td>
<td></td>
</tr>
<tr>
<td>Division with exchanging</td>
<td>Demonstrate the concepts of division by separating a set into equivalent subsets</td>
<td>Divide any number up to 100 by any number up to 10 rounding down and finding the remainder when required</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 5</th>
<th>Original MaCs</th>
<th>Recommended</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading graphs</td>
<td>Solve problems involving one or two of the basic operations (+ - x ÷) using whole numbers and decimals (money)</td>
<td>Carry out a stock-take (under certain conditions)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 6</th>
<th>Original MaCs</th>
<th>Recommended</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of whole numbers</td>
<td>Solve verbal problems involving one or more of the basic operations and percent</td>
<td>Price goods given that cartons contain no more than 10 units and markups are 10%, 20%, 25%, 50% or 100%</td>
<td></td>
</tr>
</tbody>
</table>
3.1 THE NUMERACY PROJECT

3.1.1 THE TASK

As indicated in 1.4.4 the author's concern for grass-roots education had led him and his wife to conduct a course in Lae for the Department of Commerce in 1979.[18]. Unknown to himself this coincided with a growing realisation within the Department of Commerce that lack of number skills was a very serious problem for businessmen in Papua New Guinea.†

It was the job of Business Development Officers to train businessmen to be self-reliant. Without teaching them number skills this was virtually impossible, and Business Development Officers (BDO's) were not trained to teach arithmetic. The consequence was that instead of teaching many businessmen to be self-reliant the BDO was in effect only making a few of them dependent on him.

The problem was noted by Mary Dickie, then Staff Development Officer in the Department of Commerce. She had seen a report of the author's course at Lae. As a result of further discussion he was offered a post at Laloki College. This was the institution used by the Department of Commerce to train BDO's but the author's main responsibility would be to try to solve this problem of inadequate numerical skills in businessmen.

The author had had no previous experience in commerce but the task was closely related to his concern for adult numeracy. He was therefore happy to accept this appointment in March 1980 although at this stage he had little idea of either the

† Acknowledgement should also be made of the self-assignment of Tony Wrightson a Lecturer at Goroka Teachers College who spent 3 months living in the Morobe Highlands to help trade storekeepers in the area. He experimented with the use of calculators supplied by the author while he was still at the MEC [59]
problems or a possible solution to them. To give his task a name the "Numeracy Project" was created and he was nominated as its Director.

3.12 THE PROBLEM

Some businessmen could add a column of numbers correctly, few could subtract and fewer still could multiply or divide.

Teaching adults to subtract takes a long time. The Author's wife, Mary, had spent a whole afternoon with one particular businesswoman on that course in Lae the previous year trying to do this. No matter how well motivated a student may be the subtraction algorithm requires much practice before it can be remembered. As for multiplying and dividing, this is virtually impossible without learning or making frequent reference to multiplication tables and even then the algorithms are complex.

The Department of Commerce had in fact produced a ready reckoner [60] that converted price per pack into price per unit given the percentage markup required, but this was a two-part book of 100 and 24 pages. It was not easy to understand with its use of ranges for the price per pack. Part 2 of the Ready Reckoner for example gave the results of dividing 'cost per pack' by the number in the pack. On page 23 one found that if the cost per pack was K223.39 - 225.16 then the cost each was K1.26. These ready reckoners were still in demand by those who had been taught to use them and knew no other way of pricing their goods, but they did not appear a good way to develop the work.

3.13 THE ELECTRONIC CALCULATOR

The only alternative to these methods was to use the electronic calculator, which after all is the normal method used everywhere in the Western world. The Papua New Guinean is well known for his readiness to accept modern technology so there were really only four objections to introducing the calculator:

† As stated in 1.1.3 the Kina (K) is worth 100 toea (t) or about £0.70.
its price, generally K15-K30 in the shops

(2) the likelihood of its going wrong

(3) the battery running down

(4) the difficulty of teaching without first standardising the calculators

While at Lae in 1978-1979 the author had discovered the very large mark-up (often 100%-200%) being applied to calculators by wholesalers and retailers and he had arranged for the Mathematics Education Centre to import and sell a cheap basic model at K8 each. Unfortunately these had a high failure rate of 5%-10% and the 50t battery ran down in a nominal 100 hours, particularly if one forgot to switch it off. It would have been irresponsible to sell these to village stores where they would almost inevitably have become useless status symbols.

In enquiring about a substitute for this model in 1980 however it was discovered that the Liquid Crystal Display calculator was now being mass produced and could be imported for little more than the price we had been paying for the LED variety. These had a nominal 10,000 hours battery life and an "auto power off". I also found them very reliable with a failure rate of under 1%.

From July 1980 to July 1981 the Laloki College Canteen (operating on behalf of the Numeracy Project) sold 2820 Sharps EL8158 calculators at an average price (including postage) of K7.80. It was then explained to the manufacturers what we were trying to do for Papua New Guinea and a reduction in price was suggested. They discontinued the EL8158, but offered us the EL220 which was smaller but otherwise almost the same, at a discount of 22%. From August to December 1981 we sold 1470 of these at an average price of K5.80 again with a failure rate of well under 1%. The availability and price of these calculators were sufficient to justify treating them as standard and only providing teaching materials for them. All the objections listed above were thus overcome.
3.1.4 **ADULT NUMERACY**

The advent of the LCD calculator thus heralded a new possibility for Papua New Guineans to try to overcome the lack of number skills inherited from the past. During 1978 and 1979 I had come to the conclusion that my aim should be nothing less than "making PNG numerate". Very little research however had been done on the numeracy of adult Papua New Guineans, compared with the immense effort that had been put into anthropological and linguistic research. The only relevant document I could find was the report "Youth in Their Villages" edited by Sheldon G Weeks of the Educational Research Unit of the University of Papua New Guinea. This however made no attempt at a nationwide survey, being concerned with the extent to which reading, writing and arithmetic skills were retained by young people after leaving school and returning to their villages. It covered only six specific villages.

In the absence of any national figures or the funds to carry out a proper survey to ascertain them, I decided to produce the best evidence I had available. This consisted of the memories of the Business Development trainees who were currently at the Laloki College where I was working. The major bias in this survey would be to limit it to the villages that had produced people who had ultimately entered the business field. The decision to come to Laloki had however, in the case of these particular students often been a marginal one: at this time (in contrast to the 1982 entry for example) most of those in the College had only come because they had not been given their first choice for post-secondary education. Nevertheless the result of this survey must be read with this possible bias in mind.

In the investigation "Arithmetic Skills of Adults in Papua New Guinea: A subjective Enquiry", in September 1980 information was obtained for 79 villages about one third having under 50 adults and one third having over 100 adults in them. The respondents estimated only 35% of the adults could add or subtract numbers up to 9 in their heads. Given pencil
and paper it was thought that 26% could add together 5 prices of goods in a store, 32% could work out change, 16% could multiply or divide.

By contrast these 79 villages contained some 335 trade stores, an average of one store to 38 adults. It was not surprising that the respondents considered that only 15% of these stores were run well, one of the reasons given in 93% of the cases being bad management. By contrast, only 43% of the respondents thought that "too much competition" was the reason.

This bleak picture of the potential for business life in villages was no surprise to the Department of Commerce and they were willing to support my suggestion that lack of number skills in the community itself was one of the major impediments to the development of business. A proposal was therefore put up to the Village Development Council that a preliminary survey should be carried out into the feasibility of a nationwide Adult Numeracy Campaign. A grant of K3500 was received from the Prime Minister's Non-formal education sectoral fund to enable a survey to be carried out in five Provinces between October and December 1980.

The results of this survey were affirmative and a grant of K14,290 was provided for work on the experimental stage in 1981. The original concern for businessmen remained but there was now a reason to expand the work into the non-business field. The combination of these two concerns directed the activities of the project and therefore of the author, during the latter part of 1980 and the whole of 1981.

3.1.5 OBJECTIVES

The primary objectives of the Department of Commerce Numeracy Project were defined in September 1980 as:

1. To increase the level of numeracy amongst Papua New Guinean business people, business groups and the communities in which they exist ...

2. To reduce the requirement for business development officers and other extension workers to provide simple
support to businesses and income generating projects ...

To meet these objectives we needed to answer three interrelated questions:

What should they be taught?
When should they be taught?
How should they be taught?

In the course of fifteen months from September 1980 to December 1981 we identified many different groups of people each needing to be taught different things in different ways.

At first it was by no means clear exactly who these target groups might be but looking back it has been possible to identify the following significant groups:

A Businessmen with simple but inadequate arithmetical skills
B Villagers who already know their numbers
C Village people who do not know their numbers
D Government officers and others who have already used a calculator but lack the skill to use it effectively or the confidence to teach others to use it

These four main target groups and the many sub-groups within them needed different answers to the questions "What to teach?" and "How to teach?" But all the work was relevant to the primary objectives set out above.

3.2 BUSINESSMEN WITH SIMPLE BUT INADEQUATE SKILLS

The Project's most obvious target group and those for whom it was originally set up were business people with some simple arithmetical skills but lacking those needed to run their businesses properly.
3.2.1 THE FIRST COURSE

The first attempt at providing a course for such people was proposed in April 1980, a month after the Project had been set up.

The "Trade Store Management Course" ([63], see 5.3) was based on advice from Don Moore of the Department of Commerce and Hanuatek, a group of small businesses assisted by overseas aid through a resident volunteer.

It was to consist of five self-paced units teaching calculator skills for the following:

- **TS1** Totalling and finding change, cash book and summary
- **TS2** Checking invoices and pricing, credit notes and business letters
- **TS3** Cheque account, maintaining a float, bank reconciliations
- **TS4** Stocktaking and ordering. Trading Statement
- **TS5** Analysis of trading statement using % of sales, fortnightly sales graph, balance sheet

Copies of this proposal were sent to Provincial Financial Advisers (P.F.A.s) Field Training Officers (F.T.O.s) and others for comment while the first three units were written, each with a mastery test. Those who offered comments were sent copies of the units for further comment.

Replies were received from 8 of the 19 Provinces. Most were strongly supportive. "I look forward to receiving some more materials which I very shortly hope to put into practical use" (Southern Highlands Province), "It is good to see such a programme has been prepared" (New Ireland), "I am most impressed that someone has thought of this idea and that it is a national effort" (Western), "The programme itself I agree with totally" (Oro).

One respondent suggested that a volunteer—assisted agency, "Skul bilong stoakipa", (Pidgin for "School for Storekeepers"),
had been running a similar, if not better, system since 1972 so that the proposed course was unnecessary duplication. The course referred to however required a long, intensive and residential training which few trade storekeepers would willingly contemplate. The Department had no hesitation in rejecting the suggestion that there was any unnecessary duplication.

Several of the field workers consulted suggested that few of their clients would be able to use the material proposed for Units TS4, 5 or Bank reconciliations. Units 1 and 2 were warmly welcomed however: "The basic problem which a great deal of trade stores face is the inability of the person serving to give the correct change" (Southern Highlands). "I found great difficulty in explaining the idea of pricing and costing, due to the fact that the proprietor did not have an understanding of multiplication and division" (West Sepik). Doubts were expressed about the total reliance on the calculator implied by the course.

"I would personally prefer traditional methods to be used so that the student would get a basic feel for numbers and not rely on a piece of machinery" (Southern Highlands).

"I think any Arithmetic test should be subdivided between mental arithmetic and use of a calculator" (Development Bank).

"The idea of calculators is a good idea however perhaps a basic course in its use should also be included as I know of very few persons at the village level who have ever seen one let alone used one" (Western Province).

"I am not one hundred percent sure that a basic Numeracy Course should be based on the use of calculators ... I am more inclined to feel that the arithmetic principles should be taught and practised without a calculator and a separate section of the course 'Using a Calculator' be taught afterwards. If
a calculator is to be used a very detailed explanation of its operation and lots and lots of practice will be necessary - again for my average trade store owner (referred to earlier as 'about Grade 6 standard'). Because of his lack of basic arithmetic knowledge and number sense he will get many wrong answers on his calculator. He will press 5 or more likely .5 for five toea, he will leave out the decimal point regularly and at first sight he will not know for example that 5.56324 means K5.56 (Several students selected from 200 nationwide applications for the Advanced Course at Laloki last November made these sort of mistakes)". (Milne Bay Province)

Early in June those responsible for training in the Department of Commerce met to assess these responses and to determine future policy. It was agreed that the first two units TS1 and TS2 should be tried out locally, that further material at a similar level should be written and that the name of the course should be changed to "Arithmetic for Business"(See 5.7).

3.2.2 A WIDENING EXPERIENCE

During the process of rewriting these materials the writer's knowledge of the scene was broadened by a number of experiences:

The Training Manager for Steamships Trading Company had found a problem when their cordial factory had tried to introduce a new form of invoice to facilitate 'cash on delivery' by making allowances on the spot for returned empties. This involved multiplication which could be done with a Ready Reckoner, but it also required subtraction which the drivers found very hard.

To meet this need a self-paced course (see 5.5) was written and taught by the author and his wife. At first the aim was to combine mental and calculator skills, using the one to check the other. It became clear however that few employees would in practice ever undertake this checking process. So when a large proportion of the workers we had trained had suddenly to be replaced because of their involvement in a
theft, the course for the new employees cut out the mental work and the use of the Ready Reckoner, going straight to the use of the calculator. Eighteen months later the same system was still in use, although calculators were now fixed to a heavy steel plate to make them less likely to be lost.

The author was also asked to assist with the Plantation Management Training Programme but although detailed instruction sheets were prepared they were probably found to be too complicated and too full of checking procedures to be generally acceptable (see 5.8). The Programme Director went on leave just at that point anyway.

At the Small Industries Research and Development Centre I was asked to advise on a variety of businesses where difficulty had been experienced in persuading the clients to keep their accounts. Here however non-mathematical problems intervened such as the failure of groups of weavers and carvers to buy or sell anything for more than a fortnight and the presence of book-keeping clerks employed by the Department who made it unnecessary for the potters to keep their own books.

A major decision was also make to do all future work in toea instead of Kina. The reasons were as follows:

1. Decimals were not generally understood. The common practice of writing both K and t thus K3.52t made this lack of understanding obvious. It was also not generally known that there were 100 toea in one Kina

2. In the Steamships course 0.05 and 0.50 had been frequently confused

3. The detailed instructions required to handle results such as 3.5 on the calculator had been difficult to write convincingly

4. Many commercially used pro formas provided separate columns for kina and toea, making the decimal point unnecessary
(5) The fact that inserting a decimal point was generally a less efficient means of using the calculator had also to be acknowledged (except where many items were in whole kina)

(6) A study of calculators used in large stores revealed the "Add mode" where amounts were entered in toea and the results given in kina

(7) When answers involved a large number of figures after the decimal point, as in division, it was easier to say "forget everything after the point" which you can do if you are working in toea, rather than "count two figures after the point and forget the rest" which was the version necessitated by working in Kina

The decision to work in toea was probably the most far reaching and also the most controversial one at this stage. No convincing arguments against it however have since been produced. Only at a later stage such as at Grade 10 or above, would it seem worthwhile to consider the possibility of using the decimal point to work in kina and providing the appropriate teaching for this.

On October 30/31 1980 the new "Arithmetic for Business" (5.7) was first used in a genuinely rural trade storekeepers' course at Nipa in the Southern Highlands. (The full report is in Appendix 2, in ANR3). In fact only two units proved to be generally teachable, one on totalling and finding change and another using a Check Slip to find the current balance in a Cash Book with IN and OUT columns only. Indeed even these units were much too hard for some of the clients two of whom, Agen and Oreb, had to be taught separately by my wife while I took the majority. Agen could match the numbers 1, 2, 3,..,9 to numbers of objects but Oreb could not do this. Agen could count money in multiples of 10 toea and give change for K1 but Oreb could only do it with multiples of 20 toea. Each sold 6 items in their store, priced at 20t, 40t, 50t and 60t. Agen waited until he had K240.00 in his hand, then he paid
K40.00 for transport to Mendi and bought goods with the remainder. Both were successful trade store owners in their own way and no doubt employed wantoks† to help them but one wondered if they could ever be brought up to any reasonable standard of arithmetical competency.

3.2.3 FREQUENT MODIFICATIONS

From this point on material for teaching trade storekeepers, along with other adults, was produced on individual sheets, trialled, and frequently rewritten (see 5.10).

At one point finding the mark-up % given the cost and selling prices seemed a good introduction when visiting a trade store for the first time, but the direct approach of calculating the "correct" price was reverted to later. Finding the mark-up % was a longer and more mysterious process on the calculator.

On a visit to Mendi in April 1981 the Principal of the local United Church Pastor - Training College sought my advice on a technique he had developed for checking leakage (ie losses due to spoiling of goods, stealing etc) in the College trade store they were just setting up. With some modifications appropriate to the best use of a calculator this was to become a standard part of our material. It was an attempt to control effects on "wontokism" which is generally recognised as a major problem for business in this country because along with many laudable features it also involves giving away one's goods to one's friends.

3.2.4 THE BUSINESS ARITHMETIC WORKBOOK

In May 1981 Mary Dickie, now Assistant Secretary for Training, to whom I was responsible until her departure in October 1981, proposed the writing of a "Business Arithmetic Workbook". This would be used by Business Development Officers to teach their clients either on the job or in courses. She also

† "Wantoks" are people who speak the same language ("one talk"). In PNG with its 700 languages the word has thus come to mean "friend". The "wantok system" is basic to the culture: you serve your friends first and expect them to do this for you.
suggested the preparation of cartoon strips to provide notes on specific processes which clients had to remember. The workbook would be incorporated in the Laloki College pre-service training for BDOs and would be "launched" for use in the Provinces at a Workshop for PFAs and FTOs in August. (see Appendix 2, ANR 11).

Before the end of the month six units had been prepared in Pidgin and printed in two colours from hand-written masters. Just after it had been written we received a report from Jonathan Spector, the PFA (Provincial Financial Adviser) for Manus Province, on a very popular course he had conducted, also in Pidgin, using a modified version of materials I had written earlier. A number of points he made were significant:

(1) The use of wherever possible instead of was emphasised and this tallied with our own experience of the chaos that could be caused in a class by frequent use of the key

(2) was used as a method of counting stock. We introduced this but subsequently doubted whether it was really practical

(3) He found the freight as a percentage of the total cost of a delivery and used this in pricing the goods. We included this at once as one method of pricing but were never sure whether the gain in ease of calculation quite made up for the increased "magic" in the process for clients who had no real understanding of proportion

(4) Jonathan also introduced a method of calculating profit using the value of stock at Selling Price reduced by 10% to approximate to valuation at Cost Price. He thought this was the only method his clients would be able to use anyway, and he may well have been right. We adopted it but used a 15% instead of a 10% adjustment.
The new Business Arithmetic Workbook course was tried out at Menyamya (see Appendix 2, ANR 12) where most of the students were trade storekeepers. At first it was disappointing. The difference between using $\text{CE}$ for a wrong entry and using $\text{CE}$ when a sign had been omitted between two entries caused complications. The self-paced format meant that some of them worked ahead without waiting for oral explanations or reading the verbal ones in the text.

One client asked how to work out the cost of 11 tins of fish at 45t each which was easy, but this led immediately to bills involving two such purchases and the complication of including $\text{+}$ followed by $\text{X}$: basic calculators such as the EL220 normally carry out operations in the order in which they are given so $2 + 3 \times 4 = 20$ not 14. I decided to use the memory as a means of overcoming the problem, having noted that this was in effect the method used in some larger calculators with sub-totalling facilities.

My wife also found the great benefit that could accrue from using actual goods instead of pictures. The less able students particularly seemed to benefit from the additional realism. On subsequent courses the Workbooks were used as exercises rather than as self-paced units and most of the original difficulties disappeared, leaving a number of improvements to be incorporated in the next edition.

The new edition was to be in English and was the first of the Project's materials to have the benefit of professional lay-out and illustrations, thanks to Kirsten Karanfilovic of the ILO/UNDP Project for Small Scale Enterprises and Entrepreneurship in the South Pacific.

The main modifications made in this edition [65] were:

1. combining the two units on checking invoices and pricing goods without freight

2. adding a cheque account section including the use of a "Bank Book" and Reconciliation slip
3 Increasing the number of examples of the Leakage Check calculation and introducing Jonathan Spector's Profit and Loss method but referring to it as "changes in Net Liquid Assets" to avoid criticism of an imprecise use of the term "profit"

4 The use of (RCM) twice to recall and clear the memory instead of (OFF ON) to clear it after using (RCM) once.

A copy of Unit 5 is included in Appendix 3 as a sample of the course.

It was agreed that memo sheets would be needed to remind clients of the processes they had learnt and it is hoped that such material may be produced in cartoon form in Pidgin by June 1982 with the help of an expert cartoonist, Bob Browne, as originally suggested.

A decision on translating the Workbook back into Pidgin was postponed. Relevant arguments were as follows:

1 The style is that of a self-paced course, addressed to the client. As such it includes precise instructions on what must be done and how. Pidgin is not a good language in which to give precise instructions. The result is likely to be long and clumsy.

2 In spite of the course being addressed "as to" a client it is not expected that many clients will be able to follow the instructions themselves. Even highly educated students find self-paced materials difficult to use. The style is designed primarily to enable a teacher, such as a Business Development Officer, to give correct instruction to a client. Business Development Officers do not need to have the work translated into Pidgin, they can translate it themselves when they are giving the instructions, into whatever language is appropriate between them and their clients.
3 On the other hand materials written in Pidgin would appear to be more acceptable to users, particularly in areas of the country where Pidgin is the normal means of communication, even between English speakers. For use in such areas it might be worthwhile producing a version of the course in which a minimum of instruction in Pidgin was included, but where the main teaching was still expected to be done by an English speaker who had studied the English version. Such a version would be precisely parallel to the English one, but would consist of little more than the same exercises with brief examples. It would be built up with the memo sheets in mind so that the instruction there would be reinforced.

The Workbook was produced just in time for use at the PFA/FTO Workshop in August (for Provincial Financial Advisers and Field Training Officers). It was well received by both groups, including the Leakage Check and the Net Liquid Asset calculations both of which were entirely new to the great majority of the officers present.

After using the new unit on Cheque Accounts it was quickly found to be too confusing, with much turning forwards and backwards to other pages. The work was simplified and the PNG Banking Corporation kindly ran some Bank Statements to our specification on their machine, so that they became more distinctive and recognisable.

At the request of the PFAs an extra sheet was added to the Pricing Unit, listing the current permitted retail markup % on price controlled items. Various officers had had great difficulty in getting access to such a list and in interpreting some parts of it.

The major problem discussed at the Workshop however was that of supplying calculators for resale. Any campaign to get these materials taught to businessmen obviously depended on the provision of calculators but it was not considered
generally desirable to let BDOs have supplies in advance of payment. Various means of getting round this problem were devised and the process was encouraged by offering calculators to them at K5.50 each post free for resale at K6.00. The Workbook was sold similarly at 15t per unit post free for resale at 20t. (see Appendix 2, ANR 13).

The Officers were also asked to list the businesses other than trade store keeping for which numeracy teaching would be desirable. Twenty-five such businesses were listed and some attempt was made by the Officers at identifying the mathematics involved in them. No action has since been taken on these however as considerable research would be required in each case and the demand in any one business area would be minute compared with the general need, for example, for keeping a cash book.

The original idea of the Workbook had been that it should be taught either individually on the job or in courses. On the whole the officers felt courses were more popular and less time consuming. On the other hand there is a suspicion that courses are not as cost effective as would appear because they tend to be seen as an end in themselves and as a method of acquiring some sort of Certificate rather than as a way of learning something that will actually be used.

This was underlined by the results of a follow-up of Jonathan Spector's courses in Manus. He had taught a total of 86 students on four courses. Six months later he had an opportunity to tour the island and made an effort to visit as many of the 86 as he could. In a three-week tour he could only find 12: the reasons given for absence from a village when Jonathan arrived to find a client were the usual ones - "in the bush", "at the next village", "fishing", and so on.

We shall have cause to refer again later to the practical difficulty of following up a client. (see 3.2.5.4)

Of the 12 Jonathan found only one was still working in a trade store. The other 11 had all started enthusiastically operating the accounting system they had been taught, but had then, for
one reason or another, ceased their connection with the trade-
store. The cessation did not appear to have been caused by
the new knowledge: it seems to be a feature of the area that
people come and go in their association with trade stores. It
is probable that a proportion of those who originally came were
not at the time really working at a store anyway. There was no
means of checking. They may well have come just because they
liked coming on a course and hoped to have a trade store later.

The main part of Jonathan's course had been concerned with
keeping records including a monthly stocktake and daily sales
record. But these operations in themselves did not give the
owners clear answers to either of their really relevant
questions: (a) How much profit have I made? (b) How much
have I lost through goods being given away? so perhaps this
was a mistake on Jonathan's part.

The use of the calculator as such however was now very much in
evidence. Jonathan had himself sold 100 and there were around
400 trade stores on the island. He thought it probable that
although many of the stores had had calculators before, a good
proportion of them now had calculators that worked, ie with
batteries that had not run out; a significant difference.
Jonathan's impression was that the calculators sold on his
course were now being used for totalling and finding change,
and possibly for pricing, but not necessarily by the people
to whom they had originally been sold. The one client he did
find was using X for pricing, to find out how much he would get
for a carton if the units were sold at a particular price

If it is true that familiarity with a calculator is a necessary
first stage before using it for pricing and record keeping, then
Jonathan's operation could be considered at least an initial
success.

A true assessment of the value of the Workbook however must
await evidence as to its use in the field. A first question-
naire was issued to all FTOs and PFAs early in 1982 but such
enquiries generally result in a very poor response. That was
the case when there was an Assistant Secretary at national
headquarters responsible for training. In a recent cut-back the whole division of General Business Training (including a staff deployment function) was eliminated so it is likely that requests for information from the centre will carry even less weight in the future. By the end of February about a quarter of the forms had been returned but they were too diverse to show any general pattern in time for inclusion in this thesis. (see Appendix 2, ANR 18 for copy of the questionnaire).

3.2.5 FOLLOW-UP

A certain amount of follow up of training given to village businessmen has however been carried out by the Numeracy Project itself.

3.2.5.1 NIPA

The report on the course at Nipa in the Southern Highlands on 30/31 October 1981 is in Appendix 2 in ANR 3.

The follow-up was carried out by the local BDO who had organised the course. The report on it is in ANR 12.

The Course was for 15 Trade Store Keepers. The materials used were the old Arithmetic for Business units (see 5.7) designed as self-paced material for good English speakers. The exercises were used for class teaching, apart from two older trade store-owners who did not know their numbers (see 3.2.2 above).

Lunge Rias, District BDO, kindly completed a simple form in April 1981, giving the following information about 12 of the students at the course. (The answers were all "written in" by Lunge; the author did not list any suggestions).

1. Have they still got a calculator that works? Yes - 8, No - 4.
2. What do they use their calculator for? Giving change - 3; costing - 2; pricing - 4; bookkeeping - 5; adding and subtracting only - 2; adding, subtracting and multiplying - 2; checking invoices - 1.
3. Did they learn anything else from the course that they still use? Giving change - 12; costing and pricing - 4; checking of invoices - 5; adding and subtracting - 4; memory recall - 1.
4 Do they want more training? Yes - 12.
If so, in what?
Costing and pricing - 8; checking invoices - 3;
percentages - 5; calculator memory - 2;
general use of calculator - 4.

A personal follow-up by the Director has not been possible
and there are a number of ambiguities in these responses such
as how two of them who have not now got calculators "still
use" what they learnt about costing and pricing; but there
may be an explanation. The Materials used were highly
inappropriate compared with what is now available; the request
for further training was unanimous.

3.2.5.2 KUPIANO

The course at Kupiano on 14-27 February 1981 is reported in
ANR 8 in Appendix 2.
The follow-up was carried out by the author and his wife
personally. The report on it is in ANR 13.

Details of the Course are as follows:

<table>
<thead>
<tr>
<th>Village</th>
<th>Numbers of students who claimed to have reached the following Education Grades</th>
<th>Sex</th>
<th>Numbers concerned with Trade Stores</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>GAVUONE</td>
<td></td>
<td>7</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>KELERAKWA</td>
<td></td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>WAIORE</td>
<td>1* 2* 1</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>KUPIANO</td>
<td>1 3 1 3</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>WANIGELA</td>
<td>1 2*</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>MERANI</td>
<td>1 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>WAIAVANUA</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TOTALS</td>
<td>1 3 1 10 3 5 3 19 7 22</td>
<td>22</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

*Left after $\frac{1}{2}$ or 1 day
The students details are listed above.

The course consisted of various exercise sheets (ANC Series see 5.10) including totalling and finding change, cross-totalling analysis sheets, measuring with metre rules (it was intended as part of a general adult numeracy campaign experiment so materials were not restricted to those applicable to Trade Store management), multiplying lengths by numbers, checking invoices, totalling notes and coins slips, weighing and selling cocoa/copra, mentally adding single digit numbers and finding change from a kina, pricing goods, proportion for pricing material and PMV charges, use of clock and calendar, miscellaneous questions on $x$ and $\frac{1}{2}$ and estimating lengths.

We gave them several tests during the course. One was a speed test adding single digit numbers mentally. The results were as follows:

<table>
<thead>
<tr>
<th>No. wrong, out of 81 questions</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of students, out of 19</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Average time taken for these</td>
<td>2m</td>
<td>3m</td>
<td>3m</td>
<td>4m</td>
<td>4m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>56s</td>
<td>2s</td>
<td>54s</td>
<td>8s</td>
<td>15s</td>
<td></td>
</tr>
</tbody>
</table>

A test of their ability to tell the time (in quarters, halves and o'clock) after teaching on the subject, gave the results:

<table>
<thead>
<tr>
<th>No. wrong, out of 12 questions</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of students, out of 18</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

This did not test their ability to say what the time would be in $\frac{1}{2}, 1$ or $2$ hours, which they found much more difficult.

Anyone who has attempted to follow-up a research project based on several different villages in Papua New Guinea will appreciate the cost in time, money and frustration in doing so.
To be reasonably sure of meeting one particular person, the researcher would probably have to spend 24 hours in his village and even then there is no guarantee that he will not be away at the time. One cannot normally find out in advance if he is there. Merely to reach any one of three of the villages listed above would require the hire of a boat. Thus the only practical way to follow up a course such as this personally is to put on a second course which may attract as many as possible of the same people and to rely on this and chance meetings to see as many as possible of the original students. Having once achieved one's goal of interviewing the person and tape-recording the result one can still make only a subjective judgement as to the probable truth of what has been claimed. (Further illustration of this problem is given in 3.3.5.4). In the circumstances therefore one feels that a 40% response is quite good. In this case during a subsequent five day visit to Kupiano in August we succeeded in interviewing 6 of the 15 trade storekeepers who had attended the previous course (excluding the 7 who had dropped out after one day).

A summary of the skills they appeared to have learnt at the course and now used the calculator for, is given below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Calculator now used for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warikapani</td>
<td>Totalling bills</td>
</tr>
<tr>
<td>Gerega</td>
<td>Checking Invoices</td>
</tr>
<tr>
<td>Rigolo</td>
<td>Totalling and giving change</td>
</tr>
<tr>
<td>Ai Wari</td>
<td>Totalling and giving change, totalling orders, checking invoices, measuring materials</td>
</tr>
<tr>
<td>Gideon</td>
<td>Checking invoices, pricing goods, giving change, keeping cash book, teaching others, measuring electric cable</td>
</tr>
<tr>
<td>Johnson</td>
<td>Invoice checking, stocktaking, cash book, totalling and giving change, pricing, teaching others</td>
</tr>
</tbody>
</table>
3.2.5.3 LAE

A course for Women and Youth Leaders in Lae, 4-6 February 1981 had attracted 2 male youth leaders and 2 women from the YWCA, all interested in running trade stores, 2 in a centre selling artefacts, 2 wanting to make clothes for sale and only 2 with a more general interest. The full report on it is in Appendix 2, ANR 5. The report on the follow-up is in ANR 12.

One might have thought that follow-up in Lae, the second largest town in the country, in June would be easy. A questionnaire distributed by the Field Training Officer produced two replies from the artefact centre: they claimed to use the calculator for "percentage and memory". On testing them on an invoice however they only used $x$ not $\times$. They did appear to be using it to total money and find change. Two youth leaders were out of Lae but the typist promised to get them to complete the forms later. One did so, saying he did still use a calculator and was planning to teach others later in the year. Two other students were now on maternity leave. I spent the afternoon seeking them and found that one had used it on her work before going on leave while the other had returned hers to her employer but now wanted one for her father. When in Finschhafen we twice sent our driver to fetch a woman who had come to Lae specially for the course but on one occasion she was in the "garden" and on another she said she was ill. Attempts to find two other ex-students were unsuccessful. The tenth student had only been to Ples Skul (a mission school where the teaching was given in Pidgin or "tok ples": "ples" means village and "tok ples" refers to the local language of that village). We did not find her.

3.2.5.4 MENYAMYA

The course at Menyamya from 2 to 5 June 1981 used the 1st edition of the Business Arithmetic Workbook in Pidgin (see 5.12) and is therefore nearest to a test of the materials which are now available. The students were divided into a fast group taught mainly by me and a slow group taught mainly by my wife. The full report is in Appendix 2, ANR 1 and the follow-up in ANR 17.
The 26 Trade Storekeepers who attended the course had reached the following grades:
5 no school, 2 Grade 2, 2 Grade 3, 1 Grade 4, 11 Grade 6, 1 Grade 7, 2 Grade 8, 1 Grade 9, 1 University dropout.

The Grade reached indicates the number of years they had attended school. There were no businessmen other than these Trade Storekeepers although there were some Government Officers whose numbers are included in the table on 3.5.2.

Only 6 of these 26 trade storekeepers attended the "advanced" course put on in November to try to collect them together for interviewing. One other trade storekeeper was found in the course of a two hour drive to and from Hakwange on an extremely rough road in a Mission vehicle: we did however interview friends of two others who now had their calculators. The other two trade storekeepers who had come from that village could not be found.

The remaining 15 trade storekeepers were even more inaccessible but we did interview 4 government officers and one of their wives who had been on the course. Details of all these interviews are given in Appendix 2, ANR 17.

All interviews were recorded on tapes which are available from the author. Photographs of the 14 interviewees are attached, together with one of the Hakwange road and another of the hill beside it which is believed locally to be the Centre of the Universe. Viewed relatively, why should it not be?

Free translations of the 7 interviews of trade storekeepers referred to above are as follows:

Interview # 1: James Malje, Kwaplalim,
(15 km from Menyamya)
Fast (= Fast Group in June), Gr 4 (= Community School Grade 4 education)
Q (Questionner): You find your calculator all right?
R (Respondent): Yes
Q: How do you use it now?
R: For buying coffee and running a trade store.

Q: How do you use it when buying coffee? Using $\times$?
R: Yes.

Q: In a Trade Store?
R: Using $\text{M+}$.

Q: To check invoices?
R: Using $\text{RCM}$.

Q: You use it to find change?
R: Yes.

Q: If you sell one thing at K1.25 and another at K6.15 how much is it altogether?
R: (Working on the calculator) K7.40.

Q: Then change from K10.00?
R: (working it correctly) K2.60.

Q: Suppose you have an invoice, can you use the calculator to check it using $\text{M+}$ and $\text{M-}$?
(He multiplies the number of cartons by the number of tins instead of the cost of a carton). No. I will teach you this afternoon: you have forgotten.

Interview # 2: Silas Maika, Kwapalim (15 km) Fast, Gr. 6

Q: You use your calculator in your Trade Store?
R: Yes

Q: To check invoices?
R: Yes.

Q: Will you check this one now?
R: Yes (he makes the same mistake as James did). You have forgotten this.
Q: Suppose you want to total K3.72, K5.85 and K7.43?  
(He works it correctly) 
R: K17.00. 

Q: Change from K20.00?  
(He works the sum again) 
R: K3.00. 

Q: You pressed [M-] instead of [C], but it gave the same result. You use this in your Trade Store? Do you use your calculator for anything else? 
R: No. 

Q: You use it for totalling and change only? 
R: Yes. 

Q: I will teach you more this afternoon 
You learnt how to use [X]? 
R: Yes. 

Q: You can use [X] for this one?  
(He works correctly 40 [X] 6 [+] 1000 [C]) 
Q: This gives you change? 
R: Yes. 

Interview # 4: Kemen Patiea, Panikwa. Slow (slow group in June) no school 

Q: Do you use your calculator now? 
R: Yes 

Q: How do you use it in your trade store? 
R: Using [C]. 

Q: Using [C] for change? 
R: Yes 

Q: Any other use? 
R: No
Q: Can you work this question using $\text{\textdagger}$?  
(He makes a mistake. Then adds 49t and 24t correctly) Then finds change from K1.00 for 35t. He uses $\text{\texttimes}$ instead of $\text{\textdagger}$. He tries again. He uses $\text{\texttimes}$ again in spite of hints)  
Q: You find totals only. Try this one, and write the answer here. (results not recorded).

Interview # 5: Obed Malje, Menyamya. Fast, Gr. 6.  
Q: Your calculator still works?  
R: Yes.

Q: How do you use it in your Trade Store?  
R: I use $\text{\textdagger}$ to find change.

Q: Can you do this: K1.25 and K6.15?  
R: (He works it out) K7.40

Q: Now find change from K10.00  
(He works it with some mistakes, then does it in his head).  
Now work this: 68t four times. How much altogether?  
R: (He works it using $\text{\texttimes}$: K2.72

Q: Now find change from K5.00  
R: (He adds to K2.72 what he thinks is the answer and gets it right at the third attempt).

Q: You work it in your head and check with the calculator?  
R: Yes.

Interview # 9: Inok Sakapana, Kokowniye. Slow, Gr. 6.  
Q: What do you use your calculator for?  
R: Totalling money in a trade store.

Q: Finding change?  
R: Yes.
Participants in the Numeracy Course at Menyamya

James Malje (#1) and Silas Maik (#2) trade storekeepers

Numbers in parentheses refer to the interview number used in the text in section 3.2.5.4 and in ANR 17 in Appendix 2.
Gutain Luviak, Department of Primary Industry
Benjamin Phillip, Vocational Centre trainee
Benny Bau, Department of Primary Industry

Shadrach Kopiya, (#3) Department of Primary Industry
Kemen Patiea, (#4), Trade storekeeper
Irok Sakapana (#9) Trade storekeeper
Dominic Guye (not on the June course)
The Pangu Party of Michael Somari ruled in PNG from Independence to March 1980 when it was defeated in Parliament on a vote of confidence

Yosip (#19), Smith (#18) and Elli (#20), students at the Seventh Day Adventist school
Alpies Dangi (#10) and Obed Malje (#5) Trade storekeepers, with their copies of the Business Arithmetic Workbook.

Nya Kausa (#13) Officer-in-Charge, Forestry. The hills in the background help to explain why the road to Menyamya is still not completed.
Lydia Paul (#11) Assistant Nutritionist, associate to the wife of the District Coordinator, a qualified nutritionist from Ireland. 

Mrs Kausa (#12) Wife of the Officer-in-charge, Forestry.

Mare Kovero (#14) Teacher at the Vocational Centre, who taught a group of 17 trainees at short notice. It was during this interview that a run-away truck careered down the hill and nearly overturned.
A suspension bridge on the road that will eventually lead from Menyamya to Lae, with the author's wife who assisted in the teaching at the June course.

The Mission Land Cruiser which took the author on this road from Menyamya to Hakwange. The trees by the roadside are waiting to be used to replace those on which the bridge rests.
Abaida Guiyoni (#15) at Hakwange who, astonishingly, did not need his calculator to find change but did actually use it to do the stocktaking once a week. He is outside his trade store.

The hill beside the Menyamya - Hakwange road, which is locally believed to be the Centre of the Universe.
Q: Work this: K2.25 and K1.00 then change for K5.00 (He tries to subtract K1.00 from K2.25) You buy two things: How much altogether? (He gets K3.25) Now change from K5.00 (He does it correctly). Do you use it for anything else?
R: No.

Interview #10: Alpias Dangi, Menyamya. Fast, Gr. 6.
Q: You use your calculator in your Trade Store?
R: Yes.

Q: What for?
R: To help me to add, to calculate air freight and pricing, but I do the easy ones in my head.

Q: You learned it this time? (He was the only student not interviewed before starting the November course)
R: I learned a little then. I have been looking forward to your coming a second time. Between the courses I used it for adding, finding change, markup, landed cost, adding 10% or 40%-80% on other things. The missionary's wife helps me.

Q: What do you use a calculator for?
R: Stocktaking.

Q: How do you do that? (Sr Dockery helped with the questioning)
R: I use τ.

Q: Do you count the numbers of piles on the shelves?
R: Yes.

Q: Do you use the calculator for anything else?
R: No.
Q: How do you find totals like 7St and 39t?
R: I use my head.

Q: And finding change? If a customer buys something for K1.40 and gives you K2.00?
R: 60t.

Q: Do you price your goods in 20t, 30t etc or 24t, 37t etc? (I tried to find out if all his prices were multiples of 10t but failed. I saw later that most, but not all were).
How often do you take stock?
R: Once a week.
(Later, in the store: the first part of the interview was not recorded. He bought coffee and had a scale for weighing it, but he did not use the calculator for working out the price).

Q: What price do you buy the coffee for?
R: 50t for 1 kg.

Q: That is easy. Suppose you put the price up to 55t? Would you use the calculator then?
R: At first I would use the calculator, later I would use my head.

Q: The owner has the stocktake book?
R: Yes

Q: Can you describe how you use the calculator to do the stocktake?
R: I count the tins first then multiply by the price of each. Then I add all the amounts together on the calculator. I do it every Saturday.

Q: What happens when you have worked out the total stock value?
R: I write it in the book for the owner. The owner checks the totals to see if they are making money or not.
Q: You learnt this in the June course?
R: Yes.

Q: Good. I did not believe it was possible.

Two other interviews referred to students who had been at the June course:

Interview #16: Obed who had been taught by Tom Ikwayakuli, Hakwange, Fast. Gr. 7 - who was not available.

Q: (The School master helped questioning here). Do you know how to use a calculator?
R: Yes. I use it for stocktaking.

Q: You use it to total money also?
R: Yes.

Q: Did Tom teach you how to use it?
R: Yes.

Q: You use Tom's calculator?
R: Yes.

Interview #17: Russ, Palalye, he works for Womatoye, Hakwange, Slow, no school - who was not available.

Q: Does Womatoye use his calculator?
R: No.

Q: You do not know how to use it?
R: No. I would like to learn.

Q: I think Womatoye might teach you. Or perhaps Abaidah in Hakwange. You know him?
R: Yes. I have Womatoye's calculator.

The whole operation of re-visiting Menyamya and spending three days there teaching and interviewing had been carried out in response to the very reasonable demand that the research should discover to what extent the local people had benefitted from the
work. To be realistic this had to be done in a typically remote area of the country (because most of the country is "remote"). Counting the air fare from Lae, (which I was passing through), my accommodation, a nominal charge for the use of the vehicle and the four days of my time that had to be spent in order to get to, stay at and return from Menyamya, the total cost was K300, (about £210) or K21(£14.50) per interview. If fares from Port Moresby to Lae had been included the total cost would have been K460 (£320) or K33(£23) per interview.

Perhaps this will illustrate the difficulties associated with any attempt to formalise research in a Third World country. The author was fortunate to have received a sufficiently substantial grant from the Government to enable him to carry out some such follow-up. It is unlikely that the government would have been anything like as generous had our application been made a year later. The fund which had provided for us in 1981 suffered a severe cut in its allocation for 1982 and what remained was the object of fierce competition from worthy causes. Such is the effect of falling commodity prices which may marginally reduce the cost of a cup of coffee in the developed world but cause havoc in the economies that are dependent on them.

What evidence then had we gained for our £200 to £300? Little corroboration of claims made by respondents was possible although the details of the interviews do show the attempts of the questionner to discover the truth. It did not help that most interviews had to be conducted in Pidgin which was probably a second or third language for the respondents and a second language for the questionner, who had vastly less linguistic skill than any of those he was interviewing.

There were no convenient sound-insulated booths in which to conduct the interviews. One simply did the best one could wherever one was and if a passing truck did run out of control down a steep hill while one was conducting an interview (as one did) then there just had to be a pause while one ascertained that no one had been killed before one could continue the interview.
In other cases one had to compete with nearby engines running or cassettes playing. The interviewees were after all giving a favour to the researcher by answering his questions. One could not really expect anyone to admit a failure which would lower the respondent's status with the village or in the eyes of the interviewer. Those interviewed always demonstrated the courtesy which one had come to expect in this delightful country, but scientific enquiry does not come naturally to them.

In conclusion then, what can we say? Of the 9 trade storekeepers that we interviewed at first or second hand, seven were still using their calculators three months after the first course. One other had apparently taught someone else and given him his calculator. The ninth had passed on his calculator without passing on the skill to use it.

Of the nine it was fairly clear that most of them could add money and four pretty certainly used it to find change. Several said they used it for checking invoices, pricing, stocktaking etc and although one would be inclined to doubt these claims the one on whom I did check up (#15) really did appear to carry out a weekly stocktake with it, a remarkable breakthrough.

It was unfortunate that the (expatriate) District Coordinator who had set up the original course had had to be away on this second occasion. His absence made it impossible to find out whether invitations to attend the course had actually been received by the 20 trade storekeepers who did not come to it. It was fairly clear that no one in Hakwange had heard of it so it is likely that the publicity had in fact been poor: it is no use putting up posters or issuing circulars when the people you are trying to inform cannot read. The programme "Tok Save" is designed to overcome this problem by giving out announcements in Pidgin over the radio, but not everyone speaks Pidgin, not everything announced on the radio actually happens as promised (and who would walk 20 miles on the offchance it was actually true?) and in any case it did not seem to be in use in this particular area, probably due to poor reception or relative poverty. (see Appendices to ANR 16 and 18).
If therefore the other 20 trade storekeepers did not hear about the course then one could argue that those who came were a reasonably random sample of the 26 who attended the original course. If they did hear of the new one and deliberately did not come then one would suspect that they were not interested and no longer used their calculators. But even this might be quite untrue. There are any number of reasons why someone who wants to attend a course 10 miles or so away may not do so. While we were there for example there was almost a battle between two villages in the area because of an argument about moving a Health Centre. Such events, or simply a feast or a funeral, would be a substantial deterrent to anyone wishing to attend a course on the calculator especially if they were already using it happily for the particular purpose for which they wanted it.

Regrettably therefore, one must admit that the evidence from the follow-up, obtained at such cost, is hardly significant. This however does happen even in well organised research in the western world. Judgements in the end have to be made on fairly slender evidence, particularly in the Third World. Time, with a bit of luck, may tell. What is certain in this particular case is that those who did come to the second course responded extremely well to it and were far easier to teach than they had been on the first occasion.

3.2.5.5 BEREINA

The original intention of the Business Arithmetic Workbook (5.12) was that it should be used by BDOs with clients either individually or in groups. It is too soon to provide any record of follow-up of such training but the report of one Field Training Officer who conducted such a course in Bereina is available. [148]

6 Businessmen were taught with education ranging from Grade 4 to Technical College and National High School. The course conductor reported that the course had proved to be a success because:

1. The participants were in high need of such a course
2. Most of the participants have some idea of numbers and signs
3. The language used is simple and the course conducted at the pace of the participants understanding.

4. Most of the participants are Trade Store owners."

At first there had been some difficulty because of "signs and memory" but by the end everybody knew the basic ideas of the calculator and the use of it, especially for "working out prices and use of memory in dealing with customers". The participants were enthusiastic to apply what they had learnt in their trade stores.

3.2.6 NEEDS OF BUSINESSMEN FOR MORE NUMBER SKILLS

These needs, on which the whole project was based, were often illustrated on our tours. Some samples follow:

A trade store manager in Mendi was selling cheesepops at a loss while rice, for which the price was controlled, was substantially overpriced (Appendix 2, ANR 3).

Due to the high cost of freight in the Southern Highlands and their failure to take it into account when pricing, a trader in Karil was selling blankets at K4.40 when they had really cost him K7.22 (ANR 3).

A storekeeper in Lae helped by the BDO kept a cash book with analysis columns. When I was explaining how to cross check the totals and balance I uncovered an error of K100 (ANR 5).

When checking invoices at a Haus Kai in Goroka I found the total on one was K361 when it should have been K180.50. The error had not been noticed (ANR 9).

The ablest of a group of businessmen attending a course at Kiunga assured me twice that K284.15 was more than K380.29 (ANR 15).

3.2.7 CONCLUSIONS CONCERNING BUSINESSMEN

Note: these and other such conclusions are based on experience gained through the Numeracy Project. As has been explained, formal validation of such conclusions would be expensive to
obtain and the cost of doing so would not be justified unless serious doubts were expressed about the truth of the assertions:

1. The vast majority of businessmen in PNG need more arithmetical skills
2. The provision of long-life battery calculators and appropriate training can meet this need
3. The Business Arithmetic Workbook (the 1981 edition in English, see 5.12) provides appropriate teaching material
4. It needs to be supplemented with "memo sheets" and probably a Pidgin version
5. All Field Training Officers have been shown how to use this material and have been urged to pass on this knowledge to all their Business Development Officers for teaching clients individually or in groups
6. Ways are being found of meeting the need to supply calculators at minimal cost to clients
7. This training of clients and provision of calculators needs to be monitored for some time to come. In the absence of a General Business Training division in the Department of Commerce responsibility for this monitoring will presumably rest with Laloki College and the Numeracy Project.

3.3 VILLAGERS WHO KNOW THEIR NUMBERS

3.3.1 REACHING THE CLIENTS

The main problem with villagers who were not trade storekeepers (and we met few other "businessmen" in the villages) was that they lacked the motivation to come into a town for a course.

Our first attempt to overcome this was in the East Sepik in November-December 1980 when with the help of a senior Business Development Officer we persuaded "big men" in six
villages to send "representatives" to a four day course in Wewak. Those who came were mainly young people without standing in the village. We taught them deliberately how to pass on the skills we were teaching them and hoped that the influence of the "big men" would ensure that they did in fact teach the other adults in their villages. (ANR 4)

The more we learnt about village life however, the less confidence we had in this idea. When we did eventually visit Wewak again and interview six of those we had taught, we were not surprised to find that only one of them claimed to have taught any other person. The one who had, had taught one school-girl. (ANR 16)

We attempted to gather a similar group of representatives for a similar course at Popondetta in May 1981, but the gathering had been at second hand and no one in this category turned up (Appendix 2, ANR 11). So on our next tour in Morobe (ANR 12) in June we decided we must take the initiative ourselves. We hired a Land Cruiser and set out with a business development officer to visit the villages on the road running southeast from Wau. It happened to be the Queen's birthday (their Queen as well as ours) so school children were at home and at our first stop we taught four men and four boys. At the next village we taught six men, three girls and a boy. Two days later, after a trade storekeepers' course in Wau, we set out again at 3.20 pm and reached a village at 3.45 pm but were told that most of the people were still out at their coffee plantations. The same thing happened at the next village although we did there teach two men who were most keen that we should come back, preferably on a Sunday and teach the many Grade 6, 7, 8 people they had in the Village. Alternatively, I suggested we might warn them in advance by Tok Save when we were coming: they agreed that this might work but added that we should mention them by name in the message. On our way back to Wau we revisited the village we had reached at 3.45 pm but even then at 5 pm no one had returned and we were assured that when they did they would want food and a wash before learning. Village habits would depend on the situation of their gardens and the work they had to do in them. Night
The first attempt at a village-based course: "representatives" of the villages outside the Office of Business Development, Wewak, East Sepik, with the senior Business Development Officer (top right) who had persuaded the village "big men" to send the students in (ANR 4)

Three of the women on the course at the Goroka Business Development Office in March 1981 (ANR 9)
falls soon after 6 pm.

On our next tour based on Kupiano (ANR 13) we tried to extend this approach. The idea was to tell the people we were coming and hope they would remain there to meet us instead of going to work. It had mixed success, depending mainly on the enthusiasm with which the message was delivered to the village. Sometimes the message had not got through at all, when the only people we could find might be the old non-schooled people who generally did not know their numbers and were almost impossible to teach in a couple of hours, or the young "Grade 6" dropouts who appreciated our visits but had no standing in the village, nor money to buy a calculator.

The main publicity was by Tok Save (over the radio), when the Business Development Officer would give details of our arrival. This sometimes resulted in a group of trade storekeepers appearing, but we found there was a good deal of cynicism over Tok Save messages. We had more sympathy with this attitude after we had ourselves had to break a promise to turn up at a particular village on a particular day.

Villagers were not surprisingly hesitant to abandon their normal work-habits for the sake of a new and untried experience which must have seemed pretty pointless to many unless they already had business interests.

Originally we had thought of making more than one visit to a village but we decided that this would be unproductive because the only material with universal relevance was in totalling and finding change, and this they either could or could not do at the end of the first visit.

3.3.2 WOMEN'S WORK

In Goroka, Madang and New Ireland we arranged our visits through the UNDP/ILO Women's Project. This generally ensured a good basis for our visit, except when their organisation broke down. On the other hand a larger proportion of the women were unschooled and did not know their numbers, which made teaching on a brief visit with a calculator very difficult.
This however raised in starker form the basic question of the purpose of our work.† Were we just there to provide a useful skill? If so these visits were wasted because few women had any expectation of using such skills: one of the most competent women we met (Iruk Malai in Mawan, Madang Province, ANR 17), assured us that although her brother ran a trade store he would never allow her to help with the money side of it. Out of the 142 women we met connected with the ILO Project in Madang only one (apart from the ILO associate) was managing a business and she had to hand over all her takings to her husband who then failed to use them to pay the rent on their premises. In New Ireland, similarly (ANR 18) apart from the Kai Bus (mobile canteen) operated by the project itself, we only met one business woman.

Our experience in Goroka (ANR7, 9) was particularly interesting. The Women's Project there is responsible for quite a high-powered food business operation and I was able to meet their general manager, their Haus Kai (cafe) manager, their accountant, a woman's representative in the Provincial Government and the woman BDO (all "national" women), along with the expatriate Project Manager, a Research Officer and a volunteer teacher of informal women's groups named Monika Schmidt.

They were none of them very sure that numeracy teaching would be seen as relevant by village women, or indeed by any women other than those actually engaged in the Project business. I persuaded them however that they were the only people who could pass on this sort of education to women in the villages and on this basis they agreed to attend a 3 day course in March.

My wife who assisted in this teaching was convinced at the time that nothing would come of the attempt, and the follow-up enquiry justified her doubts, (ANR 12). Monika reported that none of the women appeared to have any intention of passing on the skills to others. To check this I sent questionnaires with reply-paid envelopes to the 10 women who had attended the course. Five responded. One had taught her children and two young girls, another had taught her father and some young

† see 3.3.5 for an attempted answer to this question.
girls from her village, the BDO had taught three friends, another reported simply that the village women had neither time nor interest.

Monika Schmidt's response was illuminating and was the subject of a further report in November (ANR 17). She had taught various groups of women.

One group consisted of 12 village women for six months: from not being able to write numbers they had learnt in 8 lessons how to add and subtract on the calculator. Learning the numbers was most useful but anything more turned out to be impractical. Coffee was sold to the buyer offering the highest price for the package so the price per kg was irrelevant to them. When it came to calculating change they either shopped in big stores where this was worked out for them on a sophisticated till, or they went to a local store run by a male wontok (person speaking the same language, ie a friend) whom they would not dream of offending by actually checking the accuracy of his calculation. Their only 'business' was selling vegetables and the price was determined by supply and demand: if they had to travel to Lae to sell them the cost of the fare would be written off as part of their fun in visiting relatives.

On the other hand Monika had also taught small groups of women who were planning to take over businesses next year and for them everything was worthwhile: cash book, invoice checking, pricing goods and even proportion to find the charge for 2 days baby sitting given the price for 5 days.

A youth group however, who were involved in a baking business had found ways to simplify their calculations so that they did not need a calculator: they had learnt how to divide a sum of money by 10 so could find the price of 1 kg of flour in a 10 kg bag. They found the price of 3 kg by repeated addition and could divide by 2 to find the cost of half a packet of sugar. They also knew that they should sell for double their cost so they (probably) rounded to a kina and could then tell how many 10t cakes they must make out of their dough. One
would not expect to find such a sophisticated group of youngsters anywhere except in a big town like Goroka.

3.3.3. NEEDS

The needs of villagers for further number skills were illustrated by the following incidents:

A girl serving in a store in Kupiano said that the old people who had learned pounds and shillings painfully had now given up and asked for help with money in the store. (Appendix 2, ANR 1).

A group of women in Gavuone knew they were often cheated when buying and selling (ANR 1).

Some women in Wanigela made skirts but not dresses because they could not measure (ANR 1).

The Manager of a Village Development Centre at Popondetta said that his staff had visited each of 12 villages weekly for 3 years to encourage village industries but the whole programme needed revising in the light of the villagers' failure to understand numbers (ANR 2).

A group of responsible Mothers Union Officers meeting in Popondetta had no idea how to work out the price to charge for their macrame work. A ball of string cost K1.95 and made 2 pot holders but they could not see that this meant the cost was about K1 each (ANR 2).

A family in Kanipe village needed to know how to price their scones. They also needed a watch and to know how to use it so that the bread they cooked in their drum oven would not burn (ANR 2).

Women in Embi village were sure that K1.10 of sugar, 65t worth of fish and 60t of rice came to K2.60 "because it always did" (ANR 2).

In parts of the Southern Highlands they still counted money in pounds and shillings; they knew 60t as 6 shillings but had no idea about 23 toea (ANR 3).
They also thought the coffee buyers cheated them but few could argue the matter (ANR 3).

A Community School headmaster wanted to get his School Office roofed with iron instead of bush materials but could not work out how many sheets he would need (ANR 3).

Only one out of a group of 10 women and youth leaders on a course in Lae knew how many toea there were in a kina. One guessed 25 then 50 before suggesting 100 (ANR 5). We received similar responses on other occasions.

The mother of a course member had just made and sold tapioca parcels in the market at an overall loss of 30t, although this did not take account of the fact that she had most of a packet of salt left over and that she had eaten two of the parcels (ANR 9, section 7).

In a "fast" group consisting of the brighter students on a course, I had much difficulty in explaining the concept of "how much longer". When asked this about two pieces of material the first student did put them side by side but he proceeded to measure the wrong length and was surprised not to get the answer he had obtained by subtraction (ANR 11:7).

On a Palm Oil plantation boss-boys were in charge of ten to fifteen labourers but they were not always able to count their men correctly (ANR 11:11).

Students on courses frequently had difficulty in determining which was the larger of two numbers. One was quoted by an outside observer as having "acute difficulty in deciding whether 77 was greater or less than 74" (ANR 11: Appendix)

When a client had paid part of a bill the brightest of my students in one course wanted to add the part to the whole to determine how much more was to be paid (ANR 15:6)

3.3.4 MATERIALS

The previous section illustrates the variety of needs that may be met within village work. From October 1980 to July 1981
we produced at least 56 different exercises (the ANC series, see 5.10) including: totalling and finding change with and without the calculator, cross totalling, checking invoices, notes and coins slips, number game using the constant function, adding, subtracting, multiplying, dividing, estimating and comparing lengths, weighing and selling coffee, listing and pricing timber requirements, the clock, the calendar, profit, stocktaking, leakage, pricing food, pricing sewing, PMV charges, comparing prices in a supermarket, stock control, wages, Church health service forms, pricing artefacts and services, costs of eggs, printing, second hand clothing, travel, lumber, air freight, rice by the cupful, cardamom projects, cattle projects, plantation areas, numbers of truck loads needed, finding page and hymn numbers.

In June we prepared materials specifically for use in village visits lasting an hour or two. These consisted of AND 1,2,3, (see 5.11) a set of three A4 sheets each ruled into three sections so that they could be folded with one section only showing, the rest being folded underneath to give a thickness which facilitated writing on it on the knee, the nearest bit of wood or on the ground. The series was in Pidgin, very crowded on the paper and printed in haste from a hand-written copy.

AND 1 included totalling, finding change and cash book. In the latter the balance was to be found on each line and then checked at the end by totalling the IN and OUT columns. Additional practice was given on the back of the sheet. AND 1 was subsequently rewritten in English with answers to all the questions on the back, typed and renamed FCC 1: our First Calculator Course. This sheet became the basic introductory material used thereafter on every occasion except when the first unit of the workbook was appropriate. AND 2, and subsequently FCC2, introduced the memory first as a means of overcoming the problem of totalling the cost of purchases when + has been used before ×†. I was never quite clear how

† Some calculators are designed to do the multiplying before the addition, but that is not the case with most "basic" ones.
desirable this was although I included it in the Workbook also because it did seem to me to illustrate a basic reason for using the memory. It also encouraged them to use \textup{\textbullet} \textup{\textbullet} or \textup{\textbullet} in the same calculation while warning them of the dangers of doing so. This was hardly "village" level teaching but for the brighter Grade 6 and 7 levels or above it seemed to me to represent a piece of worthwhile concept development. I often omitted this part when using the sheet in the villages and went straight on to the more obvious uses of the memory for invoice checking and Notes and Coins slips where the numbers of notes and coins of different denominations had been recorded and the object was to find their total value. This is the sort of slip that is used in some large stores: it seemed to meet a need in womens clubs for example where I was told they sometimes had to get a man in to count the money for them.

AND 3 (and FCC 3) was an attempt to produce concept development in the meaning of \textup{\textbullet} \textup{\textbullet} and \textup{\textbullet} and in length. It also gave a few examples of pricing. The backs of the sheets provided cumulative revision work.

Test sheets were also prepared in association with each of AND 1, 2, 3, each in several versions of similar difficulty to defeat inveterate cheats, but these were rarely used.

3.3.5 FOLLOW-UP

3.3.5.1 WOMENS WORK

We were not able to follow up any of the brief village visits which marked the later tours but one would not expect a high level of response from a 1 to 2 hour course. This particularly applied to the women many of whom had had no schooling and hardly any of whom had any business expectations. On the other hand it could be very significant for a woman to have acquired, for however short a time, an academic skill which her husband might well have envied. The "conscientisation" process by which women in a country like this will gradually become aware of their own potential for working in "men's" fields, is bound to be a long-term and expensive task from which specific results will only occasionally emerge.
Groups of women being taught at Kusek (ANR 17)
Perhaps some attitudinal test could be applied but there cannot be much local experience to work on in this field. Rose Kovero, ILO Associate in Madang and Iruk Malai, one of their directors, both assured us that the operation was worthwhile. (Appendix 2, ANR 17).

The women themselves demonstrated their belief that it was important, even when they must have known that they might never be allowed to run a business. The group of women who walked 24 km one tropical day to attend a course must have had some belief in the value of what they were doing. We also noted that when we ran a course at Madang for those who had attended village courses in the area, 5 men and 9 women travelled an average of 41 km each to attend it. The similar course in Kavieng (ANR 18) was attended by women and men who travelled similar distances.

3.3.5.2 KOROBA

Perhaps the most significant follow-up for non-business people however was for the course at the Guala Christian Centre at Koroba in connection with the Literacy Programme in the Southern Highlands. Here we put on a revision/advanced course and the Mission urged all who had attended the 4 day course there in April (ANR 10) to return for a weekend in September (ANR 14).

Jenny Fountain from the Mission had already interviewed 21 of the 34 original students (6 of the other 13 students lived more than 40 km away) and completed a questionnaire for them, providing the following replies:

Do they use a calculator now?
Yes, 20, No 1.

Do they now use the metre ruler they purchased for measuring?
Yes 6 No (or did not buy one) 15

Do they now use any of the games they learnt at the course (Snap, Sum-ten, Car Race game or Calculator number game)?
Yes 13, No 8.
What did they learn on the course and now use?
Positive response 20, Negative 1.

Have they taught anyone else anything they learnt on the course?
Positive 13, Negative 8.

Do they want to learn any other number skills, if so what?
Positive 17, Negative 4.

The "skills learnt on the course and now used" included adding money for church, Bible school, trade store, women's fellowship, bookshop, medical accounts, wages, etc, playing games with a friend and for own amusement, and pricing in a trade store.

Those they have taught include literacy teachers and classes, their own children, trade store boys, a class of 10 villagers learning number skills and nurses needing to calculate mileage and other statistics. One said he wanted to teach the use of the clock.

"Other number skills they want to learn" were in fact mainly revision of those already taught to them, as one would expect. Some just said "More practice", others mentioned specific items such as the memory, %, cheque accounts and the square root.

My wife or I also interviewed 13 of these 21 and recorded them on tape (available from the author). Some of these interviews were in English and others in Pidgin. They generally expressed the enthusiasm of the students. One particularly recalled learning to count up to 19 and down to 1 again. He had found learning to add and subtract hard but easy with the calculator. He did not lend it to his literacy students but used it himself when teaching them. He wanted certificates to be given to those who learnt how to use the calculator. He wanted to know about the square root key which he described as "T".
One young Grade 8 leaver described teaching the calculator to 7 people in his village. He remembered about the ruler without being asked: he used his calculator to help two old village trade storekeepers to count their money, now he would be able to help them keep cash books.

One had been teaching his literacy students how to add and subtract. He had forgotten a lot of the things he had learnt at Easter but now he remembered them again. Another had forgotten everything about the calculator, which was why he had returned, but he had been using the ruler to measure. A nurse had been using the calculator a lot in her job. A woman literacy teacher had been teaching women and children to use the calculator. A pastor had been teaching numbers to 10 village people and also the calculator to a trade storekeeper. He had now learnt to keep a cash book.

The Church Secretary had learnt many interesting things including looking after money and "checking up on things" with the calculator. He had taught his children to measure with the ruler and to use the calculator. He knew he must practise if he was to retain his skills. A trade storekeeper took his calculator with him to check the invoice before he left the bulk store, and used it to price his goods afterwards. He used the ruler to measure material for sale. He had taught his work boys as well. He thought he might be able to remember how to keep a cheque account but would really like another lesson first.

Our own experience of teaching these "returned" students was most memorable. Previously they had struggled and frequently pressed the wrong keys. Now they were confident and tolerably accurate. In 2½ hours I was able to teach the whole of AND 1 and AND 2, including the new work with the memory and the Cash Book. This was comparable with Groups of Government Officers I had taught and it was obvious that even if they had forgotten the more complicated processes they must have spent a lot of time on the calculator with the simpler ones. They were now in some sense at least, numerate.
3.3.6 **CONCLUSIONS CONCERNING VILLAGERS who have no businesses at present, but do know their numbers.**

1. Most villages include some men and women with enough schooling to "know their numbers" i.e.: to be able to count objects and relate their counting to the Western system of numbering.

2. Few village men or women (unless they are engaged in business) can do more than add simple numbers together. Subtraction, multiplication and division have generally been forgotten if they were ever known.

3. Given careful planning and publicity and the support of local organisations and appropriate teachers it should be possible to provide village based courses that would give the average schooled villager the ability to carry out simple numerical exercises such as totalling money, finding change and keeping a cash book.

4. The First Calculator Course Unit 1 (see 5.11) provides appropriate material for such a course.

5. The long-term response to such a course will depend on the motivation of the villagers and their ability to obtain calculators.

6. In some cases, particularly with women, the provision of such courses, may be justified on the grounds that they raise the recipients level of consciousness of number even if they do not actually ever use the skills taught on the course.

3.4 **VILLAGERS WHO DO NOT KNOW THEIR NUMBERS**

In 3.2.2 we have referred above to two trade store owners who did not "know their numbers" i.e.: could not count objects and relate the result to the Western system of numbering. We have also referred to the high proportion of women in this category. During our village visits if such people were given a calculator someone else nearby, perhaps a child, would help...
them and on the whole they did not lose face although obviously they could not learn much in an hour or two. Some better system must be provided if they are to acquire the basic knowledge.

3.4.1 TEACHING THOSE WHO DO NOT KNOW THEIR NUMBERS

There are some 250 different sorts of traditional number systems in the country, but these are generally little more than methods of counting by associating numbers with parts of the body. They do not help, directly at any rate, with such tasks as adding two single digit numbers together or finding the change from a kina. Neither do they help with pressing the correct keys on a calculator.

To teach a person their numbers (Western style) is a long job, comparable with teaching literacy but a good deal easier. There is only one large scale literacy project in the country and that is in the Southern Highlands which was fortunately one of the Provinces where the Project worked during 1981.

Our first visit there was 29 October to 8 November 1980, (Appendix 2, ANR 3) when we met the Adult Education Officer, Joseph Ogaie and John Crofts who together were responsible for supporting a Literacy Programme that was largely operated by the Churches through 400-500 teachers and 50 supervisors. The latter were meeting while we were in Mendi and we were able to talk to 14 of them in an informal group. They were unanimously keen to include numeracy along with their literacy teaching.

Our second visit (ANR 10) therefore was timed to coincide with a meeting of the Provincial Literacy committee at which we offered to prepare a programme for incorporation into their scheme. This they welcomed.

In preparing it I studied courses produced by Jenny Fountain of the Christian Brethren Church, another course prepared by a colleague of hers and one by Sr. Kristen Whitehouse of the Erave Catechist Training Centre.

I was impressed by the enormous range of material included in
these courses and the fortitude which any villager and his teacher must have possessed in order to complete them. One of these courses included 40 assignments covering numbers up to 1000, adding money, multiplying by 2 and 5 and working out invoices using these two multiplication tables only. Another course of 30 lessons extended addition and subtraction in column to numbers up to 1000 including ten lessons on addition and subtraction of dollars and cents. The third course was a 2-book affair including all multiplication tables, measuring, halves, quarters, tenths, decimals, rectangles, litres, kilograms and grams, telling the time and the number of days in months and years.

Knowing the difficulties found in some of these topics by students with 10 years of formal education and knowing also that a very large proportion of the work could be done directly with a calculator anyway, I had no intention of including even a fraction of this material in the course I was preparing for the Literacy Programme. But even so I was not prepared for the shock we experienced when on our third visit in September 1981 (ANR 14) we actually taught 25 Huli teachers and supervisors and 11 others at the Asian Christian Pacific Mission at Tari.

In the first place we were a little taken aback to find 16 of the teachers had had no formal schooling themselves and about half of them had to be taught in the Huli language. There was no reason why this should not be so since the Programme was concerned with literacy in Huli, but we had not met so many un-schooled educators before who could not even speak Pidgin.

Fortunately, we had one of the national experts on Huli with whom to work and he was as concerned as we were to devise an appropriate numeracy course so translation was no problem though feedback was difficult.

They were in fact generally able to count up to 100 and knew their numbers already so this part of our course was a case of teaching techniques for teaching. When it came to teaching number bonds for sums of single digits however we felt we were wasting our time with the non-schooled teachers and supervisors.
How often, we wondered, would they really need to know that \(5 + 6 = 11\)? They could work it out on their fingers or find it out on the calculator if they did want to know and really there seemed no justification for the sweat needed to memorise these results which would almost certainly be forgotten soon afterwards through disuse. We concluded therefore that the only number bonds we should expect everyone to learn in our revised course would be those involving \(+1\) and \(-1\), i.e. being able to count forwards or backwards from any number. This would enable them to work out sums and differences with objects or on their fingers if need be. Number bonds for \(10\) also seemed worthwhile because of "change for a kina".

We had thought the calculator could be used with the constant function as an aid to learning these results but the frequency with which most of them pressed the wrong key and had to re-set their machines made us doubt if it was worthwhile. This however was only the first day they ever handled a calculator. It would have been better to start with a "straight" use of it.

When it came to using the calculator to total or multiply money and find change we did better although even here the non-school group made heavy weather of it. We gave them a test consisting of 12 such questions and the 26 teachers and supervisors scored as follows:

<table>
<thead>
<tr>
<th>Score out of 12:</th>
<th>12</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of students:</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Considering that this was only their second day with calculators and that 16 of them had never been to school, we felt this was reasonably good: many mistakes had been only due to confusing 5 and 6 or making whole kina entries.

Those who scored less than half-marks on this test continued revising the same work while the rest tackled the Cash Book, finding the balance for each entry and checking the final balance by totalling. Tests for these 11 involving cash book,
notes and coins slips and totalling with mixtures of x and + gave the following results:

<table>
<thead>
<tr>
<th>Score out of 39:</th>
<th>39</th>
<th>37</th>
<th>35</th>
<th>34</th>
<th>30</th>
<th>29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students:</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

This was a tolerably good result. As we have mentioned earlier, a similar group in Koroba made enormous strides once they had had plenty of basic practice with the machine, so we reckoned a little re-training later on would make them well able to teach these skills.

We were particularly anxious to include the Cash Book in our revised draft because of the frequency with which we heard that club and church treasurers, secretaries, etc, either lost money, stole it, or nearly as bad, were thought to have done these things. The Cash Book is the one essential if money is to be looked after properly. It only involves adding and subtracting but it can also help to teach what these processes mean, for it was by no means obvious to those we were teaching that they must use "plus" for IN and "minus" for OUT. The Cash Book also offers training in checking and correcting mistakes.

A second draft of the Basic Numeracy Course for the Southern Highlands Literacy Programme (see 5.13) was sent to the Committee in December 1981 for consideration. It includes a Teachers Book with 26 lessons very precisely set out in English (which will need to be translated) and details of exercise booklets, test booklets, number cards and "snap" cards which will be needed.

The first 17 lessons include counting up to 30 objects, games to teach "one more" and "one less", using the fingers to add numbers up to 10 on to numbers up to 20 and telling stories to illustrate addition and subtraction.
The remaining 9 units cover totalling money (+ or x but not both), finding change on the calculator and keeping a cash book.

Number bonds for 10 and change for a Kina have been omitted from this draft but should probably be inserted and practised using the constant function on the calculator (pressing 10 \( \div \) followed by numbers and \( \div \)) and the sum-ten game.

3.4.2 CONCLUSIONS CONCERNING VILLAGERS who do not know their numbers

1 Teaching adults their numbers is a lengthy process which is best done in association with some other long term educational operation such as a literacy campaign or prolonged contact with a Vocational Centre, Community Centre or the like

2 A possible basis for such a course has been prepared for the Southern Highlands Literacy Programme but much trialling translating and amending of the course will no doubt be necessary before it can be used effectively

3 Any other literacy programmes to be set up in the future should, if at all possible, include an appropriate numeracy section

3.5 GOVERNMENT OFFICERS AND OTHERS who have already used a calculator but lack the skill to use it effectively or the confidence to teach others to use it

3.5.1 INITIAL BROADENING OF EXPERIENCE

It has always been part of the work of the Numeracy Project to help train Business Development Officers. What was not so obvious, and what might never have happened had it not been for the good will of the Department of Commerce is that the Project has also from the beginning been allowed to help other agencies meeting similar problems. Initially this was of great benefit to the Director who had had no previous experience in Commerce and needed the experience he could gain from related areas.
Between March and October 1980 the Project was involved in the following:

Laloki College (Basic skills and Commercial Mathematics course for Salesmen, see 5.1, 5.2. Also selection test).

Hanuatek (the keeping of simple cash accounts).

WR Carpenters (calculator course for salesmen, see 5.4).

Steamships (course for drivers giving credit for returned empties, their selection exam and advice on new counter calculators, see 5.5).

Plantation Management Training Programme (course, see 5.8).

Small Industries Research and Development (accounts for potters).

Port Moresby School of Nursing (calculator solution to some standard problems).

Air Niugini (calculator course for domestic air freight clerks, see 5.6).

National Capital District Business Development (some regular clients).

Department of Commerce Women's Work (questionnaire).

Bankers College (advice on their course).

Melanesian Council of Churches (accounts).

3.5.2 CONSULTATION AND TRAINING

In October 1980 when the grant was received to investigate the possibility of an Adult Numeracy Campaign, I began to consult other departments particularly those with extension officers. This very often led to a request to conduct courses on the use of the calculator for such officers.

The following table indicates the number of officers consulted and the number of officers trained in each Division in each Province between March 1980 and December 1981.
<table>
<thead>
<tr>
<th>Province</th>
<th>The five &quot;experimental&quot; provinces</th>
<th>Other Provinces visited</th>
<th>NCD Nat. HQ</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Central</td>
<td>East Sepik</td>
<td>Morobe</td>
<td>Oro</td>
</tr>
<tr>
<td>ANR References</td>
<td>1 6 8 13</td>
<td>4 16</td>
<td>5 11</td>
<td>12 17</td>
</tr>
<tr>
<td>Number of Govt Officers</td>
<td>Consulted</td>
<td>Trained</td>
<td>Consulted</td>
<td>Trained</td>
</tr>
<tr>
<td>Commerce</td>
<td>5 2 11 3</td>
<td>5 10 2 9</td>
<td>4 -</td>
<td>4 1 1</td>
</tr>
<tr>
<td>Community &amp; Family Services</td>
<td>1 2 1 3</td>
<td>2 - 2 - 2</td>
<td>6 4 -</td>
<td>1 2 -</td>
</tr>
<tr>
<td>Non-Formal Educ</td>
<td>1 - 2 2 2</td>
<td>4 1 2 5 6 4</td>
<td>- - - -</td>
<td>1 2 -</td>
</tr>
<tr>
<td>Health</td>
<td>2 4 -</td>
<td>6 11 -</td>
<td>4 26 -</td>
<td>- - - -</td>
</tr>
<tr>
<td>Primary Industry</td>
<td>- 6 5 7 8 10</td>
<td>- - - -</td>
<td>9 - - - -</td>
<td>1 - 1 2</td>
</tr>
<tr>
<td>Provincial Admin</td>
<td>1 2 3 1 5 6 1</td>
<td>- 5 12 -</td>
<td>- - - -</td>
<td>- - - -</td>
</tr>
<tr>
<td>Business Management</td>
<td>1 4 -</td>
<td>3 8 -</td>
<td>1 4 -</td>
<td>- - - -</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>- - 1 - 4</td>
<td>1 - 5 -</td>
<td>9 1 -</td>
<td>- - - -</td>
</tr>
<tr>
<td>Total Govt Officers</td>
<td>11 20 23 16 37 47 7 14 22 70 4 2 2 12 4 2 5 - 5 - 47 13</td>
<td>167 196</td>
<td></td>
<td></td>
</tr>
<tr>
<td>excluding Formal Educ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal Education</td>
<td>- 1 2 - 4</td>
<td>2 - 5 23 4 - - - - - - 1 6 - - - - - - 8 409 24 441</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Church/Mission</td>
<td>2 - 2 - 3</td>
<td>7 8 80 2 1 - 4 14 - - - - - - 24 102</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NOTES ON THE ABOVE TABLE

1 The first five Provinces listed were those with which the Project was particularly concerned, the others were visited for specific purposes.

2 "Miscellaneous" included the following:
   - Village Development
   - Works & Supply
   - Post & Telegraphs
   - Public Solicitor
   - Other Education
   - Psychological Services
   - Price Control
   - Development Bank
   - National Planning Office

3 An officer being "Consulted" here means that not more than 3 of them were consulted at a time. Consultations of larger groups are listed below: these numbers are not included in the table above.

Larger Consultations involving the Numeracy Project
June 1980-December 1981

1 Six meetings of the Post Secondary Mathematics Group, Port Moresby, including one demonstration lesson [40]

2 A meeting of about 12 Mothers Union Officers in Popondetta (Appendix 2, ANR 2)

3 Five Rural Development Officers at Mendi (ANR 3)

4 Workshop on Role of Women Instructors in Vocational Centres, Mendi (ANR 3)

5 A group of 14 Literacy Programme Supervisors and Coordinators in Mendi (ANR 3)

6 Two meetings with District Officers in Lae (ANR 5)

7 The Annual General Meeting of the Melanesian Council of Churches, Goroka (ANR 7)
8 The Provincial Literacy Committee for the Southern Highlands, Mendi (ANR 10)

9 Mathematics Education Conference, Lae (ANR 11)

10 Primary Mathematics Conference (See 2.3.2)

11 Inservice for Staff at Maprik High School (ANR 16)

12 The Numeracy Project Steering Group, Port Moresby, (see 3.5.6)

Also the following in which both consultation and training took place

13 Laloki College Staff meetings and Diploma courses

14 Workshop for FTO/PFA Laloki (see 3.2.4)

15 Two Regional Conferences for Managers of Vocational Centres (ANR 16 & 17)

16 The 4th National Workshop for Mathematics Groups, Goroka (ANR 17)

Given the limitations of communications and time, (particularly as most of these meetings took place during 1981) one could certainly claim that the Project has done its best to consult with others.

Its contribution to training Government Officers has also been substantial considering that this was an 'extra' which had not been anticipated. It is hoped that this will prove to have been a good investment: it could indeed prove to be the key to success in so far as the future of adult numeracy in PNG may well turn out to be almost entirely dependent on the goodwill and enthusiasm of such Government officers.

3.5.3 Needs of Government Officers

The needs of Government Officers for training were frequently exemplified.

5 out of a group of 25 Aid Post Orderlies were un-schooled and not able to write amounts correctly in kina and toea. When the
group as a whole was asked which month was 2 months after February, both March and May were suggested before April. The date one year after 6 February 1981 also produced alternatives, the most favoured being January 1982 (ANR 10:4).

Group of 12 District Officers (probably all Grade 10) followed the procedure for calculating the number of litres per hour required for a village water supply. It came to 1150 and the stream was flowing at 4500 litres per hour: the majority of them however then assured me that this was not enough. Subsequently they were equally unable to determine whether a supply of 1150 litres per hour was sufficient if 700 litres per hour was needed. (ANR 14: 13). The ability to compare numbers is very weak even in Grade 10 graduates: 27% out of 2243 tested in post secondary institutions in 1978 had been unable to identify the biggest number out of 365,192 and 69. [32 ]

A DPI Officer brought me a sample of a Development Bank Application form to illustrate the work they had to do for Rubber Block holders. A number of corrections had already been made to the completed form but there still remained three errors: multiplying 350 by 11t, finding the cost of 350 m of wire at 90t for 30 m and 15% of K400.29 (ANR 15:2).

3.5.4 CONSULTATIONS

Consultations were generally most supportive to the work once it was made clear that the batteries in the calculators would not run out. But the main purpose behind this work with Government Departments lay in the realisation that their extension Officers provided the most potent force of adult educators in the country. It was therefore of great importance to identify the skills which they might be willing to teach to their clients. In the same way that the Project had been born out of a recognition that Business Development Officers were doing many things for their clients which the clients might do for themselves, given sufficient numeracy skills, so it was reasonable to suppose that other extension officers were also
carrying out calculations for clients that the clients could be taught to do for themselves. Self-sufficiency of the individual, as of the state is one of the primary aims of Government in Papua New Guinea.

Many consultations were therefore directed to this end and exercises were produced illustrating ways in which clients could be taught to make relevant calculations for themselves.

3.5.5 RELEVANT EXERCISES

Such exercises included the following: (from the ANC Series 5.10)

3.3 Weighing coffee/cocoa and finding the total price for selling it.
3.4 Timber Requirements: listing the numbers of pieces of each size.
5.2 Pricing cooked food.
5.3 Pricing sewing.
5.12 Pricing artefacts and services.
5.13 Calculations involving costs of printing, second hand clothing, travel, lumber, etc.
5.14 Cattle project: calculating area, perimeter, numbers of posts, lengths of wire, weights of staples, number of head of cattle, sale of steers.
5.16 Plantation area: number of trees per hectare.
5.17 Numbers of truckloads needed for moving freight.
5.18 Cardamom project: areas, numbers of plants in a field, yield, number of workers, selling the crop.
5.19 Some standard nursing problems: how much to draw up in a syringe, number of doses in one vial, proportion of intravenous fluid run in, drops per minute.

These of course are in addition to the general business skills included in the Business Arithmetic Workbook, for example, many
of which would be appropriate for clients of other Departments as well as the Department of Commerce.

This list of exercises provides an interesting attempt to identify relevant low-level applications of mathematics in Papua New Guinea. As such it is reminiscent of much good work that is being done in the West to identify similar applications that are relevant there. Typical of this movement is Burkhardt's "The Real World and Mathematics" [67]. In the Foreword he states "It is no longer obvious however that the skills learned in secondary school mathematics are being much used by most people .... Such applications as there are in school mathematics books or examinations mostly refer to highly stylized, artificial situations of little concern to the pupils who need much more help than this if they are effectively to use their mathematics in the real world".

Unfortunately what is desirable in Britain is hardly possible yet in PNG. In a country where the first school was founded barely a century ago, few numerical applications exist in the villages. The list above is not of actual applications but of desirable ones: not what villagers do (because they don't) but what extension officers have said they might be taught to do, given a calculator. At present virtually all these calculations are carried out not by the villagers but by the extension officers. (But see 4.2 below for their use in the proposed Primary School syllabus).

3.5.6 **NUMERACY PROJECT STEERING GROUP**

The success of this work of relating to other Government Departments was confirmed by the setting up of the Numeracy Project Steering Group on 1st December 1981. Representatives of the Department of Commerce, Community and Family Services, Education (Formal and non-Formal) and Primary Industry, unanimously approved a resolution which stated that: "We believe the promotion of numeracy skills, including use of the hand-held calculator, to be of great importance for the development of Papua New Guinea."
Our membership of this Steering Group implies the willingness of the Departments or Agencies we represent to support this work in whatever way they are able."

The specific work of the Department of Commerce has been described in 3.2, that of Non-formal Education through the Literacy Programme in 3.4 and expectations in full time education will be set out in Chapter 4.

The National Youth Movement Programme Co-ordinator was convinced that it would be possible and desirable to train Community Youth Co-ordinators and selected Youth Group Leaders in such a way that they would pass on the skills needed for the projects which were to form part of the Youth Programme. He provided copies of the Project proposals so that I could identify the skills and training that would be needed. An arrangement has been made to train a pilot group in Milne Bay Province later in 1982. Other representatives of the Department of Community and Family Services thought it most probable that a similar operation would benefit women's work, as here too the object was generally to set up small businesses or money raising projects.

The representative from the Department of Primary Industry was equally sure that a programme could be worked out through which Rural Development officers could impart appropriate skills to clients, assuming that a calculator was available and the client was prepared to use it. It is clear that goodwill exists with all these Departments which would permit a very flexible approach which could include both the improvement of Officers' own skills and also some further investigation and training of extension officers to pass on appropriate number skills to their clients.

Such a flexible inter-departmental policy would require a supportive base from which to operate. Up until the end of 1981 this has been provided by the Department of Commerce. From this time on however Government cuts have hit the Training Division of this Department particularly severely and some other means of providing this inter-departmental
programme may be desirable. It would be difficult to persuade another Department to take on responsibility for an operation from which the specific benefits in their own field might be relatively small. The obvious answer lies in a programme funded by overseas aid, and attempts are being made currently to set up such a scheme, although it is still possible that the Commerce Department may prove willing to continue providing the base.

3.5.7 VOLUNTARY AGENCIES

Reference has been made in the Table in 3.5.2 to consultation and training of officers of the Churches. These were concerned mainly with the literacy work in which the churches co-operate with Non-Formal Education and with the training of pastors to carry out the numerical work required by their jobs.

A further example is a course prepared by Jenny Fountain of the Guala Christian Centre at Karobo (see 3.3.5.2). This will be in Pidgin; it will be based on Numeracy Project materials and it will be designed to help those who keep accounts on behalf of the Church, the Bible School, Literacy Projects, Christian Centre, medical work, and Community School. It will be basically a correspondence course but tutorials will be arranged whenever the tutor is able to visit the students who are following it. This is a very realistic approach in circumstances where communications are particularly difficult and where there are no funds to provide transport exclusively for this purpose. A copy of the circular announcing the course and the Application Form are included in Appendix 3: 6 applications had already been received in February 1982 and many more were expected.

Here therefore we have a prime example of the same agency needing training for its own workers and also being willing to pass on numeracy skills to the people. As with any other training programmes in PNG however the costs are high in that they involve travel and accommodation either of the trainers or the trainees or of both. The churches themselves would find such expenses very difficult to meet and it has been suggested
that overseas funds provided through the Melanesian Council of Churches might be made available to assist such work.

The other most significant voluntary agencies in PNG would probably be those of expatriate volunteers serving in Government and other organisations with some financial support from abroad. These agencies have expressed much interest in the Numeracy Project and would no doubt be willing to provide specific volunteers to serve the cause should this prove to be an appropriate method of advancing the work.

Meanwhile it might be possible to provide some specific information about the Project for all volunteers on arrival in PNG so that they would know the sort of facilities and possibilities that existed. They could then make appropriate contacts if they came across specific needs in their work. One of the volunteer agencies, CUSO, has already started to do this.

The only other large voluntary agencies with which the Project has so far been associated have been the Women's Investment Corporations set up by the ILO/UNDP Women's Project. Mention has been made of work with these in Goroka, Madang and New Ireland (see 3.3.2 and 3.5.1) and there is a similar project in Milne Bay.

These represent a very important attempt to compensate for the extremely low status given to women in this country. The loss to PNG of the effective service of vast numbers of women is acknowledged, but little can be done quickly in such a cause. It is however important to give every support to those agencies that are working in this field and it is hoped that the Numeracy Project may continue to make its own contribution.

An attempt was made earlier to work through the National Council of Women but they were experiencing difficulties at the time and the materials then available from the Project were not very appropriate. A further offer of assistance to this and other voluntary agencies must be made as soon as the time and opportunity can be found.
3.5.8 COMMERCIAL FIRMS

Another significant type of agency for the spreading of calculator skills is the large commercial firm with its own training department. In the past employees tended to have to pick up their information on the use of the calculator from a colleague: there is now a move towards providing specific training for it.

The first such courses were given by the Numeracy Project for W R Carpenters (see 5.4) and Steamships Trading Company (see 3.2.1 and 5.5). These were followed by two courses run by Don Moore of the Department of Commerce at Laloki College in January and June 1981 for supervisors in the "big three" commercial firms, Carpenters, Steamships and Burns Philp. At each of these I was asked to give a course on the use of the calculator.

Since then Mary Edwards, as a Training Officer for Steamships has frequently provided on-the-job training in calculator skills. One particular course written by her for counter staff who have to convert between Retail Prices and Wholesale Prices, is included in Appendix 3. She was able before going on leave to teach one of their local staff to use this unit, so that newcomers could still be properly trained in her absence. The unit includes the use of the % and memory keys: the calculator used gives results correct to 2 decimal places so in this case it is desirable to work in kina.

3.5.9 THE MEDIA

Coverage had been provided by the media from the first but care has always been taken to emphasise the experimental nature of the work so far and to avoid raising false expectations.

The work has been featured in National Broadcasting Commission programmes on at least five occasions. A recording has been kept of each of them.
Broadcasts include:

1. Allen Edwards: A National programme on "Men on the Land".
3. A report by Bryan Wilson of the British Council after participating in one of our courses (ANR 11).
5. Mary & Allen Edwards interviewed by Peter Zovi of the National Broadcasting Commission for PNG Magazine, on 11.11.81.
6. Allen Edwards and Mary Dickie, Assistant Secretary Training with the Department of Commerce, interviewed by Ian Boden for BBC Overseas Service,
7. Mary Dickie interviewed by Ian Boden for Radio Australia, October 1981

Articles on the Project appeared in the Papua New Guinea Post Courier:

September 1979: "Towards adult numeracy for Papua New Guinea", an article by Susan Addison expressing the concern of the Mathematics Education Centre, before the University decided to restrict the Centre's attention to a narrower field. It reported the lack of "number sense" the supplying of teaching aids to schools and the course run in conjunction with the Department of Commerce in Lae.

10.6.80: "New Shop Course" concerning the W R Carpenters Course.
13.2.81: "Another Tool for Villagers" by Susan Addison.

February 1982: "Calculators lift Numeracy". The article was an extract from the Secretary's Letter included in Appendix 1.

In the Papua New Guinea Times:

23.1.81: "Learning to Live with the number problem" by Euralia Paine
In Publications elsewhere

May 1981: "Calculator helps Villagers to learn to count by 10" by Paul Byrnes in the Sydney Herald.

May 1981: "Papua New Guinea: Calculating the way to Numeracy" by Allen Edwards in Bulletin 12 of Reading Agricultural Extension and Development Centre [68] (included in Appendix 1)

16 March 1982: "White man's magic adds up in jungle" by Anita Martin in the Coventry Evening Telegraph.

1982: An article by Allen Edwards to be included in the Courier, published by the Asian-South Pacific Bureau of Adult Education.

1982: An article by Allen Edwards and Mary Dickie to be included in the International Co-operative Alliance Bulletin No.2/82.

"Wantok" and "New Nation" from the Word Publishing Company, serving educational, social and religious needs in Papua New Guinea: both considered the possibility of including an instructional series based on the Project's material, but in one case an overlapping series on trade store management had just been completed and in the other case the Project Director was not able to find time to produce the material in the form required.

3.5.10 CONCLUSIONS CONCERNING GOVERNMENT DEPARTMENTS and Other Agencies

1 The work of many Government Officers would be much improved if they could be trained to use a calculator properly.

2 Government Officers have expressed interest in helping their clients to become more self-sufficient through acquiring further numeracy skills. Materials illustrating the sort of relevant skill-training that might be given have been prepared.
3 Representatives of the Departments of Commerce, Community and Family Services, Education and Primary Industry have formally recorded their intention to assist the work in whatever way they are able.

4 A programme to train Government Officers to carry out their own numerical work more efficiently while at the same time teaching them how to pass on appropriate numeracy/calculator skills to clients, would seem likely to be a cost-effective operation.

5 Any programme endeavouring to reach out across so many inter-departmental barriers would need a supportive base from which to operate. This has been provided up until now by the Department of Commerce. Recent cuts have made it desirable to find alternative or supplementary sources of funding.

6 Cooperation with the Churches and other voluntary agencies need to be developed when the time and funds are available.

7 Instructional material could probably be developed for use with the media but time and special skills for this are not yet available.
CHAPTER 4

THE USE OF THE CALCULATOR IN FULL-TIME EDUCATION IN PAPUA NEW GUINEA

4.1 TEACHERS

The table in 3.5.2 reveals that 24 teachers and education officers were "consulted" by the Numeracy Project in 1980-81 and 441 were "trained". These figures have been separated from those of all other Government Officers because the relationship of the Project with formal education was bound to be different from that which it established with other Government Departments.

Where other Government Departments were concerned the interest lay in determining what applications of arithmetic, and particularly of the calculator, were required by the officers concerned and whether these applications could in fact be carried out by villagers given a calculator and suitable training.

With teachers however the relationship was generally different. The author could not divest himself of the fact that he had been a teacher himself for 30 years, nor could he deny that the calculator might be considered by some teachers to be a threat rather than just a useful tool.

It was therefore pleasing to find that one of the services that we were able to offer teachers was in no sense at all a threat. As in the West, many schools in PNG run "tuck shops", or rather "canteens" or "trade stores". But the teachers found it hard to run these efficiently and their superintendents were always concerned less mistakes or
dishonesty should turn a potential money-raiser into a serious embarrassment.

It was therefore with this brief, to help teachers to run their canteens correctly, that the author was asked to give 1½ hours training to each of four groups of 90 primary teachers one day during the National Inservice Training Week in the National Capital District (Appendix 2, ANRIO). A single sheet handout was prepared and very intensive instruction was given for the maximum time permitted, but where many teachers had never used a calculator before and where their understanding of mathematical concepts was by no means certain, it was impossible to teach everything to everyone. All four groups however showed great keenness and only one small group who had been at the other end of a 20 metre classroom full of teachers, complained they were "lost". Unfortunately it has not been possible to follow up that particular experiment but other groups of teachers who heard of it wanted similar treatment. Instead we suggested a more thorough course using the Business Arithmetic Workbook (5.12) and one of my colleagues at Laloki College kindly provided the teaching requested.

4.2 THE COMMUNITY (PRIMARY) SCHOOL SYLLABUS

A more significant contact occurred when the author was invited to join the Community School Mathematics Syllabus Advisory Committee at its crucial meeting in July 1981 (see 2.3.2). He had already given some thought to the impact of the calculator on the school syllabus but was conscious that it would be useless at this stage to try to change the policy that insisted on all students learning how to manage without a calculator before being allowed to learn how to work with one.

It was however possible to suggest that a number of procedures could be taught with the calculator in mind. There was no way for example that genuine stocktaking examples could be worked out without a calculator but bearing in mind the
probability that at a later stage a calculator would be available it would be very worthwhile to use simple numbers to show just how a stocktake would be carried out. Such applications would indeed in Burkhardt's words quoted in 3.5.5 be "stylized" and "artificial", but if they are clearly recognised as a way to prepare for the real problems to be solved with a calculator later then they are fully justified.

The committee at least were convinced and the following objectives were consequently added to the proposed new syllabus [58]: "The student will be able to apply the skills available to the following"

**In Grade 4:**
- Extending and totalling invoices
- Finding the total value of a collection of notes and coins
- Work out a wage sheet given the wages per week or fortnight, per day or per hour
- List and total the requirements for different sizes of timber for a job
- Calculate the perimeter of a field, the length of wire, number of posts and the number of staples needed for fencing it
- Price material given cost per metre.
- Calculate the number of pieces of wood that can be cut from a given length

**In Grade 5:**
- Weigh bags of coffee and find their total value given the price per kg
- Finding and checking the successive balances in a Cash Book account
- Total the columns of an analysis sheet and check the result by finding the grand total
- Calculating the number of plants that can be grown in a given area, given the area required by one plant
- Carry out a stocktake given that goods are placed on the shelves in piles or are in cartons
- Calculate the number of pipes etc needed for a given length of pipework, rounding up when necessary
Find out how many 5 kg or 10 kg etc units he will need if he is to obtain a given weight, rounding up when required.

Find the total cost of a number of whole or fractional air fares, rounding up if necessary.

Price services given the times that a person has worked and the rate per hour.

**In Grade 6**

Find the number of head of cattle that can be carried on a field given the number of head per hectare.

Convert wages between fortnightly, weekly, daily, hourly and yearly rates.

Calculate the cost of insurance on air freight at the rate of 1 toea or 2 toea per K2.00, rounded up.

Find the cost of air freight given the rate per kg and the basic charge.

Complete a leakage check form.

Calculate 10%, 20%, 25%, 50% or 100% of any amount up to K100.00 in relation to practical problems of the following kinds:

- Increase or decrease any amount up to K100.00 rounding up or down as required.
- Price goods (without freight) given that the cartons contain no more than 10 units.
- Price cooked food given certain restrictions on the quantities used.
- Find the import duty on a number of items.
- Calculate the Net Liquid Assets of a trade store and deduce profit or loss.

All these objectives were in fact identified from studying the "ANC" exercises referred to in 3.5.5. If indeed these items are included in the new Primary Syllabus, however stylized and artificial the examples on them may be, students should have little difficulty subsequently in applying the appropriate calculator skills.
While engaged in preparing for this syllabus review the author realised that there might here be an opportunity to get some actual calculator skills taught in the schools provided he insisted that they were only to be taught to those who were about to leave. As a substantial proportion of Grade 6 students are in fact "pushed out" by not being given High School places, the provision of a calculator skills programme for them would make a significant contribution to village life, particularly as these "push outs" generally became the best educated groups in the villages.

At this particular meeting the Committee was not willing to commit itself in this direction but it did resolve that "the possibility of including calculator-related material in the proposed Grade 6 textbook should be considered at a later date"[58].

Fortunately this resolution proved to be sufficient, since at the next meeting (Appendix 2, ANR 17) when the author reminded them of their resolution and suggested that a small research project should be undertaken to discover whether it was feasible to teach calculator skills to Grade 6 students who were about to terminate their education, the proposal was accepted almost unanimously.

The same afternoon I was invited to attend the Provincial High School Syllabus Advisory Committee as a non-member. Another substantial proportion of students are "pushed out" at the end of Grade 8, so a similar argument applied. A proposal was quickly agreed that the research project already approved by the Community School Committee should be extended to include those who were about to terminate their education in Grade 8.

By the end of Grade 10 the official view is that the students have learnt sufficient number skills to be allowed to use a calculator. Whatever one may have said about the inadequacy
of those skills, the fact remained that there was no reason why calculator skills should not be taught to all students at that stage. A proposal to extend the agreed research project further to include all Grade 10 students was quickly accepted.

The Senior Curriculum Officer for Mathematics, Bob Roberts, and the Principal Research Officer, Bernard Anderson, both gave their warm personal support to the project and the author began preparing appropriate materials.

While much of the content appropriate for school leavers would be similar to that for adults the format would be quite different. For class teaching, exercise sheets would be desirable for the students and a very detailed Manual, including precise instructions as well as the answers, would be necessary for the teacher.

Such a course was prepared in January 1982 and called the Calculator Skills Pack (5.16). In addition to the usual totalling and finding change, cash book, invoice checking and pricing of goods, units were included on measurement, calculating the period between two given times, pricing services on the basis of time spent and a number of other items. A shortened version of the Pack was prepared for use in Grade 6 and possibly 8, the whole Pack being intended for use in Grade 10.

4.4 VOCATIONAL CENTRES

The Project had always received the warmest possible support from the Non-formal Education Superintendant, Barry Reeves, and he had been the first to come forward with a specific request for a course which could be used in Vocational Centres. A preliminary trial had been undertaken at the Marshall Lagoon Vocational Centre in August 1982 (ANR 13) when AND 1 and 2 (5.11) had been taught in 3 hours and 13 of the 22 trainees had bought calculators.
The next group to be taught was in Kiunga (ANR 15) where we had 21 trainees who worked successfully for a whole day, apart from 8 who did not respond well to a large adult-orientated class in which women and businessmen predominated. The following day we took another 21 trainees and this time had two staff to help so there were no problems.

The last occasion was at Menyamya when I found a group of trainees getting in the way as I was teaching an "advanced" course to some businessmen in one of their classrooms. On this occasion I gave calculators and copies of FCC1 (5.11) to one of the Centre staff, started the trainees off, gave the teacher an answer sheet and a little advice about some later examples and then left them to it. The lesson was most successful judging by the quiet hour they spent working without another word from myself. (see ANR 17).

In October/November the Superintendent invited me to a Regional Conference for about 33 Vocational Centre Managers in Lae (ANR 16) and another for about 30 in Port Moresby (ANR 17). In each case I spent an hour or so teaching totalling, finding change and the cash book and then laid out a proposal for a core course for all trainees with additional courses for carpenters, sewing classes, etc. These were approved by the Managers. They felt it should be quite possible to obtain enough calculators to teach the trainees in groups.

At the Steering Group meeting in December the Superintendent confirmed that he would like the Project to produce a package of material which hopefully would not only provide the means for teaching the trainees but would also tell the teachers how to teach it.

Vocational Centre trainees are in fact Grade 6 leavers so their core course requirements were the same as those of the school leavers referred to above in 4.3. The Calculator Skills Pack (5.16) was thus tailor made for the Vocational Centres also.
It so happened that in the great cut-back of Government funds for 1982 the Education Research Budget had been reduced to zero. The Principal Research Officer devoutly hoped that this was an accident that would shortly be put right, and this was likely to be the case, but in February he found himself unable to promise the K2000 which he had hoped to set aside to cover the cost of the School Leavers Calculator Skills Research Project. It therefore occurred to us that bringing the Vocational Centres into the same research project might have more than one advantage. This was rapidly agreed so that, at the time of writing, there is an excellent prospect that a single research scheme using the same materials throughout will establish the feasibility (or otherwise) of teaching calculator skills to those terminating their formal education at Grade 6, 8 or 10 and also to Vocational Centre trainees.

The experiment is planned for June or July 1982 and it is likely to stand or fall on two counts:

(1) can teachers in all these institutions be trained in one day to teach the course?

(2) can the practical problems involved in buying, selling and/or borrowing enough calculators for the purpose be overcome?

If the experiment succeeds and if all these institutions in fact begin teaching these calculator skills to their students before they leave, the long-term problems of the teaching of calculator skills to adults will be almost resolved.

Given that those who have not attended school can learn these skills from those who have, the dream of "making PNG numerate" could almost come true.

4.5 POST-SECONDARY INSTITUTIONS

4.5.1 LALOKI COLLEGE

During 1978 and 1979 the writer had been Director of the Mathematics Education Centre at Lae and had there studied
the problem of low level arithmetical skills among entrants to post-secondary institutions ([32] see 2.2.1 ). In this capacity he had written a Basic Skills Course (5.1) designed primarily for the Technical Colleges but it was also being used by Schools of Nursing and some of the other Post-Secondary institutions which have proliferated in PNG.

Laloki College in its course for the Certificate in Business Management (BDO qualification) was suffering from these same remedial arithmetic problems. The author endeavoured to apply his own remedy in the form of the Basic Skills Course but encountered a good deal of student opposition to it, some students feeling it was too easy but many finding it was too hard.

At this time the cheap LCD calculator became available and it was agreed that all the students should eventually be supplied with them. The question therefore arose: should they receive them before or after the remedial arithmetic course? The argument against giving them out first was that the students would then be de-motivated from learning or revising the basic skills.

The counter to this was to enquire whether they actually needed these so called "basic skills". Obviously if they were to be able to continue with their work when their calculator was lost, broken or run down then clearly they required the manual skills. Up to the time of the advent of these new calculators the probability of their being broken or run-down was high and in the interests of safety the manual skills should be learnt. With the new calculators however, which not only had a near-infinite battery life but also had a failure rate due to faulty manufacture of under 1% (compared with 10% for an earlier model) the probability of needing the manual skills had been drastically reduced. Taken together with the cheapness of them it began to appear that one no longer needed to base the syllabus on a precaution which it was no longer necessary to take.
As an experiment therefore the students that arrived in 1981 had no basic skills revision and no commercial mathematics course either; all they were given was an introduction to the use of the calculator and the assurance that any other mathematical teaching required would be included in other topics in the curriculum at the points where the required skills were appropriate: in any case the calculator would be used for them. At the same time it was agreed that before their 2½ year course was concluded thought would be given to any specific non-calculator skills which they ought to possess. A depressing and frustrating section of the curriculum had been, provisionally at any rate, virtually eliminated.

In preparation for the 1982 intake the 1981 procedure was reviewed. While there were certain concepts and skills which various lecturers thought should be taught in a mathematical rather than a "commercial" context the overall pattern of 1981 was reported to have been satisfactory. There was no suggestion of reverting to a stress on the old manual skills before being allowed to use a calculator.

In the 1982 programme (see 5.15) therefore the original idea of starting with the calculator was confirmed and the first 26 hours of the revised "Commercial Mathematics" course would be spent on working through the Business Arithmetic Workbook, a convenient way of introducing many calculator skills. Following this there would be a course to cover a few other concepts and skills, generally those which applied to more than one of their subsequent "professional" courses. Finally a deliberate attempt would be made to show why certain arithmetical processes should still be carried out in the head without recourse to the calculator. These were desirable rather than essential but included such things as learning to give change from a kina quickly without writing anything down, a skill which appears not to be taught at primary or secondary level in PNG. (While teaching a Grade 6 class as an experiment at Kiunga (ANR 15) we found that no
child in the class knew the change from K1.00 for 25t. The Community School Headmaster at Hakwange also confirmed that he would not expect his Grade 6 students to know this either (ANR 17).)

The whole effect of this change of attitude to the mathematics course at Laloki cannot be described as anything less than radical. It profoundly affected the whole approach to the subject. No longer did one base the teaching on the assumption that the calculator would not be available - and then produce it somewhat apologetically after the work had been done (and some students possibly terminated because of their failure at it).

Instead the calculator was produced as their normal tool from then on. Its use was carefully and deliberately taught instead of being dismissed in a perfunctory manner and thereafter such non-calculator skills as were considered to be desirable were justified and taught.

4.5.2 OTHER INSTITUTIONS

The surprising thing is that this revolution is appearing to take a long time to happen in other post-secondary institutions. There may be a few technical activities in which the use of a calculator is inappropriate, but I have yet to be convinced of any: I was told that calculators were not permitted on the shop floor where chocolate was being made because if one were dropped into a vat its plastic construction (unlike a screw or a nail) would make it impossible to remove the pieces. But there are no chocolate factories in PNG.

I had discussions with representatives of the Department of Health, particularly when a high proportion of candidates were being failed on account of weakness in mathematics and and I prepared some material for a group of nurses at the Port Moresby General Hospital but I was unable to convince the authorities of the general desirability of having calculators available in the ward. At another time however two nurse
trainers in the Southern Highlands assured me that few of the arithmetical skills taught in the Schools of Nursing were actually needed anyway now that a very comprehensive Handbook was available. Perhaps the mathematics syllabus in the Schools of Nursing needs to be checked before decisions are made on the relevance of the calculator. (ANR 10)

The calculator is certainly appropriate for statistical work in rural health centres and superintendents of these need to be taught how to use them properly.

The Technical Colleges used various versions of the Basic Skills Course (see 5.1) and it was compulsory for all students in 1979-81. For 1982 however it was re-written once more by Grant Trewenack who had been appointed to try to solve their remedial maths problem, and was made optional. It was to be taught out of normal teaching hours and only to those who failed to reach a certain level. Other mathematical courses were written for use in connection with particular trade courses.

In 1982 however for the first time calculators were issued to all students, the same two models being chosen, one basic and one scientific, that the Numeracy Project had been using. The issue may therefore now arise as to whether or not the calculator is introduced immediately or later on. It will also be interesting to see whether the selection of "basic skills" deemed to be needed will in fact be modified by the availability of calculators.
CHAPTER 5

COURSES PRODUCED BY THE NUMERACY PROJECT: TRACING THEIR DEVELOPMENT OVER THE PERIOD

5.1 THE BASIC SKILLS COURSE ("BSC") [35]: See 3.5.1, 4.5.1

This was written as a 15-unit self-paced course primarily for Technical Colleges when the author was Director of the Mathematics Education Centre in 1978-79. It included +, -, ×, ÷ with decimals, ranges, 1-significant figure approximations, percentages. Parts of it were used at Laloki College in March/April 1980 with 1st semester students who had already completed much of a traditional Commercial Mathematics course.

There were some adverse reactions from the students who found it either too hard or too easy. Each unit had two alternative Mastery Tests with it. The self-paced work encouraged absenteeism from classes as the passing of tests only contributed marginally to their final assessment.

Various versions were produced for the Technical College by Grant Trewenack, with fewer tests. The 1982 version differed substantially.

5.2 LALOKI COMMERCIAL MATHEMATICS COURSE 1980 ("LC"): See 3.5.1 and Appendix 3.

This was my first course on the use of the calculator. There were 7 units: Addition and Subtraction, Addition in Lines and Columns, Invoices, Averages and other Problems, Fractions, Percentages, Discounts etc.

The material was taken from the traditional Commercial Mathematics course then being taught. More time was spent on estimating results than on working them out with the
calculator. "Possible ranges" were found for the sums and differences of sets of numbers. The mid-point of the range was used as an estimate. Errors were calculated as percentages, but without the use of the % key. As with the Basic Skills Course, deliberate mistakes were included in the answers supplied to ensure that students marked their own answers properly and investigated possible mistakes.

The course was taught to 2nd Semester students, but the accent on mental arithmetic skills, the concept of a range, and estimation were not very favourably received by the students.

5.3 TRADE STORE MANAGEMENT COURSE ("TS"): See 3.2.1

This aimed at the sort of businessmen for whom the Project had been set up but at this stage it was only intended to be taught to Business Development Officers who would pass on the knowledge to their clients. In writing the course I had received helpful advice from Don Moore at the Department of Commerce and from staff at Hanuatek, an overseas-aid based group of small business units where the volunteer adviser had been encouraging them to keep simple IN, OUT and BALANCE accounts, distinguishing carefully between 'business' and 'private' money. The methods used by 'Skul Bilong Stoakipa' (see 3.2.1) were also noted, although these did not use a calculator.

There were to have been 5 units although only 3 were actually written. They were to be on

(1) Totalling and giving change, cash book and summary
(2) Checking invoices and pricing, with freight
(3) Cheque account, including reconciliation
(4) Stocklist, ordering and stocktaking, trading statement
(5) Analysis of trading statement, fortnightly sales graph and balance sheet

There was still a considerable emphasis on estimating in the first two units but less in subsequent ones. One innovation
introduced here lasted through all subsequent courses. In finding change the money offered was subtracted from the total bill giving a negative answer. This method was adopted because of the fact that when the storekeeper had added the cost of the items this total was already on the calculator. It would have been inefficient to erase it in order to enter the money offered first.

The pricing was done on an Invoice Extension sheet which had to be glued onto the original invoice. This was necessary because of the many columns required by the pricing procedure: number in one unit, total number bought, cost price each, markup %, markup each, selling price each.

Further complications were admitted by attempting to deal with credit sales and cash loans, both of which are recognised as frequent causes of bankruptcy among Papua New Guinean storekeepers.

While the first three units were being written, with their mastery tests, views of BDO's in the field were sought and twelve responded with many helpful and detailed suggestions. There was general agreement about the need for the course, but doubts were expressed whether many would be able to follow the more difficult parts of it. A meeting at Commerce Headquarters accepted this view and suggested that the material should be broken down into smaller units and a series of such units should be produced to cover the whole range of 'Arithmetic for Business'.

The original material however was first tried out with the 2nd Semester Laloki students and a group of experienced BDO's on an Inservice Diploma Course. It was also shown to various people outside the Department, in the National Council of Women, the ILO Women's Project, the Central Province Business Development Office, the College of External Studies, the Office of Village Development and the PNG Development Bank.

They generally confirmed the wisdom of these decisions and strongly endorsed the need for such a course. The long-life
characteristic and low price of the LCD calculator were particularly appreciated.

5.4 W.R. CARPENTERS (PNG) LTD: See 3.5.1

Carpenter's Training Manager, Alf Yaya, had agreed that although many of their salemen used calculators they had never been taught to use them efficiently. He therefore welcomed my offer to write and run a course for them.

The main need was to use the memory keys for totalling invoices and the % key for finding discounts. The format of self-paced units (with deliberate mistakes in the answers) and mastery tests was retained, as was the emphasis on estimating (eg checking the total of the K10's) and mental work (eg 10% and 20% alongside the use of the calculator).

The course was taught by the author and his wife during one whole day. At the end we felt the work was still too complicated and the checking process unrealistic.

5.5 STEAMSHIPS TRADING COMPANY: See 3.2.2, 3.5.1

The Training Manager for Steamships had met a serious problem when the manager of their Cordial Factory wished to start a new scheme involving cash on delivery. This required that the staff should calculate the refund for bottles etc returned empty, and deduct their total value from the bill. The Training Manager had solved the first part of the problem by producing an ad hoc ready reckoner but had been completely defeated by the fact that few of the personnel could subtract.

The author produced a course to teach subtraction and the use of the ready reckoner, using the calculator as a check. After two sessions it was clear that some of the workers could not add either, so fresh units were written for this. After six sessions we had produced a group of reasonably competent students. Unfortunately most of them were then found to have been involved in a criminal operation and at the same time the accountant would not accept the procedures the manager had worked out. So a completely new start was needed.
When a new group of employees were trained soon afterwards by Mary Edwards (who was taken on by Steamships as a training officer) it was agreed that the calculator alone would be used, and the course was re-written on this basis.

A result of this experience that influenced all future courses was our observation that 5t and 50t were frequently confused when entered in kina as .05 or .50. I was also asked to advise on the use of a new calculator for use on the counter and found that using the 'add' mode one entered money in toea although the result was shown in kina. I had also had difficulty in explaining that with an ordinary calculator a result such as 3.5 meant K3.50. "Putting 0's on the end of a number" was one of the things one generally tried to discourage. I also noticed that even experienced BDO's wrote answers as K3.75t, which made nonsense of the concept of a decimal: the "point" was believed to be merely a device to separate the kina from the toea. Attempting to change a concept like this seemed hopeless at the adult level. Finally I also realised that working in toea would make it far easier to deal with the eight-figure decimal numbers which are obtained in division. "Forget the figures after the point" is much easier than "Forget the figures after the first two figures after the point". Except when there are a lot of whole kina in the work it is quicker to work in toea anyway.

Thus in all courses written subsequently the work was done in toea while the answers were written in kina. Plenty of those who had used a calculator before queried this procedure, but no-one who started this way ever had any trouble with it. In the 1982 Laloki Commercial Mathematics Course however working in kina was a separate skill that also had to be mastered and used when appropriate.

5.6 AIR NIUGINI: See 3.5.1

After a day spent checking various aspects of Air Niugini's work at Jackson's Airport I was able to recommend training
in the use of the calculator in one area, that of the Domestic Cargo Counter. I wrote two self-paced units, the first for standard rates only, the second for Express and Discount rates. They used the memory to find the total charge. The only complication lay in the fact that there was a fixed basic charge of K2.00 and most total charges consisted only of this and one product of a weight and a rate. To avoid using the memory in these cases we did the multiplying first and then added the basic charge. Where there were several items with weights and charges each had to be put into the memory which could then be recalled before adding the basic charge as in the simple example.

With the excess charges and discounts the use of the % key made it easy. There was one complication however. Where the discounted charge included a fraction of a toea the rule was to round up the entry on the charge sheet. Should this be done with several items however, and the total found with the memory, it was quite possible that the total, even when rounded up, might be one or two toea less than the sum of the rounded up items. The only rule with such cases was that when more than one item had been rounded up the total should be checked by adding the individual item charges at the end.

All results were to be checked: the instruction was simply to repeat the original procedure but not to worry about the sub-totals provided the final total agreed with the previous calculation.

Instructions were given for using \( \text{M}^- \) to cancel an item which had been entered into the memory in error. It was also explained that if \( \text{M}^+ \) had not been pressed, \( \text{C} \) would clear an item without affecting the memory.

5.7 ARITHMETIC FOR BUSINESS ("AB"): See 3.2.1, 3.2.2, 3.2.5.1

The work of breaking up the original Trade Store Management Course units and taking note of all the advice received, turned out to be a long process, entailing a whole series of revisions
and amendments to the units and to the forms that went with them. These forms included petty cash sheets, notes and coins slips (for counting money), bank book sheets and reconciliation slips, analysis sheets, invoice extension sheets, fixed asset valuation sheets, trading statements and balance sheets. Each sheet had precise instructions on the back which were intended to cover all eventualities.

Unfortunately, even with shortened and simplified teaching units, the system remained too complex for most tradestore keepers to think of operating it. It also assumed that each individual sale was recorded on the cash sheet. This was the practice of some conscientious tradestore keepers, but never would be of the majority, unless of course they used a till roll.

The units were used by 2nd and 4th Semester Laloki students. The latter surprised me by showing that even at this stage in their training they were still not sure how to find 10% of an amount, while finding 30% by multiplying this by 3 seemed to be a new idea to them. Many did not know that 1% was 1/100 so had to be told this as well as that they could find 3% by multiplying it by 3. A few knew that 25% was a quarter but only some of these could find this by dividing by 4. All this had of course been in the traditional commercial mathematics course that they had done previously. The lack of such elementary skills made the mental estimating of results impossible for the majority.

It was at this stage therefore that I concluded that we ought to assume the use of the calculator throughout their work and consider very carefully what else they should be taught.

5.8 PLANTATION MANAGEMENT TRAINING PROGRAMME (PART OF AB):
See 3.2.2, 3.5.1

A section of the Department of Commerce was concerned with training nationals to manage plantations many of which had originally been set up by expatriates but were now taken over
by Papua New Guineans. A complicated system of bonus payments was in use to encourage workers to collect more cocoa or coconuts, and a whole series of record sheets were also to be completed. I was asked to prepare a scheme for teaching this, using the calculator. Three units were prepared totalling 42 pages, still using the self-paced unit and mastery test format. They were gratefully accepted but at this point the director of the PMTP went on a year's study leave and the units were never actually used.

This particular exercise however brought me to a conclusion about the use of estimating to check the answer obtained by the calculator. Initially I had given methods for estimating the total of two or three numbers in the general range of 100 - 300 by "estimating the 10s". At a later point I showed how to estimate the number of hundreds when adding 3-figure numbers together. This involved starting with the 10s and noting how many hundreds they would (probably) contribute. The process is the sort that many people in developed countries with a reasonably numerate background would use almost without thinking. When converted into precise instructions for someone lacking this background however the process appeared very complicated.

In this case I found that the result could be checked by adding, subtracting and multiplying the totals, so I replaced the estimating process by this self-checking procedure.

At this point I was beginning to doubt the validity of trying to teach estimation at all where the general background of number skills was lacking. My doubts were settled by enquiring about the estimating procedure which had been included in the final version of the Steamships course. My wife was still teaching from this but had a more realistic approach to the subject than I. She assured me that however much they were taught to use estimating procedures to check they still would not do so.
I accepted the inevitable and decided that if estimating procedures were to be taught at all they should be taught in school, not at the time-expensive stage of in-service training. I regretted that in fact no serious attempt seemed to be made to do this, in spite of half-hearted instructions in school text-books that generally lacked the force of "right or wrong". I noted that one of the few contributions I had made to the current High School programme, that of using 1-significant figure approximations to find possible ranges for products and quotients had been deleted because it was found not to be understood. Perhaps however the essential basis for any such approximation lies in good mental arithmetic skills, and such skills only appear to be taught in a very few primary schools in PNG at the present time. A realisation of the importance of estimating as an adjunct to the use of the calculator could result in a radical change in the attitude to mental arithmetic and perhaps even "rote learning" in formal education.

5.9 USE OF CALCULATOR COURSE (PART OF "AB")

The first group of experienced BDO's on the Diploma Course had appreciated the training in the use of the calculator which they had first received through the Trade Store Management Course, but I was now somewhat concerned by the complexity even of the revised Arithmetic for Business version of it. Instead of giving this therefore to the second group of Diploma students I wrote a special course concentrating on the different uses to which a calculator could be put.

This started with totalling and finding change, working in kina (which was what they were used to) and checking the result by finding a range and estimate (the middle of the range). The second unit covered the Cash Sheet (IN, OUT and Balance) worked in toea, and procedures for correcting a wrong entry or pressing a wrong sign. The third unit illustrated how to arrange one's work so that the number in the display was used for the next calculation: it totalled the columns to give the final balance another way.
The fourth unit used material from the Plantation Management Course to illustrate the use of the constant function and checking additions mentally. The fifth unit used invoice checking and pricing to illustrate the use of the memory and % keys.

This "Calculator Course" met with a ready response from a number of people who felt there was a real need for teaching the use of the calculator, but the complexities in the programme probably made it inappropriate in practice.

5.10 ADULT NUMERACY EXERCISES ("ANC"): See 3.2.3, 3.2.5.2, 3.3.4, 3.5.5, 4.2 and Appendix 3.

In October 1980 with the grant from the Council for Village Development the emphasis shifted to producing materials suitable for general adult use although the "business" background remained. What was important however was that the work was now no longer being written on the College campus and modified by reactions received second-hand through BDO's. Instead the new materials were trialled and re-written almost continuously as a consequence of the personal experience of my wife and myself in teaching and consulting people in the rural areas of the country where the vast majority of Papua New Guineans live.

I started with somewhat grandiose ideas of what could be done, beginning with a "First Draft of a Possible Syllabus for a Proposed Adult Numeracy Campaign" which was unfortunately printed six months later in a publication [68], by which time it appeared to the writer incongruously out of date.

The proposal clearly began by looking at the formal education syllabus and deciding what could be included in a "minimal" version of it for use by villagers. It assumed that "concept development must come first". The basic concepts in formal education being addition, subtraction, multiplication and division, it seemed essential to introduce all these ideas before using a calculator to evaluate the results. Thus the
2x table was to be learnt, and used to multiply and divide sums of money up to K10 using pencil and paper, while lengths, weights and times were also to be estimated.

A 3-day course was designed to start with, the first day covering simple addition using the constant function of the calculator to help teach the number bonds. It was glibly assumed that several parts of the Arithmetic for Business Course could be completed including the use of the memory. The concept of adding lengths, weights and times would also be illustrated, along with a few calculations on the calculator.

The second day was to deal with subtraction including the concepts of "how much more" money, weight, time and length. Day 3 would "deal with" multiplication including the paper and pencil method for multiplication by 2 using carrying figures, and even multiplying decimals by 10.

The total unreality of such a programme became evident the first time we thought of using it, in Nipa on 30th October 1980 (Appendix 2, ANR 13). Instead we used various Arithmetic for Business units appropriate to the tradestore keepers we had in front of us. By the time my wife had spent the afternoon trying to teach two of them how to match the numbers 1, 2, 3, ...., 9 with numbers of dots, and to give change from K1 for multiples of 10 toea, we decided we must scrap the "school syllabus" approach and teach what the students wanted, and were able to learn.

By the end of this trip to the Southern Highlands, a Fourth Draft of a Proposed Adult Literacy Syllabus had been written. This began by listing what then seemed appropriate skills, but looked at from the maturity of 12 months' field experience, it remained hopelessly ambitious.

The "appropriate skills" included measuring in metres to 2 decimal places using special new measuring sticks. These were marked in centimetres and labelled in metres, ie, with a decimal point and two figures for each centimetre mark. This
meant that the notation for a length (in m) corresponded precisely with that for money (in K) so that the same calculator techniques could be used for both. It was also hopefully assumed that weight could be measured similarly in kg to 2 decimal places but this was never really a practical possibility: they have no scales in villages.

They were to know how to tell the time in hours, halves and quarters, which we later found involved a very hard struggle unless they happened to own a watch already. They were to learn to use a calendar, which even Rural Development Officers, we discovered later, may find very difficult.

Given these practical concepts of money, length and weight, they were to be able to add, subtract, multiply and divide them using a calculator. These skills were then to be applied to such problems as finding the number of plants in a rectangular plot, the number of bags of fertiliser needed, the price of coffee given its weight, the length of wire needed for fencing a field, the number of posts and staples needed, price of a crocodile skin given its dimension†, the number of metal roofing sheets needed for a building, the cost of a number of tinfuls of flour and the cost of making a scone or a garment for sale.

Individually these were realistic objectives: what was probably not realistic was the idea that adults could be taught the "measuring" concepts of cost, length and weight and the "mathematical" concepts of +, −, × and ÷ and be able to put the two sets of concepts together.

Most of those we taught subsequently had had six years of education but few of them for example would have been able to measure two pieces of wood and know that they had to subtract the lengths to find "how much longer" one was than the other. The development of concepts is a long term operation; it is the job of formal education or life itself. It is something that may be encouraged in non-formal

† Crocodile skins are valued on the basis of one dimension only, the distance between two specified points on them.
education but unless the concepts are used regularly it is unlikely that they will be retained. My conclusion is that adult numeracy can teach skills but can only hope to develop concepts if these happen to fit in with the normal working activities of the client.

By the end of January 1981, 31 units consisting generally of one or two sheets each had been produced. Two months later the series had been re-organised and extended to 55 units. "Games" consisting of 'sum-ten'; in which sets of four counters labelled 1, 2, 3, 4, 5, 6 or 7 had to be arranged to total up to 10, and numerical "snap" cards, introduced into the country as part of TEMLAB, an earlier stage of the Primary Mathematics syllabus, were included.

Later a "car race game" copied from the current Community Mathematics syllabus but rarely used there in practice was also introduced. This was to meet a specific need we found when we had taught Rural Development Officers the use of the calculator (See Appendix 2, ANR 10). We confirmed that they had difficulty in "counting on" correctly: they were liable to say that February 17th was 2 months after January 17th for example, counting both January and February. This was not acceptable when calculating gestation periods. We reckoned that dice games like Ludo had helped us to "count on" in the past; hence the introduction of the "car race" game.

To make this practicable however we had to find some alternative to the use of dice, which would inevitably be lost in a village. We broke through this problem by showing how the calculator could be used to give sufficiently random numbers by continually dividing by 7 (or using the square root key) and selecting the final digit.

5.11 FIRST CALCULATOR COURSE (AND 1/2/3 AND FCC 1/2/3): See 3.3.4, 3.3.6, 4.4 and Appendix 3.

The provision of new exercise sheets continued with another 10 exercises (ANC 5.10 - 5.19) by mid-July, but the new
desire to teach villagers in their villages led to the introduction of a 3-sheet course in Pidgin ("AND") followed by a revised translation of it into English ("FCC"). These were very crowded in appearance but were intended for free distribution and use by a competent teacher. The instructions on them were mainly for the teacher and were very brief. The first of these sheets included the maximum that we could normally cover in one 1-2 hour session with village adults. It covered the use of +, × and - for totalling and finding change, working out balances line-by-line in a cash book and checking the final balance by totalling the IN and OUT columns.

The second sheet covered the use of the memory while the third sheet attempted to explain the relation between × and ÷, to use the % key for markup and to illustrate the applications of +, -, ×, ÷, to measuring.

The format made it possible to fold the sheet into three which made it easier to write on. In practice we found the first sheet very appropriate for use and had no wish to modify it as a single-sheet introduction. The other two sheets were used less often. We could never quite decide whether introducing the problem of using both × and + when totalling bills was confusing or helpful. Some were certainly able to see that × could be used in this context provided + had not already been used and that the memory enabled one to deal with the cases where + had already been used. But no doubt some clients would have been confused. The same no doubt applied to the exercise on the relation between × and ÷.

Such work was only appropriate to those with at least Grade 6 education: plenty with Grade 10 had not acquired a clear idea of the relationship between the two concepts, as was illustrated by the Central Government Officers taught in February 1981 (ANR 6) when they made an average of over 5 mistakes each out of 27 exercises that required little more than deciding which number to multiply or divide by which and using the calculator to do it.
5.12 **BUSINESS ARITHMETIC WORKBOOK (BAW, BAWE)**[65]: See 3.2.4, 3.2.5.4, 3.2.5.5, 3.2.7, 4.1 and Appendix 3

In May 1981 it was agreed that materials must be produced to meet the needs of businessmen which could be taught to them by BDO's. Mary Dickie, then A/Assistant Secretary Training, suggested a series of Business Arithmetic Workbooks. Details of these are given in 3.2.4. BAW is the original version in Pidgin, BAWE the version resulting from revision and translation into English. It became the "standard text" of the Numeracy Project.

5.13 **NUMERACY COURSES ("BN1", "AN27"):** See 3.4.1

Details of these courses are indicated in the section of this paper concerned with villagers who do not know their numbers (3.4.1). The first draft (BN1) consisted of 22 lessons on addition and subtraction without a calculator. They were translated into Pidgin by Kove Waiko, a Non-formal Education Officer with a University education. These were followed by 15 lessons using the constant function on the calculator to help reinforce the teaching and learn the number bonds. The calculator course as taught to other villagers (AND or FCC) would complete the course.

After trialling this at Tari (ANR 14) the course was radically reduced and re-written (AN 27) with 17 lessons on addition and subtraction without attempting to get more than the "+1" and "-1" relationships learnt, then 9 lessons on the use of the calculator for totalling with + and \( \times \) (separately), finding change and Cash Book.

5.14 **DOUBLE ENTRY BOOKKEEPING**

While following up the work done with the first group of Literacy Teachers in Koroba, I was asked by the mission staff to advise on a problem with their own mission accounts. These were kept by an expatriate missionary and had gradually become more complicated over the years. Before handing them
over to a national it was essential that the system should be rationalised. The essence of the new system was to provide separate accounts for individual staff members, and also for such accounts as fuel, literacy, groceries etc, involving stock. All these needed to be reconciled so that individuals did not run into debt and the fuel account for example did not make too much profit or loss.

The situation seemed to call for a double-entry system so I prepared suitable cards and set out what I hoped would be a complete set of instructions covering every eventuality and not requiring specialist training to carry them out. It was used in a modified form.

5.15 **LALOKI COMMERCIAL MATHEMATICS COURSE, 1982 (CM):** See 4.5.1

Having had a traditional (and in my view quite inappropriate) Commercial Mathematics Course in 1979, the same course together with a repetition of parts of it using the calculator in 1980, and no course at all in 1981 other than an introduction to the use of the calculator, by the time we came to 1982 anything might have been expected.

In fact we listed all the calculator skills we thought they needed and supplemented the Business Arithmetic Workbook to cover any that were not included in that course. We then worked out what we felt they should be able to do without the calculator (or any working on paper) and inserted this. The rest of the College staff were then asked to suggest any items that they thought should have been included. These were generally only admitted if they were shown to be relevant to more than one other course. If the mathematics was to be seen as a "service" course, then every item which only appeared in one "professional" course was deemed to be better treated within the context where its application could be seen.

There was unanimous agreement over the content of the new course and the items additional to those in the Business Arithmetic Workbook were written in the form of questions
with minimum instruction. The intention was that the course should be taught, not self-paced, leaving it open to the teacher to increase the number of examples of any one type in so far as this was found to be desirable. In general each type of question would be done on the board first, and the one in the duplicated course done by the students on their own.

Before starting the course all students worked carefully through the Business Arithmetic Workbook (BAWE: See 5.12). This introduced the calculator together with the most common uses of it they would be meeting and the standard materials they would be expected to use for teaching it to clients as part of their job.

Content of the rest of the course included:

How and when to work in kina instead of toea
Cross checking with a grand total (using the memory)
Uses of % not already covered in BAWE
Evaluating 1%, 2%, 10%, 20%, 50%, 100%, 200%, of any amount mentally
Checking percentages by seeing whether results lay in the ranges determined by the values that could be calculated mentally as above
Mean of two numbers found mentally where possible by either of two methods
Finding the greatest and least in a set of either whole numbers or numbers to 2 decimal places
1-significant figure ranges for whole numbers, ie, the range from the 1-significant figure number below it to the 1-significant figure number above it, and for numbers given to 2 decimal places

† 1 kina = 100 toea = £0.70
Estimating products of whole numbers or numbers to 2 decimal places by multiplying the ends of their 1-significant figure ranges

Estimating a total by adding the largest units (thousands etc) that can be added mentally to find the lower end of the possible range and adding 1 "unit" for each number in the set to give the upper end of the range

Estimating differences by subtracting the largest units that can be subtracted mentally and using the units, one below and one above this difference, to give the possible range

Estimating divisions by single digit whole numbers by identifying the first figure and the number of digits in the answer

The use of "enough", "plenty", "adequate", "too much", simply in terms of "more" or "less than"

Multiplying and dividing numbers to 2 decimal places by 10 or 100

"Composition of 10" and its use to give quickly the change from K1, K2, etc, to K100

Finding the decimal equivalent of a fraction with the calculator

Learning to give quickly the decimal equivalents of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{3}$, $\frac{2}{3}$ and any number of fifths, tenths or hundredths, including mixed numbers

Finding the % by which a quantity has been increased or decreased, with the calculator

Proportion by increasing or decreasing all numbers in the set by the same percentage

Proportion by identifying an "old" and a "new" number of the "same" thing and finding what the "old" number has been multiplied by to give the "new" number

Proportion by using the formula: new of "same" $\div$ old of "same" $\div$ old of "other" $\times$
Comparing prices of different packs of the same goods
"Flat rate" interest given per day, per month or per year
Writing each quantity in a set as a percentage of the total of the quantities
Constructing pie charts, bar charts, using proportion for scaling
Constructing pictograms using the square root key to find the linear dimensions
Weighted means
Representation of frequency distribution by bar charts and histograms

The work will be preceded and followed by a speed test on mental arithmetic and some of the other contents of the course including the spotting of "obviously wrong" answers. The course is currently being trialled and will no doubt be revised for use in later years.

5.16 CALCULATOR SKILLS PACK (CSP): See 4.3, 4.4
This Pack will consist of exercise sheets for the students and a Teachers' Manual giving very precise instructions together with answers to the questions. It is intended for the use of school leavers in Grades 6, 8 and 10 and for Vocational Centre Trainees. After trialling in June/July 1982 it will probably be revised to form a basic course appropriate for almost any class teaching situation. After revision it should become our standard work for class use just as the First Calculator Course or the Business Arithmetic Workbooks is our standard work for teaching adults.
CHAPTER 6

RATIONALE AND CRITIQUE

6.1 RATIONALE?

So what was the rationale of four years' work in a Third World country, two years spent largely on persuading people to teach basic number skills and the other two spent persuading them to use a calculator? The two activities might appear to contradict one another.

To some extent of course they do, but it is just possible that an amalgam of the two dissimilar approaches may provide some light in an area which is now the scene of much current research.

Professor Dieudonne of France, at a South East Asia Mathematical Society Conference in Singapore in May 1979, stated: "Mathematics should not be taught for future mathematicians" [69]. He did not say: "Mathematics curricula should not be planned by mathematicians", but perhaps that is a corollary. At least let us recognise that if we have had the privilege of specialising in the subject then we shall need to be extraordinarily sensitive to the true needs of others if we are not to view them through mathematically polarised spectacles.

Wilson in a paper written for the Indian Journal of Mathematics Teaching [70] stresses the "acute and urgent" need to devise courses "to meet the real needs of the majority of students, rather than expect all students to follow a course originally designed for the most able, and then to call them failures when they cannot manage it".

It was a professor of engineering, J Arthur Shercliff, then at Warwick University, now at Cambridge, who said to me when I was
appointed to my post at the University of Technology, "If you want to help engineers you must forget you are a mathematician". What applies to servicing another academic subject must apply much more strongly to the servicing of non-numerate villagers. A year's concentration on their needs may have helped a little to de-polarise the spectacles.

Most of what was done by the author in the course of four years' in Papua New Guinea was in fact empirical. It would be a rash educationist anyway who went from Britain to a Third World country with pre-conceived ideas, but perhaps sufficient time has now passed to permit the statement of certain principles and to submit critique and experience from elsewhere to justify or dispute those principles.

6.2 MATHEMATICAL EDUCATION OF THE MAJORITY: A SUGGESTED PROGRAMME

In considering the mathematical education of the "majority" in the western world in the 20th century, eg those who did not go on to further education, one might characterise it broadly as follows:

The first quarter century: the skills of the clerk - computation

The second quarter century: the skills of the clerk, the technologist and the mathematician - computation, algebra and geometry

The third quarter century: concepts - and a tendency to decry skills

In the same broad sweeps, what could become the characteristic of the mathematical education of the majority in the last quarter of the twentieth century? Not a return simply to the skills of the Victorian clerk, though the "Back to the Basics" movement has been near to demanding this. Not a return to teaching how to manipulate complicated algebraic expressions which the majority will never require, or to the memorising of theorems in the misguided belief that this will somehow provide the majority with the capacity to think and argue as a mathematician. And in no way will the world continue to permit the expenditure of public money on a forlorn
attempt to teach only theoretical concepts of mathematics and to ignore the skills applicable to daily life.

Perhaps the author therefore may put forward the following as the principal needs of the majority, while not forgetting of course that for much of their lives the majority will be inextricably mixed with the minority and that the actual teaching programme must take account of the needs of both.

For the majority themselves the needs would seem to be primarily
A A number sense
B The ability to use a calculator
C The ability to quantify

By "number sense" I mean a combination of the skills and concepts that are appropriate to someone with a calculator in their pocket.

What skills and concepts are appropriate when a calculator is available?

1 First one needs concepts to know when to use which of the basic functions on the calculator. Addition, subtraction, multiplication, division, percentage are the principal ones. The fact that these are found on nearly every calculator suggests that these are the processes that are needed in real life: the calculator manufacturers have no doubt been researching needs for their own sakes. In teaching these concepts one must, of course, use the applications that are most relevant to the society of the day.

2 Secondly one needs the skills to carry out the processes for which one will not want to take the calculator out of one's pocket. Simple addition and subtraction, particularly subtracting from 100, multiplying and dividing by 10 or 100, perhaps doubling and halving: these are the survival skills of the late twentieth century.
3 Thirdly one needs the concepts and skills of estimation. These can be immensely complex and today tend to distinguish the competent from the incompetent. But they are needed by all and barely appear in the textbooks save in the form of exhortation. This surely is the area in which mathematical educational research is most urgently needed. For too long the "competent" have used their estimating ability to shame the incompetent. Both concepts and skills are required for it. The principal concepts are those of place value and range, the latter still hardly appearing in most syllabuses. The skills include some techniques for estimating addition and subtraction (and these are complex) together with a knowledge of the multiplication tables and the understanding needed to insert the correct number of zeros in multiplication and division.

By the "ability to quantify" I mean all the other concepts and skills needed in the real world, spatial understanding [71], the ability to measure distance, weight, time, capacity, temperature, angles, areas, volumes, the ability to read charts and graphs and an understanding of probability. Again, the choice of these must be related to the most probable needs of the majority whom we are considering.

Perhaps too particular techniques need to be developed for solving problems but this is an aspect of mathematical education that would still seem to have to prove its worth. One cannot but agree that solving problems is one of the principal motivations for learning mathematics, as indeed it is for other aspects of education, but one has still to be convinced that the theoretical analysis of problem solving techniques is actually going to assist the majority as distinct from the minority.

To summarise this in broad outline then, the programme that I would put forward for the teaching of the majority of our students in the final quarter of the twentieth century is this:
A Number sense: the concepts of +, -, ×, ÷ and % and their applications in the real world, the survival skills of mental arithmetic, the concepts and skills of estimation

B The calculator, and how to use it properly

C Quantifying: measurement, graphs, probability and the rest, in so far as they are relevant to the society of the day and the place

6.3 TEACHING THE MAJORITY IN PAPUA NEW GUINEA

How do the educational programmes in PNG today compare with the suggestions I have set out above? This is of course largely what the previous five chapters of this thesis have been about, but a brief review of them may be helpful before looking at the situation elsewhere.

6.3.1 PRIMARY

In Primary Education 2.1 sets out the extent of its failure, in the eyes of the author, while 2.3 shows the hope for the future. In particular the proposed new syllabus (2.3.2) includes an impressive list of practical applications relevant to the real village life of the Papua New Guinean majority. The research referred to in 4.3 points the way to introducing the use of the calculator in relation to these applications. At present that is only being considered for those who are about to leave. What is needed here, as elsewhere in the world, is a realistic programme for using the calculator earlier in the course so that the applications can be made realistic at once instead of having to be taught in a stylised manner and only later being dealt with properly with the calculator. This however must wait until people have put aside their prejudices about the calculator so that they can use it to the full, not only in handling applications realistically but also in teaching the survival skills of mental arithmetic and the purpose and practice of estimation.
Coupled with the introduction of the calculator into, say, the fourth year of the Primary course would come the elimination of a good deal of the course that would then be unnecessary for the majority, such as long multiplication and division and most of the work on fractions. In exchange one could introduce more of the groundwork on which estimating skills can latter be based, such as the concept of the range and approximation to 1 significant figure.

6.3.2 SECONDARY

If the rationale of 6.2 were accepted the calculator would already be familiar and available throughout the course. Along with it would go the emphasis on mental skills and estimation which are its essential complement. Apart from this the concern of the High School must also be to cater for the minority and on this the author is offering no specific programme although the principles mentioned above would clearly have a radical effect on the whole of the educational system, for the minority as well as the majority and in other branches of learning such as science and the technical subjects.

6.3.3 POST-SECONDARY

The programme set out in 4.5.1 illustrates the "remedial" work that will be needed so long as these new concepts and skills are not taught at the secondary level.

If by some miracle the revolution occurred and students actually arrived at their post-secondary institutions with plenty of experience with the calculator, a good number sense and the ability to quantify distances, weight, time, etc, then the whole curriculum of every post-secondary institution in PNG could be re-written and the present disadvantages of the non-numerate culture would be largely overcome.

6.3.4 NON-FORMAL

The work in adult numeracy in Chapter 3 is of course based on the principles now being considered. Non-formal education is
A 2-hour course at a village on stilts in the Marshall Lagoon, August 1981 (ANR 13). The double-canoe with outboard motor is the ordinary means of transport here.
so much more costly per student per hour that priorities must always be most carefully considered. As will be seen the order of teaching proposed is:

1 Counting and concepts of + and −
2 Use of calculator
3 Other concepts and mental skills

If 1 and 2 could become universal in PNG the possibilities for non-formal education in the teaching of 3 would be limitless.

6.4 EXPERIENCE AND CRITIQUE FROM OUTSIDE PAPUA NEW GUINEA

If research is to be relevant to real life it is most desirable that those carrying it out should be involved as deeply as possible in that life. Indeed any other sort of research in a Third World country should be viewed with considerable suspicion. Beeby in "Teachers, Teacher Education and Research" [72] has many wise things to say in this respect. In particular he calls for research workers who

(a) have taught
(b) have worked alongside administrators
(c) can write in language a layman can understand, and
(d) have "that curious blend of assurance and humility that is so necessary in anyone who takes it upon himself to plan the lives of others"

If these are the priorities then the author trusts that he may safely leave proper analyses of these issues to research workers who are based in developed countries. The conditions under which one can work at all in a Third World country are restricted and some of their limitations to research are illustrated in 3.2.5.4. Another restriction is that so long as the research worker remains in a post which is primarily concerned with providing a service rather than a thesis, his ability to give full consideration to all the literature available on a subject is bound to be minimal.
In what follows therefore there is no attempt to review the whole of the literature on any of the topics apart from that of adult numeracy in the Third World (where the literature appears to be mercifully scarce). Throughout his work as an officer in the Department of Commerce in PNG the author has collected what papers he could (and he is particularly grateful to Bryan Wilson of The British Council and to Michael Smith of the Literacy Documentation Centre of the University of Reading for supplying many of them). What follows is a review of those papers (and a few obtained subsequently while on leave) which, in the time available, he has been able to study.

The papers are grouped under the major headings with which this thesis is concerned but these are inter-related and one critique may well refer to several different areas which have been discussed in the course of this work.

The primary interest in these lies in their application to the Third World but the author did have thirty years of experience of teaching in Britain before his four years in Papua New Guinea and he does believe that some of the lessons learned overseas, where some changes can happen quickly, may be of relevance to the "West".

The critique that follows is therefore concerned not only with the Third World. It will also make some points in relation to the West, or more particularly, to England.

6.5 CONCERNING NUMBER SKILLS IN FORMAL EDUCATION

6.5.1 INTERNATIONAL CONFERENCE ON DEVELOPING MATHEMATICS IN THIRD WORLD COUNTRIES, KHARTOUM, 1978

This Conference in Khartoum in March 1978 set down certain objectives for the teaching of mathematics at the primary level. They listed:

1 'Functional numeracy' which included place value, decimals and an appreciation of the size of the number
2 Mental attitudes to enable the development of problem-solving strategies

3 Representing and interpreting data

4 Measurement, approximation and estimation

5 Spatial concepts and the ability to draw them

[73, p 4]

These objectives clearly include what has been defined in 6.2 as 'number sense' and 'the ability to quantify'. The omission of the calculator is understandable in 1978: the cheap LCD version had yet to be produced.

The Conference deplored the habit of contrasting 'traditional' and 'new' mathematics and suggested that "the fine details of the syllabus .... is not a major problem - the proper preparation of teachers is much more important". (page 7)

The history of mathematics teaching in PNG would certainly underline the need for the proper preparation of teachers, but the gross excesses of 'logic', 'relations' and multi-base arithmetic in the syllabus, making it virtually unteachable in the circumstances, must bear much of the blame.

The Conference also recommended that "mathematicians should be encouraged to take the initiative in seeking closer co-operation with the decision-making bodies in an institutional way, in order to involve themselves in the process of formulating national priorities and to initiate joint interdisciplinary actions" (page 12). An obvious way to contribute would be to set up University-based Mathematics Education Centres with freedom to co-operate with multi-disciplinary Government agencies and so be in a position to involve themselves in the decision making processes. The experience described in 1.4 in this paper exemplifies such an arrangement admirably. Mathematicians who are willing to look at practical problems and offer realistic solutions can be assured of a warm welcome at least some of the time. When
the welcome wears thin they must be able to withdraw and
develop some other contact until the earlier co-operation
can be restored. This underlines the need for the very broad
field of operations, such as was permitted to the Mathematics
Education Centre at the University of Technology in 1978
and 1979.

One other relevant recommendation was that "local mathematicians
convene regularly to discuss general mathematics policy in
their countries as a first step towards the co-ordination
of efforts on an international scale" (page 13). The informal
Mathematics Groups of Papua New Guinea as described in 2.2.1
and 2.3.1 had a practical role which provided an admirable
base for general policy discussion.

6.5.2 NIGERIA AND KENYA

The disenchantment of parts of the Third World with the
products of "modern mathematics" is significant. One of the
strongest arguments used in the Papua New Guinean debate was
the danger that continued failure to modify the effects of
"modern mathematics" could result in a wholesale turn around
ddictated by political considerations and the loss of much
that was good in that movement.

News of the dogmatic manner in which the Nigerian government
had terminated the reign of "modern mathematics" in or about
1980 lent strength to the argument.

Kenya was involved from the early '60's with the American
based African Mathematics Programme and from 1965 with the
British based "Southampton" Mathematics Project. In August
1981 the President, Daniel Arap Moi, was reported to have
"directed that the teaching of new maths should start winding
up in primary and secondary schools immediately all over the
country". He gave as his reason: "The new mathematics is
making children slow thinkers. It is unsuitable for teaching
in Kenya schools" [74].
The reference to "slow thinking" suggests that perhaps the real objection lay in the failure to teach mental arithmetic. One wonders how many good things in the development of mathematics teaching in the last two decades may now be lost because of their association with this failure to teach this most obvious of arithmetical skills.

6.5.3 THE POSITION PAPER OF THE NATIONAL COUNCIL OF SUPERVISORS OF MATHEMATICS, USA

Perhaps one of the most important reactions to the "Back to the Basics" trend in the United States in the '70's is this paper from the National Council of Supervisors of Mathematics (NCSM) [75].

It arose from a Conference on Basic Mathematical Skills and Learning held in Euclid, Ohio, in October 1975 at the instigation of the National Institution of Education.

Their report was discussed by the NCSM at their 1976 Annual Meeting where more than 100 participating members expressed a need for a unified position on basic mathematical skills. The Position Paper is the product of a task force set up by that meeting.

In essence the Position Paper accepts the need for teaching computational skills but underlines the necessity for these to be accompanied by other skills which are listed as follows: problem solving; applying mathematics to everyday situations; alertness to the reasonableness of results; estimation and approximation; geometry; measurement; reading, interpreting and constructing tables, charts and graphs; using mathematics to predict (probability) and computer literacy.

As computational skills the Position Paper lists facility with addition, subtraction, multiplication and division with whole numbers and decimals. It is recognised that today "complicated computations will usually be done with a calculator", but "knowledge of single-digit number facts is
essential and mental arithmetic is a valuable skill". It also acknowledges that "there are everyday situations which demand recognition of, and simple computation with, common fractions" while "the ability to recognise and use percents should be developed and maintained".

This clearly influenced the author's suggestions in 6.2 although the emphases are different: those on the calculator are more, those on fractions are less. He would also wish to see more evidence before agreeing with the need to teach problem-solving strategies involving "posing questions, analysing situations, translating results, illustrating results, drawing diagrams and using trial and error". You do not need to do all this to become an effective Papua New Guinean trade-store keeper.

6.5.4 A C BAJPAI AND R M BOND, LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY

Evidence of the need for number skills in Britain is provided in an unpublished thesis written by R M Bond under the supervision of Professor A C Bajpai, "An investigation into the mathematical needs of school leavers entering craft apprenticeships and, based upon the information gained, the preparation of relevant material for use within schools" [76].

Bond carried out a survey of the opinions of 87 training officers responsible for over 6100 craft apprentices. In reply to the question "Is enough emphasis placed on mental arithmetic in schools?" 47 said "No" and 40 were "Not sure". No one said "Yes".

The subsequent success of Bajpai and Bond's "Apprentice Maths" [77] confirmed the appreciation of the need for numerical skills among those responsible for training craft apprentices. A later edition designed for use in the United States includes a section on the use of the calculator and this will appear in any further edition for use in the United Kingdom.
Another study of the relevance of number skills to the work situation is provided by "Mathematics and Engineering, an illustrated guide to basic skills" [78] and a paper on "The Case for the 16+ School Leavers Attainment Profile of Numerical Skills" [79], both by R L Lindsay of the Shell Centre for Mathematical Education at Nottingham University. In the latter paper, which foreshadowed the successful introduction of the School Leavers Attainment Profile of Numerical Skills (SLAPONS) now administered by the Royal Society of Arts [80, p 27] Lindsay says [79, p 4]: "It is a phenomenon of 'real life' that those who had difficulty (or apathy) over problem-solving and determining whether it is 'a multiply or an add' find such decisions easy in the context of their daily work. .... But if the manipulative skills, the algorithms of arithmetic, are not ready to hand, the way is hard, frustrating and almost irretrievable without great effort on the part of apprentice and instructor". He concludes that "It would, then, seem highly appropriate to test for these numerical skills first and foremost. Those who have them are a good bet, or at least are less of a thundering nuisance!"

The lower priority here given to problem-solving is an interesting corrective to the many demands to make this a substitute for the "set theory" which at one time was acclaimed as the proper basis for all mathematical education. That is not to say that problem-solving (or set theory) is unimportant. In general life, for those who have the ability to think mathematically problem-solving may indeed be of the utmost importance. For the majority in their place of work however the variety of problems that have to be solved is relatively small and constant repetition of the same problem relieves the operative of the need for any mathematical insight at all.

One final comment however is that the "thundering nuisances" who lack numerical skills might become somewhat more acceptable
if they were provided with a calculator and taught how to use it.

6.6 CONCERNING ADULT NUMERACY

6.6.1 IRAN

A great deal of literacy work appears to have been undertaken in Iran, and some of this has had a numeracy component. Sohan Singh's "Learning to read and reading to learn" [81] is no doubt relevant there. So also are Gholian's "Conception of Teaching Mathematics" in General Programmes of National Literacy Crusade [82] and a paper from the Functional Literacy Pilot Project on "The Work-oriented Adult Literacy Pilot Project in Iran" [83].

The author of course has no qualification to consider these in relation to their use in Iran. Suffice it to say that they would be quite inappropriate in Papua New Guinea.

Sohan Singh's interest in the infinity of the decimal system, for example, would certainly not be to the taste of our villagers who may not even have a genuine sense of number, let alone decimals and certainly not infinity. As has been said, even sophisticated and experienced Business Development Officers frequently write a sum of money as K3.75t, making nonsense of the whole concept of the decimal.

"In our opinion", writes Gholian, "the teaching of mathematics should not be limited just to provide an adult with the aptitude to calculate and solve the daily quantitative problems ..." [82, p 25]. In our opinion, in Papua New Guinea, that is the maximum at which we can hope to aim, initially at any rate. Our problem is rather that there are no 'daily quantitative problems'. When you have never had any means of handling certain types of problem, you will certainly have learnt to live without solving them. The problems only arise for our villagers as they seek to enter into the new and strange world of the West.
Gholian continues "... but to teach him how to think properly, understand the notion of relation, and lead him to a greater initiative in applying mathematics to various types of problems". Excellent advice no doubt in Iran and perhaps everywhere else in the world - but not in Papua New Guinea. Here one would hesitate to claim that we could teach a national to 'think properly'. After all, what do we really know of their method of thought and what right have we to judge it? The well-bred expatriate here has no such illusions of grandeur. He is paid (and if on contract, well paid) to provide the Papua New Guineans with the expertise they desire. Nothing is said on the contract about 'teaching them to think properly'.

"The Place and Role of Mathematics Teaching in Functional Literacy": the Iranian Experiment [83] is similarly inappropriate for our island. The problem-oriented approach (page 1) is indeed the method that has mostly been used in Papua New Guinea. There, however, the similarity ends: the types of problem in PNG have largely had to be dredged out from a study of what extension officers think villagers ought to have problems about, whereas in Iran the sort of problems that arise apparently involve much more difficult concepts such as speed, time, angle, proportion, and even arithmetical and geometrical progressions (page 3). We have tried to teach the clock and calendar but found any more complicated concept of time difficult; we also included a form of proportion when comparing prices of different packs of goods in a supermarket, but these are problems for government officers or town dwellers rather than for the 85% of people who still live in villages.

The author's reaction to these materials, which may indeed be suitable for Iran but are certainly not so for PNG, is to suggest that anyone concerned with adult numeracy anywhere in the Third World should carefully consider which of the now tried alternatives is most appropriate to their circumstances.
6.6.2 A FIELD EXPERIMENT IN ECUADOR

"Developing Arithmetic Skills Among Rural Villagers in Ecuador Through Non-formal Education: a Field Experiment" by Luis M Laosa describes an experiment involving the teaching of 68 adult villagers in four isolated rural communities. There were control groups totalling 33 in two other villages. [84]

In order to overcome the problem of villagers being out at work, gasoline lamps were provided by the research project to enable the teaching to take place in the evening. The non-formal educators (all Ecuadorian and in their early 20's with some post-high-school education) slept the night at the village.

In each case five weekly lessons were given, all sessions being based on a non-formal education game called Number Bingo. For this each player had a game board and a supply of markers. The game leader, one of the villagers selected by the group each time, selected a problem card at random, read it out and displayed it. The problems would consist of either sums or products and each player marked on the board what he or she thought was the answer. The boards were differently laid out and the winner was the first to complete a row of markers so there was luck as well as skill in the game. The winner's results were checked and any error would mean that the win was forfeited. Each session was preceded by a discussion of learning objectives and followed by a period of reflection, conceptualization and discussion of practical applications, their relevance to individuals' lives and proposed course of action.

Pretests and Posttests given to measure arithmetical skills included a variety of addition, subtraction, multiplication and division items from orally presented sums of two single-digit numbers to division of a three-digit number by a one-digit number on paper.
The experiment showed significant gains where the game was appropriate to the level of the villagers involved, ie, having zero or low levels of education. The most responsive village was the one with the youngest students and the lowest initial scores: Asunción with 16 students with a mean age of 20.27 (SD = 7.44), and an average of 2.40 (SD = 2.23) years of education raised their pretest mean score of 23.47 (SD = 5.11) out of 32 to a posttest score of 26.47 (SD = 3.36). By contrast Rumipamba with 12 students with a mean age of 35.58 (SD = 13.71) and an average of 4.33 (SD = 1.44) years of education raised their pretest score of 30.50 out of 32 (SD = 1.51) to a posttest score of 30.58 (SD = 1.50).

Perhaps it would be fair comment to suggest that the cost-effectiveness must have been fairly limited and would presumably be lower still if the posttest had been taken, say, 6 months later when the respondents would have had a chance to forget the number bonds they had learnt over the five weeks. On the other hand if the course could be combined with some other programme this would obviously reduce the per capita cost and make it more worth while.

6.6.3 THE TURRET BASIC ARITHMETIC COURSE FOR ADULTS, SOUTH AFRICA

The Turret Correspondence College in Johannesburg is operated by the Sached Trust and is concerned with the teaching of people for whom English is not necessarily a first language.

In February 1978 it was agreed that there was a need for an "Arithmetical Course within the Commerce Project", aimed at those with standard 2-4 education. It was appreciated that a tutor would be needed for the course and that student materials would have to be written in both English and Zulu [85].

An initial test helps to select students. It includes counting and writing numbers up to 100, and questions: R5.00 + R8.00; R20.00 - R16.00; R1.00 - 25c; 13 + 6; 20 - 9; 14 + 5; 21 + 6; 9 - 4; 26 - 3 (the last 4 being written in column)
together with two questions requiring literacy together with addition and subtraction, but these last were not considered essential for passing the test.

The Course consists of 24 lessons split into 4 units. Unit 1 covers addition of up to twelve numbers with 1, 2, 3 or 4 digits, subtraction up to 400 928 - 219 309, and applications to the payslip and budgeting.

Unit 2 covers multiplication to 713 \times 29, division to 683 \div 19 with revision of Unit 1 and applications to working at Rate of Pay.

Unit 3 covers fractions to adding halves or thirds (not mixed); finding \( \frac{2}{3} \) of R1,04, expressing 8269 \div 7 as a mixed number and rounding to the nearest whole number, with applications to calculating overtime rates (at \( 1\frac{1}{3}, 1\frac{1}{2} \) or \( 1\frac{2}{3} \)) and overtime pay up to 8\( \frac{1}{2} \) hours at \( 1\frac{1}{3} \) times a basic rate of 64c an hour.

Unit 4 deals with decimals and percentages with applications to Interest and Discount and General Sales Tax.

There are tests at the end of each unit and a Final Test after another lesson on budgeting.

The Course was tested on a group of workers at Afrox Chemical Factory in the Transvaal, South Africa between March and November 1978 [86]. Afrox provided a tutor and 20 male workers, mostly machine operators between the ages of 25 and 45 who were paid overtime (\( x \frac{1}{3} \)) for attending. After the initial test about a third of the workers were dropped for being either "too good" or having serious reading and writing problems. 24 weekly 1-hour classes were conducted by the tutor and observed by the writer or editor of the course.

The tutor was recognised as being exceptionally good and contributed largely to the identification of weaknesses in the course where it had to be re-written. The entire session was in the vernacular but the observers felt confident that
the tutor manual could be used successfully by any potential tutor if he were serious about his role.

Some students missed some lessons through no fault of their own and would have had great difficulty in catching up if the tutor had not given up lunch breaks to help them.

Most lessons were successful in themselves, only a few needing major re-writing. The testing revealed that students had difficulty in working from a diagram of a payslip but no problems with an actual one (compare 3.2.4 where it is noted that problems in a Bank Book unit were eased by making photocopies of an actual Bank Statement). It was also found that by the end of the course place value and subtraction with double borrowing had been forgotten since being done in the first unit. Revision exercises were therefore added which as the editor of the course remarks is often necessary in a written course whereas a good classroom teacher will normally do it automatically.

The greatest difficulty occurred with the fractions lessons.

After marking the final tests it was decided that not all students could be considered to have successfully mastered the course so certificates were given indicating the parts of the content that each student had mastered.

The production of the students' workbooks and tutor's manuals are excellent and anyone wishing to write such a course for their own use would be well advised to study this one. My only regret would be that this immense load of work had to be undertaken when the whole course could probably have been covered with a calculator in a quarter the time, at half the cost (including the calculator) and with four times the enjoyment!

6.6.4 **THE GAMBIA CO-OPERATIVE FUNCTIONAL NUMERACY PILOT PROJECT**

This well-researched and thought-out project appeared at one time to be about to become one of the few Third World campaigns
outside PNG concerned solely with adult numeracy. In the event however, it became part of a literacy campaign.

The Co-operative Union and the International Co-operative Alliance were already involved in literacy work in the Gambian. In the course of it the learners were consulted about their needs as they perceived them: "by far the most strongly felt specific functional need among farm household heads is to be able to understand groundnut sale transactions... the fear of being cheated is strong... Farmers cannot read the scales or receipts, do not understand the measures nor the few English terms employed" [87, p 7]. This indeed had a familiar ring: the corresponding problem with the sale of coffee in PNG is referred to in 3.3.2.

Subsequently in an annexe on literacy in the same report [87, p 29] it is stated that "The reasons offered by villagers for wanting such classes were however more concerned with numeracy than literacy". In the face of such reactions and because of an unresolved problem over the use of English or a local language for literacy work it had been agreed that a decision on literacy should be postponed while an ad hoc numeracy programme was launched and pilotted in 1980 [87, p 10].

A very useful Socio-economic Background Study was produced by King in October 1979 [88] and Hans Peter Schwobel was appointed as consultant. After a full discussion shortly after his arrival it was agreed that the numeracy teaching should in practice be combined with a literacy programme. As Schwobel stated [89, p 2] "It is possible, of course, to teach numeracy without literacy. But in the Gambian case it is useless, because all calculations to be done and all figures to be read and written by the groundnut farmers are connected to words and sentences".

The resultant numeracy course was thus only part of an ongoing literacy programme and the report on it is included in the "Evaluation of the 1980 Co-operative Pilot Literacy Project" [90].
The first primer used for the programme [91] included 9 lessons on arithmetic and the second primer 4 (judging by the Teachers' Manual, the actual primer not being available to the author). The first of these lessons introduces the numbers 1-9, the second deals with addition "for real quantities (groundnuts, etc)". In the third lesson subtraction is introduced and in the fourth the numbers are extended to 19. The next lesson introduces multiplication and requires the two-times-table to be learnt by heart. Thereafter numbers are extended to 99 and all times-tables up to $10 \times 10$ are to be learnt by heart. The work in the first primer concludes with subtraction involving borrowing, and division.

The second primer includes extending numbers to 1000 and the use of metric weighing scales together with a price tariff and work on taxes.

Other publications by Schwöbel which (presumably) have been used in connection with the course are "Teaching Arithmetic in the First Spiral" [92] and "Operating Arithmetic on the Flannel-Board" [93]. The former is largely a commentary on Singh [81] while the latter gives useful suggestions for teaching addition, subtraction, multiplication and division. Some difficulties however might be caused by the use of terms such as "inversion", "the symmetry of addition and subtraction", "dividend", "divisor", and "bunches" by which he means sets of relations such as $6 \times 3$, $20 - 2$, $5 + 5 + 8$, $35 - 17$, etc all of which are equal to 18.

The evaluation of the Gambia Project [90] took place in June/July 1980, on classes which had begun in January or March of that year and had been held about 4 times a week by teachers resident in each area: 11 teachers and 65 students were interviewed. The students consisted of one third of each of 11 classes and were selected by the teachers.

The majority of the teachers, but only 8% of the students, replied that "writing" was the most difficult part of their literacy/numeracy teaching. Two-thirds of the students how-
ever said arithmetic was the most difficult part.

A test was given to the participants with the following results:

<table>
<thead>
<tr>
<th>Questions</th>
<th>% correct replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4 \times 2, 3 \times 4, 5 \times 2$</td>
<td>87%</td>
</tr>
<tr>
<td>$3 - 2, 10 - 9$</td>
<td>86%</td>
</tr>
<tr>
<td>$9 \div 3, 6 \div 2$</td>
<td>75%</td>
</tr>
<tr>
<td>$5 + 4$</td>
<td>82%</td>
</tr>
<tr>
<td>$36 + 64, 98 - 25, 25 + 32, 10 + 20$</td>
<td>70%</td>
</tr>
</tbody>
</table>

One cannot help but compare the effort implied in reaching such goals as had been set, with the rapid strides that could have been made if calculators had been available. Familiarisation with the machine might have taken three lessons, learning to use the scales a fourth, and learning to check the price paid for the groundnuts a fifth. Admittedly the knowledge of number bonds and times-tables would not have been acquired but in place of this a facility with the calculator would have been established. A major problem here may have been the poverty of the villagers, but it is noted that the estimated recurrent cost for the numeracy project alone, was £20.10 per participant [87, p 21]. Even if calculators had been provided free of charge the per capita cost would certainly have been less.

The Project Document [87, p 14] also refers to a Benin government National Literacy/Numeracy Programme which begins with practical numeracy (weighing, etc) for 10 days and calculation skills (addition and multiplication) for a further 15 days, but details of this are not available to the author.

6.6.5 LESOTHO DISTANCE TEACHING CENTRE

This distance Teaching Centre is of international renown, principally for its work in literacy. Lesotho probably has the highest literacy level in tropical Africa. One of the
Learning Games that the Centre has sponsored [94, p 9-12] is a simple one involving two sets of cards. One set represents items that can be bought in a trade store, the other represents coins with which to buy them. An exact match has to be made between an item and a set of coins.

This sounds an excellent aid in many countries. Indeed it could well be tried out in Papua New Guinea as it would assist in the transition that is just beginning to take place in villages from a commercial system which never requires any coins smaller than 5 toea into one which uses the 1 toea and 2 toea 'coppers'. It might even convince the holders of copper coins that they were actually worth keeping, even in the villages. The value of coppers is of course already somewhat better appreciated in the towns where prices are in units, not multiples of 5 or 10.

6.6.6 JOHN GAY, NATIONAL UNIVERSITY OF LESOTHO

John Gay is the author of "The New Mathematics and an Old Culture" [4] referred to in 1.2.2. He kindly wrote personally concerning his thoughts on the use of the pocket calculator in the Third World. He is "convinced that newer technologies will bring the price down to an almost ridiculously low figure in the near future", and is fully in agreement with the principle of using it in adult numeracy work.

He also criticised the early Trade Store Management Course Units, picking up, as we did also, the complications inherent in the attempt to teach estimation. He suggests there may be local language uses of 'rounding' such as using 'three and a half pans' to imply simply that a measured quantity is more than three but less than four. With 700 languages to check it would be tedious to try to determine whether or not this is the case, though I would doubt it myself for the vast majority of languages. The time where it does occur is in the non-traditional weighing of coffee by the kilogram: most buyers 'round down' on the principle that the weight of the bag has been included. In the end, however, as
explained earlier (3.3.2) the decision to sell is often based on a final price rather than on a 'per kilogram' quotation, which obviates any need for the seller to weigh or to calculate.

This particular suggestion of Gay's underlined the general point he was making in a paper prepared for the Sixth Biennial Pan-African Afrolit Society Literacy Workshop in December 1979. In this paper [95, p 9], he asserts that "competent, functioning adults in every society already know a great deal about mathematics". He may be right, and it may be that the speakers of all 700 languages in this country are anxious to explain to us expatriates just what that mathematics is. But I doubt it. Gay indeed quotes an example from Papua New Guinea [3, p 44-52] where the Kewa have a system of body-tallying which they use in relation to a pig-killing festival, but it could be that 'transfer' from this to counting anything else, let alone to trade store arithmetic, would prove to be more difficult than the learning of a new counting system. There are languages in PNG where the same number has different names depending on what is being counted, a situation which suggests that the concept of number itself is not truly formalised. The arguments have already been set out in 1.2.2. Perhaps they can be concluded by pointing out that this whole idea of 'transfer' from traditional to modern systems lay behind the highly professional Indigenous Mathematics Project, which Lancy directed. In spite of this, the Project has now come to an end and no recommendations appear to have been made along the lines that Gay has been urging.

A second letter was received from John Gay in March 1982, written in spite of the extreme pressure of other work. He had studied the Business Arithmetic Workbook and some earlier papers. He concludes that "what you have done is miles ahead of anything else I have seen, and should be shared widely".
This however followed four pages of detailed criticism and suggestion. His main concern was with the ability to estimate which he considers "central to mathematical competence". He also quoted a friend as saying that "the only really important statistical test is not chi-square or F-ratio, but is the eye-ball test".

He makes a number of suggestions for teaching students to operate the "eye-ball test". Principal among these is to include wrong answers in the workbooks every once in a while. He believes they would recognise and respond to a nonsensical answer. To some extent one can do this, and there are indeed cases of it in the Workbook which Gay himself noticed. But, sadly, my judgement is that for our particular clients in Papua New Guinea anything other than a very obvious error, pointed out immediately and explained, would cause only distress and confusion. Here of course I am thinking primarily of ordinary businessmen, but experienced Business Development Officers with whom I tried out the earlier courses in which deliberate errors were included, responded badly to them. This is not to say that the method could not be used in other parts of the world, or with advanced students in PNG where a firm teacher-student relationship had been established, but experience so far would restrict it to that.

John Gay also suggests adapting the use of the calculator to traditional games. He urges us to seek out such traditional games and model them. Again this sounds an excellent idea where the culture is sufficiently uniform to possess these features. It may be that something sufficiently widely known may be found if we do search in PNG, but my colleagues in the Mathematics Education Centre had had long experience of the country and would almost certainly have made use of such games had they existed.

An important warning given by John Gay in this letter concerns the differences between different varieties of calculator. He refers particularly to the type of calculator that
evaluates products in an expression before adding the terms eg $40 + 60 \times 3 = 60 \times 3 + 40 =$. This is the case with the scientific calculator (Sharps EL508) which the Numeracy Project sells as a convenience to clients who particularly need it, but it does not appear to be the case with the basic machines such as the EL220 which is used in our general work.

This comment underlines the necessity for standardising the type of calculator before attempting to write instructional material. It may well be the most important factor in many situations. We were fortunate in Papua New Guinea that the markup charged by retailers (reckoned on average to be much higher than in most parts of the Third World) was sufficiently great for the Project to be able to offer a good model at about half the usual price and still make a small profit out of the sales. In such circumstances, and particularly as the classes were generally held a long way from the nearest retailer, it was safe enough to write the instructions specifically for this calculator. There was some concern when the original one went out of production but its replacement operated in an identical manner and apart from descriptions of where to find the keys, no changes to the material had to be made. It is of course possible that the manufacturers could make radical changes at anytime although they may hesitate to do this if it could lose them a near monopoly of a substantial market. If such an event does occur however, the material will have to be adapted and appropriate "conversion" units prepared, but once the habit of using a calculator is established it should not be difficult to explain such minor modifications as are likely to be required.

John Gay also picks up the usual question of why the work should be entirely in toea while the results are written in kina. This is fully dealt with in 3.2.2 : at post-secondary level of course the student should be able to use either method and understand the relationships, but our experience with new and less numerate users has abundantly
confirmed our decision to avoid using the decimal point as long as possible.

The problems of "rounding" to which he also refers are associated with this decision. It is so much simpler to "leave out everything after the point" or even to "go up to the number above", than to attempt to teach what would amount to an understanding of the decimal system. The failure to understand this after 10 years of school was one of the most commonly observed phenomena in post-secondary students. Experienced businessmen writing "K3.42t" underline their failure to appreciate the meaning of "working in kina" or "working in toea". The purpose of adult education is primarily to teach what the students believe they need, and not to risk failure in this by trying to teach them something more that the teacher thinks they ought to need.

John Gay's desire to restore the teaching of approximation by "casually saying" that 48 is about 50 and 1430 about 1500 or sharing a freight cost of K20.00 between two items, must be countered by the stark reality of the group of Mothers' Union leaders referred to in 3.3.3 who actually posed the question "what should we charge for a potholder when two of them can be made from a ball of string costing K1.95". It was hard to persuade them first that K1.95 was "nearly K2.00" and second that if two did cost K2.00 then one would cost K1.00. It is extremely difficult for anyone who has never taught such people to understand how such things can be. But they are. No doubt it is different elsewhere but it is possible, perhaps, that the experience of this extreme situation could be of use in teaching some of the mathematically disadvantaged people elsewhere in the world.

Finally John Gay urges us to seek out the "network of knowledgeable village and town people" who can tell us who are the competent and outstanding shopkeepers. Perhaps we could learn from the keen store keepers who do not come to our courses. There may indeed be something in this because in the past our contacts have mainly been through Business
Development Officers who might well not be consulted by the most competent businessmen. One does however wonder how any businessmen could, for example, calculate the controlled price for a packet of soap unless they had sufficient arithmetical skills to evaluate the cost of the freight, divide by a two-digit number and add $12\frac{1}{2}\%$, thus giving the legally controlled maximum price. They may have learned such skills from formal education or from some expatriate or they may use the Retail Ready Reckoner but it seems unlikely that they will have any skills that will significantly replace those which a calculator can provide. This is not for a moment to say that acquiring calculator skills is either necessary or sufficient for being successful in business. It is just that it seems to help most businessmen in the West, so why should it not be allowed to do so in the Third World?

6.6.7 BRITISH TELEVISION PROGRAMMES

A number of these programmes have been used in adult numeracy work in the United Kingdom. "Numbers at Work" [96] was made by Yorkshire Television, "It Figures" [97] by the BBC and "Make it Count" [98] by the Independent Broadcasting Authority. These are not reviewed here because neither the content nor the medium is particularly relevant to adult numeracy in Papua New Guinea.

6.6.8 NORTH-SOUTH: A PROGRAMME FOR SURVIVAL

Perhaps we may conclude this section with a quotation from the Report of the Independent Commission on International Development Issues which met under the chairmanship of Willi Brandt.

"The call for appropriate technology does not prescribe any particular type; much less does it imply that the technology should not be the latest or most sophisticated... Only the developing countries themselves can decide which machines and systems will suit their own local needs... But inter-
national co-operation can help to develop new technologies and to disseminate them." [99, p 195]

In other words, let no-one decry the use of the Liquid Crystal Display electronic calculator with Auto Power Off, if that is the most appropriate tool for the villager in Papua New Guinea or elsewhere. International co-operation could indeed help to disseminate them by making sure that the lowest possible prices are passed on to the countries that need them, with as little delay as possible.

6.7 CONCERNING THE USE OF THE CALCULATOR IN FULL-TIME EDUCATION

6.7.1 UBIRATAN D'AMBROSIO OF BRAZIL

D'Ambrosio is President of the Inter-American Committee on Mathematical Education. A paper by him on the use of hand-held calculators in schools was published in 1978 in the International Journal of Mathematical Education in Science and Technology [100]. D'Ambrosio groups the objections to the use of hand-held calculators into three main issues:

1. Will they block reasoning and make individuals mentally slow?
2. Will their use make individuals dependent on the machine and will their absence be a handicap for daily needs?
3. Will they broaden the gaps between rich and poor and between developed and underdeveloped nations?

The author clearly has no space in a short article to deal fully with these objections, but he makes the following points in refutation of them.

He quotes Plato in "Phaedrus" where the invention of writing is denounced by King Thamus of Egypt as a danger to civilisation: children and young people who used to apply themselves to learn and retain whatever was taught would now cease to exercise their memories and consequently be less diligent and capable, said the King. The human race seems
to have come to terms with the use of writing; it is reasonable to assume it will also come to terms with the pocket calculator.

At a humbler level d'Ambrosio remembers being forbidden to use ball-point pens (and I remember having to forbid students to use them) on the grounds that handwriting would be so spoiled as to become illegible. There are more powerful reasons for legibility than the inconvenience of dip-pens: so there are better reasons for mental arithmetic than the need to use it in paper-and-pencil algorithms.

D'Ambrosio also stresses the need for 'quantitative common-sense', which has a similar meaning to my 'number sense'. Where precision is required the calculator is there to give it, but the very fact that it is so easy to produce this accuracy may encourage people instead to give a 'reasonable quantitative result'. The important thing is to be able to combine 'number sense' with 'ability to calculate'.

The President of an Inter-American Committee is in a good position to comment on the relevance of the calculator to the problems of social imbalance and global inequality. The only effective way, he says, to challenge these destructive elements is to provide whole generations of 'have-nots' with the abilities and tools possessed by the 'haves'.

He refers to the young Peruvian boy who, after much effort, learns how to do arithmetic with pencil and paper. He then goes for a job in the city and sees the boss merely pressing a few buttons to get the same results. The lad is immediately 'put down': had he been taught to use a calculator, he would not have been.

Finally, d'Ambrosio refers to the immense new power to use realistic numbers in modelling real problems. This alone should be a sufficient justification for making the use of the calculator universal in mathematical education.
Pam Harris was in the Curriculum and Research Branch of the Department of Education, Northern Territories, Darwin before being appointed Project Officer for the Mathematics in Aboriginal Schools Project.

In May 1978 she presented a paper on 'Measurement in Tribal Aboriginal Communities' [101] to the Second Annual Conference of the Mathematics Education Research Group of Australia. This took as its starting point a national survey conducted by the Australian Council for Educational Research in October 1975. This survey aimed at assessing the number of children who were failing to attain the basic skills of reading, writing and numeration. It also sought to specify relationships between these attainments and various other factors including ethnic origin.

In their final report published in 1977 [102] one chapter was devoted to the comparative performances of aboriginal students. The conclusion was drawn that "the overall performance of students in aboriginal schools in the Northern Territory on the tasks set in the Reading and Numeration Tests was very low indeed".

Examples of this were given, such as the following test results:

<table>
<thead>
<tr>
<th>Description of Test Item</th>
<th>% Correct</th>
<th>Aboriginal students in the Northern Territory</th>
<th>Australia overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Students aged 10 years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addition of 5 coins</td>
<td>17</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>totalling 37¢</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculating the cost of 3</td>
<td>6</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>articles costing 25¢ each</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write down the time (11.35)</td>
<td>2</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>shown on a watch face which has Arabic numerals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In her paper Pam Harris shows just how irrelevant some of the mathematics taught in primary schools is in remote communities where the children speak an Aboriginal language most of the time.

Questions were asked to discover the availability and use of abstract terms such as 'length' and 'weight'. It was clear from the replies that apart from time and money, such abstract terms do not exist in Aboriginal languages. This however did not mean they could not discuss such problems. Objects would normally be measured by comparing them with what would have been expected in the circumstances, or by imprecise references to English measurement terminology.

The terms used for money were not always helpful: more than half the respondents reported the use of a word meaning "stone". Few of the terms used gave any indication of the value of the coin or note. In many places copper coins were referred to as "the brown ones" and silver ones as "the white ones". 1¢ and 2¢ coins were almost unknown to many Aboriginal children. They were usually thrown away.

In conclusion Pam Harris suggests that "a measurement programme prepared for white English speaking school children living in an urban situation is unlikely to be appropriate for introducing the study of measurement to Aboriginal children living in remote tribal communities".

She recommends that a programme of research aimed at developing appropriate mathematics curricula should be set up immediately.
In association with Bill Ryan, Pam Harris presented a paper "Teaching Mathematics in Aboriginal Schools" to the National Conference for Teachers of Aboriginal Children in September 1978 [103]. It attempts to draw some attention to the areas in which the ability of the Australian Aborigines is in fact superior to that of white Australians. She refers to their skill with the boomerang and their ability to identify accurately the directions of distant places even after a long and circuitous chase in the desert.

The writers also quote a method of body-tallying which enables Aborigines to count up to 30, in contrast to the maximum of four or five which Australian folklore asserts as their limit. Skill in card-playing is also referred to as evidence of mathematical ability.

Their recommendations include the following:

"Rather than attempting to force children onto formal work early in the primary school, a period of one or perhaps two years should be devoted to kindergarten-type activities. The majority of these children commence school with very limited pre-number experience and therefore need a greatly extended readiness programme."

"The importance of activities with money or token money should not be overlooked. These activities maintain high interest, give valuable experience in handling money and provide number experience in 'real life' situations."

"Measurement activities should form a large part of the mathematics programme. It is important however that children be given the necessary prerequisites before launching into measurement using standard units. These prerequisite experiences should form part of the early kindergarten-type course."

"In schools where the mathematics course consists of rote learning of the four processes and drilling of basic facts it is evident that attitudes to mathematics are poor and children's concentration spans appear very short. This approach is considered inappropriate."
The writers also quote results of a survey of Aboriginal education in Western Australia [104] which included the following:

"The four processes with whole numbers were generally not mastered, however most pupils were able to demonstrate intuitive understanding using concrete material such as Multi-base Arithmetic Blocks."

"The idea of reversing addition and subtraction, multiplication and division, was in most cases retarded."

"The level of success and enjoyment in activities involving money or token money was much higher than in more abstract activities."

"Most texts and workbooks available were considered inappropriate for children with language or literacy problems."

The revised Western Australian Primary Mathematics Syllabus was subsequently recommended for use in both Urban and Aboriginal schools in the Northern Territories in 1980. An in-service programme was initiated in which the publication of a lively and well-produced primary mathematics newsletter "Sumthink" [105] played a part.

Much in this brief review of Aboriginal Education is indeed relevant to Papua New Guinea. Similarities include the low performance in standard "Western" tests of numeration and such details as the idea that small 1¢ and 2¢ coins are worthless.

The main difference lies in the fact that the whole curriculum in PNG is supposed to be concerned with students from such cultures, while the Aborigines represent only a small minority concern in Australia and do not yet have their own curriculum.

It is not the purpose of this thesis to study the whole area of mathematical education in these societies. It is concerned primarily with number skills and the application of the
calculator. On this basis the author would therefore, with much deference, make the following suggestions:

1 If the community life currently involves so little numeracy is it not perhaps wasteful to put too much effort into teaching them number skills that involve a substantial amount of memory work? If they are not going to be used frequently they will be forgotten anyway.

2 An alternative to this would be to introduce the calculator as early as possible, perhaps as soon as the ability to count forwards and backwards has been assured.

3 Subsequent teaching of number-skills could be based on the assumption that a calculator was available. Estimation and approximation would be emphasised.

4 The principal application of mathematics would be to money.

5 The teaching of all forms of measurement would assist in the concepts of continuity and range which are essential if estimation and approximation are to be understood and practised.

6.7.3 CALCULATORS IN THE PRIMARY SCHOOL, NORTHERN TERRITORIES, AUSTRALIA

This article by F J Meredith of Jingili Primary School illustrates some of the experimental work being done in Australia in 1980 [106].

He emphasises the dangers that might arise from excessive use of the calculator: failure to develop non-calculator computational skills, lack of understanding of the mathematical principles involved, inability to evaluate or question the accuracy of their answers.

Meredith's school purchased five Dataman Programmed Calculators for use in years 1 to 3. These are similar to the "Quizkids" that were sold through the Mathematics Education Centre at Lae in 1979 (See 1.4.4) : the machine produces the questions
and the answers have to be entered. The Dataman could be programmed by the teachers to test particular types of number-fact questions required. (Information on such machines is provided in "Calculators for Kids" by Gribbin J & M [107]).

Use was found to be effective and enjoyable operation methods being picked up quickly.

Ordinary calculators were also experimented with in the upper primary classes. Various games were played and the teachers agreed that they could be used effectively for:

- Survival skills for children needing remedial programmes
- Developing problem solving skills
- Self-correction of written exercises
- Experimentation leading to concept development
- Creating number patterns

6.7.4 ROLF HEDRÉN OF SWEDEN

In Sweden the Board of Education has set up a committee to analyse the consequences of the introduction of the hand-held calculator. One of its teams works in the upper primary school: its chairman is Rolf Hedrén of Falun-Borlänge. His article on "Hand calculators and maths in primary schools" was published in the UNESCO Quarterly Review of Education in 1979 [109]. He has also kindly provided a summary of results of tests carried out with experimental and control groups in form 4 during the school year 1979-80.

Hedrén recognises that the elimination of pencil-and-paper algorithms would substantially reduce practice in simple number skills but he does not consider that this is sufficient justification for the estimated 50% of teaching time devoted to such algorithms. Instead her urges increased training in mental arithmetic per se.

He has also urged increased training in estimation, but, like others, has found this by no means easy or popular with the students. Even after considerably more practice in it
than was provided for the control groups, the experimental classes achieved only a slightly better result. Hedrén's comment on this [109] was that students might not be so frightened if they were taught to round off more roughly, as was explicit for example in my Basic Skills course. It is also significant that rounding off 'to the nearest' is a much less common practice in real life than it is in schools. In commerce there is a tendency to round up or down according to quite other criteria, usually those of ease or profit. In Sweden students are even being taught to round 25 down to 20 but 35 up to 40, so that the last given digit after the rounding off is even. One wonders how much further one could remove school mathematics from the ordinary world. A general rule to round down would seem to be much more realistic. It could be followed, perhaps at the secondary level, with a study of the effects of such rounding, particularly, as Hedrén's committee suggests, in cases where further calculations are made following rounding. But the whole teaching of estimation is clearly worthy of further research and experiment.

The main emphasis in Hedrén's work, however, lies in the use of the calculator to facilitate the construction and solution of realistic word-problems. In spite of this he concludes that "it is easier for the students to grasp the idea behind a problem when the numbers involved are uncomplicated" [110]. There is no doubt that teaching in this field also requires much more research but the experience so far does seem to support the suggestion in 4.2 that artificially simplified numbers in word-problems should precede the introduction of real-life examples.

Hedrén is convinced that the results so far obtained "clearly indicate that hand calculators can be and will be introduced in schools as early as upper primary school".

6.7.5 LILA BENTAL, BARNET, UK

Ms Bental is author of the NFER "Essential Mathematics Test" and Teachers' Guide [111]. She is also a member of the Child
Guidance Remedial Service of the London Borough of Barnet. In a letter commenting on the similarities between the problems of teaching villagers and non-numerate city children, she agreed with an approach through the use of money and considered that this was probably one of the most fruitful ways of approaching the learning of arithmetic concepts, process and language.

She expressed the common concern about the dangers of misusing calculators and producing wrong answers. She emphasised therefore the value of estimating and approximating but appreciated that this was a "challenge". In spite of her doubts she had in fact suggested to her own colleagues that the calculator should be introduced to younger remedial pupils instead of leaving it till the fourth year of the secondary school. She was subsequently pleased to note that the Cockcroft Report had recommended the use of calculators extensively at least throughout the secondary level (See 6.7.6).

6.7.6 THE COCKCROFT REPORT, ENGLAND AND WALES

This report is of such importance for the future of mathematical education that one can only regret that the timing of this thesis has meant that it was practically complete before a copy of the Report [80] became available to the author.

In studying its comments on number skills and the use of calculators the author was however pleased to note that there is considerable agreement with his own views previously expressed. Differences are largely accounted for by the differences between the situations in Britain and Papua New Guinea. It is hoped that putting these views side by side may be of help in both countries and perhaps also elsewhere. The method adopted here therefore will be to quote passages from the Report and to comment on them either on the basis of their relevance to Papua New Guinea or on the basis of the author's own previous experience in Britain.
1 "Since there appeared to have been very little research carried out to identify the mathematical needs of adults, we decided ... to commission a small study to be carried out ..." (page 5)

It is pleasing to observe that PNG in effect commissioned such a study through the Numeracy Project in 1980-81. The difference however is that in PNG many of the needs have to be presumed whereas in Britain they can be observed (See 3.5.5).

2 "We felt that such an investigation would be of use to both bodies because although the problems and methods of teaching adults are different from those of teaching children, an understanding of the goals to be achieved should be of value both to those who teach adults and to teachers in schools" (page 5).

The direct incorporation of much of the experience gained by the Numeracy Project in the revised Primary syllabus proposed for PNG is a clear example of this (See 4.2).

3 "This apparently widespread perception amongst adults of mathematics as a daunting subject pervaded a great deal of the sample selection; half of the people approached as being appropriate for inclusion in the sample refused to take part." (page 6)

This is a quotation from the study referred to in 1 above [12]. It must act as a warning of the long-term effects of allowing mathematics to become a "daunting" subject in school. It underlines the urgency of dealing with this problem in PNG (See 2.1).

4 "... some felt that there should always be an exact answer to questions involving mathematics and so found themselves in difficulties when it became necessary to approximate or round off a result. 'I get lost on long sums and never know what to do with the "leftovers"?' 'My mind boggles at the arithmetic in estimation'." (page 8)
The students on the course at Popondetta (ANR 11) with their Certificates. On the left is Bryan Wilson of the British Council, who helped in the teaching.

The metre rules marked .01, .02, ... .99 in use.
The inability of the Mothers' Union group in Popondeta (See 3.3.3) to relate K1.95 to K2.00 illustrates this. There would seem to be two important means of overcoming this misconception of mathematics as being always exact: a concentration on measurement (See 6.7.2(5)) and on the use of the calculator with its necessity for rounding.

5 "... a widespread inability to understand percentages" (page 8).

If they are not understood after so many years of formal education it could be that a new approach would help: little would be lost if it did not. The calculator makes it easy to calculate percentages and also the effects of increasing or decreasing by given percentages. Perhaps frequent use of these, without the trauma of manipulating fractions, would in fact help the understanding.

In his "Relational Understanding and Instrumental Understanding" [113] Skemp distinguishes these two types of understanding. However, as the Cockcroft Report comments (page 68) "mathematical understanding is not 'all or nothing'". Familiarity with the results could lead to a better "understanding" than what is in effect an "instrumental understanding" dependent on the use of a particular set of algorithms for calculating it. The "minority" may well be able to see beyond these algorithms to a full relational understanding, but clearly the "majority" cannot. Some sort of understanding provided by much practical use facilitated by a calculator may be far better than no understanding at all.

6 "About 70 per cent of those interviewed ... had access to a calculator if they required it but one-third of them said that they never used one. Some of the latter admitted that they did not know how to use a calculator and others expressed doubt and distrust. 'I never use it because of the risk of major mistakes." There were also those who maintained that 'brains are better' or
that 'they make you lazy'. Some who had tried to use a
calculator had been discouraged by the large number of
figures which had appeared after the decimal point ... On
the other hand there were some, whose computational
skills were weak, for whom the use of a calculator made
all the difference. 'I know the theory but without the
calculator I couldn't do it.'"

This quotation states so well many things the author has
been struggling to assert.

Calculators are very widely accessible: so education
must take account of them.

Some do not know how to use one: teaching is needed.

"The risk of mistakes", "brains are better", "they make
you lazy": are three classic objections any advocate of
calculators will meet. All, one suspects, are compounded
with a large proportion of prejudice.

"discouraged by the large number of figures which appeared
after the decimal point": the use of toea rather than
kina was partly to offset that danger (See 3.2.2 ). A
first approach which simply says "the part after the point
is only a 'bit'" can be followed later by a more
sophisticated understanding where some of these figures
are significant.

"... some whose computational skills were weak, for whom
the use of a calculator made all the difference": this
could apply to practically every Papua New Guinean and
perhaps even a majority of Britons. So why indeed should
the calculator not be allowed to "make all the difference"
for them?

"I know the theory but without the calculator I couldn't
do it": 'knowing the theory'is not true of the average
Papua New Guinean even if it is of most Britons.
So what does one do if the theory is not known and if one cannot teach it, either for lack of time (eg in non-formal education) or for lack of ability in the student? Does one just give up and say "too bad for them"? Or does one accept what appears to be the only alternative, teach the skill without the theory, ie rely on "instrumental" rather than "relational" understanding. In doing so one accepts the probable loss of long-term memory over it, but if it is something that will be used frequently that does not matter.

This then is the justification for much of the approach used in the Numeracy Project: there was no hope of teaching the "theory" so we just taught the "practice" and accepted the fact that if what was taught was not used, then the process would be forgotten. This is why we had grave doubts about teaching the many women who could not expect to be able to apply their knowledge at once. In their case the justification was different (See 3.3.5.): even if all the skills were to be forgotten some tiny gain in "conscientization" was considered worthwhile.

7 "... some people appear to use practically no mathematics because they have organised their lives so as to avoid its use ..." (page 10): this is the basic cultural situation from which one starts in Papua New Guinea so we can sympathise and might even be in a position to appreciate their problems better because of it.

8 "... we would include among the mathematical needs of adult life the ability to read numbers and count, to tell the time, to pay for purchases and to give change, to weigh and measure, to understand straightforward timetables and simple graphs and charts, and to carry out any necessary calculations associated with these ... as a necessary accompaniment to this list which we have given it is important to have the feeling for number which permits sensible estimation and approximation..."
This applies almost word for word to Papua New Guinea: it is a good check list for the Community School there as indeed it must be for the secondary schools here. There is no excuse for falling down on these things even if the only way to achieve them is to teach everyone to use a calculator.

9 "We would wish the word 'numerate' to imply the possession of two attributes. The first of these is an "at-homeness' with numbers and an ability to make use of mathematical skills which enables an individual to cope with the practical mathematical demands of his everyday life. The second is an ability to have some appreciation and understanding of information which is presented in mathematical terms, for instance in graphs, charts or tables or by reference to percentage increase or decrease" (page 11). This admirable definition should be widely accepted although the author might personally prefer Girling's "Numeracy is the ability to make intelligent use of a hand-held calculator" [14]. Its application however will of course depend on what everyday life demands and what information is presented in mathematical terms. These are far less in PNG than in the UK, but education there must look ahead to the probable demands and presentations of the next twenty years. This must be a minimum aim for formal education and perhaps a maximum aim for a "Numeracy Project".

10 "Although fractions are still widely used within engineering and some other craft work these are almost always fractions whose denominators are included in the sequence 2, 4, 8, ..., 64. ... The need to perform operations such as $\frac{2}{5} + \frac{3}{7}$ does not normally arise, and manipulation of fractions of the kind which is commonly practised in the classroom is hardly ever carried out. In the rare instances in which it is necessary to multiply or divide fractions, it is usual to convert each to a decimal before performing the operation, if necessary with the help of a calculator." (page 21-22). This applies even more so to Papua New Guinea.
where metrification is virtually complete and even the first sentence in the quotation does not apply. Coupling this with the desperate need for other mathematical skills in PNG there really seems now an unanswerable case for the limitation of fractions even in High Schools to using them to express division and to converting them to decimals.

It has always been to the author's regret that John Hayter who wrote an admirable report on the teaching of mathematics in High Schools failed (in the author's view) to grasp this nettle [115 p 29]. He admitted that retaining the topic was difficult to justify on the grounds of use but he refrained from recommending any change for fear of "undermining the teachers' confidence".

11 "One of the more surprising results of the studies is the explicit use which is made of algebra. Formulae are widely used by technicians, craftsmen, clerical workers and some operatives but all that is usually required is the substitution of numbers in these formulae and perhaps the use of a calculator ....... Formulae are also used regularly in nursing. An example quoted in the report of the Nottingham study is: Child's dose = \( \frac{\text{Age} \times \text{Adult dose}}{\text{Age} + 12} \). It is not normally necessary to transform a formula; any form which is likely to be required will be available or can be looked up. Nor is it necessary to remove brackets, simplify expressions or solve simultaneous or quadratic equations, although algebra of this kind is sometimes encountered on courses at further education colleges. Solution of linear equations is required very occasionally." (page 22). So here we have another candidate if we are looking for something to replace by more relevant mathematics. All we need is a calculator and teaching how to use it. The formula quoted cannot be carried out without the use of the memory or one of the other techniques which can be taught but are rarely discovered otherwise. Given this the whole of algebra other than substitution could be moved to the post-secondary field where it could be taught as required to those who needed it.
"Industry and commerce rely extensively on the ability to estimate" (page 22). This, as the report says, includes both the ability to judge whether the result of a calculation is correct and also to make subjective judgements about a variety of measures. This is of course vitally important, particularly if we are to make a greater use of the calculator. Unfortunately as Hayter points out in the report quoted above [115 p.39], "In various parts of the world discussions on basic skills in mathematics frequently lead to the listing of 'the ability to estimate' amongst the essential skills ... "General approval appears often to have been sufficient as a case for inclusion, without I feel a close analysis of what such skills involve. For teachers, educators and practioners in the field of mathematics there is little doubt about the use they make and the value they place on estimation ... What is not so obvious is:

i The method by which they estimate
ii the variety of estimation methods which they as individuals use
iii the time and the way in which they learned to estimate
iv the mathematical ability of those who choose to use estimation.

My hunch is that most of us come to estimation at a relatively late stage and at a time when we have gained some confidence in our ability to do the computation by the precise method. Further, I suggest that the methods or algorithms we use are often created for our own purpose, often for a particular task which is encountered with some frequency. Estimation is hence a "friend" to be used and not a "foreigner" to be learned and related to our own framework of knowledge. Finally I suspect that estimation is a skill used by relatively sophisticated users of mathematics except where, for instance, a
craftsman uses a narrow range of estimation skills, which are probably used with startling precision!"

All this should be carefully noted by anyone rash enough to urge the teaching of this type of estimation, that of judging the correctness of a calculation. If however it means that many such skills have to be left till post-grade 10 work (as I would advocate) the concepts, such as the 1-signification figure range, could well be taught much earlier at the Primary level and related to the second method of estimating, that of making subjective judgements. For the Papua New Guinea trade storekeeper, this may well have to suffice. He should be able to judge whether the price he calculates is likely to be about right. For the rest he must simply learn to check his calculations.

The Committee believe that estimation is "an area in which further study is required" (page 77). This has already been strongly urged in 6.2(3) above.

13 "It is of fundamental importance - and we believe, not as self-evident as some might suppose - to appreciate the fact that all the mathematics which is used at work is related directly to specific and often limited tasks which soon become familiar" (page 24). This is probably even more true in PNG than in Britain. It is our justification for teaching skills when we lack the opportunity successfully to teach concepts (see 5.10).

14 "There are certainly some things in mathematics which need to be learned by heart but we do not believe that is should ever be necessary in the teaching of mathematics to commit things to memory without at the same time seeking to develop a proper understanding of the mathematics to which they relate." (page 70).

"Ever" is a strong word, modified only by the word "seeking". In particular if you know well that some or even all of the students in your class are most unlikely ever to "develop a proper understanding" of a particular topic does this
quotation mean that you must never teach it "by rote"? Or can one salve one's conscience, but probably harm the teaching, by offering an "explanation" which one knows they will not understand? I suppose there may be some mathematics teachers who have never said "you won't understand this now but you may do one day and it's true anyway", or words to that effect: There really is no need to understand how a calculator works any more than it is to understand the chemistry which explains how a pencil writes. Most people who learn statistics have to accept formulae without understanding the mathematics on which they are based.

The criterion is surely that we reduce such occasions to the minimum, but we must accept that there are situations when it is right to base the teaching on faith in the teacher rather than on an understanding of the mathematics. In other words, syllabuses need not be totally determined by the desirability of 100% understanding prior to learning. If other considerations make it desirable to learn the multiplication tables while some or perhaps many, of the students do not really understand their relationship to the addition tables, then so be it. The issue may sound pedantic but such principles can make or break a syllabus, and have indeed contributed to the disaster of the unrevised "MaCS" syllabus (see 2.3.1).

15 "We believe the decline of mental and oral work within the mathematics classrooms represents a failure to recognise the central place which working "done in the head" occupies throughout mathematics" (page 75). The frequency with which mental work has been urged in this thesis should make the author's agreement with this quotation abundantly clear.

16 "An excessive concentration on the purely mechanical skills of arithmetic for their own sake will not assist the development of understanding in these other areas. It follows that the results of a "back to basics" approach (as we understand the words) are most unlikely to be those which its proponents wish to see, and we can in no way
support or recommend an approach of this kind" (page 80).

The author would wholeheartedly agree. Unfortunately discussion has sometimes been so polarised that anyone urging that increased attention should be paid to number skills was automatically assumed to be part of a "back to basics movement. It is largely thanks to Bob Roberts, the Senior Curriculum Officer in Mathematics for PNG, that such misconceptions have now largely been overcome there. The new spirit of cooperation was referred to by Lancy in an address to a joint meeting of the four Mathematics Groups in 1979 [116]. The price of compromise may have been paid but dialogue and agreeing to differ seem to have produced the desired fruits in the end.

17 "It is therefore essential that children should be helped to attain a secure and rapid recall of addition facts up to $10 + 10$ and the related subtraction facts, and of multiplication facts up to $10 \times 10$ and the related division facts .... Learning needs to be based on understanding, but understanding does not necessarily result in remembering." (page 87)

Such specific requirements have now been written into the proposed revised MaCS (primary school maths syllabus) in PNG, but not before it was time. (see 2.3.2)

18 "The development of general strategies directed towards problem solving ... can start during the primary years ... Not a great deal is yet known about the ways in which these processes develop nor are suitable materials for the teachers readily available." (page 94) The warning should deter any enthusiastic band-wagon jumper in the Third World from instant incorporation of problem solving strategies into the syllabus. It is a piece of research and experiment which the author feels can better be left to the developed countries where it is easier to pick up the pieces of shattered illusions. This, he believes, does not apply with the same force to the early introduction of the
calculator where the lack of numeracy in the culture makes it a matter of greater importance and urgency in PNG than in Britain.

19 "The increasing availability of electronic calculators has made it all the more important that, in the teaching of low-attaining children attention should be given to the development of concepts and applications. Once these are understood, it becomes possible to make use of a calculator to overcome lack of computational skill, but a calculator can be of no assistance until a child knows which arithmetical operation it is necessary to carry out" (page 99).

At first sight this might be viewed as a warning not to introduce the calculator too early. On the other hand the number of applications which are meaningful to a child are limited, particularly of course in Papua New Guinea. Teaching them which operation to use is then a fairly limited task, and what better way than plenty of practice on the few applications that are relevant? In any case the majority of applications there probably only require + or −, concepts which are not really difficult to teach. The concepts of × and ÷ are far more difficult but it hardly seems right to postpone tackling such problems until after the concepts are established. As it must frequently be remembered, understanding is as likely to follow practice as it is to precede it. Being told what operations to use on one occasion does not hinder and may indeed help a child to ultimately acquire enough understanding to determine the matter for himself or herself. The argument in (14) above surely applies here: you indeed "seek" to give understanding but for the many (in PNG) who will never really "understand" × and ÷, those who cannot understand may have to be told.

20 "From all the studies the weight of evidence is strong that the use of calculators has not produced any adverse effect on basic computational ability" (page 110). This refers particularly to the considerable number of research projects that have been carried out in the United States. It answers the common "they make you lazy" reaction quoted in (6) above.
"Calculators have revolutionised computation and barely numerate students can overcome their weaknesses with these" (page 110). This is a quotation from a submission to the committee but it happens to be so apt to the content of this thesis that perhaps it is a good one on which to conclude these references to the Cockcroft Report. Anyone wishing to consider the matter further should read Chapter 7 of the Report itself.

6.7.7. THE SPODE GROUP. a Schools Council project

These have been one of the groups of teachers in Britain trying to relate mathematics more closely to real life [117]. According to a report in the Education Guardian of 23 March 1982 [118] their recommendations include the splitting of schools mathematics teaching into two distinct courses, one concerned with practical mathematics, "mental arithmetic, percentages, fractions, graphical representations, the 24-hour clock and other simple mathematical ideas, while an additional but optional course would be available to put those keen enough to try it in touch with the more imaginative and artistic kind of mathematics".

The idea is not new of course but the circumstance are. The old "arithmetic only" examinations lacked status and required a fairly good facility in computation. A new "Basic Mathematics" course which could be shown to provide all the skills needed for life or normal employment might be able to overcome the credibility gap and be fully accepted. If the standard demanded for the "imaginative and artistic" mathematics students were set sufficiently high, the basic one would have to be accepted.

It is only to be regretted that administrative problems in PNG would make such an arrangement in the High Schools very difficult but in reality it is only the "Basic" one that is needed there. "Imaginative and artistic" mathematics at that level might be encouraged informally and could become the main constituent of the "major" Grades 11 and 12 mathematics course in the four National High Schools.
6.7.8 ELECTRONIC CALCULATION IN THE ELEMENTARY MATHEMATICS CURRICULUM

This report [119] by C A Gregory, surveys recent developments in the stated field.

The National Council of Teachers of Mathematics (NCTM) recognised the calculator's potential in September 1974 but failed to identify the real issues.

The National Advisory Committee on Mathematical Education (NACOME) published an analysis of school mathematics in 1975 [120] in which they suggested a decreased emphasis on manipulative skills and an increased emphasis on estimation/approximation. It also proposed that at the end of Grade 8 calculators should be provided for all students including those who are not "functional" with numbers, for use in all mathematical work, including tests.

It also identified basic questions on when and how calculators might be best introduced, how they would affect children's grasp of basic facts, when paper and pencil calculations would still be necessary, what calculator designs might be optimal and how calculator use in the early years might affect High School mathematics. The need for curricular revision was noted.

Still in 1975 the National Institute of Education (NIE) conference at Euclid [121] (already referred to in 6.5.3) called for research into "true functional needs", the potential of calculators for learning and long range effects of their use.

A National/ Foundation (NSF) Report [122] analysed the role of the calculator and beliefs about its role. In the Introduction Marilyn Suydam summarised the arguments cited for and against calculator use.

The Case for

1 Aid to computation
2 Facilitate understanding and concept development
3 Lessen the need for memorisation
4 Help in problem solving
5 Motivate children
6 Aid in exploring, understanding and learning
   algorithmic processes
7 Encourage discovery, exploration and creativity
8 They exist.
The only real question was how they should best be used.

The Case against
1 They are substitutes for developing computational skills
2 They are not available to all
3 They give a false impression of Mathematics - it may
   be equated with computation
4 They will be misused by teachers and students
5 They are faddish - there has been little planning or
   research
6 They may present maintenance and security problems

Suggestions for Research were also made:
1 When and how should they be introduced?
2 Procedures for learning?
3 Calculator algorithms?
4 Long-term effects of use?
5 Effects on curricular sequence and emphasis?
6 Relationship between work with calculators and computers?
7 Changes in teacher education curricula?
8 Optimal designs for calculators?

It was strongly recommended that restructuring the curriculum,
and research, should proceed hand in hand.

Gregory in his report [119] from which this information is
taken maintains that all the major issues were raised in one
or other of these four reports. In the United Kingdom, he
says that there had been little general awareness of the
extent and depth of the American literature and that much of
the writing in British journals was relatively fragmented
and incoherent.

The current research and development has been summarised
recently [123, 124 and 125]. Virtually all studies so far have been "experiments" carried out in the United States using control groups.

In spite of the recommendations of the principal reports referred to earlier hardly any curriculum materials designed for calculator use have been employed. More than half of the 100 studies reported up to 1980 have been adjudged inadequate in design or execution. There is little doubt however that the calculator is being "more intensively researched than any other comparable teaching aid".

Furthermore, there were, according to Gregory, a number of curriculum projects being undertaken ranging from "the cautious (Philadelphia [126]), through the rather more ambitious and experimental (Northern Iowa Problem Solving Project [127]) to a few which have attempted to base learning on the calculator itself (Oregon [128])."

In Britain there have been two main projects, one set up by the Schools Council in Durham, following a feasibility study carried out there in 1973-6 [129] and the other in Nottingham sponsored by the Shell Centre and Leicestershire LEA which will be referred to in greater detail in 6.7.12.

The Mathematical Association's Computers and Calculators Sub-Committee and the Schools Calculator Working Party which meet three times a year at the Shell Centre (6.7.11) provide opportunities for exchange of ideas while the Calculator Information Centre at The Ohio State University does this in America.

Gregory also provides an interesting historical background. Between the 13th and 16th centuries there was continuing debate between "abacists" (in the Universities) who favoured the use of the abacus with Roman numerals, and "algorists" (mainly merchants) who used the Hindu-Arabic numerals and sought to "free man from a machine" [30].

When in the 16th century the algorists succeeded in their aim through the use of decimals they promptly started the search
for faster and easier computation which led eventually to
the calculating machines of Babbage and Odhner.

Hopkins however [131] has argued that both calculating machines
and paper-and-pencil algorithms are equally calculating
devices. This surely is true, the algorithm providing the
student with little more genuine insight into the operation
than does the machine.

The significance of this history therefore lies in the assist­
ance that it may give in overcoming some of the prejudice that
exists concerning the calculator: the paper-and-pencil phase
was merely an interlude between the use of one type of machine
and another, it was better than the abacus but not as good as
the calculator.

6.7.9 CALCULATOR EXPLORATION FOR CONCEPT REINFORCEMENT

This is the title of an article by David Johnson of Chelsea
College [132]. Perhaps it may stand for the many papers
currently being produced in the field.

It makes use of a set of exercises in which each box
represents a missing digit or operation, for example:

Find the missing digits in:

\[
\begin{align*}
93 \times 8 \square &= 8 \square \square 1 \\
7 \times (\square 8 - 2 \square) &= 112
\end{align*}
\]

Find the missing operation in:

\[
\begin{align*}
(37\square 21)\square 223 &= 1000 \\
6975\square (36\square 39) &= 93
\end{align*}
\]

As Johnson points out the activity provides plenty of variety
for children of differing ability, practice in single-digit
basic facts, inverse operations, place value and estimation.
Correct answers are apparent: once a solution has been found
the calculator checks it immediately. It is possible to
create exercises at any level from early primary to late
secondary. The students could even be asked to create their
own problems, when they will have to deal with questions of alternative solutions.

This is but one example of many. Perhaps this type of activity is the one through which most development will come. Such an informal unstructured approach however may be less appropriate in the Third World where teachers are less inclined to use their own initiative.

6.7.10 COUNTDOWN TO MATHEMATICS: OPEN UNIVERSITY

This book [133] is introduced as a sample of the use of the calculator that one will expect to find in texts today: it happens to be produced for the Open University but its style seems likely to be copied.

A scientific calculator is used throughout the work. Specific instructions for it are given on 40 of the 61 pages covering the first module. These are concerned with estimating, negative numbers, use of brackets, decimals, scientific notation, accuracy, fractions, percent, reciprocals, squares, and square roots.

6.7.11 THE SHELL CENTRE FOR MATHEMATICAL EDUCATION, University of Nottingham

A visit to the Shell Centre is probably the quickest way in which anyone in Britain could find the answer to enquiries about the use of calculators in schools. An Information Pack was available in March 1982 including the following:

1 "The Case for Calculators: ammunition for arguments."
Thirteen examples are given of objections to the use of the calculator, many of which I have heard in Papua New Guinea. The answers are helpful.

2 "How to run a calculator conference", "Notes on discussion starters" and "Some Calculator Questions". These were no doubt produced in connection with the Schools Calculator Working Party referred to in 6.7.8.

3 "Calculators in Public Examinations" is in draft form providing information about the uses permitted in GCE and CSE examinations.
4 "Choosing a Calculator" by Ken Tyler, which begins by emphasising the importance of the LCD calculator.

5 A paper headed "Towards a definition of Basic Numeracy" (see [114]) in which M S Girling starts by pointing out that a cheap calculator can now be bought for the price of two good cabbages. It goes on to emphasise the need for checking answers, mental work, techniques of approximation, scientific notation and the investigation of pattern in numbers.

6 "Calculated Risks", [123] see 6.7.8, is an article in the Times Educational Supplement in which Barry Blakely looks at some of the research into calculator usage.


8 A report from the Institute of Mathematics and its Applications (IMA) Working Group on Curriculum Development and Dissemination: this includes a suggestion that calculators should be introduced to children by the age of 9, and possibly as early as 7. This would agree with the author's own suggestion for introducing them in Papua New Guinea as soon as students can count, and understand what is meant by addition and subtraction (7.3.5). Their mathematical knowledge at that age in PNG will be far less than in Britain but so is the extent of functional numeracy that the majority will ultimately require. If there are only a handful of applications that are likely to be relevant to their life in the village the broad mathematical base that one wishes to provide in Britain might be better left to a later stage. In 1976 and 1977 nearly 20,000 students dropped out of primary education after only two years or less [12, p.224]. Is there not a case for ensuring that such children do at least return to their villages with a knowledge of the calculator on which non-formal education could later build? Such a suggestion would of course require much research if it were to be considered seriously, but the impact of the calculator is so radical that no alternative should be dismissed without being given due consideration. This is research which would have to be carried out in Papua New Guinea: the conditions in the western world are totally different.
9 A report from the IMA Working Group on "The Content of Mathematics - What should be Retained, What should Go and What should be Added" [135] here the importance of teaching efficient calculator use was stressed, and the desirability of retaining mental skills which might be lost if calculators were always available.

10 "Calculators: Promising Practices in the Teaching of Mathematics (including current and needed research)". [124] see 6.7.8. Here F R Watson of the University of Keele points out that "the effect of the calculator is likely to be more profound and may be greater even than that of the curriculum reforms of the 1960's" because whereas teachers were free to take or leave "modern mathematics", the calculator cannot be ignored. It is here. It is even in Papua New Guinea. Watson goes on to suggest various uses suited to the secondary school.

11 A report from the IMA Working Group on "Numeracy in a Calculator Age" [135] referred to strong arguments for retaining vulgar fractions in school teaching, but these were based on the continued use of Imperial measures in Britain. It also referred to claims that "the use of a calculator could enlarge the numerical vocabulary and broaden the mathematical horizons of pupils in all age and ability ranges, though some doubts were raised at the too-early introduction of calculators in infant classrooms". The Group was clearly divided in its views.

12 A report on the IMA Working Party on "Teacher Training" [135] urged research on the best use of calculators in schools. Some members with experience in the primary section felt that simple calculators "should be an essential part of the apparatus available in primary schools".

13 "The Calculator Mathematics Curriculum of the Future" [136]. Here Blakely redefines numeracy as basic to the curriculum and adds four new areas: estimation and reasonableness of results, errors, algorithms and procedures, modelling. He considers the SMP Books A to H and X, Y, Z [137] and proposes the following deletions: slide rule, log and trig tables, fractions to any depth, linear programming, latitude and longitude, the matrices transformations link. These would remove 22 out of the 124 chapters.
"Calculators in Mathematics" by Peter New describes the phenomenal development since October 1971 when the first hand-held four-function calculator appeared at £79.95. As he says "The time scale of development has been breathtaking compared with the evolution of either the motor car or the aeroplane."

"Calculators in the Classroom" by Alistair McIntosh answers some practical questions.

"72 x 49" by Chris Jones describes a lesson forming part of the Durham Junior Calculator Pilot Study.

"Personal Calculators and Mathematics" is the submission to the Cockroft Committee from the Schools Calculators Working Party. It discusses the use of the calculator as a calculating aid in applications in mathematics and other subjects, its various uses as a teaching aid in the current mathematics curriculum and the wider changes that will gradually follow from its introduction.

"Calculators: Abuses and Uses" by David C Johnson of Chelsea. His "abuses" include Calculations for no apparent purpose, games and puzzles with no apparent mathematical objective, "Mystical button pushing" in which he includes the practice of "making words by turning your calculator upside down" and checking answers which have been obtained by pencil-and-paper methods. Under "uses" he includes Calculations, Patterns, Estimation, Errors, Algorithms, Iterative procedures, Mathematical modelling, Exploration for concept-demonstration, concept-reinforcement and problem-solving and Applications to consumer and social needs.

"Using Square Roots" by William Wynne Willson of Birmingham. Willson describes how the \( \sqrt{ } \) key on a simple calculator can be used to evaluate, by iterative processes, cube roots, trigonometrical functions, logarithms, exponentials and inverse trigonometrical functions.

"Fractions by calculator" by the same author. A "reasonably easy and natural" way to deal with fractions on the calculator is explained.
21 "Iowa Problem Solving Project" by John Torr, manager of the project. This lists (in October 1979) 18 instructional modules on Problem Solving, of which two are on the calculator and two on calculator codes.

22 Two useful booklists, one from the Mathematical Association Teaching Committee (Calculators sub-committee) and the other of the Shell Centre's own publications complete this most useful package of materials.

23 The work of the Shell/Leicestershire Primary School Calculator Project is described in the next section.

6.7.12 KEN TYLER, THE SHELL/LEICESTERSHIRE PRIMARY SCHOOL CALCULATOR PROJECT

This project, sponsored by the Shell Centre and the Leicestershire Local Education Authority started in 1979 and has developed materials in association with 13 Primary Schools. A very eirenic approach was used, striving to overcome teacher prejudice and avoiding any appearance of laying down the law.

Most of the teachers concerned now accept that the calculator can help in the formation and development of number bonds and place value. Some children who had long been "failures" had found fresh motivation. Enthusiasm has been retained by children who have been using the calculator in these ways for the past three years.

Ken Tyler himself was a member of staff of one of the Primary Schools that had been involved in "A Calculator Experiment in a Primary School" [145] in 1978 which paved the way for the current project.

The main product of the Project's work has been "Calculators in the Primary School, A Short Course on the Role of the Calculator in Primary Mathematics". This workbook is to be published in June 1982 by the Mathematics Education Research Group of the Open University. A second draft was issued in 1981 but I was able to study what was virtually a final version.[146].

The introduction explains that the workbook is to be used alongside the existing mathematics scheme, developing and reinforcing
number bonds and encouraging mental arithmetic. Tyler suggests that in practice it is unnecessary to "teach" the children how to use the calculator: they generally find out quickly for themselves as part of the learning process.

The first exercise on addition consists of filling in missing numbers in $3 + \square = 10$ for example and checking with the calculator. Place value with two digit numbers is also revised. The work must be shown to the teacher before the page is turned. Reinforcement is provided on the back of the sheet. Then the student has to forecast the results of additions, and check with the calculator.

Subtraction is dealt with similarly. Multiplication is gradually built up from multiplying by 10, by multiples of 10, by 100, then multiplying two multiples of 10 and treating groups of products like $8 \times 2$, $80 \times 2$, $8 \times 20$, $80 \times 20$. In all these the calculator is used only to check the work.

Division is treated on 10 sheets, in some of which the calculator is used to obtain the answers, in others only as a check. A range for the answers has to be found in the last four sheets.

Other groups of worksheets tackle the following:

- Using the calculator (relating addition to multiplication)
- Decimal fractions
- Place Value (14 sheets on this)
- Number chains
- Multiplication patterns
- Number patterns
- Number grids
- Missing keys (18 sheets)
- Targets
- Estimation (7 sheets)
- Reading numbers
- Trial and Error
- Problems
- Money
Games are also described in Teachers Notes, for example:

"Reading numbers" where one partner reads out the numbers given in words on the sheet, the other enters them into the calculator and presses $+$ after each one. They compare this final sum with the "check number" provided.

"Arithmetrick" is a game for two players using cards with numbers 0 to 20. Each time a card is turned over the player must try to enter an operation which will produce the number on the card from the number that was there before. If the player succeeds he keeps the card.

"Space Invaders": this consists of entering a 3 or 4-digit number; say 1352. These digits are the "aliens" and have to be "shot down" by entering $2$ $50$ $300$ $1000$ $2$. In a second version the aliens have to be shot down in ascending order by $2$ $300$ etc. A third version requires them to be shot down by addition: $4$ $60$ $200$ $8000$ $3$. A fourth version introduces a decimal point into the original number.

This is the result of three years of practical experimentation. Only eleven years after the introduction of the four-function calculator to Britain (at £79.95), this is a remarkable achievement. It leaves one wondering what mathematics teaching will be like in another eleven years. Will this be the mark of mathematical education for the majority in the last quarter of the 20th century?
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 SUMMARY

We have observed causes and effects of innumeracy in adults and have shown how the calculator can be used to meet the needs of Papua New Guinean businessmen.

We have pointed to the potential of the cheap long-battery-life calculator for universal numeracy and we have outlined relevant programmes needed to achieve this objective through formal and non-formal education.

All that remains for us to do here is to specify these programmes more precisely and to suggest what further research is required to fulfil them.

The conclusions and recommendations which follow are based on the work in Papua New Guinea coupled with thirty years previous teaching experience in England. They obviously cannot be expected to be applicable in every detail everywhere but they are offered as a basis on which to work.

Those which specifically refer to Papua New Guinea are in section 7.5 but even these may have applications elsewhere.

References in parentheses are to some relevant sections of the text.

7.2 CONCLUSIONS AND RECOMMENDATIONS CONCERNING ADULT NUMERACY

7.2.1 THE NEED

1 The demand for numeracy teaching may well be greater than the demand for literacy (See 2.3.3, 6.6.2).
2 Without a calculator worth-while numeracy is virtually unteachable to adults (See 3.4.1).

3 Using a calculator, numeracy is reasonably cheap and easy to teach provided the participant "knows his numbers" (See 3.4.1).

4 Everyone seeking numeracy and able to buy or borrow a calculator, should, if possible, receive appropriate training.

7.2.2 DISADVANTAGED GROUPS

Particular consideration should be given to the possibility of providing calculator-skill training for disadvantaged groups within the community (See 1.1.7, 6.7.1)

7.2.3 STANDARDISING CALCULATORS

If detailed instructions on the use of a calculator are necessary it is most desirable to standardise the model for which they are to be written, (see 6.6.6).

7.2.4 THE LCD CALCULATOR

Where a power supply is lacking and spare batteries may not be readily available, a reliable calculator with a long battery life is essential. In 1982 this points to the use of an LCD (Liquid Crystal Display) calculator (See 3.1.3, 6.6.8, 6.7.11(4)).

7.2.5 SALE OF CALCULATORS

One way to standardise calculators is to arrange for them to be imported and re-sold at a price substantially below the normal retail prices (See 3.1.3, 6.6.6).

7.2.6 CUSTOMS DUTY

Customs Duty should not be charged on cheap LCD hand-held calculators.
7.2.7 **PRE-CONSIDERATIONS**

Any decisions concerning a possible Adult Numeracy programme should be based on the following considerations:

1. The current level of numeracy (see 6.7.6(1)).

2. The likely motivation for improvement (see 6.7.6(2)).

3. The possibility of making a standard calculator available at an attractive price.

4. The willingness of voluntary and statutory agencies and their officers to participate in such a programme.

5. The possibility of setting up an Adult Numeracy Unit (See 7.2.8).

6. The possible relationship of adult numeracy teaching to traditional mathematical concepts and activities, (see 6.6.6, 6.7.2).

7.2.8 **ADULT NUMERACY UNIT**

A small Unit able to co-ordinate an Adult Numeracy Programme would require:

1. Staff with appropriate expertise in training and preparing materials and a willingness to adapt to new situations.

2. Facilities for selling calculators and other materials as required (See 3.2.4).

3. Facilities for typing, copying, printing and graphics production.

4. Funds to permit trialling of new materials under appropriate conditions and generally monitoring the Programme (See 3.2.7).

5. Built-in relationships with Government and other agencies having staff able to assist in the actual training of participants.

6. Good public relations.
7.2.9 ORDER OF ATTACK (See 3.4.1, 5.10, 5.13, 6.6.3, 6.6.4, 6.6.6)
In adult numeracy the starting point must depend on the level of the students. In general the order of attack will be:

1 Reading and writing "Western" numbers, and counting forwards and backwards.
2 Understanding the concepts of addition and subtraction.
3 Learning to add simple numbers using the fingers or other concrete aids.
4 Learning to use the calculator for simple processes such as totalling cash, finding change and keeping a cash book, including the use of the 'clear' and 'clear entry' keys (See 3.2.4) and the need to check results. (see 6.7.6(6)).
5 Learning the composition of 10 and finding "change from 100" mentally, using the constant function on the calculator to practise these skills.
6 Meeting other specific needs of the students with or without the calculator.

7.2.10 OTHER SKILLS (See 3.2.5.2, 3.3.4, 3.5.5., 5.10, 6.6.1, 6.7.2)
Other skills for which teaching is likely to be required in a Third World country include:

1 Use of scales to weigh commodities for sale.
2 Finding total value given price per kg.
3 Checking invoices.
4 Pricing goods purchased in bulk given the freight costs and the % markup.
5 Finding the % markup given the cost and selling price (See 3.2.3).
6 Pricing products based on the "batch", eg, cooked foods.
Pricing sewing, duplicating, etc, where the cost has both fixed and variable elements.

Measuring, comparing, totalling, differencing, multiplying, dividing and estimating lengths.

Listing and pricing timber requirements for construction of furniture, etc.

Telling the time and finding what it will be in 1, 2, 3, \( \frac{1}{2} \) or 1\( \frac{1}{2} \) hours, (to keep the work simple).

Calculating the period between two given times and pricing services based on this.

Reading a calendar and finding the date in so many days, weeks, fortnights, months or years.

Finding the number of days between two given dates.

"USE BY" dating on perishable articles.

Cross-totalling.

Totalling money with a "notes and coins slip".

Calculating wages at "time", "time and a half", etc.

Completing, checking and correcting a wages sheet.

Stocktaking (See 3.2.5.2).

Calculating leakage in a trade store (See 3.2.4).

Calculating profit in any business (See 3.2.4).

Comparing prices of different sized packs of similar goods.

Deducting a discount.

Calculating interest.

Keeping a cheque account.
26 Calculating the perimeter of a field and the number of posts, length of wire, weight of staples needed to fence it.

27 Finding the area of a field and calculating results dependent on this.

28 Finding a page or hymn number by comparing numbers (without a calculator).

29 Use of the constant function on the calculator for the conversion of units, scaling of marks, etc.

7.2.11 MATERIALS

Materials required are likely to include:

1 Simple, reliable, hand-held calculators with long battery life (See 3.1.3, 3.2.7).

2 Workbooks with full instructions that can be used on a one-to-one basis by personnel who are neither trained teachers nor experienced in the work (See 3.2.4, 3.2.7, 5.12).

3 Exercise sheets containing the same questions as are in the one-to-one materials but intended for use in groups, and omitting most of the instructions (See 3.2.4).

4 Exercise sheets suitable for use by trained and experienced operators (See 3.3.4, 3.3.6, 4.3, 4.4, 5.11, 5.16).

5 "Cartoon posters" or "memo sheets" to remind the students of key processes they have learnt (See 3.2.4, 3.2.7).

6 Numeral cards and "snap" cards for teaching number facts.

7 Various games including those based on progressing along a route with numbered squares, with instructions for using the calculator in place of dice (See 5.10, 6.6.5, 6.6.6).
8 Metre rules, preferably marked in centimetres and labelled .01, .02, ...., .99 (see 5.10).

9 Clock faces with movable hands.

10 Scales for weighing in kg.

11 Exercise sheets with full instructions available if required for the tasks listed in 7.2.9.

7.2.12 ESTIMATING AND CHECKING

Estimation and approximation are difficult skills to teach, particularly to students with poor number skills. Checking of calculator results should therefore normally be either built into the procedures taught or should be done by repeating the calculation (See 3.2.2, 5.2, 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.15, 6.2.(3), 6.6.6, 6.7.2, 6.7.4, 6.7.5, 6.7.6.).

7.2.13 AVOIDING THE DECIMAL POINT

Adult numeracy work should not assume an understanding of decimals if it can be avoided, although it may be hoped that such understanding may develop in time. Where possible therefore calculations involving two units (eg kina and toea or dollars and cents) should normally be carried out on the calculator in the smaller units, leaving it to the user to insert the decimal point in the answer when necessary (See 3.2.1, 3.2.2, 5.5 6.6.6).

7.2.14 MEASUREMENT

1 Measurement for general purposes should be expressed in whole centimetres, whole metres or in metres to 2 decimal places, thus providing numbers in the same format as for money. More specialised treatment requiring millimetres should be expressed in whole mm, whole metres, or in metres to 3 decimal places.

2 The teaching of skills and concepts of measurement can make an important contribution to the concepts of estimation and approximation (See 6.7.2, 6.7.6(4)).
7.2.15 **LITERACY PROGRAMMES**

Every literacy programme should have a numeracy programme associated with it if desired by the participants (See 3.4, 5.13, 6.6.4).

7.3 **CONCLUSIONS AND RECOMMENDATIONS CONCERNING FORMAL EDUCATION**

7.3.1 **LACK OF NUMBER SKILLS**

Inadequate number skill teaching in Primary and Secondary schools leads to uneconomic remedial work having to be done in post-secondary institutions (See 2.2, 5.7, 6.5.2).

7.3.2 **CHANGES OF SYLLABUS**

Changes in syllabus must be accompanied by appropriate supplies of materials and adequate in-service training (See 2.1).

7.3.3 **TECHNICAL & COMMERCIAL EDUCATION** (See 4.5, 5.7, 5.15, 6.3.3)

In technical and commercial education the order of attack in mathematics teaching should normally be:

1. The use of the calculator including clear, clear entry, percentage and memory keys, using relevant examples.

2. Non-calculator number skill work needed for estimation or other specific purposes (assuming a calculator will always be available).

3. Other calculator and non-calculator concepts and skills as and when required for specific tasks related to the course including a proper understanding of the use of decimals (See 6.6.6).

7.3.4 **SECONDARY EDUCATION**

In Secondary education the use of calculators should be taught at the beginning of the course. They should then be used throughout for concept development and to enable realistic problems to be solved without undue time being spent on computation (See 6.7.1, 6.7.8, 6.7.11)
7.3.5 PARTIALLY NUMERATE CULTURES

In cultures where the applications of numeracy are sparse the calculator should be introduced as early as possible in Primary schools to reduce the waste of time on learning number facts and algorithms which will subsequently be forgotten through lack of use (See 6.3.1, 6.6.1, 6.7.2, 6.7.6(7, 18, 19), 6.7.11(8)).

7.3.6 MATHEMATICS FOR THE MAJORITY

The mathematics syllabus for the "majority", from the Primary level onwards should concentrate on:

1. The use of the calculator (See 6.2, 6.5.3, 6.5.4, 6.5.5, 6.7.3, 6.7.4, 6.7.6, 6.7.8, 6.7.10, 6.7.11, 6.7.12)

2. Mental arithmetic including multiplying and dividing by simple multiples of powers of 10, ranges, rounding up, down or to the nearest, methods of approximation and estimation (See 2.3.2, 6.2, 6.5.1, 6.5.2, 6.5.3, 6.5.4, 6.5.5, 6.6.6, 6.7.4, 6.7.5, 6.7.6, 6.7.8, 6.7.12)

3. Other mathematical concepts and skills having relevance to daily life (See 1.3.1, 3.5.5, 4.2, 6.1, 6.2, 6.3.1, 6.3.2, 6.5.1, 6.5.3, 6.7.6, 6.7.7)

7.3.7 REDUCTION OF SYLLABUS

Time spent on activities which are better tackled with a calculator should be reduced or eliminated, particularly long division (See 6.7.6(11), 6.7.11(9, 13)).

7.3.8 SCHOOL LEAVERS

If the use of the calculator cannot be included in the general educational programme it should at least be taught to all students before they terminate their formal education (See 4.3, 6.7.11(8)).

7.3.9 MATHEMATICS EDUCATION GROUPS

Informal groups of mathematics teachers can make a valuable contribution (See 2.2.3, 2.3.1, 6.5.1, 6.7.6(16)).
1 They should be independent of the Education Department but supported by it.

2 The Group should co-operate responsibly in preparing materials, criticising proposed materials and assisting with in-service training.

3 The responsible Curriculum Officer should undertake always to respond to any formal proposition from a Group, whether agreeing with it or not.

7.4 GENERAL CONCLUSIONS AND RECOMMENDATIONS

7.4.1 UNDERSTANDING AND LEARNING

Where, for good reasons, it is not possible or appropriate to teach the understanding of mathematical concepts and skills, it may be good and right to teach only the actual skills needed, without "understanding". (See 5.10, 6.7.6(5, 6, 13, 14, 17, 19)).

7.4.2 MATHEMATICS AT WORK

The numbers of different mathematical processes that ordinary workers have to carry out in the course of their jobs are relatively few (See 6.5.5, 6.7.6(13)).

7.4.3 SELF-PACED LEARNING

Fully self-paced teaching materials which require a significant amount of explanation in words are generally only appropriate for well-motivated, reasonably able students with a good grasp of the language (See 5.1, 5.2, 5.6, 5.8, 5.15, 6.6.3, 6.6.6).

7.4.4 METRICATION TO AID THE DISADVANTAGED

The pace of metrication should be reviewed in the light of the needs of the mathematically disadvantaged. Where these form a substantial proportion of the population a case may be made for accelerating the metrication process so as to reduce the extent and variety of their mathematical needs.
Such considerations for example might point to the elimination of the half-penny from the British monetary system.

7.4.5 MATHEMATICS EDUCATION CENTRES

1 The setting up of a Mathematics Education Centre related to a university should be mainly concerned with making the facilities and expertise of the university available to users elsewhere in the country (See 1.4.4, 1.4.5, 6.5.1).

2 Any such Centre should not be considered primarily as a means of servicing that university or carrying out work for which its Mathematics Department is properly responsible (See 1.1.2, 1.4.3, 1.4.5).

3 The broader its permitted field of operation the more cost-effective it is likely to be, assuming that wise choices can be made of the particular forms of assistance it should offer (See 1.4.4, 6.5.1).

4 It could make an ideal base for an Adult Numeracy project provided its staff were appropriately oriented and sufficiently closely associated with Business Development (See 1.4.4).

7.4.6 RESEARCH IN THE THIRD WORLD

If research is being paid for from the resources of the Third World its cost-effectiveness must always be borne in mind. In general such research should be carried out by people involved in the work and in close touch with the administrators. It should be written up if possible in a language that the political decision-makers can understand (See 6.4, 6.6.2).

7.5 CONCLUSIONS AND RECOMMENDATIONS SPECIFIC TO PAPUA NEW GUINEA BUT POSSIBLY RELEVANT ELSEWHERE

7.5.1 TRADITIONAL NUMBERING SYSTEMS

The traditional mathematical concepts in PNG are minimal, diverse and in most parts of the country so quickly being
forgotten that it is in general unprofitable to try to relate current to traditional usage (See 1.2.2, 3.4.1, 6.6.6).

7.5.2 BUSINESSMEN'S NEEDS

The vast majority of businessmen have inadequate number skills (See 3.1.1, 3.1.2, 3.2).

7.5.3 BUSINESSMEN'S RESPONSE

Businessmen respond well to being taught to use a calculator but will probably need to use one for simple purposes for a considerable time before being ready to learn and remember the more sophisticated processes (See 3.2).

7.5.4 WOMEN

Women should be taught calculator skills to assist in their "conscientization" even if there is no immediate prospect of their being able to use the skills (See 3.3.2, 3.3.5.1, 3.3.6, 3.5.7, 6.7.6(6)).

7.5.5 GENERAL MOTIVATION

The only uses of the calculator that are generally relevant and appreciated everywhere are:

1  Totalling cash
2  Calculating change
3  Operating a cash book
(See 3.3.1, 3.3.6)

7.5.6 TRADESTORE KEEPERS

All trade store keepers should, in addition to the items in 7.5.8, be taught:
1  Invoice checking
2  Pricing as appropriate
3  Stocktaking
4  Determining leakage (See 3.2.3)
5  Nett liquid assets (See 3.2.4)
7.5.7 ADULT NUMERACY UNIT

The present Numeracy Project forms an adequate base for an Adult Numeracy Unit as described in 7.2.8:

1. The Director and at least one other professional staff member should be free to carry out the programme full-time.

2. The present flexible arrangements with Laloki College for the provision of calculators and other materials are very satisfactory (See 3.2.7).

3. Typing, copying and printing present no problems and graphics are done by Kirsten Karanfilovic by courtesy of the ILO/UNDP Project for Small-Scale Enterprises and Entrepreneurship in the South Pacific (See 3.2.4), but arrangements for enlarging and reducing graphics by the Department of Education Printery are tenuous.

4. The principal trialling costs have now been covered and some further expenses may be included in training costs which it is hoped may be paid by other Departments involved. Additional funds would however assist in more rapid development of the Programme, particularly in work with voluntary agencies (See 3.1.4, 3.5.7, 3.5.10).

5. The Numeracy Project Steering Group appears to be working well as a co-ordinating agency with other Departments and good relations exist with the many government officers contacted largely because they appreciated both being consulted and being provided with calculator-skill training themselves (See 3.5).

6. The media have always responded well to information received from the Project (See 3.5.9).

7.5.8 MATERIALS FOR ADULT NUMERACY

With reference to those listed in 7.2.11:
1 The Sharps EL220 calculator as supplied by the Numeracy Project is suitable (See 3.2.7).

2 The workbooks should be in English (as in the Business Arithmetic Workbooks) since most potential trainees understand it and Pidgin is not a good language for giving precise instructions (See 3.2.4, 3.2.7, 5.12).

3 Exercise sheets for use with the Workbooks should be in Pidgin (at the time of writing these have still to be prepared).

4 The First Calculator Course (FCC) and the Calculator Skills Pack are suitable for use by experienced operators eg teachers (See 3.3.4, 3.3.6, 4.3.4.4, 5.11, 5.16).

5 Cartoon posters in Pidgin are required (funding for them was still in doubt in February 1982) (See 3.2.4, 3.2.7).

6 The numeral and "snap" cards as prepared for TEMLAB are suitable.

7 The "Sum-ten" and "Car Race" games are suitable (See 5.10).

8 Metre rules as supplied by the Numeracy Project are suitable (see 5.10).

9 Clockfaces are produced by the Department of Education and should be used when this part of the programme becomes operational.

10 Scales for weighing coffee etc can usually be borrowed when required.

11 The "ANC" series of exercises (See 5.10) will need continual updating as needs are expressed.

7.5.9 RESEARCH IN PNG

The difficulty of communication means that formal verification of research hypotheses may not be cost-effective. Long-term experience may have to be substituted for short-term confirmed prognosis (See 3.2.4, 3.2.5, 3.2.7, 3.3.5.2).
7.5.10 BUSINESS DEVELOPMENT OFFICERS

Business Development Officers should continue to be trained and encouraged to teach clients the use of the calculator and other materials supplied by the Numeracy Project (See 3.2.4, 3.2.7).

7.5.11 OTHER GOVERNMENT OFFICERS

1 Many Government officers need to be taught how to use the calculator properly (See 3.5.2).
2 Until they have been taught themselves they cannot pass on the skills to others.
3 For this reason calculator-skill training should be given to Government officers (and staff of voluntary agencies) as part of the adult numeracy programme (See 3.5).

7.5.12 OTHER AGENCIES

Full co-operation with the Departments of Commerce, Education and the Community and Family Services has already been established. The Department of Primary Industry is investigating possibilities. Co-operation with other Departments, Provincial Governments and with voluntary agencies need to be further developed (See 3.5.10).

7.5.13 REACHING THE VILLAGERS

1 The attempt to teach villagers by giving an intensive course to representatives failed because the representatives did not pass on what they had been taught (See 3.3.1).
2 Visiting villages for an hour or two and giving a lesson to those adults who were available appeared to produce good results but no systematic follow-up of this attempt was carried out (See 3.3.1).
3 Prior organisation for such visits however was essential and when this broke down the visit could be wasted (See 3.3.1, 3.3.2).
4 Visits specifically to train village people would only be practicable if staff were specially appointed to carry out such a programme.

5 Appointing staff specially to carry out a nationwide programme of direct teaching would be very costly.

6 The practicable alternative would seem to be to work through existing agencies and their extension officers (See 6.3.4, 7.6.7).

7.5.14 CALCULATORS IN SCHOOLS

The Papua New Guinea culture is certainly (at best) partially numerate and the principle of 7.3.5 applies: calculators should be introduced into Primary Schools as early as possible (See 3.5.5).

7.6 SUGGESTIONS FOR FURTHER RESEARCH

7.6.1 THE CALCULATOR AS AN EDUCATIONAL AID (See 6.7.3, 6.7.4, 6.7.8, 6.7.9, 6.7.10, 6.7.11, 6.7.12)

The use of the calculator at all levels in:

1 Concept development
2 Learning of number facts
3 Applications to specific situations likely to be met in real life.

7.6.2 FRACTIONS

The extent to which the teaching of fractions can be safely reduced, particularly in a metric society,

eg: in Primary education, only the use of \( \frac{1}{2} \)'s and \( \frac{1}{3} \)'s?

in Secondary education for the "majority", only \( \frac{1}{4} \)'s, \( \frac{1}{3} \)'s, \( \frac{1}{5} \)'s, \( \frac{1}{10} \)'s, \( \frac{1}{100} \)'s, the use of fractions to denote division, and "cancelling down"?

(See 5.15, 6.5.3, 6.7.6(10), 6.7.11(20))
7.6.3 **RATIO AND PROPORTION**

The various methods which may be used to teach the solution of problems on ratio and proportion with the calculator (See 5.15).

7.6.4 **APPROXIMATION AND ESTIMATION**

The various methods of approximation and estimation that are appropriate in real life situations (See 5.8, 5.15, 6.2.3, 6.6.6, 6.7.6.12).

7.6.5 **OPTIONAL MATHEMATICS FOR THE MINORITY**

The provision of optional mathematics courses for those who wish to take the study of mathematics beyond that which is appropriate for the "majority" (See 6.1, 6.2, 6.3.2, 6.7.7).

7.6.6 **ADULT NUMERACY**

Any practical adult numeracy work using the hand-held LCD calculator will provide an opportunity for further research in this new and potentially vast field (See Chapter 3, 5, 6.3.4, 6.6, 6.7.6.6).

7.6.7 **REACHING VILLAGES IN PNG**

The major research that must now be carried out in Papua New Guinea is to discover whether an Adult Numeracy Programme can be effectively carried out through existing agencies and their extension officers (See 7.5.12).

7.6.8 **PROBLEM-SOLVING TECHNIQUES**

To what extent will the currently popular analysis of problem-solving techniques actually assist the "majority" in the real world? (See 6.2, 6.5.5, 6.7.6.18, 6.7.11.21).

7.6.9 **MICROCOMPUTERS**

In all research with the calculator it should be remembered that it may before very long be replaced by a cheap hand-
held microcomputer. This may not yet be a realistic subject for specific research but the escalation of development in this field requires that the probability should be borne in mind (See 6.7.8).
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APPENDIX 1

Information Pack prepared for the Numeracy Project

January 1982

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Letter from the Secretary, Department of Commerce, John Wauwe

The Numeracy Project, by Mary Dickie [5]

Papua New Guinea: calculating the way to numeracy, by Allen Edwards [68]

Calculator helps villagers to learn to count by 10, by Paul Byrnes

Newsletter No 1, by Mary Dickie and Allen Edwards

Newsletter No 2, by Mary Dickie and Allen Edwards

Materials available from the Numeracy Project

Note: copies of the First Calculator Course (Unit 1) and the Business Arithmetic Workbook (Units 1-5) were included in the Pack. Samples of these are in Appendix 3.
NUMERACY PROJECT

DEPARTMENT OF COMMERCE
PAPUA NEW GUINEA

Project Development Staff: Mary Dickie
Allen Edwards
Mary Edwards
ACKNOWLEDGEMENT

The Cartoon on the front is reproduced by permission of The Grass Roots Comic Company, Port Moresby.

A rough translation of the Pidgin is:
No! The Consumer Price Index decrease from last year until now means that one betelnut and one mustard is 3.52 toea.

Forget it ..... Give me 20 toea and shut up.
FROM THE SECRETARY, DEPARTMENT OF COMMERCE.

ADULT NUMERACY

The invention of the cheap calculator with long-lasting battery has created a new possibility of universal adult numeracy.

Papua New Guinea has an eighteen month headstart over any other country on such a programme. In March, 1980 the Department of Commerce set up a Numeracy Project which received support from the Prime Minister's Department Non-formal Education Sectoral Fund. Some of the resulting teaching materials are in the enclosed Information Pack.

Business Development Officers are being trained to use the materials. Other Departments and agencies are working out, in consultation with the Project, how to adapt or use the materials and training that are available.

The Southern Highlands Provincial Literacy Committee for example, is concerned with people who cannot read or write or use "Western" numbers. A special course has been written for them to use alongside their literacy teaching.

The Mathematics Syllabus Advisory Committees for both Community and High Schools have asked for research to be carried out in 1982 into the feasibility of teaching calculator skills to those who will leave school from Grades 6, 8 and 10.

The Community and Family Services' Department has asked for advice on materials and training for youth leaders and women's workers. They are already telling their officers how to obtain materials and suggesting they approach their Provincial Business Development Officers to assist with the training.

Non-formal Education has requested a comprehensive programme to use with their own trainees in Vocational Centres and in extension work with villagers engaged in income-generating projects.

An overseas volunteer agency has begun to brief its workers on their arrival in the country, so that they can spread knowledge of the materials and training available.

Experience has shown that business people and others are keen to learn, but they do need to be taught. The Business Arithmetic Workbook is intended as a manual for the teacher as well as an exercise book for the learner. Very few villagers could learn direct from the Workbook: they would find it hard even to use the Book to remind them of what they have learnt. A series of cartoon posters has therefore been planned with minimal writing, in Pidgin, to remind them of the procedures they have learnt.
A Calculator-skills Pack is also proposed, to include the material in Units 1 and 2 of the Workbook together with work on the Cash Book and Measurement applications. This would probably consist of a detailed teacher's guide in English together with exercise sheets in Pidgin.

The first priority of the Numeracy Project now will be to discuss the possible programmes with Government Departments and other agencies who have the capacity to carry the teaching to the people. It will also be concerned, through the media, to stimulate the demand for numeracy. Cost-effectiveness comes from matching provision to demand.

There is no one in the world who can tell us how to programme adult numeracy. There will be plenty of other countries eager to learn from Papua New Guinea's experience.

Could the people with whom you are concerned become more self-reliant if they had better number-skills? If so, and if you think we could help in any way will you please contact us? Then we can discuss how the materials could be adapted and the training provided.

If you are interested please write or telephone to:

The Director,
Numeracy Project,
Laloki College,
PO Box 1864
BOROKO.

Telephone: 281060/281064.

JOHN WAUWE,
SECRETARY.
For the majority of Papua New Guineans who live in rural areas (some 85% of the population) and who still follow a more or less traditional way of life, the 700 different languages and 250 counting systems present no real problem - as long as they stay in their own village. As soon as they step beyond its boundaries, they need to be able to communicate with others and to deal with the changing social and economic environment. Most people in accessible areas do learn and use one of the official languages (English, Pidgin or Motu) but few have yet come to grips with international counting and measuring systems to enable them to deal with money and numbers as they need.

In the village setting, the requirement for using "western" numbers might seem very basic - as simple as putting a price on the scones baked in a drum oven; but if you cannot add together the price of ingredients and fuel and divide by the number of scones made, you could easily sell them at a loss. And many people do. If you have a small commercial, industrial or agricultural project, you need greater number skills than that - for working out materials estimates, overheads, prices, stocktaking, bank accounts etc. And yet the kind of basic arithmetic involved is often beyond the skills of a university student, so for those who have had little or no formal education, these problems seem almost insurmountable. However, 1980 saw the introduction of the liquid crystal display calculator - a remarkably cheap hand-held calculator, with an estimated battery life of some 10,000 hours. This new technology provided a tool which could be used in a village for a very long time, provided that people could learn how to use it to solve their number problems.

So during the last 18 months, the Department of Commerce has been trying to find out what sorts of problems people encounter with numbers in their daily lives and to discover a means of teaching people to tackle these for themselves, without the help of an extension officer, by using a calculator. The range of problems we uncovered was very wide - a man who could not re-roof the community hall because he could not work out how many sheets of iron he should buy; a woman who made tapioc parcels to sell at the market and ended up with less money than she started with, after she had sold them all; many tradestore keepers who could not give the right change from a kina; farmers who could not work out how many posts and how much wire to buy to fence their coffee blocks. The examples are endless. Collecting all of this information together only served to emphasise the extent of the problem we were trying to deal with.
Following this, we have been experimenting with a whole variety of training methods and materials, with village and business groups and government extension workers in 5 Provinces. We have tried to teach people the basic and essential number skills they need for their own practical purposes, basing all our efforts on the use of a hand-held calculator as the means of learning and the means of solution.

During all this time, the project has focussed certain key facts:

- people in Papua New Guinea have very readily adapted to using new technologies in many spheres of everyday life, so learning the Arithmetic they need with the help of a calculator could be appropriate, provided that the calculator itself would not run down.

- to be successful, basic skills training has to be directly related to practical tasks, and teaching has to be aimed at the problems which each individual or group has to deal with.

  e.g. understanding and using a calendar to calculate gestation periods for pigs or cattle

  e.g. adding costs and dividing by quantities produced, for a women's group making clothes or bread

- new skills can be learned for new needs, without destroying or changing traditional ways.

  e.g. just as many people learn pidgin or english, but do not "forget" how to speak ples ëlak, so could they learn western arithmetic without abandoning their traditional counting systems for village uses.

- developing new concepts is the most difficult problem in education, but learning a routine to deal with a specific task is not; so our training should be aimed at teaching people precisely what to do, when and how, which numbers to use to solve a problem, rather than attempting to achieve an overall understanding of arithmetic.

Further details of the project's activities and results of the experimental period are described in the attached collection of papers.

The project is now aiming to extend its work outside the "business only" boundaries which it has previously emphasised. Preliminary discussions with 3 major extension departments - Education, Primary Industry and Community and Family Affairs - have been very encouraging and we hope to be working very closely with them in 1982, and to produce materials appropriate to their areas of interest.

Any further information about the project which may be required can be obtained from the Project Director, Allen Edwards, at Laloki College, PO Box 1864, BOROKO.

October 1981

Mary Dickie
Assistant Secretary, Training & Staff Development, Department of Commerce
Papua New Guinea: Calculating the way to numeracy

By Allen Edwards

Adult Numeracy in Papua New Guinea presents a challenge of which some features are worldwide but others are unique to this country. The Highlands of Papua New Guinea have been one of the last populated areas of the world to be 'opened up' to development. School enrolments increased by some 60% between 1966 and 1979 but the school system has suffered badly from 'modern mathematics' enthusiasts. Their negative message to 'stop all rote learning' has been almost universally accepted but their positive contribution of 'teaching for understanding' has had relatively little success. As a result many children leave the primary schools today with few arithmetical skills beyond that of addition.

There is however one technological advance which could prove the salvation of a numeracy-starved country. This is the hand-held electronic calculator with liquid crystal display. Such calculators can be identified by a power rating of around 0.0003 watts, an automatic switch-off device and consequently an almost inexhaustible battery life. In country areas this is of crucial significance. The first act of the Department of Commerce Numeracy Project when it was set up in March 1980 was to arrange for the import and sale of such calculators at the equivalent of £4.75 each. This was less than half the usual retail price here, and is within the means of practically any village community in the country.

The primary task of the Project was to provide teaching materials for servicing the ubiquitous trade stores which are a feature of PNG life. A recent survey of 79 villages estimated one store to every 37 adults. This task however quickly merged into that of providing for general adult numeracy, since many villagers would like to take up some form of business if they could, and recognise their lack of numeracy as a major obstacle.

The idea of a national campaign to teach adults the number-facts and algorithms of school arithmetic is frankly non-viable, but the possibility of teaching the arithmetical skills that are needed when a calculator is available is a very different proposition. It presents a challenge which the Numeracy Project has been investigating during the last quarter of 1980, thanks to a £2,000 grant from PNG statutory funds to enable a survey to be undertaken. There are three major questions to be answered:

1. what concepts and skills are still needed when a calculator is available?
2. how can these concepts and skills be taught?
3. how can a Campaign be organized to provide this teaching?

Given the availability of a calculator, arithmetical skills would seem to be required for three purposes:

1. to be used when the calculator is not to hand;
2. to check that the calculator result is reasonable;
3. to enable arithmetical concepts to be understood.

Let us begin with the first of these, simple computations without the aid of a calculator.

What is the minimum requirement for, say, a customer in a store when a calculator will not be in his hand? It would seem that he will need two skills, namely:

- to estimate the total cost of a number of items to see whether they can all be afforded, and
- to work out the change (exactly, if possible) to ensure that he is not being cheated.

The first of these could probably be reduced to the skill of rounding to the nearest 10 and adding the 10's. The second requires mainly the subtraction of two-digit numbers from 20, 40, 60, 80 or 100 and of larger sums from K2.00, K5.00 or K10.00 (the PNG coinage is in kina and toea: the 50 toea piece is not in common use).

The second need for skills which we have identified is that of checking whether a calculator result is reasonable. We have come to the conclusion that wherever possible this is best done by introducing a self-checking procedure, such as repeating the calculation in a different way or using the totals of rows or columns. Sometimes however these methods are not appropriate and we have developed distinct procedures for:

- totalling up to five amounts, each less than K10.00. To find the minimum total cost, you add up the prices in whole Kinas (ignoring the toea): to find the maximum total cost, you add to the minimum total one Kina for each item in the set;
- totalling three numbers each between 100 and 300: this can be done by adding the tens and recognising that the answer must have this number of, or one or two more, tens;
The project is still at the stage of identifying an appropriate syllabus and method of teaching: to devise a campaign structure is the next task.

With widespread use of calculators, the most important skill to be taught at school mathematics may well be that of approximation.

• multiplying two 2-digit numbers: the least the product can be is found by rounding down the numbers to the nearest 10, the most by rounding them up;
• estimating one number as a percentage of another by noting whether it lies between 0 and 10%, 10% and 50% or 50% and 100% of it.

The greatest difficulty here is that each occasion may require a different method of approximating: for those of us who have been brought up with numbers a whole variety of strategies are possible. Those who have not acquired a strong 'number-sense' will need to be taught specific techniques.

In view of the future availability of the calculator it could be argued that learning to approximate is the most important skill that needs to be taught in school mathematics today. This clearly requires some concept development. It is particularly important to grasp the concept of the range, to understand algorithms suitable for mental work and to learn some number facts. The current pre-occupation with problem-solving in the mathematical education world would seem to be side-stepping this urgent and practical need.

The third use we have identified for number skills is that of concept formation.

The normal method of teaching of practically any arithmetical concept is to illustrate it with simple examples which students can, wherever possible, do in their heads. To illustrate the idea of multiplication you can say, "if one tin of fish costs 40 toea what will three cost?" From adding three 40's together you move to learning the algorithm and number-fact needed for reading off the result. You have now started to conceptualize multiplication. With this mastered, you can see how much 79 tins at 43 toea each would cost by pressing the multiplication key, \( \times \), on the calculator. But I think concept development, using simple illustrations, must come first.

If this is so then all one needs is a few multiplication tables, certainly not the 6\( \times \), 7\( \times \), 8\( \times \) or 9\( \times \) tables. Fortunately the 'constant' function of the calculator can be used to help learn these tables. Pressing say 4 \( \times \) 4 = will 'set' most calculators so that subsequently pressing any key followed by \( \times \) will show 4 times the number and this can be continued until the table is learnt.

'Addition tables' can be similarly taught. When it comes to subtraction using a calculator, the concept of 'difference' is more useful than that of 'minus'. For example, after buying a number of items and totalling the cost, you are left with a number in the calculator display representing this total. To calculate the correct change you need to know the difference between this and a second number, representing the amount you offer to the shopkeeper. There is nothing to be gained by 'losing' the first number, putting in the second and then putting the first one back in again, which is what you have to do if you wish to find the change by 'subtraction'. If you are content to find the 'difference' you merely put in -- the second number and ignore the minus sign which may appear in the display.

Given this understanding, 'difference tables' can be practised. The table of 'differences from 4' is discovered by setting the calculator by 4 = and pressing any key followed by \( \times \). If there is a minus sign in the display you ignore it. You probably know that 1 is less than 4 and 10 is greater than 4 without having to be told it by the calculator: what matters is that the differences are 3 and 6 respectively. This technique is obviously particularly useful in practising the vital algorithm of 'change from 100'.

We have given some hypothetical answers to the first two of the three questions posed at the beginning of this article: namely, what basic numeracy skills are important and how they should be taught? A very tentative first draft for a syllabus is shown, and any comments will be warmly welcomed. The task of the Numeracy Project is now to find out if these answers are acceptable to the people concerned. It may then be possible to approach the third question and devise a campaign structure. In Papua New Guinea we plan that one or two key people from each village will be trained to teach their fellow villagers.

Given appropriate publicity, plenty of calculators, some sort of reward for success and the co-operation of all the available extension officers, it may be possible to make great improvements in the standard of village numeracy in Papua New Guinea within a very short time. 

Allen Edwards is a mathematics teacher of 25 years experience. He was Director of the Mathematics Education Centre at the Papua New Guinea University of Technology in 1978/79 and from there moved into adult education as Director of the Papua New Guinea Department of Commerce Numeracy Project. Allen would be grateful if Bulletin readers could write to him and comment on his draft syllabus and methods. He can be contacted at: Department of Commerce Numeracy Project, Laloki Co-operative College, PO Box 1864, Boroko, Papua New Guinea.

University of Reading Agricultural Extension and Rural Development Centre A10
ONE of the better known statistics about Papua New Guinea is that in its people speak more than 700 languages. What is less known is that they also have 370 different methods of counting which tends to be a little confusing.

In Australia we have a basic 10 number system. On paper, we use PNG, but in previous centuries parts of the country operated on bases of anything from 1 to 12 and sometimes more.

Recently, officers of the Commerce Department on the Gulf Province have taught them to use a base 20 — counting by 20, 40, 80, 100, 200, etc., on each side and 200 in the total number.

However, most of the coastal systems have only a traditional application and are not good for dealing with modern PNG number systems.

PNG has a decimal system with the base the single unit and the base the larger units. As a result, there are no independent ideas of independence in PNG. Hence, they are still using the same methods they developed before the modern number systems.

Yet the years have seen PNGers will talk in dozens, score, and some high numbers in Palau and side numbers in the mainlands. Now, generally, some PNGs still talk in dozens.

It has been estimated that only one in three PNG villages can add together two numbers under 10 or work out the change of 10 from 20.

The department believes most PNG people currently living in PNG villages know 20 or most of the population lack the basic numeracy skills they need to deal with money on a management basis in PNG.

"The real problem is that many of the PNGers don't yet understand their country," according to Dr. Mary Deak, one of the people who have set up the Commerce Department's numeracy project in March last year.

Numbers can be different in PNG, in PNG, the idea of dozens and the ability to comprehend base 20 numbers is critical understanding.

For example, one of the department's first tasks was to find a PNGs group during a visit to the Northern Province last year.

In some developing countries, innumeracy is of great concern. PAUL BYRNE reports from Port Moresby on how Papua New Guinea is coming to grips with arithmetic.

In some developing countries, innumeracy is of great concern. PAUL BYRNE reports from Port Moresby on how Papua New Guinea is coming to grips with arithmetic. People are using calculators, computers, and many basic numeracy teaching tools and courses that have been tried and tested in developing countries.

"The same way that you can drive a car without knowing how it works, you can still manage a calculation to solve a mathematical problem," said Mrs. Deak this week.

"But we haven't yet understood the mathematical concept, just how to operate the machine and the tools to be used. We teach someone an operational skill, to identify the numbers he needs and the framework to use.

The advantage is that most calculations likely to be needed in a village can be done on a calculator, multiplication tables do not have to be learned and the calculator can be used to teach basic numeracy.

The biggest disadvantage is that it teaches the concept, but the PNGs have the tools to learn and develop their own calculators. The department has one calculator in the village of a new concept which gives a different feel of financial literacy with an automated equation-solving calculator.

Another drawback was the cost — more than $10 retail in PNGs, but PNGs have brought in VCDs which are much cheaper.

In PNGs, the government has the potential to use the department to reduce the number of calculators used by the PNGs.

Reproduced from the Sydney Herald, May 1981
We also hope to make specific visits to women's projects in five other Provinces. The proportion of women with Primary Education is lower than for men, but the influence that women can have on the development of pre-school numeracy is probably far greater.

The whole emphasis in 1981 will be on experimenting in Adult Numeracy with the Calculator, a field where no work is known to have been done elsewhere in the world. By the end of the year it should be possible to determine whether a large scale campaign is justified, and if so, how it should be carried out.

Any advice or offers of help or requests for further information will be welcomed. Reports are available on each of the survey visits already undertaken and it is hoped to keep interested observers informed by producing newsletters quarterly through 1981.

Further enquiries may be sent to

The Director
Numeracy Project
Laloki Co-operative College
P O Box 1864
BOROKO
Papua New Guinea
Telephone: 281060

Assistant Secretary - Mary Dickie
Project Director - Allen Edwards
ADULT NUMERACY IN PAPUA NEW GUINEA

Papua New Guinea has 700 different languages and 250 different methods of counting. It is also one of the most recently developed countries in the world. In Africa for example Arab and European traders have been buying and selling for centuries. It is hardly surprising that most people in Papua New Guinea, and nearly all those who live in villages, lack the ability to handle the sort of numbers they need for dealing with money or measurement in the Western sense. Developing a "number sense" may take generations.

It has been estimated that only one in three villages adults can add together two numbers under 10 or work out the change for 65 t from K2.00.

Even if villagers were willing to learn to add simple numbers together (as they probably would be) and also learn their multiplication tables (which they would probably not be) they would still not be able to carry out many of the calculations they may need.

An interim report was presented to the Council for Village Development in December 1980 and as a result a grant of K14,290 was promised to enable pilot projects to be set up in the five provinces during 1981.

Up till now the work has been carried out by the Director of the Department of Commerce Numeracy Project with voluntary assistance. The Department is seeking permission to appoint a woman assistant to the Director for 1981 to ensure that men and women continue to receive equally fair treatment in the exercise. Materials are being provided by the Materials Centre at Laloki Co-operative College. The special metre rules are being made by the Department of Education Curriculum Unit Materials Section.

Active co-operation has been received from the national departments of Education, Community and Family Affairs, Health, Primary Industry, the Office of Village Development and voluntary agencies.

Ten visits have been planned, two to each of the five Provinces. Each time it is hoped to teach a group of village representatives and also to provide any training or advice that may be welcomed by extension officers from any department or other agency. On the second visit an attempt will be made to assess the success of the work done on the first visit.
were learning. They were shown how to use the "constant function" on the calculator to play games which would teach the basic number facts and how to find change from a kina in their heads.

They were particularly keen to learn how to check the prices they were being paid for their coffee and cocoa: this involved reading the scale as well as using the calculator. They were taught how to use the calculator memory to check an invoice, how to find the number of iron sheets needed to cover a roof, how to read a clock and a calendar and how to work out a percentage markup.

At the end of the course we revised it thoroughly, gave them additional exercise sheets to use on their village "students" and were delighted at the amount they had remembered.

The Future

The fifth visit in the survey, to Morobe Province, is planned for February 1981. It is hoped to run experimental courses for a women's group and a youth leaders' group, in addition to discussing ways in which numeracy skill teaching could help extension workers in other departments.

Even the simplest question such as the price of one tin of fish when a carton of 48 costs K16.85 involves the sort of calculation which less than 40% of first year University and College students in PNG could carry out correctly in a recent test.

Metrical has further compounded the problem, although simplifying it in other ways.

To take one example, plywood sheets for the walls of a hut were 4 ft by 8 ft, so to find the number needed one had only to divide by 4 or 8, a normal Primary School skill in most countries. Now they are 1.22m by 2.44m and there are relatively few Primary School pupils anywhere in the world who can divide by such numbers.

In developed countries such calculations are now normally carried out with an electronic calculator. But such calculations may be needed for the smallest village business or the simplest self-sufficiency project.

The Department of Commerce Numeracy Project was set up in March 1980 to see how number skills could be taught to businessmen. A decision had therefore to be made whether or not to base this work on the calculator.
Advantages of Calculators for Village Numeracy

1. Any calculation likely to be needed in a village can be done on a calculator with a memory and a % key.

2. Multiplication tables do not have to be learnt.

3. The "constant function" can be used to teach the sums of numbers up to 10 or the "change from a Kina."

Disadvantages

1. The battery runs down. This was a serious drawback until the invention of the Liquid Crystal Display. Nowadays calculators with ordinary batteries can last 10 000 hours and have an automatic switch-off.

2. Cost. Calculators such as the above are sold in shops in Papua New Guinea for K16 - K20. By importing in quantity however Laloki College has been able to obtain them for under K7.00 each. A village could buy three calculators for the cost of two cartons of beer.

Calculations that villagers could carry out for themselves if they had calculators. Community Development Officers were anxious to know how to use the calculator to help them with pricing.

At the same time the low level of numeracy in the villages became more apparent. A course was held for Trade Store owners and managers, two of whom could not recognise numbers up to 10. They only sold 6 items in their stores, priced at 20t, 40t, 50t and 60t. Even then one of them could not always give the right change from K1.00 for one item, let alone add the prices of three together. Any idea that they could calculate the legal maximum for price controlled goods was ludicrous. Yet they operated their stores to the apparent satisfaction of their villages, waiting till they had K240 in their hands, giving K40 to the truck driver and then going down to Mendi to spend the rest on goods for re-sale.

A Village Representatives' Course

Our fourth visit was to the East Sepik where we tried out an experimental course which we had designed for village representatives. Ten Grade 6 students from six villages completed the four-day course. All were enthusiastic and took seriously their responsibility to pass on the skills they
Here too the needs of the women became more apparent. A group of highly responsible office-holders were unable to find the approximate cost of one macramé pot holder if the string for two of them cost K1.95.

At Mendi we discovered the great interest displayed by officers from other departments. Adult Education have their biggest literacy drive in that Province and a group of their teachers unanimously welcomed the idea of incorporating a numeracy element into the course.

In formal education, the headmaster of one Community School that had been attempting to take its "community" aspect seriously, suggested teaching Grade 6 leavers how to use a calculator. These would become the village leaders of the future.

A group of teachers from Vocational Centres were keen to use the calculator in their teaching. Mature students in a theological college found numbers very difficult but saw the need for them if the church accounts were to be kept straight. Nursing and Aid Post Orderly supervisors needed calculators to complete statistical returns. A group of Agricultural extension officers listed

3. Calculators go wrong. Out of 800 of the above calculators sold over the past six months only two have so far had to be exchanged under the 3-month guarantee. Most cases of calculators giving wrong answers are probably due to batteries being low. This need no longer apply. A village with three calculators should be quite safe.

4. It has been suggested that the calculator is an undesirable importation of Western technology. It does indeed appear that the calculator is thought of by some as a part of the "white man's magic." The normal Papua New Guinean response however is simply to delight in mastering it.

5. It is easy to make a mistake by pressing the wrong key. Because he or she lacks "number sense" the operator may not realize that a mistake has been made. This is a serious danger. It can be reduced by emphasizing the need to check or repeat important calculations. It is also possible that the best way to develop a "number sense" is to learn to use numbers. They will certainly not develop that sense under the present conditions when they hardly ever use numbers at all.
One could also suggest that estimating, which is an important part of 'number sense', is something that will develop more as people learn to measure and read clocks and scales. Little of this is done even in the schools and the only way to get people to do it is to show them how to use the results.

The calculator makes it possible to work out the number of sheets of plywood for a building or the price for so many kilograms of coffee. So the calculator may in the end prove to be the main stimulus for developing the "number sense" which is desirable when using it.

**Adult Numeracy**

On balance therefore it seemed right to base village numeracy teaching on the calculator. At this point however the idea arose that such a development could be extended beyond those who were specifically concerned with village businesses. Raising the level of numeracy generally in the village could make a significant contribution to business development. It could also have far-reaching effects on the general development of the country, particularly if it could help to maintain rural...

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**The First Survey**

So in September 1980 the Department of Commerce obtained from the Council for Village Development a grant of K3500 to enable a survey to be carried out in five provinces on the needs and feasibility of an Adult Numeracy Campaign.

In the first Province visited, the Central Province, it became clear that there was a strong desire to learn and the readiness to buy calculators. The people also responded enthusiastically to the suggestion that each village should nominate one or two young people, preferably with grade 6 or 8, who would be given a course to enable them to teach the rest of the adults in the village.

In the Oro Province these indications were confirmed. The problems of teaching any sort of technical skill without a background of numeracy were underlined at the Village Development Centre. The question of measurement in metric units was resolved by deciding to use a metre rule marked in centimetres and labelled .01, .02, ..., .99. This enabled lengths to be measured in metres and centimetres with the answer expressed in exactly the same form as kinas and toea. The same calculator techniques would then apply to both measurement and money.
Thanks to the generous support from the Prime Minister's Discretionary Fund for Non-formal education, through the Council for Village Development, and the willing co-operation of the Department of Commerce, progress during these last four months has been rapid.

The main tasks in the next period will be to try to assess what has been learnt by those who have been taught and of course to trial the new materials.

The principal problem looming ahead however is to discover how the organisational, teaching and mathematical skills needed for a national campaign can possibly be accessed and co-ordinated. Unfortunately the times are not opportune for seeking large scale financial assistance.

Co-operation with other departments has always been a major concern of the Project and this may generate substantial support. It may be however that small-scale sources must be found. If that is the case then any help that can be given by any reader of this Newsletter will be most gratefully received.

Ideas, comments, criticisms, encouragement and offers of help will all be gladly acknowledged by the Director, Numeracy Project, Laloki Co-operative College, P O Box 1864, Boroko. Tel: 281060.
The main emphasis during this period has been on the production and improvement of suitable materials.

When we started we only had materials that had been designed for use in formal education. It was clear that a totally different style was needed.

As a result there are now more than 40 exercises, occupying 1 or 2 sides of an A4 sheet each and we also have 7 different sets of cardboard material for re-enforcing teaching with games, an extremely valuable resource when one remembers the boredom of much of village life.

The production of these exercises was by no means the result simply of armchair thought. Some 60 individuals were consulted and their views included in reports on seven visits outside Port Moresby during the period. About a quarter of these interviews resulted in some development of the material. Details of these are given later in this Newsletter.

The other main source of development was of course the students themselves. During the period 141 students were taught for between 2 and 4 days while a further 526 were taught for between 1½ hours and 2 days. In practically every case a course resulted in some revision of an old exercise or production of a new one.

<table>
<thead>
<tr>
<th>MATERIALS: FEBRUARY - MAY 1981</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials revised or generated as a result.</td>
</tr>
<tr>
<td>Value of trees as lumber.</td>
</tr>
<tr>
<td>Number of truckloads needed.</td>
</tr>
<tr>
<td>Sum-ten, Snap, Numerals cards.</td>
</tr>
<tr>
<td>Cattle project.</td>
</tr>
<tr>
<td>Pricing billums, secondhand clothes, necklaces, and coconuts from Lae.</td>
</tr>
<tr>
<td>Pricing mats.</td>
</tr>
<tr>
<td>Notes &amp; coins slips. Pricing scones.</td>
</tr>
<tr>
<td>Land area.</td>
</tr>
<tr>
<td>Valuation at cost price given value at known markup.</td>
</tr>
<tr>
<td>Net worth and Leakage check</td>
</tr>
<tr>
<td>Pricing kaikai. Pricing sewing.</td>
</tr>
<tr>
<td>Basic non-calculator numeracy material.</td>
</tr>
<tr>
<td>Pricing of duplicating and printing.</td>
</tr>
<tr>
<td>Land areas.</td>
</tr>
<tr>
<td>Date</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>2.2.81</td>
</tr>
<tr>
<td>3.2.81</td>
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<tr>
<td>5.2.81</td>
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<tr>
<td>9.2.81</td>
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<td>16.2.81</td>
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<td>16.2.81</td>
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<td>18.2.81</td>
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<tr>
<td>23.2.81</td>
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<tr>
<td>27.2.81</td>
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<tr>
<td>23.3.81</td>
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<tr>
<td>20.3.81</td>
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<tr>
<td>25.3.81</td>
</tr>
<tr>
<td>18.4.81</td>
</tr>
<tr>
<td>7.5.81</td>
</tr>
<tr>
<td>12.5.81</td>
</tr>
</tbody>
</table>

The calculator is no longer "white man's magic": these Kuplane people appreciate its 10000 hour battery life, which is due to its Liquid Crystal Display.

Concurrently with the production of this Newsletter three major revisions are to be carried out, based on the material already produced. First, the material directly of concern to most trade store keepers will be re-written, initially in Pidgin, in workbook form for printing in two colours. Subsequent versions will be illustrated. Ancillary to this workbook will be "memorandum sheets" which the client may pin up to remind himself of the processes. There will also be teaching guides to enable Business Development Training Officers to teach Business Development Officers how to teach clients. If these materials really come into use a very wide application of calculator skills should occur. This in itself would make a significant contribution to adult numeracy in the country.
A second development of the present materials which should be completed very soon is the first draft of a basic numeracy course to be included in the large scale literacy campaign which is being undertaken in the Southern Highlands. This must be designed for the many unschooled adults in that area and would be appropriate for similar clients elsewhere.

A third development will be to extend the current materials "upwards." Most of those at present in use are intended for the majority of our students. But the interests of individual adults are far from uniform. Where an adult is well motivated and desires to learn to deal with a particular arithmetical situation, he or she is perfectly capable of advancing well beyond the general level. An example of this was in Koroba in April where a third of the students were unschooled but where there was also a demand for teaching on the use of a cheque account.

### April - May 1981

<table>
<thead>
<tr>
<th>Duration</th>
<th>Materials revised or generated as a result.</th>
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</thead>
<tbody>
<tr>
<td>2½ hours</td>
<td>Cheque account, Freight rates.</td>
</tr>
<tr>
<td>3 mornings</td>
<td>Cash Sheet, Leakage Check. Stocktaking.</td>
</tr>
<tr>
<td>2 hours</td>
<td>Wage sheets. Totalling lists with repetitions. Correcting such totals. Use of $\div$ $\times$. One amount as $%$ of another. Constant function.</td>
</tr>
<tr>
<td>4 hours</td>
<td>Pricing goods with 34t/kg freight.</td>
</tr>
<tr>
<td>1½ hours each</td>
<td>Calculations in Trade Stores.</td>
</tr>
<tr>
<td>2 hours</td>
<td>Leakage checking.</td>
</tr>
<tr>
<td>Date</td>
<td>Place</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>7.4.81</td>
<td>Mendi</td>
</tr>
<tr>
<td>8.4.81</td>
<td>Mendi</td>
</tr>
<tr>
<td>9.4.81</td>
<td>Mendi</td>
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<tr>
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</tr>
<tr>
<td>15.4.81</td>
<td>Mendi</td>
</tr>
<tr>
<td>16-18.4.81</td>
<td>Koroba</td>
</tr>
<tr>
<td>20-23.4.81</td>
<td>Koroba</td>
</tr>
<tr>
<td>29.4.81</td>
<td>Port Moresby</td>
</tr>
<tr>
<td>11-14.5.81</td>
<td>Popondetta</td>
</tr>
<tr>
<td>13.5.81</td>
<td>Popondetta</td>
</tr>
</tbody>
</table>

The Government Station at Koroba was established in 1955. Twenty-six years later Huli people like these are carrying out calculations that few in the developed world would be able to do without a calculator.

This underlines one essential characteristic (or some would say weakness) of this programme. Concept development essentially takes time: it is really not possible, for example, to explain to anyone the many different processes that are represented mathematically by multiplication, let alone division. All one can do in the limited time available is to show how to solve some problems using these signs. That may be all the client ever knows. Those with a greater capacity to conceptualise may just possibly be able to see similarities in other situations and apply the same processes to solve them, but one cannot depend upon it. This approach however is general in industry and commerce worldwide. It is only in formal education that the time can usually be found for concept development.
<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Number and Type of students, with educational levels.</th>
<th>Duration</th>
<th>Materials revised or generated as a result</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.81</td>
<td>Lae</td>
<td>6 Senior District Co-ordinators.</td>
<td>1½ hour</td>
<td></td>
</tr>
<tr>
<td>4-5.2.81</td>
<td>Lae</td>
<td>8 women and 2 Youth Leaders, (1 Grade 8, 5 Grade 6, 1 Grade 5, 1 Grade 4, 1 Grade 3, 1 Primary School)</td>
<td>3 days</td>
<td>Clock, Calendar, Pricing sewing, Exercise on ○ and □.</td>
</tr>
<tr>
<td>6.2.81</td>
<td>Lae</td>
<td>6 Business Development Officers.</td>
<td>1½ hours</td>
<td>Instructions for Storekeepers. Pricing goods.</td>
</tr>
<tr>
<td>16-20.2.81</td>
<td>Loxengau</td>
<td>20 Businessmen. This course was run by the Provincial Financial Adviser using materials developed by himself.</td>
<td>5 days</td>
<td>Stocktaking. Stock Control. Net Worth.</td>
</tr>
<tr>
<td>24-27.2.81</td>
<td>Kupiano</td>
<td>26 Village Representatives and Trade Store Keepers, (1 Grade 2, 3 Grade 3, 10 Grade 6, 3 Grade 8, 5 Grade 9, 3 Grade 10, 1 Grade 4).</td>
<td>4 days</td>
<td>Lengths. Pricing Sewing: Clock. ○ and □. Metre rules.</td>
</tr>
<tr>
<td>10-12.3.81</td>
<td>Goroka</td>
<td>10 women intending to teach other women (3 Grade 10, 1 Grade 9, 3 Grade 8, 1 Grade 7, 1 Grade 6 and an expatriate.)</td>
<td>3 days</td>
<td>Snap game, Piles of money, Pricing sewing, Pricing kaikai, Calendar, ○ and □, clock, Stocktaking, Cash Sheets, Comparing Prices.</td>
</tr>
<tr>
<td>13.3.81</td>
<td>Port Moresby</td>
<td>About 40 National Inservice Training Week Co-ordinators.</td>
<td>1½ hours</td>
<td>Comparing Prices, Converting from Imperial to Metric units and between currencies, Constant Function.</td>
</tr>
<tr>
<td>17.3.81</td>
<td>Laloki</td>
<td>About 20 Business Development Diploma students.</td>
<td>2 hours</td>
<td></td>
</tr>
</tbody>
</table>
Terms: Strictly Cash, ILPOC, PO, or cheque (made out to Laloki Calculator Project), with order.

Guarantee: Calculators carry a 3-month guarantee.

Basic Calculators:

Sharps EL220 with Memory, % and \(\sqrt{\text{ }}\) keys, and 10 000 hour battery life: K6.00 including 50 toea postage.

Sharps EL8158 (production now discontinued) as for EL220 but slightly larger: K8.00 including 50 toea postage.

Scientific Calculators:

Sharps EL508 with 31 functions including trigonometric and statistical, 5 000 hour battery life. K13.00 including 50 toea postage (Orders of 50 or over K12.00 each including 50 toea postage.)

Arithmetic Workbook

Unit 1: Totalling and Finding Change.
Unit 2: Checking Invoices and Pricing Without Freight.
Unit 3: Pricing with Freight.
Unit 4: Cash Book and Bank Book.
Unit 5: Leakage and Net Liquid Assets.

Each unit includes full instructions and examples and is self-contained except that Unit 3 depends on Unit 2. Memo sheets summarising the skills taught are included with each unit.

20 toea/unit including 5 toea postage.
K1.00 the set including 25 toea postage.

(Elaboration of the same price is being prepared.)

First Calculator Course

3 units consisting of 1 sheet each, with minimal instructions and revision exercises on the back.

Unit 1: Totalling with + or \(\times\) and finding change, Cash Book.
Unit 2: Totalling with + and \(\times\) including use of memory, Checking invoices, Notes and Coins Slips.
Unit 3: Use of \(\times\) and \(\div\), Pricing cargo, Measuring in metres and centimetres with use of \(+ - \times \div\), Analysis sheet.

1 toea/unit *

Cut Trace Game: 1 sheet of card 5 toea *

Tin-Tea Game: 2 sheets of card. 10 toea *

Snap cards: 4 different sets (as in Tem lab): 6-10 half-sheets of card. 20 toea *

Metro Rulers: Each centimetre marked and labelled.
K2.00 including 50 toea postage.

* There is no charge for posting items marked * provided the total cost of any one order is at least K1.00. For smaller orders add reasonable postage.

\[
100 \text{c} = \text{K1.00} \quad \text{K1.00} = \text{£0.70}
\]
APPENDIX 2

Report on the 18 tours undertaken on behalf of the Numeracy Project

October 1980 - December 1981

CONTENTS

Description of tours and references to text of thesis

ANR 1   ANR 10
ANR 2   ANR 11
ANR 3   ANR 12
ANR 4   ANR 13
ANR 5   ANR 14
ANR 6   ANR 15
ANR 7   ANR 16
ANR 8   ANR 17
ANR 9   ANR 18

Note: The ANR number is to be found at the bottom of each page of the Appendix.
### ANR REPORTS

**Tours by Mary and Allen Edwards in Papua New Guinea 1980-81**

<table>
<thead>
<tr>
<th>ANR</th>
<th>Location</th>
<th>Dates</th>
<th>References in the text are in sections</th>
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(All tours are referred to in the Table in 3.5.2)
DEPARTMENT OF COMMERCE NUMERACY PROJECT

REPORT ON VISIT TO KUPIANO BY MARY & ALLEN EDWARDS, 15-18 OCTOBER 1980

Purpose

The purpose of the visit was to assess the arithmetical needs and possibilities of providing training for (a) regular clients of Business Development Officers, (b) other businessmen and women, (c) other adults who wished to learn more basic arithmetic for business or other reasons.

Co-operation. The District Business Development Officer, Paul Baru and the Area Business Development Officer, Cuthbert Sirisi, were most helpful throughout, one of them always accompanying us. The (female) Community Development Officer also kindly came on one of the days and made it easier for Mary to contact and understand the women.

Visit 1. Client CK 1: Ocogiu Family Store, Kupiano

Alova Alama and Aopi Vele were interviewed with Paul Baru: English was adequate. They had a hand-held calculator which they sometimes used for change.

They seemed able to price merchandise using their calculator. They would welcome being taught to do a Bank Reconciliation and do their accounts.

A girl serving was questioned by Mary: she had worked there 2 years and was able to total bills and work out change accurately and rapidly in her head. She said the old people who had learned dollars and shillings painfully had now given up and asked for help with money in the store.

Visit 2. Client CK2: Gathoa Kerlierlipu Business Group (Inc)

Philip Mita had a calculator but did not know how to use it for pricing goods. They did not have a cheque account because one had been misused. He would be glad to be taught how to keep accounts.
Visit 3. Client CK 3: Vuvuara Trade Store

Laa Rabu has Grade 10 but is very hard to converse with. He did his pricing correctly using long division. (He also used long division to divide by 10).

He did not want a cheque account, paying cash for goods: he also thought he did not want to keep accounts, but Paul says he wants to get a bank loan so will have to.

Group GK 1: Gavuone Village (IMS Part, not SDA)

Laa Rabu and one or two others talked about their businesses. Some were trying to start a fishing business. There were enough educated people to run businesses. About 10 had calculators in 400 adults.

On the other hand Laa did think most adults would want to learn more arithmetic if given the chance, especially carpenters and canoe maker

Kina Kagena, a grade 8 leaver (Kwikila 1973) took Mary to a women's group who meet on Wednesday afternoons. Of the 30 women, 3 had spent 2 years in High School and 8 others had a Community School education.

There was noisy agreement that,

(1) they did not know enough about numbers

(2) they wanted to learn more

(3) they knew they were often cheated when buying/selling.

(4) Why couldn't Mary come and teach them all about Kina and toea next Wednesday afternoon?

If a programme were provided Kina would like to help and to learn to teach the women.

Visit 4. GK 2: Kerelakwa Village

Mr Milila ran a Tractor concern but the tractor was out of order and still on Hire Purchase. He used it for gardens. He also dealt in copra, firewood and fishing. Some collected crocodiles. Some want
to set up a petrol outlet (it appeared to be for sale at K1.75 a gallon with kerosine at K1.70) and others had applied for cash for a Copra drier but DPI had turned them down. Agaware, Grade 8, kept the books but not I imagine very much though he had a calculator.

They were sure plenty would want to learn number skills if they could, and that someone could be found to go to Kupiano to learn how to teach the rest.

Mary saw the pastor (UC) and his wife: they said coastal women do understand money. All the older people had been well taught at the old IKS school and could still $ - x$ and $\div$. The younger ones were being helped by the older ones. The pastor was also worried about the reading skills of children today who were no longer taught phonetically and therefore could not read their own language in which they had the Bible.

Visit 5. GK3: Waini Village

This is on stilts in the lagoon, though the villagers used to live on land. We were welcomed vociferously by hordes of young children. There were plenty of passengers and freight for canoes with outboard motors (20t to Kupiano; 50t for a bag of copra: K1 was asked but refused): their income seemed to cover expenses. Canoes were built: K250 for a big one. Crabs, fish and prawns were sold. Trade stores do not last long, possibly because of under pricing. The client's rule of thumb said "3lt in Moresby so 45t here."

Plenty would want to learn number skills given the chance, "so that they can run their own businesses by themselves." None of them have calculators. Their use would be appreciated particularly for knowing how much they should receive when selling copra, and checking invoices.

They would be glad to send someone to Kupiano to learn how to teach them the skills.

This was confirmed by Mary who talked to the Pastor's wife. Their motive would be more because they wanted to learn new things, rather than because of business interests: they make mats for church funds and reckon the cost of a small one is K1.00 so try to sell it at K2.00 and so on.
Visit 6. **GK4: Wanigela**

This was a larger, SDA village on stilts. Mr Uroni is a big man and in the Provincial Government. They have Trade Stores, a cattle project, farming, fishing, outboard motor, transport, PHV (Kupiano to Moresby). He sells kerosene and benzene. Coconuts are being planted now.

Gideon has a calculator to keep their accounts, but pricing appears to be done with an old ready reckoner which gave the total selling price but this was an arbitrary figure above the actual cost price, in one case 25% and another 40%.

They would be pleased to send someone to learn how to teach the adult the suggested skills. They do not know how to measure in metres. They had one calculator which had cost K25.00 and thought various families would buy one at K7.00 each.

Some women make skirts but generally not dresses, because they cannot measure. Older women cannot even count money although they do buy and sell. Young women have been to school but are not allowed to go buying and selling.

Visit 7. **Group GK5: Kapari Village**

We reached this by c.r over 5km of shore while the tide was out; the alternative is a long walk through swamp or a rough sea journey. We spoke to Councillor Renagi Puele whose son is at Sageri.

Some trade stores in the village failed because of the high and unreliable charges of PHV operators: small loads are costly and if the prices are too high the customers will not buy.

Renagi does well, but he only records the cash he has in the till each week. He has Passbook but no cheque account. He only adds an invoice to check it.

The village would send representatives to a number-school course. They only know feet and inches, and need to be taught metres.
Mary found the Pastor at first unwilling to believe they needed to be taught, but he eventually agreed that the women's fellowship would welcome it and needed the skills, especially measuring, as without it they could not learn to make clothes. He would like us to come to their Women's fellowship Convention, 6-12 November and teach the women there.

The pastor complained because he had not been told we were coming. He was much more co-operative when he heard that I was the Hon Treasurer of the Melanesian Council of Churches.

Group GK6: Further half of Kapari Village

We found two responsible men in the further half of the village where they own no land and live by fishing. They build big racing canoes. They have 5 Trade Stores: some were said to fail because of "misuse of funds."

Most people can count money but are not good at calculating change. They would happily send representatives to a course in Kupiano to learn how to teach number skills to the rest of the adults.

There seemed little demand for business skills because of their lack of land on which to set up projects.

Visit 8. Group GK7: Lalaura Village

We spoke, through Paul Daru, to Bill Genia, the father of the Secretary for Lands. They have an excellent trade store, with tins of refrigerated pineapple juice. They are open 6 am to 8 pm with 3 shifts of sales staff. Mary talked to the girl on duty and showed her the quick way to find change on the calculator. She had been working there 2 months and knew enough to recognize wrong answers.

Bill Genia claimed that legislation in 1973 had promised adult education but that this never materialised. They very much wanted to be taught basic English and arithmetic.

I asked him why his people wanted money: he said "to set up their own businesses and for their basic needs."
Paul Baru does the statement and Balance Sheet for the Group: he did not seem to think it worthwhile teaching them the rather complicated procedure for converting their well-kept records into the form of accounts that were needed.

Visit 9. Group GK9: Nerani Village, Bonguina

The spokesman runs a Trade store and does most of his own bookkeeping. He is a DPI clerk. Members of the Council Committee were gathered around and I asked that they consider whether or not they would be willing to send representatives to a course to learn how to teach their adults arithmetic. After some discussion they gave their approval. There would be no problem in finding families who could buy calculators at K7.00 each: the spokesman bought one there and then.

They still measure in feet and inches and weigh in lb except for copra, when they are unable to check that they are being given the correct amount.

Mary found a very responsive group of women with a Grade 10 boy to translate. (He was hoping to go to Sogerii or Laloki). The women admitted that they sold mat-making materials to another village at K1.00 per roll, but that it took 2½ such rolls to make a mat themselves, which they then sold for K2.00.

Two of the older women led the demand for teaching in basic English and Arithmetic. They had some Grade 8 drop-outs whom they would send for training and the adults would learn from them.

They told Mary, in effect, "We know we are old-fashioned in this village but we want a woman to come and teach us things like sewing, European cooking, English and how to work out change. Will you come and spend 3 days in our village doing this for us?"

Visit 10. GK9: A group of men from Dom village

With their pastor they were building an Aid Post beside the main road.
They had Trade Stores: these failed because transport costs were high and unreliable. The PMV operators had no fixed system for charging so the Trade Store keepers got frustrated.

They were keen to learn and would happily send representatives to a course.

**Accommodation:** The Guest House had been allowed to deteriorate for years and had been taken over the previous week by a citizen Trevor Baker. He explained the inconveniences which we happily accepted, and were pleased to find that the charges were appropriately reduced. Trevor Baker is a very fast worker: he bought the property including trade store, Post Office, Tavern and petrol outlet at a low price and obtained completion in 31 days. He intends to set up a wholesale business which will solve many of the problems of the local trade stores. He intends then to indicate recommended selling prices on his invoices, as is done by Steamships. I believe he will offer fair prices: I have no doubt it will be in operation very soon.

One of the nicest things that happened to us was that Cuthbert invited us to stay in his house on our next visit.

**Conclusion**

Some regular clients could probably be assisted with training in pricing though this could be reduced if Trevor Baker's scheme gets going. A few could benefit from using correct chequing procedures, though a cheque account does add to their risks. The BDO seemed to think that very few if any would benefit from being taught to keep their accounts.

The vast majority however were keen to improve the general arithmetical level in the villages and would happily co-operate by sending representatives to a course and by purchasing calculators.

My feeling is that on our next visit we should set up such a trial course and include alongside it specific teaching in individual matters as requested by businessmen and particularly by BDO clients.
Co-operation

George Auro, Acting PBDO, introduced me to the PCDO Noel Tererembo and the Women's Advancement Officer Barbara Maira, the Adult Education Officer Benson Toroi (the Provincial Superintendent being in a meeting) and the Manager of the Village Development Centre Guma Elijah. The Administrative Secretary James Siooa was not available.

All expressed interest in the suggestion of an Adult Numeracy Campaign.

Business in Cro Province

George Auro ran through his list of businesses in the Province which can be analysed as follows:

96 Business Groups including:

18 ceased or dormant
17 not yet operating
4 Coffee buying
4 PMV
2 Rubber buying
2 Cocoa buying

and 1 each of Workshop, Workboat, Cattle raising, Fishing, Second hand Clothes. Also 27 "small trade stores in villages", 14 other trade stores.

28 Private Companies including:

2 ceased or dormant
6 not yet operating
8 expat-owned or managed
8 cattle
2 coffee buying

and 1 each of Cocoa buying, Business Arm of Provincial Government.

26 Sole Traders including:

7 ceased or dormant
1 not yet operating
4 builders
2 secondhand clothes
and 1 each of road maker, trade store, wood carver, seamstress, crocodile buying, plumber, painter, electrician, truck operator, ice block maker.

855 other traders who had consulted the BDO during the past 3 years including:

- 79 at Afore
- 66 at Ionia
- 91 at Kokoda, with help still being given to
  - 1 Theatre
- 530 at Popondetta, with help still being given to:
  - 3 workboat

and 1 each of PMV/TS/Crocodile skin operator, cattle, hire car/taxi, secondhand shop, trade store, chicken farm.

and 89 at Tufi.

Substantial help was being given to:

- 19 of the Business Groups
- 3 of the Private Companies
- 7 of the Sole Traders

These included:

- 15 Trade Stores
- 3 PMV/Trucks
- 3 Coffee buyer

and 1 each of workboat, Fishing, Wood carver, Seamstress, Electrician, Ice block maker and the Business Arm of the Provincial Government.

5 other traders received substantial help from the Technical Officer, Benson.

In reply to my question "What is it that really takes up the BDO's time", George replied:

In Trade Stores: Loan application, pricing, initial teaching of use of cash book, doing accounts six monthly.

In PMV's: Loan application, initial teaching on cash book.

In big stores a much longer period of initial training was needed and in some cases did not appear to end.
On the other hand the larger firms were now moving towards employing professional accountants.

The main problem for FMV's is the high price of spare parts and repairs.

Village Development Centre

This is one of 5 supported by World Bank loans, the others being at Pangia (SH), Vanimo, one near Goroka and one near Kainantu.

Mr Guma has 7 staff including:

3 Home economics, 2 agriculturalists, 1 carpenter/builder and 1 mechanic.

Each of 12 villages had been visited weekly for 3 years and another 13 were now being visited weekly.

The whole program, he said, needed reviewing in the light of the villagers' failure to understand numbers. This lack made it very difficult for them to undertake any operation without expert assistance. Clothes for example could only be made if they had patterns, and dimensions for buildings had to be worked out by his staff.

We discussed the content of a basic arithmetic course for adults. It was agreed that all needed to measure and estimate in metres but it was difficult to decide whether mm and/or cm should be used as well.

A more substantial course was needed for the potential carpenter/builders: this would involve knowing sizes of sawn timber, plywood, corrugated iron and arranging lengths of buildings to be multiples of sheet sizes etc.

I asked if there were any number-based games that could be taught. Cards are used exclusively for gambling.

Women's Work

Barbara (WAO) took Mary to a Meeting of Mothers Union Officers at the Bishop's House (at which she subsequently discovered there was an NBC reporter present).
The women were very aware of their ignorance of pricing procedures: This was illustrated by the macrame work they had been doing. Mary had to ask them how many pot holders they could make with K1.95 worth of materials. This turned out to be 2. She then had to persuade them that K1.95 was nearly K2.00. Then only a Grade 10 person, after long thought, was able to work out that 1 pot holder had cost K1.00. They still had no idea what the selling price should be.

They were very keen to be taught. They would be happy to learn from a Grade 8 "drop-out" if one could be trained to teach them, provided she was female.

Client CP1: Yega Basabuga Business Group

This had only been open 7 months and one of the group had attended a course run by the BDO. They had an automatic till and kept excellent records. Their pricing was done meticulously but their allocation of freight costs was in fact erroneous. They did not, I think, do a Bank Reconciliation and could not do their stocktaking with the present complicated pro forma.

They also wanted a course on the relationship between chairman, committee and secretary.

Client CP2: Edojari, Popondetta

The manager was out but was apparently competent except perhaps on Bank Reconciliation. They would like to be taught how to do the accounts themselves.

Client CP3: Stafford Weroura at Oro Bay

We were with BDO Willie Gaviro all day, which was excellent as this was his home area. Stafford was very lively and had had his store since January 1979. He bought a calculator as soon as I showed him one and he learnt how to price his goods on it, although he uses pencil and paper at present.

He even did his own Trading Statement and wanted to be taught how to do a Balance Sheet. We would be happy to come to Popondetta to learn more.

Client CP4: Orereba & Sons, Oro Bay

Lomas has operated successfully for a long time but has a very limited education and keeps no cash records but has promised the BDO he will start to do so. He has a separate bank account (passbook?) for each of his businesses. He was not in: his wife uses paper and pencil to give change.
She also told Mary that she was hoping to get a K9000 grant to build a Community Centre. The girls were already earning money but this was going towards the Centre so they were not able to get a sewing machine. She did not seem to be keen that the girls should learn arithmetic.

Client CP5: Murray Bundu, Baberada

He had just started a canteen and was keeping his cash book neatly. I explained how the total should be written in on each line and how a calculator could be used to total the columns and cross check with the grand total. I also showed him how to check an invoice.

Group GP1: Baberada

They run a Trade Store, and sell coffee, cocoa and copra. Our informant could check the cash received for coffee by long multiplication in a simple case but agreed a calculator would be useful for him and essential for others.

Most of them can work out change but they would be happy to send a representative to learn more arithmetic.

The women were too excited about their imminent departure to dance at the Morobe Show to discuss anything much, but they did agree that they had no idea how to price the scones they were making for sale. They would be glad to send a representative to a course.

Group GP2: Kanipe Village

The family of 12 adults and cheerful well-fed children had had a Trade Store since 1975 which now sold secondhand clothes. They had a Baking oven built for them by Vocational Centre. One had a calculator and was keen to learn how to use it to keep his accounts. He records his daily takings but not his expenditures. Prices are "estimated". They did once check an invoice and found they had been overcharged.

They mostly know the very basic arithmetic but would like to learn more so that they can price their scones. They also burn their bread and need to borrow a watch and learn to use it.
This was the only village we came across where the women appear to have a real say in what goes on. The oldest child is a girl in Grade 9 and they hope she may get to Sogeri.

Group GP3: Embi Village

This was one of the poorest villages we have visited, with gardens a long way off and little business except a small trade store (according to the men, but not even that according to the women). Both men and women said they could add money: the women were sure that 1 kg of sugar at K1.10, 1 tin of fish at 65t and 1 packet of rice at 60t came to K2.60 "because it always did".

Most had been to the Mission School, up to Grade 2 but that was probably all.

Group GP4: Agenahambo Village

It was at one of these villages that we worked out the correct price for tins of fish being sold at 60t each and found it was 43t. This might not however encourage the Trade Store keeper to use a calculator. Other uses I suggested were for finding the lengths of wood required for building a hut (but they only used offcuts from the sawmill) and for finding how many sheets of corrugated iron they needed for a roof. In practice they guess how many sheets to buy: if they get too many they use them for something else, if they get too few the rain comes through till they can go and get some more. This happy-go-lucky attitude to the use of materials is similar to their attitude to pricing: "If we charge too much for the fish and too little for the rice does it matter?"

One can sympathize with and even take a delight in this attitude but in reality it is precisely this care-free approach to life that makes it so difficult for them to compete in a world dominated by the "North". Arithmetic provides the precision which is a necessity for survival today.

We had also come to the conclusion that we really must do some objective measuring to determine how much the ordinary adult really knew. Mary therefore took the test which had been prepared and applied it, as far as seemed appropriate to one of the Grade 6 women.

Language was no real problem but getting across the idea of "profit" proved to be impossible. The organization of the test also proved difficult because when it was designed I had no idea which questions would prove hard and which easy. It will be sorted out before our next tour.
Group GP5: Hohorita Village

(On the way we visited Koipa Village but not enough people were around on a Friday morning to make it worth interviewing them.)

As in the previous village they were soon convinced that it was "important for them to learn how to use the calculator" and they would happily send representatives to a course with money to pay for one.

Mary again enquired about "profit". A Grade 6 woman knew that if 1 scone was sold for 20t, 5 would be sold for K1.00. When shown four 20t and two 10t coins she could see that if she had had to pay 30t for the ingredients the "profit" would have been 70t, but it is not certain if she had really understood "profit" and she certainly could not work it out without having the coins in front of her.

(The next call was at Edogori Store, Isivini, but the manager was away while it was being renovated by a carpenter - who was working in feet and inches of course).

George Clapp, District Officer

We had a very useful talk with this experienced officer who initially wondered whether we were "academics" with unrealistic ideas of villagers' potential. After explanation and discussion he expressed himself fully convinced that the operation was worthwhile even if, as we all knew, there would be plenty of failures. In particular he pointed out that Grade 6 "dropouts" might be more interested in finding a chance to get away from their village, than they would be in teaching their fellow adults. If however the village had deliberately sent them on the course for this purpose there was a reasonable chance they would carry out the task first. It would not matter if they subsequently took advantage of their own additional skills.

Paul McAdam's Materials

George McAdam kindly made available to me the teaching materials that had been left behind by Paul McAdam, the CUSO Field Training Officer.
The following were included:

1. Directors' Course Tufi: a Test Sheet.
   - Finding Unit Cost Price given price for a carton.
   - Definition of markup as "difference" between Cost Price and Retail Price.
   - Adding a % markup. Profit.

2. Training & Reporting Sheets


4. Co-operative Director's Course.

5. Miscellaneous course papers including Case Studies, Running a Marine Industry Service, Balance Sheet for a Workshop, a Test including long multiplication of 38654 x 297 and division of 86535 ÷ 43.

Proposal

The following proposal was agreed by George Auro and will be put to the Administrative Secretary and FCDO subsequently.

It is suggested that if the funds and approval are given to continue this work in 1981, Mary and I should set up two pilot courses to run concurrently, lasting a full week in either February or March. One would be for businessmen, with a BDO to help. The other, with the assistance of a woman CDO if possible, would be a "Numba Skul" to train 2 or 3 adults from each of several villages so that they would be able to go back and teach the rest of the adults in the village.

All those attending these two courses would have to bring or buy calculators.

NOTE ON MEASUREMENT

The metric system of measurement is poorly adapted to village use. The official "Système International" or "SI" system, units which differ by factors of 1000: kg and g, l and ml, m and mm. This immediately involves the use of numbers over 1000 if the smaller units are used, or 3 decimal places with the larger units. Neither of these concepts is likely to be acceptable to a villager for a long time.
On the other hand the villager is familiar with numbers to 2 decimal places: they are used to dealing with sums of money up to K10.00 or even K100.00. The obvious idea then is to use the same sort of notation for measurement.

Most of the lengths which would be used by a villager are less than 10m, or 100m at most, so the suggestion is that we introduce a metre rule that is marked in centimetres and labelled .01, .02, .03, ..., .99.

Given this instrument reasonably accurate measurements could be made of furniture, buildings, fencing, gardens or games areas.

Sawn timber requirements for a piece of furniture could be found using the calculator to multiply and add (as in an invoice). Quantities of fertilizer required could be found, based on area. The numbers of sheets of corrugated iron for a roof, or plywood for a wall could be found by division. Later when designing the building one could decide first the number of sheets to use and then adjust the dimensions of the building to use an exact number of sheets, avoiding wastage.

Mathematically there is another very important advantage in introducing this idea of measuring in metres to 2 decimal places. It is that numbers are used (1) "discretely" as in money where you only use a whole number of toea, or in counting tins of fish, (2) "continuously" as in lengths or weights which are never exact but always require some degree of approximation. (The ordinary clock tells the time on a "continuous" basis: the digital watch uses numbers "discretely".)

The "discrete" idea is generally familiar to the villager but the "continuous" is not. This probably accounts for his extreme difficulty in estimation. The idea that 1.95 is "nearly 2" is obvious if we think of numbers stretched along a line, but there is little obvious relationship between a pile of coins worth K1.95 and a K2.00 note.

Those of us who have been brought up with numbers are able to slip easily from the discrete to the continuous, as when measuring a person's age "discretely" in years for example, but then being able to distinguish between "just 6" and "nearly 6" using a "continuous" idea of time.
This transfer between the discrete and the continuous is probably an essential element in the process of estimation, and the lack of this facility could be one of the most serious blockages in the villager's understanding of numeracy.

So long as numbers are thought of "discretely" this blockage will remain. Only when the villager becomes familiar with some "continuous" use of number will the break-through occur and transfer to other applications become possible.

If lengths are measured in metres to two decimal places, it is easy to use the calculator to add, subtract, multiply and divide them. The fact that the same notation is used for money and for length would make transfer possible. This development could provide villagers with one of the most important and useful mathematical concepts.

(The above note results from my discussions with Guru Elijah, Tony Watt an agriculturalist at the Christian Training Centre, the villagers at Agenahambo and my wife.)
DEPARTMENT OF COMMERCE NUMERACY PROJECT

REPORT ON VISIT TO SOUTHERN HIGHLANDS BY MARY & ALLEN EDWARDS

29 OCTOBER - 8 NOVEMBER 1980

(29 October)

Group GM1: Village of Koen

Alistair Woodcock, FTO, suggested we visit the trade stores in and around Mendi but we asked instead to be taken to a village.

At Koen we saw a Councillor who organised the women into meeting Mary, and the men into meeting with me after I had interviewed their Trade Store keeper.

Language was difficult, Alistair translating into Pidgin and a Grade 6 lad called "King" translating that into Ples Tok.

The Trade Store keeper, Mr Kekan (ref BM1) was old and uneducated. He found some invoices and I saw that the addition on one was in error. I showed him how he could check the invoices with a calculator but I am not sure he even understood then that he had been overcharged. "King" did understand and I suggested Mr Kekan might like one of the youngsters to learn how to use the calculator to help him. He agreed, but was doubtful when I explained it would cost K7.50 for a calculator.

The village had had some cattle once but now only sold vegetables. No doubt the main income would be wages from work in Mendi. They had no wish to set up more businesses.

They agreed they would like to learn more and would be willing to send "King" to Mendi to learn how to teach them, and would pay for a calculator. The only Grade 8 lad living in the village had some English but had forgotten his Ples Tok.

Mary found inability to write numbers although they could work out 4 scones at 20t. It proved impossible to convey any idea of profit: reference to a cost price of 30t for the ingredients produced wild answers like K7.00.
(The next village on up the old Hagen road was completely deserted and doors were padlocked.)

Group GM2: One Village

They listed their "businesses" carefully: (1) selling pigs, (2) bride price, (3) selling vegetables, (4) selling karoka nuts, (5) 2 Trade Stores. They would like to grow and sell coffee.

They counted money as shillings (= 10t). They knew the change for 60t from K1.00 but had no idea of K1.23 from K2.00.

They had an iron roofed government-built building and thought they might want to put up iron roofs one day. Some of them understood when I showed them how to calculate the number of sheets needed, using my newly made measuring stick (in cm, marked .01, ..., .99).

They were impressed and would like to learn. They would also be willing to send a Pidgin speaker to a course in Mendi to learn to teach them and they would find the K7 for a calculator.

The women were less responsive. 1 girl had once left the village to be a nurse. They knew they could not check change. The girl Mary tested was not sure about recognising numbers and could not count out money involving coppers.

(We found another small deserted village before returning to Mendi.)

Bernadette Mone CDO She was President of the new Mendi District Women's Association. They are thinking of selling secondhand clothes. Her job as CDO is to encourage sewing and cooking. She seemed to find the idea of profit difficult. She did not appear confident on pricing and intended to get help from the DOs. She was sure that she and the Presidents, Treasurers, etc, of the other Women's Associations in the Province would be pleased to attend a course.

Joseph Ogaie, Adult Education Officer Joseph had a most interesting programme in which he worked through the churches in the area to teach literacy, mainly in the local languages. Some of these teachers would
be meeting in Mendi before we left so he would see if I could be invited to meet them. Fortunately I had already written to most of the missions enclosing introductory letters from the Melanesian Council of Churches.

(30 October)

Joseph Keviane, Provincial Secretary  He had already approved Mary Dickie's request and instructed Alistair to assist me. I explained that in our brief visit so far we had got the impression that adult numeracy in the Southern Highlands might have to be only for special groups due to the apparent lack of present need for it in the 2 villages we had seen. I also said we thought it would be fine if we could get the Literacy people to incorporate some numeracy in their courses. This he warmly endorsed and arranged to see me again at the end of my visit.

Trade Store Course at Nipa  Alistair had arranged with the Nipa BDO Lunge Rias to run a course on the Thursday and Friday. He had handed this over to me so I had brought 15 copies of Units AB111, 211, 212, 213, 223 for an expected 10 candidates. 15 turned up together with 17 High School students whose relations ran Trade Stores in their villages.

One or two expatriates in Mendi had expressed doubts about the suitability of calculators although one substantial argument - battery failure - no longer applied. We were therefore very interested to see how these people would respond.

The language difficulty was largely overcome by Lunge and the High School students, who attached themselves to individual storekeepers. At first the students caused some confusion by giving different instructions from mine but they eventually accepted the role of occasional adviser and, in about 4 cases acted as writers for those who could not write numbers.

2 other older trade store owners were in fact the only ones who were unable to cope with totalling and finding change with the calculator. These two, Agen and Oreb, were so clearly out of their depth that Mary spent the afternoon with them, with the help of a student translator. Agen could usually match the numbers 1, 2, ..., 9 to numbers of dots, but Oreb could not. Agen eventually admitted to knowing the English names for 1, ..., 9, and 10, ..., 90, but Oreb did not. Agen could match multiples
of 10t to coins, but Oreb could not. Agen could make up sets of 1t, 2t, 5t coins worth 10t, but Oreb could not. Agen could count money in multiples of 10t (thought of as "shillings", no doubt) and gave change from K1 or (very, very slowly) K2, but Oreb could only do it with even multiples of 10t, after much thought, and not for K2.00 (referred to locally as £1). But Oreb could make up K1.00 out of a mixture of 20t and 10t coins.

They each sold 6 items in their Trade Stores, all priced at 20t, 40t, 50t or 60t. They could generally add two of these prices together and Agen could sometimes add three of them: he could also tell the price of 2 of any one item or 3 of the 50t or, surprisingly after a long silence, 4 at 60t. When asked in ples tok how he did this he would only say "in my mind".

Oreb seldom gave the right change from K1.00. He used fingers to add and to find 3 at 20t. He showed intelligence by trying to work out 6 at 40t by collecting 6 lots of 40t together but there was not enough change available.

Agen waits till he has K240.00 in his hand, then he pays K40.00 for transport and goes down to Mendi to buy K100 - K200 worth of goods.

One wonders what sort of training course should be offered to such people: perhaps basic numeracy would enable them to work in toea instead to 10t's. (This is essential if price control is to operate.)

Most of the rest of the class successfully completed the test on totalling and giving change with the calculator. Some completed Unit 211 on checking the Cash Sheet and entering "unders" or "overs".

Before the end of the first day 6 of the 15 had paid K7.50 each for calculators.

(31 October).

Most of the class turned up next day except for Aken. Oreb and one or two others who could not write were happy to watch others do the work and at this stage we did not insist.
Most finished Unit 211 and did the test satisfactorily. After lunch I wrote three invoices up on the board and took them all, as a class, through using the memory to check the invoice, and to do pricing and calculating the total profit (if all sold). This was quite an ambitious undertaking but the brighter storekeepers and the High School students who were still present managed it.

For the freight we worked in "packages" consisting of 1 carton of fish, 2 bushknives or 20 tins of tobacco etc. The freight per package was found by division. There was some difficulty when 1 package contained 3 boxes of bubble gum each box containing 60 "gums", as this meant dividing the Landed Cost of the package by 180, but on the whole this method seemed to be the best I had tried so far: in practice, with an actual "package" in front of them they could probably see easily enough how many units it contained.

It was clear that none of those present had had any idea of pricing previously. Lunge assured me he would follow up the teaching so it will be interesting to observe results.

At the end, one of the Grade 9 students asked where he could continue learning these things: I suggested he opted for Laloki next year: Lunge also assured him that Alistair and he would be running more courses locally.

Group GM3: Kuare Village

The District Manager at Nipa had suggested we would get a better response to the adult numeracy suggestion around there than we had had at Mendi. So on the way back we called at the driver's village.

One of the group was Grade 8 and well able to translate. They sold vegetables and coffee and would like to start cattle and chicken projects. They confirmed something else the District Manager had said, that they thought the coffee-buyers cheated them but few could argue the matter. They said the buyers avoided the Grade 8 adults.

The group were quite clear that they would welcome adult numeracy and agreed that if there were a course in Mendi they would send some adults to it with money for calculators.
Nipa Girls Homecraft Centre

We had visited this United Church Vocational Centre in 1978 when we had also stayed at the High School. We were pleased to see how rapidly both institutions had developed. The warden of the Centre, Mrs Nawai (from Fiji), said she would be in Mendi for a Workshop shortly so we hoped to get invited to discuss numeracy with them.

(3 November)

Health: Mick Hohnen, District Health Officer and Janet Hohnen, World Bank Health Training Officer

In a brief interview we explained that our concern was with adult numeracy with the use of the calculator. Janet appeared to be immediately convinced that the use of a calculator could solve many of the at present unanswered problems in Aid Post Orderly work.

The fact that Aid Post Orderlies live in villages makes their involvement in any Adult Numeracy programme highly desirable.

I mentioned that I had suggested to Mrs Williamson in Popondetta that it was the task of the APO teacher to identify precise problems they would want APO's to solve, Janet agreed that this was the only way, although it would be a time-consuming exercise. She had just been at a conference in Port Moresby and suggested I contact Prof Chang of the WHO when I return there.

Mick invited us to continue the discussion on Friday when Janet will have returned from a visit to an outstation.

St Paul’s (United Church Pastors Training) College

Mary tried out part of the proposed Basic Numeracy course with a group of 6 men and 3 women at the College. 4 had Grade 6, 5 had no schooling at all. None had seen a calculator before. The language used was Pidgin. (The warden’s wife, with an Oxford degree, was also present, having never used a calculator either.) All the students had had some numeracy teaching from the Warden, the Rev Bernie Collins, and knew their numbers.
in English up to 999 and some to 9999. They spent about 30 minutes learning the "+1" game, ie setting the calculator with $1 \Rightarrow 1 \Rightarrow$ and then taking it in turns to put up a number and call out the "next" number which could then be checked by pressing $\Rightarrow$.

They also learnt how to add columns of numbers with the calculator. Both these activities were extremely popular.

B M Tente Trade Store, Mendi

Felix Rotsomana, the Mendi BDO, took me first to a largish store with haus kai but this turned out to be part of a group of 3 stores and the assistant in it had little responsibility. Instead therefore we went to the Tente store which had been bought from an expatriate (for K20 000 in March, empty of stock, and was being managed on behalf of a Business Group by Ms Joyce K.

She had all invoices and books at home and agreed to bring them tomorrow so that we could do the accounts together. Meanwhile we did a stock-take during which I taught her how to use the calculator to work out "15 piles of 3 and 4 over" etc. She took a long time to multiply $7 \times 10$ in her head. Stephen, a Government employee and a member of the group, came into help.

Bob Bailey, Adult Education, Waigani We joined him for lunch and he agreed in principle to my suggestions that what was needed was a Basic Numeracy Course which all adult teachers would use, together with additional units for particular specialising, eg pricing. This would meet his most pressing problem which was that Vocational Centre teachers were not able to devise suitable programmes for themselves.

Zachusa Thanaweka, Head of the Mendi Trade School We discussed measuring: his students are taught to convert between mm, cm and m but use mm, even for measuring lengths of buildings. He fully appreciated that village people could not be expected to handle the large numbers involved and warmly approved my suggestion of using metres to 2 decimal places, giving numbers of the same kind as in Kina and toea.

He had put up a proposal for an extension programme in Village Technology for the second half of 1981. He had specifically indicated that it should
be integrated into the Adult Education programme and welcomed my suggestion that it should include the proposed Basic Numeracy Course, together with additional items appropriate to the practical application he intended. This was to build better houses with bush materials.

(4 November)

Adult Education Workshop on the Role of Women Instructors

On the invitation of John Crofts and Bob Bailey, Mary and I took a 2 hour session with 12 women from Vocational or Village Development Centres.

We pointed out that few school leavers anywhere had sufficient arithmetical skills to enable them to multiply and divide the sort of numbers they needed to use in real life (eg 9.35m ÷ 0.76m). So the only real hope for functional numeracy lies in the use of the calculator.

We then showed them how the calculator could be used to teach number facts by "setting" it with $1 + 1 = \text{or} 10 \times 10 = \text{or} 2 \times 2 = \text{etc.}$. I illustrated the use of the memory for checking an invoice. I then showed them how to measure in metres to 2 decimal places and how to calculate the number of sheets of corrugated iron for a roof by dividing by 0.76m.

I had prepared my Second Draft for a Basic Numeracy course, this time adding a number of supplementary modules "for those interested in" business, carpentry, health, etc. These we discussed and there was general approval although some parts did seem too difficult, such as learning to multiply and divide by 2 with paper and pencil. Bob Bailey (with building trade experience) urged that cm should be omitted from the Carpenters' module: it is true that if one measures in m to 2 decimal places, mm do provide the only other unit required. So it is unfortunate (though understandable) that the schools use cm most of the time.

I also put before them my current "idea for the Campaign" which consisted of a two-pronged attack. One was to set up specific courses lasting, say, a week, a train representatives sent in by the villages so that they could teach their fellow adults. The other way was to train as many of the existing extension officers as possible so that they could pass
the knowledge onto the villages where they worked regularly.

Either way the emphasis would be on self-reliance, the villages buying their own calculators and persuading their own adults to learn. Specific funding for the Campaign would be kept to a minimum.

(The concept of "additional modules" has been subsequently revised to "additional specific skills", eg skills related to cattle projects rather than a module related to DPI work.) They were interested in learning how to price goods in the sort of activities women largely undertake, so it was agreed that Mary should explain this at an (extra) evening session on Wednesday. They would then be invited to respond further to the ideas we had put before them today.

**Tente Trade Store**

I spent the afternoon teaching the manager and Stephen. We first calculated % markups and discovered they were selling cheesepops at a slight loss while other goods were overpriced. We totalled the value of the stock using the calculator memory and analysed the income and expenditure.

(5 November)

**Henry Koale, Assistant Secretary Education (= Superintendant)** I thought it proper to see the Superintendant, having already had dealings with the AEO. I asked him about the community work of the Community Schools, which he agreed was probably more significant here than elsewhere. It was policy to encourage it and it was co-ordinated by the AEO so I could approach these schools through him. I also mentioned my interest in the Mendi Mathematics Group, of which he approved.

**Adult Education**

I then went to John Crofts and Joseph Ogaie and arranged with them to visit a school an hour's drive away and a nearby non-formal education officer tomorrow. Felix added a Trade Store in the area and sent messages by Tok Save to ensure they would all be available. John asked whether I was thinking of including genuine scales in the Numeracy kit
as some villages were selling kaukau by weight. I said no, because I want to keep the cost to a minimum so that villages can pay for it themselves.

St Paul's College

Mary took her 9 students again and used the calculator to teach them "composition of 10" (ie, 8 + 2, 4 + 6 etc). When they knew it she asked for "change from 10t": only one saw the connection. Mary had to write it, 2t, ..., 10t on shells and play shopkeepers with them explaining carefully the connection. After repeated efforts, particularly with 5 of the group, she eventually got the transfer across.

Mary then tried to transfer this further to change from 100 for multiples of 10t. Only one knew that there were 10 x 10 toea in 100 and only one other (a non-school adult) knew that 10 x 10 was 100. They became bemused when she did "change from 100" on the calculator however, so she reverted to the shells, relabelled them 10t, 20t, ..., 90t and eventually got them to give the correct change. It was not clear whether the earlier knowledge was or was not transferred to this: they might have known it all the time. All this took a total of 2½ hours.

The women's fellowship consisting of 15 urban women was not very enthusiastic although one who had done Grade 7 and left to get married was very helpful. They want money for school fees and food. They saw baking as a means of earning it and were getting an oven, but had no idea how long food took to cook and agreed that being able to tell the time would be helpful.

Tente Trade Store

I had developed a simpler algorithm for finding the mark-up % and taught it to Joyce. She managed it, with the instructions in front of her (though she could not read English). Stephen had left replies to some questions so I was able to complete their accounts but I gave them to Felix to check before passing them on.
Felix arranged for me to visit him as someone to whom I could teach my latest technique for pricing (or rather, finding the markup & given the price). I was surprised to find he already had a calculator and picked up the instructions quickly. He had not been keeping any accounts but had all his invoices and a deposit book so we resurrected most of the data needed. I completed a Trading Statement and Balance Sheet which I also passed on to Felix to check and return.

He said he had applied for a Stret Pasin Stoa course but had not received their invitation to an interview in time. He wanted to know what the BDOs could teach him so I left him the rest of my pro-formas, convinced that with a little help he would be able to do all his accounts himself. (I am beginning to believe training would be better on a one-to-one, rather than a course basis.) Afterwards I was told he had held an important post in Port Moresby.

Mendi High School: Sr Susanna, Head of Maths

I went to see her partly to arrange contact with the Mathematics Group. She was very interested, had no serious criticisms to offer and was convinced by me, (as she had not been previously) that she should introduce the calculator into school work. She will happily provide liaison for me with the Group, which has two women Community School teachers as its officers. She said she would come to the meeting this evening with the Vocational Centres Workshop.

Workshop on the Role of Women Instructors

The women were too exhausted at this stage to respond in detail to Mary's invitation to comment on the proposals we had put before them earlier. It was however agreed after some discussion that pricing of garments required the division of the price of a bolt of material by 42 to find the price per yard (the unit still being used). They did not go into details of then multiplying by a number of yards, dividing by the number of articles made and adding an amount based on the time and skill taken to make the garment.
The group were however anxious to obtain calculators, both for this sort of use and to play the "1 + 1 = " type of teaching game we had shown them earlier. Bob said he would purchase calculators from Adult Education funds and send them to them.

(6 November)

Kuma Community School

We set off with Sione Teatutai on the exceedingly poor "old Hagen" road which we had ourselves travelled, in error, in 1978. After 19 km we reached Kuma School and met the Headmaster, Dan Isaram who had been alerted by the Tok Save message.

I shared with him some of my own experiences in setting up a genuinely community-oriented school in UK. He too had representatives of the Community, of the Parents & Citizens Association and of the church (Lutheran) on his Board of Management. One of his staff members, Carl Kopaja had voluntarily engaged in teaching numbers and language (tok ples and pidgin) to adults. When Carl had left to go to Port Moresby In-service College however no one was able to continue this work: he did not have staff who were paid to do community work, whereas in England out of our staff of 135, 6 had been specifically paid to do community work (in fact many more than this did it on a part-time community-work-in-lieu-of-teaching basis).

He was clear that the greatest need in Community work was to help people with pricing. I demonstrated how this could be done with a calculator. I then suggested people sometimes wanted to put iron roofs on their houses. He said this was just what he wanted to do with his School Office but he did not know how many sheets he would need so he could not estimate what the cost would be. We immediately measured the roof using my measuring stick and found it was 5.94m long. We measured the width of 5 sheets on a classroom roof and found it was 3.80m, which gave just 0.76m per sheet. Dividing 5.94 by 0.76 on the calculator gave 9.4 which we rounded up to 10 sheets. He bought a calculator and I gave him a measuring stick.
He had prepared an interesting looking programme for Grade 6 leavers. We both thought a course on the calculator would be most appropriate for them, particularly if they were going to stay in the village. He suggested that the teachers should have a course on it in their next NIST week training and he said he would write to the In-service Committee suggesting it. I feel this is an excellent idea and I would be delighted to be involved in such a course experimentally in 1981 with a view to preparing a course for use nationwide in NIST week 1982, if this should be agreed by the Departments of Commerce and Education.

We mentioned a few other matters such as the need for scales so that they could price their kaukau and rice better. I showed him how one could use the memory to check an invoice and he asked for my materials on bookkeeping and stocktaking. He was very interested in the "Games" using the constant function on the calculator.

With Sione's help Mary had talked to some women but found them unresponsive; they seemed to do little outside their own houses and gardens. The recent frost, the worst since 1972, had destroyed most of their kaukau and they were hoping the government would provide some relief.

Mary found this typical of most of the local women she met in the Southern Highlands. The only females who impressed her as showing initiative were the CDO and 4 girls at the Kuma Community School where the Headmaster said he was hoping to send quite a number to High School this year. This suggested that the women had the potential need, but failed to develop it because of lack of encouragement from the men, due to the local culture.

GM3 & GM4: Marupukom Yanokom Business Group, Karil Village

We were warmly welcomed by a Councillor, the Trade Store keeper and Malu, the Adult Education Officer. They had Trade Store and Haus Kai and hoped to set up a Club and Tavern in addition to the poultry project run by Malu.

In their village of 600 adults no one had any schooling above Grade 6 though some children were now at High School.
I demonstrated how the calculator could be used to help in pricing and was horrified to learn that freight for a small load from Hagen was K65.00, K80.00 or even K100.00. No doubt it would have been the same for a larger load, but using their last invoice the freight worked out at K3.72 per blanket or packet of wool. The blankets had cost K3.50 each in Hagen and were being sold at K4.40. Sione explained that they were losing on every sale. We worked out the markup on the wool however and it came to 15% which was good.

They were selling good Lae Wholemeal flour and using it to make tasty fried savoury scones with onion which they sold for 10t each in the Haus Kai. The work was being done by men. We did not attempt to work out their pricing of the flour and scones which we felt might have had depressing effects.

On being asked, they were enthusiastic to come to Mendi and learn how to do the pricing if a course should be put on. They were also sure the rest of the adults should learn more numbers skills and would happily send 3 representatives, with cash for calculators, to a course to train them to teach the rest of the villagers.

It must be remembered that this was a carefully selected, and not a typical village, but there was no doubt about their enthusiasm to learn.

(7 November)

Vicki Reed, Provincial Nursing Officer

I had a long and interesting discussion with Vicki and with Dulcie Pinau, A/Community Health Nursing Supervisor, the main points of which were:

1 Calculators were issued last year to the 30 or so Health Centres and Sub-Centres. These were Canon Palmtronic LC-BM with 0.00022W rating and could therefore be expected to have long battery life, although they do not switch off automatically. (Some Palmtronic BM's with a rating of 0.4W had also been obtained and I warned that these were likely to have short battery-lives.)

2 These calculators are already used to total columns of numbers in CHN Monthly reports and Immunisation figures.
A major change-over was in process, from age to weight as a means of calculating dosages. Nurse Aids were not trained to do this as it was not their job officially, but in practice, due to shortages of staff, it would be very helpful if they could do it.

The process of standard medication required the following calculation:

\[ \text{wt-of child} \times \frac{\text{mg/kg of child weight}}{\text{number of mg in ampoule}} \times \frac{\text{no. of ml in ampoule}}{1} \]

It was possible that nurses could be taught to use a calculator to do this, but it would mean substantial new training and a high probability of error in a process involving 4 inputs with the correct functions between them. A peculiar feature of the calculation was that most of inputs would be very limited in their range, eg the no. of mg in an ampoule is likely to be one of only 3 or 4 different numbers and the no. of ml in an ampoule is probably either 1 or 2. These particular numbers are likely to be specific to a particular drug any way, so that given the drug, the calculation may only in effect require two inputs, eg the weight of the child and the mg/kg or some other function of the seriousness of the condition.

In these circumstances therefore a single sheet of paper related to a particular drug might contain all the information required and a nomograph could be used to do the one process of multiplication that remained. (A nomograph is a set of 3 equidistant lines marked with log scales, such that if a ruler is placed across them the reading on the middle scale is the product of the readings on the outer scales. Words describing a condition could be used to replace numbers on a scale if desired.) Nurses are used to reading scales so they should be able to use a nomograph without undue difficulty: this does not apply to most adults who are quite unfamiliar with reading scales.

In conclusion therefore I agreed with Vicki that so far as the particular problem of medication is concerned, a calculator does not at present seem appropriate, if a satisfactory alternative system can be designed and implemented.
Primary Industry

I met with Gregory Onesii, Staff Development Officer, two Livestock Officers, and Crops Officer and an Extension Officer.

We discussed the various applications involving number and identified 11 which are listed in the attached Fourth Draft of the Proposed Adult Numeracy Syllabus.

No experts were currently available to advise on uses for poultry, fish ponds or forestry.

The calculation of areas, drenches, insecticides and the completion of loan applications had to be done by RDOs either because of the difficulty of the operation or because of the dangerous consequences if a mistake were to be made.

The Provincial Secretary

I had a short talk with Joseph Keviame and promised to send copies of my report to himself and to his senior officers concerned. I said we had had a more enthusiastic response from the villages we had visited since we first saw him and were now hoping we might put on training courses for village representatives, if the project proceeded to the pilot stage. In addition to this we would of course be happy to co-operate with anyone else who was willing to learn how to teach the course. He suggested we should be careful not to work only in Mendi.

Adult Education Officer

I explained to Joseph Ogaie that if my survey and proposals were approved by the Department of Commerce and the Council for Village Development then the next stage would be to carry out pilot projects, one of which might be in the Southern Highlands.

I suggested that if this were the case he might wish to sponsor a course for village representatives but he pointed out that even if the villagers paid their own travel costs and bought their own calculators there could still be a substantial bill for accommodation, the lowest local charge being K10.00 per day.
Joseph was very keen that numeracy should be taught but he did not have the staff to do so himself so was very dependent on the willingness of the literacy teachers to do it. This we might test tonight.

Johnson Maladina, Provincial Community Development Officer

Johnson had been away earlier in the week and was most interested when I explained my ideas. He would be very pleased if his Youth Organisations, (concerned with pigs, chickens, vegetables, etc) could be taught the use of the calculator and was sure that women's groups needed instruction in pricing. He thought he would probably be able to solve the problem of accommodation if it came to this next year.

Dr Janet Hohnen, World Bank Health Training Officer

Janet only arrived back on Friday evening but invited me at once to come and discuss the possibilities of calculator use by APOs. She first confirmed the impression I had gained from Vicki that the calculator was not appropriate for calculating doses because this could be better done by making out charts for individual drugs. (Since my return to Port Moresby I have been told that this has been tried and not worked, but the matter is not really my business.)

On the other hand there could be many duties of APOs and AP Supervisors which would be easier with calculators. In particular she mentioned the recording of numbers of pills in "units of issue", which might involve dividing by 100, 20, 5, etc, and the adding of numbers of patients in different categories of illness for the monthly record. She also emphasized the need for teaching in the use of the calendar.

Literacy Programme Conference

The Literacy Programme in the Southern Highlands includes some 400-500 teachers and about 50 supervisors, who receive some financial support from Adult Education funds, together with programme co-ordinators etc, who are mostly paid by the Missions. The supervisors and co-ordinators were attending a Conference concerned with the teaching of Paulo Friere. They had a tight programme but John Crofts kindly arranged for me to see a reasonably representative group of 14 supervisors before the Conference
proper began. Don Burkins of the Capuchin Catholic Mission translated into Pidgin for me.

I explained that PNG villagers had few arithmetical skills but that they needed these for almost any development: I instanced the number of sheets of iron for roofing, the number of posts, wire and staples for fencing cattle, the pricing of scones and Trade Store goods. They fully agreed with the need for number skills to aid in development.

I pointed out that it was unrealistic to expect adults to learn multiplication tables, so that the only possible way to give them those skills was to teach them to use a calculator. They agreed that at K7.50 villagers could afford to buy these.

I then asked them if they would themselves be willing to learn to teach the use of the calculator as part of their literacy teaching. The response was an unanimous affirmative.
DEPARTMENT OF COMMERCE NUMERACY PROJECT

REPORT ON VISIT TO EAST SEPIK BY MARY & ALLEN EDWARDS

24 NOVEMBER - 4 DECEMBER 1980

NOTE: See also REPORT on the FIRST VILLAGE REPRESENTATIVES ADULT NUMERACY COURSE
(24 November)

Department of Commerce We were met by BDO John Baure and driver. Geoff Martin (A/PBDO) introduced us to the rest of the staff, Irancis Iko, Joe Kwaisombi, Pullung Tangoman, Heather Martin, James Ankas, Anthony Wampai (UTECH) and Cuda Kappagoda (artifacts).

Provincial Affairs The Provincial Secretary, Paul Bengo, welcomed us and passed us on to Ray Bray, Staff Development Officer who promised support, particularly transport if required.

Rural Development We had a brief meeting with Richard Dixon, PRDO who was interested in his staff learning more than the minimum about the use of the calculator. He asked us to give him at least a month's warning if we were going to put on a course which they could attend.

Community Development Mrs Lehia, A/PCDO had only recently arrived and would be moving to Port Moresby in December. Her replacement, Martin Kenia, would arrive about 8 December from Lae where he was attending a conference concerned with the National Youth Movement Grant Scheme. This scheme would be operating next year in the East Sepik and numeracy teaching would readily fit into the programme which included self-employment projects, community services in villages, sports, etc. These ongoing activities would be co-ordinated. Representatives of youth clubs in a regional group might well be brought in to be taught numeracy so that they could pass the skills on to their club members.

Christian Books Melanesia Inc Mr Loader had offered his services as a consultant. They publish the popular Kisim Save series of Literacy Primers on reading and writing in Pidgin. The reckon that an all-age
class will complete the course in 80 weeks at 4 mornings a week. The Southern Highlands are their largest customer.

Mr Loader had had 7 years' experience in "the bush" supervising 30 teachers, in addition to Primary teaching in New Zealand and a special interest in mathematics. He felt sure that a numeracy section could easily be included in the literacy course and would be pleased to arrange a workshop at which teachers could find out by experiment how this could best be done.

He immediately identified the selling of coffee as a prime motivation for numeracy: they sell many ready reckoners for this purpose but the purchasers do not always get training in their use.

He assured us that the "generation gap" was not a serious problem in the villages, in that his teachers would often be in their early twenties and had "big men" in their classes. They were happy to learn "western" skills in this way: modifying traditional skills eg in agriculture, was another matter.

He stressed that language was an important means of developing mathematical concepts but said these could easily be expressed in Pidgin. He also emphasized the problems of approximating and understanding place value but I suggested that these were still major problems in Tertiary education so it was unlikely we would solve them quickly in villages. I thought the lack of measuring was one of the main causes of this weakness which is why it is important that this is included in any adult numeracy course, even if its usage will be minimal.

(26 November)

Sepik Cocoa Growers Co-op Ltd Brad Wilson, newly appointed manager, explained some of his difficulties as well as his procedures for buying cocoa. I also sketched the scale used in these purchases.

Commerce Sewing Training Course Mary visited this Course with Heather Martin who had set it up. 19 women were taking their first 6-week residential course. None had left since it started 5 weeks ago. We commented on the format Heather proposed for calculating the prices and
suggested the women could be taught to do it themselves, with a calculator. Mary visited BP's and a Chinese store and found that all dress material in Wewak was still being sold in yards. We could understand individual stores hesitating to make the change to metres first, but hoped some pressure could be applied to make them all change at once. If this happened the pricing calculation would have to be re-worked in metres. We recommended that .25, .50 and .75 should be used rather than ¼, ½, ¾, even while the measurements were in yards.

The Assistant Secretary Education and the AEO I was given every possible encouragement when I visited Eli Wanera (Assistant Secretary) and Joe Weiefi (Adult Education Officer). Eli bought a calculator immediately for his own use and after listening to my theories asked if I would be willing to come to teach the use of the calculator at their next NIST week.

The AEO, explained they had 43 "Correspondence Centres" in the Province: these were mainly sponsored by churches and gave 1 year courses to Grade 6 adults using the COES material and also "additional component courses" in practical areas such as health, carpentry, sewing, typing. Joe had already had requests for numeracy courses and would be pleased to incorporate something along the lines I proposed. Two Vocational Centres were also acting as Correspondence Centres.

He also referred to 14 Literacy courses which were part of the scheme to which Mr Loader had referred.

Skul Bilong Stoakipa Geoff took me to see Uwe Seigl, the manager, where I was made most welcome. They have 30 students for a year or 18 months if necessary. With the latest course they spend the whole of the first 2½ months on arithmetic, and the students are not bored. Even after this however, they have still not acquired sufficient number sense to recognise wrong answers. The published course is still used for its commercial component, but not for the arithmetic in it. They teach three different methods of allocating freight costs: per carton, per kg and as a % of selling price. They advise the students how to select the appropriate method. It was suggested that the law on controlled prices is very vague on the allocation of freight costs.
Turubu Bros  This store was near the Business Development Office and James Ankas introduced me to the proprietor. His calculator battery was low so I showed him on mine how to calculate markup %, controlled prices and checking an invoice. This took me about half-an-hour: I left him the "Training Sheet" which he had been using successfully to calculate his mark-ups.

Skul Bilong Stukipa  I had a 1½ hour discussion with Uwe and Andrew. My main point was that if calculators were going to be used in the end then it was better to develop techniques appropriate to them as soon as possible. Uwe thought the insistence on non-calculator work ensured a better "understanding" of the mathematical processes. I challenged this contention, suggesting that frequent use of the % key to give 10%, 12.5%, 25%, etc, could result in a familiarization with the results of these processes that constituted an "understanding" of them that was just as genuine as being able to obtain the same results by dividing by 10, 8 or 4.

I was very interested in Uwe's assertion that "Profit and Loss is too complicated" for the ordinary storekeeper. Instead he emphasized the use of a Stock Control Sheet (on page 66 of their Course Book) which they had used since 1972. They had recently experienced leakage themselves and had added further sophistication by introducing "spoilt goods" credit sales and consequences of reducing or increasing prices, into the equation. The main difficulty with the system is that the total selling value of every invoice has to be calculated and entered. (Geoff Martin subsequently pointed out that an alternative form of stock control was to keep a stock book in which purchases of each item are recorded so that the number sold between any two stocktakes can be found. These can be multiplied by their selling price and totalled to give the amount that should have been received from sales in the period. This seems a reasonable alternative if only a few lines are kept, at fairly constant prices.)

I mentioned that I was concerned to find commercial outlets prepared to sell calculators at very low prices as a service to PNG villages. I suggested Uwe might propose an arrangement under which Laloki College Canteen acted as a middle man with, say, a 2% markup while Skul Bilong
Stuakipa sold them at a slightly larger markup. Even if "bush" stores then retailed them at a further mark-up the availability of them at a major centre not too far away would ensure that profiteering was kept to a minimum. Uwe was very willing to help as their own aim was also to serve rather than to maximise their profit.

(November 28/29)

Visit to Angoram We spent the weekend at Angoram (at our own expense). We talked informally with the priest in charge of the Roman Catholic Mission, Fr John Dwyer, who had been a school master for 8 years in the area, and with a member of staff of the Vocational Centre (the Headmaster was in Wewak). It seemed clear that this would make a good centre for a class at some later date.

(3 December)

Skul Bilong Stuakipa Uwe and I discussed the Stock Control Sheet that I had devised largely because of his assurance that this was likely to prove more useful than other accounts. It was based on Geoff Martin's alternative proposal mentioned above. In response to my earlier suggestion, Uwe proposed that in order to get calculators into the villages as cheaply as possible, they would sell them at a markup on landed cost of not more than 12%, at K8.00 (11.1%) if we could supply them to him, freight paid, at K7.20. He would sell them wholesale and retail at the same price so that any retailer buying them from him would be discouraged from trying to make an exorbitant profit. We agreed that at this markup it would be clear to all that Skul Bilong Stuakipa was only seeking to provide a service, on a virtually non-profit making basis, and would not be referred to as an "agent" which might suggest they were doing it for profit.

I said the arrangement seemed to me to meet the need to supply calculators to villagers very well and I would seek formal approval for it.

BDO course on the use of the Calculator

At Geoff Martin's request I took a day's course with all his BDO's. They
learnt quite a lot about the calculator that they had not known before, such as the use of the memory and correct procedures when a mistake has been made. We dealt with giving change, finding Selling Price and Markup \%, pricing hand-sewn clothes, stocktaking and the new Stock Control Sheet I had devised. Much of the pricing exercise depended on using data written on actual cartons obtained for the purpose. This proved to be a little disorganised, but apart from that the course was considered by the A/PBDO to have been very successful.

(4 December)

Francisca, Butchers Store, Wewak  Heather took me to see if I could help her. I showed her how to use a calculator to find change and to check her invoices: she found she had been undercharged K1.50 on her last bill and overcharged K20.00 on the previous one. She had borrowed about K3.00 - K20.00 from each of about 15 people to help buy her freezer 3 years ago. Heather had suggested she repay them with 10\% interest. They had demanded a flat rate "repayment" of K22.00 each whatever they had lent. We showed her how to use the calculator to work out repayment with 20\% interest. Her prices appeared to be well above her costs but were still below BP's. She had tried to keep accounts but had not been able to total them correctly and had given up. She bought a calculator and Heather said she would help her with her cash records.

Turubu Brothers, Wewak  I saw Roy Balthasar again and explained the use of the new Stock Control Sheet. He seemed to understand and asked for copies. He bought one of our calculators.

East Sepik Rural Development Project  Having some minutes to spare I tried to see the Manager and Crops Intensification Officer to find out if they had any use for village numeracy in their project; but they were both out.
Preparatory Visits to Villages: the Passam-Maprik road

We spent 25th November visiting villages on the Passam-Maprik road.

At Japaraka No.1, 28 km from Wewak, I explained the usual uses of number skills, counting money, giving and getting change, checking invoices and pricing goods, checking the amounts received for coffee or cocoa, and calculating the number of sheets of iron needed for a roof. As usual we were told that many adults had none of these skills. The fall of the world prices for coffee and cocoa were given as reasons for the drop in price from 80t and 35t to 40t and 20t per kg, but the growers were rarely able to check. The priest from the local mission had told them how many sheets of iron they would need for a new trade store roof. They said they would like to send 2 representatives to the course on Thursday, Friday, Monday and Tuesday.

We suggested that one should be a woman but did not insist as no women had grade 6. The two Mary spoke to could in fact add 40t and 50t and give the change from Kl.00 quickly, but one of these was about to have her sixth child and we thought the complete lack of formal education would result in complications we wished to avoid in our first, experimental, course.
At Nangummarum (52 km) at a roadside market we received a similar response but the Grade 6 woman Mary spoke to here Rosalyn Kawa, was determined to be on the course on Thursday. Everybody in her village helps with the coffee, cocoa etc owned by her father: money is required for bride price and to buy a truck. One girl had gone on to Nursing School.

At Maimboreo (94 km) they not only grew coffee and cocoa but also had a Cattle project, trucking business, forestry plantation and 2 or 3 trade stores. The Village court was currently in session. Lacking any women who could speak English Mary asked our guide to translate for her but this did not prove satisfactory.

On the way back (68 km from Wewak) we called at Harua/Wamaian where they had 6 Trade Stores, a piggery, a cattle project, garden crops and a Club as well as coffee and cocoa. One of their young men had gone to University, and there were plenty of Grade 6 men and women. They also had a treadle sewing machine as had other villages, though no one seemed to use them for business purposes. The women in this village were almost all at a women's group meeting to which our young translator offered to conduct us. This meant a rough 12 km there and back on a mud road only to find the women were elsewhere.

We did however talk to the Secretary Carl Wallison of the Sahinda Youth Group at Niakandegum Village. They had 22 mainly Grade 6 members and had built a trade store, grew coffee and ran a social club. He was fairly sure one would come on Thursday with K5.00 for a calculator and metre rule. They had had some girls in the club but they had split off to form a separate group.

If all of today's promises were fulfilled we would have 11 or 12 at our Course on Thursday, but in view of the distances they would have to come, and the lack of any arrangements on our part for their accommodation, we shall be most surprised if half that number turn up.

Villages on the Turubu road. Francis Iko (Area BDO for Wewak) accompanied us this time. He had attended a course I had given to Diploma students at Ialoki and wished to be assured that I did not intend to use the same course on villagers. I said it would be completely different.

At Sawarin (10 km from Wewak) Francis explained our course to the elder, Mâriwa, who was keen to send representatives. Francis explained that it was really two villages so that they ought to send two men and two women instead of one of each. Simultaneously one of the women was telling Mary that women could not be expected to come singly so all subsequent villages were invited to send either one man and one woman, or two of each.
The women were very responsive. One with grade 10 had returned to the village to have a baby. She has a sewing machine and uses a tape measure (m & cm) but does not make clothes to sell. There were also 2 with grade 8 and plenty with grade 6. One hopes to go to a Secretarial College, two to teach. They help the men with their copra.

At Mandi (13 km from Wewak) Francis again explained the purpose of the course very clearly to a councillor who agreed to send representatives to it.

We spent some time enquiring at Forok No.1 and No.2 villages, an area of scattered homes, but we could not find any responsible person there. Francis mentioned that our green Land cruiser had previously been used by the CID, but in this instance it was thought the adults were simply at work.

Near Pasangu (21 km) we found a group of copra workers by the roadside, including women and children and a big man of the village. After Francis' explanation he felt sure they would send representatives to the course, and the other men present were equally positive.

At Turubu (27 km) we waited a long time while the Chairman of the Co-op was fetched. Francis quickly convinced him that they should send representatives, although they thought that transport might be a problem.

12 started the course, 10 completed it including 6 men and 4 women. Each brought K8.00 to pay for a calculator, exercise sheets and a metre measuring stick, to use in teaching the adults in their village.
The First Experimental Course for Village Representatives: the First Day

Mr Mariwa was there before 8 am and introduced his four representatives. We started at once, Mary giving a familiarisation programme on the calculator stressing the special figures used in the display (4 & 7, 5 & 6 are often confused) and adding two numbers. I took them on to totalling money and finding change (working in toea). By 9.15 am another 7 had arrived and all went straight into the "1 ① 1 ②" and similar games including "change for a Kina". They did a written exercise, without a calculator, on adding 1 or 2, subtracting from 10, and adding numbers to give 10 or 11. Only one student was really quick and good at all these: one or two were very slow. All were Grade 6 except one who was grade 8.

We got some offcuts from the local sawmill and practised measuring (in metres to 2 decimal places), ordering, differencing and adding lengths, comparing the measured result with the one obtained with the calculator. A similar treatment was given to piles of coins (mainly cardboard, by courtesy of the Education Department).

After lunch only 9 of the 11 returned but they seemed to be quite keen to continue and the 3 who had actually paid for their calculators asked us to keep them for them. The others promised to pay on Monday. In view of the shortness of notice we had given them it was reasonable to lend them calculators while at the course. One BOO and a teacher, Andrew, from Skull Bilong Stuakipa joined the course for the first day.

Experimental Course: 2nd Day. We expected a further drop in attendance and were delighted to find 10 of the original 11 plus an extra woman from one of the same villages. Later in the morning two others, one from Maprik, asked if they could join the course. We took their names in case we should run one next year.

We revised the "1 ① 1 ② etc" Games* and added the 1 ② 1 ②, to assist in learning/teaching the number facts for adding 10, adding 9, 6 + 6 and 6 + 7 etc. We gave them a test on the earlier number facts: all but one completed 81 questions in 1½ - 3 minutes. The manager of the Sepik Cocoa Growers Co-op kindly donated a no-longer-serviceable scale which had been used for weighing cocoa. It still worked reasonably well up to 57 kg so was ideal for demonstration purposes, giving quite a hilarious time when individuals pretended they were bags of cocoa.

*These are games using the "constant function" on the calculator to teach number facts e.g."the number after ...", "what is needed to make ... up to 10?"
Learning how to find the correct price for a bag of coffee was an
important motive for those attending the course.

Dockets were made out with current prices for cocoa and coffee, using $\times$ and adding the results on the calculator. We continued the exercise after lunch going as far as introducing a check by totalling the weights and using the constant function or "times game" as a further sophistication. We suggested that someone standing in front of the scale with a calculator in their hand set to multiply by the price per kg should reduce any temptation on the part of the buyer's clerk to cheat.

No one had failed to wake up and return for the afternoon session thanks to the coffee provided mid-morning and/or the enthusiasm for the very relevant pricing exercise.

Our final exercise was to calculate the lengths of different sizes of timber used in the construction of a table and a trestle, using the actual prices per lineal metre for 2" x 3", 4" x 1" etc Dressed All Round timber that I had persuaded the local sawmill to work out for me. (They said they had gone metric but had now reverted to imperial measure, so used the price per 100 foot super even though it was also quoted by the cubic metre.)

The 3 who had paid for their calculators went off with them to practise over the weekend while the rest departed exuberantly with every indication that they would return on Monday.
Experimental Course: 3rd Day. As usual, Mary and I shared the teaching, interrupting when we thought the other had not made something clear, and consulting frequently on ambiguities in the programme.

10 of Friday's 11 turned up on time and all but one paid for their calculators. The tenth already had one of her own - of which the battery very soon ran out.

We revised the "games" and completed Unit AB22 (except that most had done it on their own over the weekend) and gave them the test on it which included 81 sums of pairs of single digit numbers, which they completed in 2½ to 3½ minutes.

We then taught them how to check an invoice using the memory and to total numbers of notes and coins similarly. Later we revised the selling of coffee with a new exercise duplicated that morning and again used the memory to find the total and checked by totalling the kg (instead of using the constant function as before).

One of the students volunteered himself as a bag of coffee.
We introduced division by finding the number of iron sheets for the roof of the Business Development Office. We also calculated the number of Fibre sheets (on their sides at 2.44m = 8ft and on their ends at 1.22m = 4ft)

We showed them the Certificates we had prepared and explained the words "literacy" and "numercy". They will be headed "Department of Commerce Numeracy Project" and will refer to the course which they will have attended as being "for teaching numbers with a calculator."

Experimental Course: 4th Day.

All 10 turned up punctually. We revised and extended the "Change for a Kina" game to include non-multiples of 10t but several found this difficult: they did not yet seem to be sure of "the number needed to make up to 10'.

We checked invoices again and found Unit Cost Price by division and rounding down. We then explained why storekeepers had to charge more than the cost price and showed how they could find the Selling Price after deciding on a 10%, 20% or 30% markup.

To keep it simple we did not try to allocate the freight costs, and to avoid embarrassment we avoided any reference to controlled prices.

Our final new piece of work was on the calendar and most of them found this more difficult than we expected: more careful preparation for teaching it should help.

In the last 4 hours we went right through the course again treating it all from the point of view of "how will you teach this to the adults in your village?" We gave them a clean copy of each of the sheets they had filled in so that they could show this to their "students" and ask them to say the answers. This would mean the clean sheet could be re-used as many times as they liked. The sheets they had filled in provided them with 'answer sheets'.

In going through the work and reminding them what they had to do we were both very impressed with the amount they had remembered. The confidence with which they handled the calculators after four days use was a real pleasure.

At 3.30 pm we all had coffee and biscuits. Francis gave an excellent little speech, Geoff Martin presented the certificates, we had group photographs and everybody was happy. One, who had Grade 6, asked for an application form for Laloki College.
All had been fully convinced, by constant repetition, that their job now was to teach the rest of the village. How well they will succeed we cannot tell: the difficulties will be enormous, particularly as they will have to translate everything from the English in which they have been taught. But that they will all try, we have no doubt at all.

Statistics of the 1st Experimental Course

Thursday, Friday, Monday, Tuesday, November 27 - December 2; 8 or 9 am to 11.45 or 12.00, 1.00 or 1.15 - 3.15 or 3.45. 12 in all came of which 9 remained throughout, 1 only attended the first half day, 1 only attended 2 days and 1 attended only the last 3 days.

Of the 10 who were there at the end and were given certificates: 6 were men and 4 were women; 9 were Grade 6 and 1 Grade 8; one said he was 28 the rest said they were between 15 and 23. 8 came from the Turubu direction; 4 from Sawarin (10km from Wewak), 2 from Mandi (13km), 1 from Musangan (22 km), 1 from Dagawat (21 km), 2 came from the Maprik road; 1 from Japaraka (28 km), 1 from Naikandegum (74 km). All except 1 (who had a calculator) received a calculator, a metre measuring stick and cups of coffee, for the sum of K8.00 each.
ADULT NUMERACY CAMPAIGN

REPORT ON FINAL SURVEY VISIT TO LAE BY MARY AND ALLEN EDWARDS:
2.2.81 - 10.2.81

(2.2.81)

1 Documents Papers generally distributed were the Newsletter No 1 and the "Units in the Current Adult Numeracy Course - 27.1.81" (AN8)

2 Andrew Kamrai, Field Training Officer, Business Development No praise could be too high for the way in which Andrew advised and assisted us throughout the visit. Without him half the visits on the first day would have been impossible.

3 Elizabeth Robertson, BDO She had been away the previous week but she was now helping Andrew to organise the Women's Course which they had planned on my behalf. We had some preliminary discussion of the sort of programme the women would want. We also discussed the extent to which "concepts" needed to be taught, eg whether finding mark-up % was adequate without knowing that "%" was.

4 Greg English, PRDO and Assistant Secretary Agriculture, and Ian Reardon, in charge of Training Both were keen to co-operate. Greg was sure arithmetical skills would be useful in work with pigs and poultry and in keeping records. He arranged for me to see Ori Avuapo. He would like me to attend an inservice conference of District Rural Development Officers if one could be arranged.

5 Samson Mangot, Adult Education Officer He suggested it would meet local needs and provide an interesting challenge to run a course in Menyamya. We agreed provisionally to put on a 3/4 day course there during June 1-11. Transport to it is now possible by road or air. There is a Vocational Training Centre there which could be used as a base.
6 Patrol Officers A group of eleven were in the midst of a training course. I was invited to speak to them. They all wanted to buy calculators for themselves and generally welcomed the idea of an Adult Numeracy course in their areas. None came from Menyamya which they felt would be a particularly difficult place to start because of the lack of development in the area. I suggested that if they were keen enough to learn numeracy for its own sake, then development might be assisted by having learnt the number-skills first.

7 Roy Harvey, Regional Secondary Inspector, Education I explained my purpose and we had a short discussion.

8 William Varmari, Senior Inspector, Education We had lunch together and I explained why I thought the calculator was so important, particularly for Grade 6 leavers. He suggested the Lae Maths Panel might assist in providing an in-service programme which included the use of the calculator. NIST week in Morobe was being spread over the 4 weeks beginning 27 April. He suggested I approach Mrs Josephine Laufa of the Staff Development Unit, concerning the NIST week Co-ordinators Workshop being held at the Inservice Training College, March 2 - 6.

9 Andrew Oibi, A/Assistant Secretary, Forestry They have 2 Area Officers, at Lae and Bulolo, with various district offices at Mumeng, Menyamya etc and also sectional officers under them. Most of these used calculators regularly although they may not have received specific training in it. There are also Extension Officers with Grade 6 and a six-month course at Bulolo, such as the one at Garaina, who would certainly benefit from such training.

We discussed practical uses to which number skills could be put. The department is mainly concerned with tree planting. The number needed was calculated by one of the experienced officers, but there is no reason why villagers should not understand this calculation. After first planting, the trees need tending every two months, which involves the use of the calendar. At 5 years they have to be pruned to 1.50 m. At 7 years there is a stock count, first thinning
and second pruning. These calculations are based on a 0.1 hectare sample (10m x 100m) and are normally done by an extension officer. There is no reason why villagers should not understand this however, if they can.

It was also policy to encourage small sawmills (eg at Wasu, or near Wau or Finschhafen) and although these were initially for sawing timber belonging to the village that owned the sawmill, the time would come when they would buy trees from neighbouring villages. Where big sawmills are concerned the Forestry Officers calculate the price, but again it would be good if villagers could themselves check this calculation and so understand what was happening. I suggested that a suitable formula for an approximate value would be:

\[\text{mean girth} \times \text{mean girth} \times \text{height} \times 12.6 \times \text{value per m}^3\]

Finally, with large scale forestry, the villagers would receive a lump sum eg K10 00 and K2 000 pa for 10 years. The total for this, or for alternative offers could be compared by the villagers themselves given the calculator and a patient forestry officer.

10 Ainea Singero, Assistant Secretary Community Development He had helped to find candidates for the Women's Course, but had been restricted in this by the lack of funds to bring in people, eg one who had telephoned from Finschhafen having heard the Tok Save. I suggested his Youth Leaders might join the Course. He explained the difficulty in Menyamya which lay in the scattered nature of the habitations: there were few large villages, so communication was difficult. He confirmed that English was generally an acceptable language for such courses.

He was keen to learn more about the calculator himself and we thought a short course for senior government officers on Monday might be worthwhile.

11 Veari Ani, Assistant Secretary, Commerce He introduced me to the Minister with who he was engaged, and assisted in the provision of transport for me around Lae.

12 Dr John Garap, Provisional Health Officer He was most enthusiastic
and offered support at every level including the purchase of calculators if necessary.

He also welcomed the idea of training courses at all levels for government employees, and would support any such proposal being made to the Administrative Secretary.

Micah Yawing, Health Extension Officer at Menyamya would co-operate in a project there.

13 Vincent Dubee, Director of Parks and Gardens, Lae City Council He stopped on the road as I was walking and took me to my next appointment, buying a calculator on the way.

14 Br Hubert Hofmans, Extension Worker for St Joseph's Technical School He runs JOB Builders for ex-St Joseph's boys and others, and wrote to me in response to my letter to the RC Bishop asking for a consultant.

Br Hubert warmly welcomed the use of the calculator, agreeing with my proposals on measuring and my belief that mere multiplication and division by single digits, even if learnt by Grade 6 leavers, was inadequate for most simple village calculations, eg dividing by 1.22 to find the number of sheets of plywood needed.

He had earlier initiated work with people in the Settlements but interest had lapsed. He felt it would be well worth trying again with a weekend (or several evenings) adult numeracy course. He would be on long leave from April to September but his colleagues and/or the Community Development Officers might be happy to arrange a weekend programme at the RC Pastoral Centre (St Joseph's) during June 1-11. He would be happy to co-operate personally after his return from leave, particularly with the people associated with his own extension work.

(3.2.81)

15 Les Mohr, Training Officer for District Co-ordinators, Community and Family Affairs Les Mohr serves a national function but is based in Lae. He had a group of 6 or 7 District Co-ordinators. I explained
our idea of adult numeracy and he approved. There were special difficulties in Menyamya but on the whole if we could do it there we could do it anywhere. He said a new District Co-ordinator, Derek Thomson was returning from leave shortly and he would try to arrange for him to contact me while in Por Moresby so that we could make a firm decision on that project.

Ori Avuapo, Provincial Agriculture Officer (Poultry) To start a Broiler Project, the extension officer marks out the site for the 50 ft x 20 ft shed and arranges for the farmer to enter into a contract with Niugini Table Birds who supply the feed, chickens etc. The 1000 chickens require artificial heating for two full days, and 12 following nights. They are given "Broiler starter ration" for 4 weeks and "Broiler finisher ration" where the farmer is paid 99t/kg for birds weighing around 1.7 kg, less cost of chicks, feed etc. About K100 to K200 is received in each 9 week period. The extension officer provides a Poultry Farm Record which involves subtracting the number of dead chickens. Niugini Table Birds do their best to explain the rest of the calculations to the farmer, but they are probably not very successful. Ori would try to arrange for me to meet their manager or training officer. Understanding a calender would clearly be helpful anyway.

Egg-laying hens are kept mainly by expatriates. Piggeries ceased to be profitable in the late '70's. Cattle are the responsibility of Solomon Ndra. Copra is in the coastal and island areas, where extension officers are based in villages. The officers in charge come in up to once a month for conferences.

Peter Homu, Provincial Agricultural Officer (Crops) Coffee buying is done mainly by the exporters, Namasu, Angco, Harrison & Crosfield, and some smaller co-operatives etc. The PAO obtains a price from Moresby and normally quotes 5t/kg less for "station" buying and 10t/kg less for village buying. Little is in fact bought at the DPI Stations and Buying Points, but the effect is to provide a check on the purchasing prices of the private buyers. This will only work if the farmers can compare rates in t/kg and know they are getting the rates quoted.
There is still the usual suspicion of the buyers, with their scales and kuskus, who have to take freight into account in fixing their prices.

An ability to check the figures would be appreciated by the farmers. It might be helpful if I enquired of the buying firms, such as H & C, who also buy spices. Namasu deal with the most remote farmers.

Vegetables are mainly produced for subsistence and nutrition: extension work is done by the Fresh-food Market Corporation.

The Copra Marketing Board have a depot in Lae and a sub-depot in Finschhafen. All produce is inspected by the DPI Inspector. Each grower has a CMB number but again they would be happier if they could check the money given.

Spices are bought by private firms but DPI notifies outstations of appropriate prices as a slight safeguard: again, freight charges make this ambiguous.

18 Kath Anderson, Mathematics Adviser in the DWS Training Section

Kath is Headquarters staff with a national function. She still uses my Basic Skills Course but is fully convinced of the desirability of basing all training on the use of the calculator, and adapting courses accordingly. Even the labourers often need to calculate, even if only to know how many truck-trips will be needed to move a certain load. Our calculators are gradually being supplied for use.

There is however considerable prejudice against the calculator as for example in one specific area where the original course was set up by New Zealand staff a few years ago and is based entirely on the use of 4-figure logarithms.

19 District Co-ordinators

Six of these were being trained by Les Mohr. I explained the idea of village representative courses which could, ideally, be set up under their initiative. This would ensure co-operation of the various extension officers in the area. District Co-ordinators were also the only group of people who effectively covered the whole country.
They were pleased with the idea. Noah Leule who is Acting DC for Menyamya supported the idea of such a course in his area, understanding that it would be the DC's responsibility to explain the purpose and gather the clients for the course, which would take time. He would consult and let me know which 4 days in June 1-11 would be most convenient.

Tony Wrightson and Elizabeth Robertson were both expected in the Morobe highland areas and their work was much appreciated.

The group asked me to return later in the day, when I gave them a 100-minute training session on the use of the calculator. In the time available I dealt with correcting mistakes, the use of the memory for invoices, and measuring, but only had a few minutes to deal with percentages.

Susan Addison, Post Courier  Susan asked if she could write an article on our work. Having obtained the permission of the Assistant Secretary (Training) I invited her to come to the course and provided her with our documents. She came for over an hour on Wednesday morning and again on Friday when she showed me a draft of her article.

Hartmundt Holzknecht, Planning Officer  Hartmundt had tried to arrange for me to see the Provincial Secretary or his Deputy, and the Senior Provincial Affairs Officer, Gus Schweinfurth but unfortunately due to political circumstances none were available then. Andrew Kamrai and I explained the work to Hartmundt. I offered to provide a calculator course for senior Provincial Government Officers on Monday. He made enquiries but found the notice was too short on this occasion.

Numeracy Course for Women and Youth Leaders at Lae Business Development Training Centre: 4 - 6 February

Andrew Kamrai assisted by Elizabeth Robertson and Ainea Singero had set up the course through personal contacts and Tok Save on the radio.
The need to pay for calculators had not been mentioned, but this did not seem to matter as we were able to lend them at first and all paid for them by the final day, which was pay-day.

We were not clear of the precise objectives at first: we were aiming to provide the individual students with the skills they themselves were likely to need, although we did mention, particularly for the Youth Leaders, the possibility of teaching others.

We had the following students:
2 women who wanted to make clothes for sale, both Grade 6
2 male Youth Leaders, interested in possibly running a trade store: Grades 3 and 6
1 woman who had heard the Tok Save in Finschhafen and had come specially: Grade 4
2 women from the Morobe Cultural Centre: both Grade 6
1 woman from Morobe Women's Association: Plea Skul
2 women from YWCA interested in running a store: Grade 5 and "COES Grade 8" (sic)

All stayed for the whole 3 days of the course except the 2 from the YWCA who missed the first day.

The course was organised and taught by Mary Edwards, with my assistance for most of the time. Andrew was often there and was most helpful.

We gave the usual introduction including calculating change and were surprised to find that only one knew there were 100 toea in a kina even when the two coins were held out. One guessed 25 and was shown a 20t and 5t. She then guessed 50 and was shown two 20's and a 10. Then she got to 100.

We taught the usual number games: they learnt the number bonds for 10 and we transferred from that to change from a kina for multiples of 10. We spent some time teaching how to subtract other amounts from a kina.
Invoices were checked, first without, then with the memory. Notes and coins slips were totalled with the memory. We found Selling Price given markup % and vice versa.

We did the "clock" teaching, using only ½ past, ⅟ to, ⅛ past but this time we include "the time in 1, 2, or 3 hours". Most did it by visualising the movement of the hour hand but some added the hours. Our Ples Skul student "added" 1 to 12 and got 1 (without any previous teaching of module 12 arithmetic). They found it hard to add an ½ hour even to o'clock or ½-past times, and 1½ hours was almost impossible. "Time before" was even more difficult and was dropped, as was an attempt to say that the time was "between ¼-past and ½-past 6" for example: it would probably be easier to teach 5-past, 10-past, 25-to, etc. None of the students had digital watches or we might also have had to deal with that method of recording time. The teaching of time clearly constitutes a major problem: perhaps the Community Schools could pay more attention to it.

The calendar also proved difficult to understand. We had expected that urban students would be more familiar with it but even finding the date "in one week's time" was difficult.

Mary had prepared a new exercise sheet on cost per metre of material bought by the bolt. She also did the cost of 2, 2½, 3, 1⅝, 1⅞m but not ⅞m, ⅝m, ⅝m as .75 etc seemed more difficult than 1.75. We wondered if we should teach the calculation of say 60cm by multiplying by .60, but did not attempt it this time, simply teaching 2½ to be 2.5 etc. Only the COES students had learnt to use centimetres, the rest having been taught in feet and inches. There are many more problems to sort out in this area and further consideration of them is needed.

Mary also spent considerable time on the meaning of × and ÷ although the new exercise on the applications of them was too difficult.

I concluded the course by revising all the Trade Store work using a new "Instruction Sheet" indicating as clearly as possible what signs to press when. This is certainly necessary for calculating markup % given SP (perhaps the most important process to teach) and at least
one student was still not clear what sign to use when totalling the items or when finding change. For her the "instruction sheet" was essential: it will be a long time before the meanings of +, -, x and ÷ are understood even by these Grade 6 adults.

Our general feeling about the course was that it was the best we could provide in our present state but that further work in teaching people with specific needs may help us to develop the appropriate materials so that they can be available in the general Adult Numeracy Programme. Invoices and markups may not be of interest to all, though no one complained of them: measurement, clocks and calendars may meet a wider need.

(I undertook the following 2 activities while Mary was teaching the women/youth leaders' class.)

23 Mathematics Education Centre, UTECH I was fortunate in being given a considerable quantity of cards which I had had printed while I was Director of that Centre. They had originally been prepared for Community School work and large numbers had been issued through Teacher's Colleges in 1979. Out of the surplus I selected "snap" cards with simple sums and differences on them, a "Sum-Ten" game which involved placing 4 counters in a row with the numbers on them totalling 10, a Car Pace dice game adapted from the MaCS syllabus, and sets of large and small cards printed with numbers from 0 to 10. These should provide a good basis for experiment in games for adults.

24 Course for Business Development Officers Yeari Ani, Andrew Kamrai, Nelson Hungabos, Elizabeth Robertson, John Orim and Zemo Biwa (passing through from Finschhafen) attended a very intensive 100-minute course based on the new "Instructions for Storekeepers" sheet. The two trainees were unfortunately otherwise engaged.

They all agreed that it was desirable and practicable to teach these skills individually to store-keepers, particularly finding markup & given SP. It was clear that the procedures for "with freight" and "without freight" need to be taught quite separately, the concept of a "carton" being different in the two cases.
I posed the problem of supplying calculators. The DBO's did not feel that they would like to handle the money even for small numbers but Zemo suggested that Waoym Store in Finschhafen would be willing to sell them on the same terms as Skul Bilong Stuakipa, viz. selling at K8.00 if received at K7.20 freight paid. They could supply them to Lae until such time as a similar public-spirited vendor could be found there. We thought a Trade Store course in Finschhafen might be a good idea for June.

25 Highland Products Ltd, Zenag, Lae Mrs Leahy told us they had introduced calculators for their national staff in 1979 and had been delighted with the result. Their only regret was that the batteries ran down. She bought 4 of ours. Co-Air also issue calculators to any staff needing to use them.

26 NBC Mr Goa interviewed me for the national programme "Men on the Land" on Friday at 9.06 pm. Mary Edwards was also interviewed, in Pidgin, for a Morobe Radio programme for women, the same day, Thursday at 7 pm.

(9.2.81)

Namasu Coffee I saw the manager who explained that all their buyers had calculators although there were problems over batteries running out. He bought five of ours. They are probably going to set up a buying point in Menyamya. He agreed that it would be good if the farmers could check the prices they were being paid and so reduce the danger of dispute.

G K Stores, Lae Andrew took me here. They already had a calculator but it failed every now and then, probably because of a low battery: they bought one of ours.

They already knew how to use it to find the total and change. They kept a cash book with analysis columns. I explained how they should use the calculator to cross check the totals and balance, and I pointed out an error of K100 in one of his entries.
I explained how to check the invoice and to find the markup %, using my instruction sheet. His pricing seemed to have been quite well done, by some other member of the group, but he was glad to be able to do it himself and two lads with him seemed able to learn also, thanks to the instruction sheet I left behind.

Homiya Asini Holdings: Omili Shopping Centre, Lae Andrew took me to this store also, with which Business Development has had much contact, but with an expatriate manager it seemed unlikely they would need instruction in the use of a calculator; they in fact use desk models. William Corfett, Managing Director, was interested in the idea of numeracy by way of the long-life battery calculator and particularly keen on the very low price. I pointed out that we needed someone who would supply them locally at a low price as a service rather than to make a profit. He fully appreciated this and warmly accepted my offer on the same terms as Skul Bilong Stuakipa and Waoyam Store, Finschhafen (see 24 above). He expects to sell a lot through the local schools. Andrew and Veari Ani seemed to approve of the arrangement which means that if they teach local businessmen to use calculators there will be somewhere for them to buy them. The Business Development Office have purchased 15 of which at least 10 will be kept for use on training courses.

Solomon Nara, Provincial Livestock Officer Solomon explained the uses of number skills in a cattle project. Having determined the space to be enclosed the fence lines must be measured. Big 7 ft (2.10m) "strainer" posts are needed every 100 m and small 5 ft (1.50m) posts or iron pickets are needed every 3 m. 4 strands of wire 1 ft (0.30m) apart are required for the outer fence and 3 strands for dividing the paddocks. About 2 kg of staples are needed. Designing the stock yard and planning the finance requires expert help. The calender must be read so as to anticipate the dry season and reduce stock. After floods the fences may need repair. For prime meat the cattle are sold after 2½ years to an agent of a butcher who determines the price, at present K1.25 per kg dressed weight. The receipt shows live weight, dressed weight and price per kg.

Sheep are being kept on a trial basis and involve similar calculations.

There is an Agricultural Station at Manyamya where the Officer in Charge is Musa Forena: they are starting cattle and sheep projects up there.
Derek Thomson, **District Co-ordinator, Menyamya**  
I was able to speak to Derek in Alotau on his way up to Menyamya. He could see no difficulties in the way of our proposal and will write to me naming 4 days within June 1 - 11 when we would train up to 30 Grade 6/8 village representatives whom he will gather, explaining that they will have to bring K8.00 for a calculator and measuring stick. From one to four representatives could come from each village but if more than one then they must include at least one woman. He will arrange accommodation for the course and (hopefully) for my wife and myself.
ADULT NUMERACY PROGRAMME

REPORT ON TRAINING COURSE FOR CENTRAL PROVINCIAL GOVERNMENT OFFICERS TO BECOME ADULT NUMERACY TRAINERS: KONEDOBU, 11 - 13 FEBRUARY 1981

Background

As a result of the Management Team decision on 30 January, 18 officers came for training in the COES Conference room: 4 from BMS including the A/Provincial Training Officer, Avon Siaoa who had just been given this new appointment, 1 from Review Co-ordination and Communication (= Political/Executive Liaison), 2 Agriculture, 2 Forestry, 1 Commerce (Maleir Okaipa), 1 Information, 3 Health, 1 Education, 2 Welfare. They included 5 women. All except 2, who had other duties, remained to the end.

The purpose was to train them so that they could either train village representatives or teach in a village themselves. 3 of the 18 currently live in villages.

Only 2 had their own calculators, the rest borrowed ours.

They were a very keen and intelligent group so we covered the ground rapidly, only one or two appeared to be unable to work at the speed of the rest, but this was not for want of trying.

The First Day

On the first day we completed most of the work included in the "Proposed Village Representatives' Course" as revised after the first such course, 2 December 1980.

I omitted "Finding Markup % given SP" and adopted the "Clock" unit to include "Time in 1, 2, 3 and ½ hours", I used the new "Pricing scone" unit: they agreed that "½" and "¼" bags were good but not "¼".

They were so keen we worked through the morning break, simply pausing to drink coffee, and did not stop again until 12.15 pm.

They all clearly learnt many new techniques with the calculator and probably some other skills as well, such as thinking out the "change from a kina" for any two figure number.

I frequently emphasized the fact that I was not just trying to teach them but also training them to teach: only two had had previous teaching...
experience.

The Second Day

On the second day I explained that they should know how to measure with rulers marked in cm or m but that the rulers I hoped they would get for the work were designed for measuring in m and cm, the lengths being written just as for K and t. Most of them understood this and did the measuring exercise successfully. I had to explain how to determine the greater of two numbers, though this was easier when they were all to 2 decimal places and proceeded by 0 if less than 1.

As usual the coffee-weighing exercise was of great interest. There was a sustained argument about whether the buyer should pay for a whole extra kg when the weight was just less than this. One officer seemed to feel that there was a moral issue here. My own view was that the buyer and seller made a free contract and so long as the buyer made his terms explicit this was fair. The DPI officer present explained that some buyers gave credit for half a kg but their policy was to round down to the kg below because of the weight of the bag, which for copra was in fact 1.5 kg. Most of the class used the "memory" method to complete the slip and the "constant" function" to check it.

The great success of the day was the popularity of the "Sum-ten" game which practises addition of numbers up to a total of 10. They played it much of Thursday afternoon and started again on Friday morning while the class was re-assembling.

They also took two tests while I had to be absent at a previously arranged meeting. I told them not to put their names on the papers. The clock test included time in 1, 2, 3, ½ and in one case 1½ hours time.

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ANR 6 A97
The Third Morning

On the Friday morning we did the "Calendar" exercise, which needs to provide more practice by using different starting dates. Also the new "Estimating Lengths" and the new "Local Distances and PMV" charges sheet which involved giving rates per km in toea to 1 decimal place: this is probably too confusing in the village but the km rates for local journeys (up to 39 km) were 1.2, 1.3, 2.0, 2.5, 2.5 and 2.7 toea, which would mean little if rounded to a whole toea.

A Mathematical Problem

Revised "Pricing Sewing" and "Timber Requirement" sheets were well received: both involved pricing in toea per metre, which was easily done for material, omitting the decimal point as usual in the kina. For timber it was assumed that the metre price would be given by the merchants as sale by the 100 ft has been illegal since January 1. With the cloth I was delighted to find that a recent "Simplicity" paper pattern gave the measurements for cloth required in metres to 2 decimal places, exactly as I had decided last October to do for all lengths in the Numeracy course. Unfortunately, in order to find the price of the cloth the decimal point must be included when entering the length on the calculator. With the timber we rounded up to a whole metre, but this did not really solve the problem as one may not wish to do this. If one wants 8.50 m one must enter the decimal point.

These two cases of finding the cost of a length in m/cm, have worked out the price per m, have become virtually the only occasions in the course where the decimal point has to be entered. (The only other case is with a 12.5% mark-up).

Explaining the need is difficult because the students tend to write money as K3.24t saying, logically, "3 kina 24 toea", and will think of 8.75 m as 8 metres 75 centimetres even if they are not allowed to write it m 8.75 cm.

In other words they do not yet have the true concept of a decimal.

Acquiring the concept will take time. Until they realise that K3.24 is kina and NOT toea and 8.75 m is metres and NOT centimetres, they cannot be expected to understand that the price per metre must be multiplied by 8.75 and not 875, which is what they would enter when adding lengths or multiplying lengths by numbers.

This therefore must be recognised as the first point in the course where
the omission of the decimal point causes some trouble. After months of use of the "omit the point" convention however, I have no doubt at all that it is the right one and we must persevere with it even if it means that a mystery at this stage will be unresolved until the users are able to conceptualize further. The major advantages of "omitting the point" lie in

(1) avoiding the necessity of inserting a decimal point (in the right place) in every entry of money, including those less than K1.00.

(2) avoiding results such as 1.9 or 2 which would arise from doing this; (they find 190 and 200 easy to recognise as K1.90 and K2.00: 1.9 and 2 they do not).

(3) being able to "ignore everything after the point" when a sum of money (or length) has been divided by a number.

(4) adopting the same practice as is current in larger tills and calculators using the "Arithmetic" function, where items are entered in toea and answers are given in kina.

The Third Afternoon

Some time had been spent in the morning sorting the exercise sheets they had been given. This would have been easier if each had been correctly referenced, as they will be when they are re-printed. It would however, help a lot if a folder could be supplied to each participant and all papers kept initially in the order in which they were issued.

We spent the final hour or two on going through the whole course, explaining how it should be divided up into the 4 days and giving advice on teaching techniques, the most important perhaps being "You are not there to show them how clever you are".

Plenty of time was left for group photographs and a final discussion in which they generally expressed satisfaction with the course and proposals for the next stage. They seemed to look forward to teaching it. They confirmed the desirability of awarding certificates to the village representatives they would train.

The Next Stage

Gimana Iamo, Assistant Secretary, BMS, asked what I suggested. I had already discussed this with Maleir Okaipa and one of the women on the course who had agreed with me, so I proposed that a village should be found
where one of the "trainers" who had been on the course lived or had wantoks. They and a trainer of the opposite sex should conduct a 4-day course there for representatives of local villages. I would take the materials they needed and start them off.

I suggested at this rate that the main expenses would only be calculators for the trainers (who could have them at the special price of K7.00 for this purpose), travel one way and minimal accommodation costs. I would provide the exercise sheets required.

The Assistant Secretary approved and said he would brief the Management Team that was meeting that afternoon. He suggested they might wish to publicise the project and I asked that whenever it was mentioned the work "experiment" should be included, through 1981. I also emphasized that I would wish to visit the villages concerned, some time later, to assess the results of the teaching.
DEPARTMENT OF COMMERCE NUMERACY PROJECT

REPORT ON VISIT TO GOROKA BY ALLEN EDWARDS

(a) To discuss the approach to women in relation to Business Training and Adult Numeracy

(b) To attend a part of the Annual General Meeting of the Melanesian Council of Churches: 16 - 18 February 1981

(16.2.81)

Helen Kelly, BDO

Fay Moakes, PFA, introduced me to Helen. She said the manageress, assistant and secretary of the Goroka Women's Investment Corporation already used calculators for stocktaking, invoices, wages, etc. They have a cash register which calculates change.

I asked for any occasions Helen could think of, when women used number skills.

One woman is a Trade Store owner: the same training as for men is appropriate.

They sell vegetables in the market: as change is rarely given the numeracy needs are minimal.

Women make and sell Meri Blouses: my unit on this is presumably applicable although Helen said they are still selling material in yards and think in terms of $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ yards. I expressed the hope that they may soon begin to use metres/centimetres in the same way they now use kina/toea, starting with 0.25 m, 0.50 m, 0.75 m, etc.

They make and sell bilums: if they live in town they buy string in 10t lots, so the cost calculation is very simple.

They make bead necklaces: beads and string have to be bought. Further investigation may provide a useful unit here.
They get and sell secondhand clothes from Lae: the bulk nature of the purchases make calculations difficult but we might check that they can price the goods properly. It may be that pricing is easy in a seller's market which will not last indefinitely.

Some get seafood, coconuts, bananas, taro from Lae and sell them in the market. Costs vary as goods may be bought from the roadside. The 2-way fare costs K12.00 so this has to be deducted from the receipts, but this is not difficult. Coconuts bought for 20t may be sold for 50t.

Baking is not common but there is one club doing it with the support of a Community Development Officer named Jenny.

One woman buys coffee.

My tentative conclusion from this interview was that in general these women's needs for numeracy were so slight that they might not form a sufficient basis for any large scale campaign.

Sr Mary MacDonald and Fr René, Melanesian Institute

Their experience was based more on the Southern Highlands and the Port Moresby area than Goroka but they had much knowledge of PNG. They emphasized that the position of women varied greatly over the country and that any approach to them must take account of this.

In the Southern Highlands for example, it would be inappropriate to approach women separately since any additional instruction they received would be resented by the men. In Goroka the women's groups tended to employ young men to do their number work, but in general husbands approved of their wives acquiring skills and they might well help them in trade stores.

Sr. Mary had done adult numeracy work in the Southern Highlands and found it popular, but it has since been discontinued. It had been suggested that the spread of primary education made it less necessary but she was not convinced of this. I also pointed out that primary education without a calculator was unable to solve many relevant arithmetical problems.

Adults sometimes resented children's learning and this might provide a motive for adult education.
In some areas women's clubs were strong, particularly in the United Church.

Some clubs made mats, which involved a pricing problem.

I asked whether women might be persuaded to learn numeracy for general educational reasons, or to enable them to prepare children better for school, but my consultants felt they would only learn what they could see they needed.

It was however, agreed that learning to add multiples of 10t and find change from a kina would be seen to be relevant. The use of non-multiples of 10t was also likely to grow with inflation etc or stricter price controls.

Sr Mary suggested I find an ex-pupil of hers, Evan Epi Wapi, now in the Southern Highlands Provincial Government, who had proved to be very bright with numbers. He does not speak English however.

They urged a recognition of the traditional methods of counting simply as a recognition of their worth, and providing a sense of continuity between the old and the new. It was only necessary to ask them about these things, and to express appreciation. Knowledge of them was not required.

Mealanesian Council of Churches

I printed out that the Creation involved mathematics and the Bible was full of mathematical statements. Understanding numbers was an important part of understanding God's world. Most countries (I thought) have learnt their number skills (other than mere counting) from other countries: Papua New Guinea has only recently started to do so. It may take generations for the people here to develop the "number sense" that people from other countries have already learnt. Because PNG started late they are able to use the latest technological aids in their development. So it is perfectly reasonable to introduce the long-life battery calculator as a tool of village numeracy.

In setting up a numeracy campaign everyone's help will be needed. The more people who can use a calculator the more chance that others will learn also. I therefore appealed to the churches to initiate such training, particularly among their pastors and lay workers who would then be much better able to keep the church accounts.
In discussion it was clear that a number of the church leaders present were seriously considering this possibility and I said that I would be happy to give the appropriate training to groups of pastors etc if I could fit it in with my programme. About half of those present bought calculators and asked to receive Newsletters in future.

Mrs Basanu, MCC delegate

Mrs Basanu is a member of the Lutheran/United Church Women's Fellowship in Kundiawa, where they run a trade store. She was one of those who bought a calculator. I showed her how to use it to total amounts and find change. She had had no education and found it difficult to remember when to use $+$ $+$ or $\otimes$, but she persevered and worked very accurately throughout.

The chief lesson from this was the amount of teaching time that may be needed by someone with little education. A whole day may be needed to teach little more than adding and subtracting.

(18.2.81)

Meeting set up by Gunnel Bergquist, to enquire into women's numeracy needs and to assess the likely value of a course for them in the Eastern Highlands.

9.45 am - 11.45 am

Present:  Gunnel Bergquist, ILO Project Manager;
Betty Ketauto, MBE, General Manageress, GWIC;
Margaret Soga, Manageress GWIC;
Alice Torokina, Account GWIC;
Loraine Sexton, Research Officer;
Monica Schmidt, Volunteer Women's Group;
Baunke Uke, FTO;
Rex Ragawe and Ivan Gore, Trainees - BDO's;
Also briefly near the end, Mrs Dauga Anapaku representative in the Provincial Government.

Outline of available materials

I lent calculators all round and showed how they could be used to teach number bonds and change for a kina. Everyone present had used a calculator so I went fairly quickly through the sheets I felt were relevant and illustrated the use of the memory, rounding off etc. The following sheets were covered: 1.1, 1.2, 1.3, 1.5 (cross-totalling an analysis sheet: relevant to them but not to most women), 1.8 (they thought counting
money, deciding "most" and "least" and "how much more" was definitely helpful), 3.1, 3.2, 3.3 (they agreed that working out change mentally from a kina for 6lt etc was relevant to all), 3.5, 3.6 (women's groups often had to count large collections of money: the notes and coins slip, with use of memory was good), 3.8 (I explained how we measured in m and cm), 3.9 (there was discussion about clocks and watches which few villagers have: I suggested that if they knew how to read them they would be more likely to get them, and timing was necessary for cooking), 4.4 (there was difference of opinion over the need for the calendar but Betty favoured it). 5.1, 5.2, 5.5 (in pricing scones it was suggested that it was in fact necessary to work backwards: custom determines the selling price, so the size of the scone must be adjusted accordingly.

GWIC sell about 1000 scones a day at 5t each and use one or two 50 kg bags of flour, yellow egg, baking powder and oil. Cost of flour 4 extras 0 fuel 1 3 0 would give the number of scones they would have to make out of the mixture to give a markup of 2t per scone, or 66%).

Discussion

There was general agreement that the material I had outlined was relevant and well worth teaching to women in the Eastern Highlands, particularly in Goroka. When it came to the teaching however, it was pointed out that very few women could spend a whole day on a course, let alone 3 or 4 days: 2 hours a week for 6 weeks was better. Betty also emphasized that the teaching ought really to be done as nearly as possible "on the job" - wherever the women were doing their work.

The idea then occurred to us that we might find a small group of women who could spare the 3 days, particularly if arrangements could be made for looking after the children, and that these ladies could then train the rest of the women at times to suit them. Betty reckoned she could find 6 - 10 such, including herself I believe. Such a group of trainers would be a most valuable resource. I therefore asked if such a course could be set up as soon as possible. Baunke was already engaged in other courses until May but he kindly agreed to be responsible for the organisation of this one, in consultation with Mrs Ketauwo. Mrs Anapaku said she would send someone from Community Affairs. We agreed that Tuesday - Thursday March 10-12 would be suitable: my wife (if possible) and I would arrive on Monday 9.
Metrication

My flight to Moresby was delayed so I visited the 4 stores where material is sold by length to check on the suggestion that they were still selling in yards. Steamships and PB had some recent notices indicating that they had just converted to metres. Collins and Leahy had not. I talked to the departmental manager who tried to tell me they had to sell in yards because that was what they bought in; that they often sold by weight (lb) and that the customers only know f.s.d. So I saw the manager, pointed out the difficulty I would have in March if he did not change, and left it at that. Carpenters New Guinea had also not changed, but the Acting Branch Manager promised to contact Alf Yaya and if possible make the change before my course in March.

Peter Joyce, ex-Principal of Laloki College

I was warmly welcomed by him as manager of the Bookshop and he very kindly invited us to stay with Barbara and himself when we came up for the course.
Someone from Kapari, to whom we had spoken last time would have come if he had had somewhere to stay but the PMV fare was K2.00 each way so daily attendance was too costly.

Paul was also afraid that the message listing villages we had visited last time may have offended some villages we had not visited, but there did not seem to be many of these.

The Business Development typist, Manu Wamala from Wairavanua explained that villagers tended to leave for their gardens about 6 am, might take an hour or so reaching them by foot, truck or canoe and often did not get back till about 6 pm, so visiting villages during the day was not likely to help. She was keen to attend the course herself and might find someone else from her village to do so.

A DPI typist, Gari Vuatha from Kelerakwa had used a calculator as a bank employee but might seek permission to attend part of the course and might also get others to do it from her village.

Laa Ravu from Gavuone, the nearest village, would probably come and Leah One who lived there would try to find others. Leah would also try to contact Bill Genia of Lalaura who had complained of the Government failing to provide adult education as promised in 1973.

From Kupiano itself the following were thought likely to attend: Mafi Ravu (SDA), Golo Ora (IMS), Aopi Vere (Youth Leader), Mrs Sirisi (Cuthbert's wife), (of these, Golo and Aopi did).

We also visited the Health Centre where a number of workers present expressed interest and said they would try to get representatives from their village. The Officer-in-Charge was away but would be back Tuesday morning.

We had been told we might have to pay K5.00 a day for the use of the Council Chamber, the only suitable room for the course. Paul said he would pay this if necessary from his vote but we went to see the Council clerk, Mr Geno of Waiori who said we could have it free. He would also try to get his brother Samuel to come from his village.
As a result of these more positive responses and personal messages explaining that the K7.50 was to buy a calculator, it was decided that we would probably get a reasonably wide representation tomorrow, and a proposed evening visit to local villages to get support was postponed.

(24.2.81)

3. First Day of the Course

By 10.30 twenty students had arrived and we said "enough," and several thereafter were turned away although others were subsequently accepted after special pleading.

<table>
<thead>
<tr>
<th>Village</th>
<th>Education Grade (as claimed)</th>
<th>Sex</th>
<th>Concerned with Trade Store</th>
<th>Total</th>
<th>Agreed to Teach.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 3 4 6 8 9 10</td>
<td>M</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gavuone</td>
<td>1 6 1 1</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Kelerakwa</td>
<td>1 1 2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Waiori</td>
<td>1 2 1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Kupiano</td>
<td>1 3 1 3 2 4 3 4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Wanigela</td>
<td>1 2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Merahi</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Walavanua</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>1 3 1 10 3 5 3</td>
<td>19 7</td>
<td>22</td>
<td>26</td>
<td>15</td>
</tr>
</tbody>
</table>

*left after 10.30.*

There were no representatives from Kapari, Viriolo, Lalaura, Dom.

4 of the Grade 9 students had obtained their qualification by COES.

Out of 22 on the first day 13 paid their K7.50 at once, the other 9 being lent Numeracy Project calculators. Of the 26 who attended, 24 bought a total of 28 calculators. 7 others were sold locally.

The wide range of educational standards made teaching a little difficult but one man's eyesight was a more serious problem and he did not return for the afternoon session. Their arrival being spread over 2 hours also caused problems but Mary did the introductory work with each successive group and I followed up with the first formal exercise. Those who completed the first 3 exercises went on to cross-total analysis sheets (1.5), with or without the memory.
By the afternoon they were sufficiently together to do the revision exercise 1.4 at the same time. I explained that our hope was that they would all go back and teach their fellow-villagers although this had not been explained to them in advance. I taught them the usual number games and explained how they could be used to teach their fellow villagers to add 1 or 2 or to learn the "numbers that make 10".

I was able to collect plenty of offcuts (free) from ANG timbers which we used for measuring with the new rulers. I wished they had been printed on both sides in opposite directions, so that if one side was found to be starting from .99 one could simply turn it round to start from .01, although the numbers would then be upside down. Fun was had measuring each other and by writing their heights on the chalkboard we practised determining the tallest, shortest etc.

We followed this up with the relevant exercise (1.7) which they did in groups of 1, 2, 3 or 4. Here some were lost, largely through language problems, not knowing where and when to write the answers. The differences and totals were measured and calculated; the attempt was made to explain the discrepancies in these results.

Folders were issued for the first time and this greatly improved the keeping of the sheets. We were sorry to learn that the Council had decided to charge K4.00 per day after all, for the use of the Council Chamber. Paul agreed to pay this from his budget, for which we were most grateful.

We had only charged K7.50 for the course including the calculators. It has been agreed that in Adult Numeracy work Laloki College will only expect K7.00 for them, so this left 50t to pay for the rulers and coffee, milk, sugar. The main cost of the rulers has been met from the CVD grant leaving only incidentals (eg Polyurethane varnish) to be paid by Laloki. I thus reckon to pay Laloki 40t for a ruler in general but only 10t when it is for adult numeracy. If we include this 10t in the K7.50 paid by the students it leaves 30t per head for the coffee etc which should be about right. (We subsequently decided on 10t in cash over and above the K7.50.)
4. Second Day of the Course

Nineteen students came and stayed all day, the dropouts being all storekeepers: three Grade 2/3's from Waiori and two Grade 6's from Wanigela. This was said from the Business Development point of view but probably less serious from the point of view of Adult Numeracy. The course is geared mainly to the Grade 6's and 8's: if one goes too slowly with it the brighter ones who ought to be teaching their fellow villagers, will be bored. We retained 14 Trade storekeepers (or assistants) out of 22 such.

We revised and continued the number games for simple addition. We did the "piles of money" exercise (1.8) which went smoothly. We tried out a new idea: Mary did the use of x with practical money examples and I did lengths similarly, eg., find the length of the room using 1.22m for the width of a standard plywood sheet and add on the extras, also by using the length of the sheets used for the ceiling (rather more than 2.44m) and finally by using the width of a window, multiplying by the number of windows and adding the extras. It proved a good introduction to \( x \) for those who were not familiar with it and illustrated the truth that whereas in school answers may always be either right or wrong, in real life this is not the case.

We then introduced the memory, to the positive delight of several students who had used calculators before but had no idea what the "magic" \( \times \) meant. Some even appreciated the use of \( \times \) for repeating a line.

We followed it up with similar use on Notes and Coins slips (3.6), Timber requirements (3.7), and Cocoa/Copra weighing (3.5), although the latter did not appear to them to meet a need as they send their copra to Moresby and do not seem to doubt that they are always given the right price for it.

The triumph of the day, as with the Konedobu course, was the Sum-ten game (2.5) and to ensure that no loss over the course was involved, we decided to charge 20t for the two sheets of card that constitute the board and counters.
I closed by reminding them that I hoped so of them would agree to teach numeracy in their villages. I asked them to consult with their village leaders so that they could give me a definite answer on this: if they were to become teachers they would need some extra copies of the sheets, and they could also expect us to come round to their villages in the next month or two to find out how much had been learned.

(26.2.81)

5. 3rd Day of the Course

Two who had only been on the first day came again, one probably on a morning's 'sick leave' from his full-time job, running a trade store being his part-time concern. One (Grade 4) who came for the 2nd day sent his daughter to sit in for him on the 3rd day: we let her stay but did not include her. So we had 19 in the morning and 18 in the afternoon.

We taught them to find change from a kina for any amount and although they were good compared with many they certainly learnt something here. We gave them the test on adding single digit numbers together the results being as follows:

<table>
<thead>
<tr>
<th>No. wrong, out of 81 questions</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of students, out of 19</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Average time taken for these</td>
<td>2m 56s</td>
<td>3m 2s</td>
<td>3m 54s</td>
<td>4m 8s</td>
<td>4m 15s</td>
<td></td>
</tr>
</tbody>
</table>

It would clearly be of more interest to test them before and after the teaching, but setting a test too early in the course could have an undesirable effect on the participants. As it was I was careful to tell them not to identify themselves on the papers, as this would help us little and could embarrass them much.

We revised the checking of invoices and worked out selling prices without freight. Mary did the "pricing of sewing" where we did an instant amendment, going direct from cost per metre to cost for a length given in metres and centimetres, eg 1.80m, the method we had been using for measuring and which I had found on a "Simplicity" paper pattern. This led into proportion which we then used later on PMV charges and even on the cost of a 25 HP outboard motor given that a 40 HP motor cost K866, although we did try to point out that whereas you could imagine the material cut up into
metre lengths and two bits put together to make the required length, when it came to outboard motors, chopping them into 40 pieces and using 25 of them would not help. But we had no other exercise available on a topic which clearly interested these lagoon dwellers.

The unit on the clock went fairly well, about a third of them having watches, but they were still not good at saying what the time would be in ½, 1 or 2 hours. The test we gave only asked them to tell the time (in quarters, halves and o'clock), with the following results:

<table>
<thead>
<tr>
<th>No. wrong, out of 12 questions</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of students, out of 18</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The writing of the answers was less of a problem than I expected: by this time we had no one with less than Grade 6. As an exercise they could use to teach their fellow-villagers it was clearly worthwhile.

We resolved the problem of Trade Store people versus Village representative teachers, by deciding that when we come again to assess the work of the latter we would put on a one or two-day course for trade store keepers, but only for those who could use calculators. This solution pleased Paul Baru who was obviously very much concerned with these, who formed the majority of the class. He virtually suggested the solution by proposing to put on a course himself.

We also resolved in our own minds the problem of issuing the metre measuring sticks, which I am anxious to get used in the villages, by deciding to charge 10t for each, this being a subsidised price but enough to discourage those who will not use them.

(27.2.81)

6. 4th Day of the Course

18 came again, 15 of whom had attended every session. We revised the "change for 10" and "change for a Kina" games, then read out the X and Z questions (3.8) but did not say more than that the first exercise was on X, the second on Z and the 3rd on a mixture. We failed to emphasize the need to write correct units and many answers either lacked units or gave wrong ones (eg "people" instead of K).
Results of the test were as follows:

<table>
<thead>
<tr>
<th>EXERCISE 1</th>
<th>EXERCISE 2</th>
<th>EXERCISE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 questions</td>
<td>10 questions</td>
<td>7 questions</td>
</tr>
<tr>
<td>Multiplication only.</td>
<td>Division only.</td>
<td>Mult &amp; Division Mixed</td>
</tr>
<tr>
<td>No. of Students</td>
<td>No. of Correct Answers</td>
<td>No. of Correct Numerically</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>MEAN</td>
<td>MEAN</td>
</tr>
<tr>
<td>18</td>
<td>6.8</td>
<td>2.6</td>
</tr>
</tbody>
</table>

* 2 or more questions unanswered on one paper. "only correct numerically" means that the number given as answer is correct or that the wrong, or no, units are given. Corresponding results for the Konadobu Course for Central Provincial Government Officers were as follows:

<table>
<thead>
<tr>
<th>EXERCISE 1</th>
<th>EXERCISE 2</th>
<th>EXERCISE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>MEAN</td>
<td>MEAN</td>
</tr>
<tr>
<td>16</td>
<td>8.4</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Note: in this case there was no time limit and the test was not supervise by me.
Most of the students managed to estimate lengths (4.6) and decide if they were between half and twice the true length, but some failed to understand.

A fresh invoice (4.1) was used for the checking and pricing routines, which most of them remembered. We omitted the effects of freight cost and finding markup % on the grounds that we would do this in the promised Trade Store course, along with Cash Sheets and Stock taking.

Mary did the calendar exercise (4.4) with them and found them less clever at this than at other work they had done.

They were asked if they would be teaching in their villages and reminded that if they did we would want to come and find out how successful they had been. Many took time to decide but all said "yes" except for the two government typists and one other.

We also enquired whether any would wish to collect a group of ladies whom Mary could teach while I did the Trade Store course on our next visit. They would ascertain the possibilities.

To the 15 "teachers" we gave fresh copies of sheets 1.3/5, 1.4, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.10 and of Newsletter No.1. We also sold 19 rulers at 10t each and all 20 Sum-ten games at 20t each.

Paul Baru, who had been present for most of the time, made a helpful speech and presented the Certificates, made out for "a course for Numeracy with a calculator", which were much appreciated. Group photographs followed and all finished on a joyful note at 11.55 am to enable us to return to Port Moresby the same day.

7. Local Calculator Sales

Following our policy of setting up local commercial outlets willing to sell our calculators at a maximum of K8.00 (if they can receive them from us at K7.20 post paid), we found that one of the members of the course, Aopi Vere (with Grade 8) was keen to obtain calculators for use in his youth work. He also managed Ovoagiu Trade Store, nearly opposite the Business Development Office, where Paul had first introduced me to him. I therefore invited him to act as a supplier on the usual terms (though I did stipulate payment, eg for 10, in advance). He agreed, as did Paul, and we announced it to the group.
8. Kwikila Enterprises Pty Ltd.

This was the store run by Veari Ani's brother Mari Ani, where we had called on the way to Kupiano. On the way back we called again and were enthusiastically welcomed by Mari who quickly understood the routines of invoice checking, pricing and finding his markup %. He particularly wanted to know how to convert to cost price when he had done his stock-taking at selling price. He was able to evaluate and use the formula $100 \frac{p}{100 + p}$, being the % by which to reduce the figure when it has been marked up by p %. I was impressed by this ex-student of Laloki (from 1975). He bought 3 calculators in spite of already having a till which calculated change (except during a power cut).

9. Conclusions and further thoughts

During and after the course we came to the following tentative conclusions.

9.1 The course as it stands is generally not suitable for students with less than Grade 6. They might however have found it easier if they had spoken pidgin, when we could have given them more help with the language.

9.2 Giving businessmen a course on the calculator and allowing them to become familiar with its use should be a good preparation for a subsequent course specifically designed for them. From this point of view the mixture of Trade Store keepers and others was a good thing: it ensured that the educational and vocational aspects of the work were kept in balance.

9.3 Charging 10t for a ruler and 20t for a copy of the Sum-Ten game was a good way to distribute them. Along with the 50t profit on each calculator and the payment for travelling and accommodation and other materials out of the VDC grant, this made the course self-supporting.

9.4 The time might be ripe to seek a volunteer (paid on national wages) who would experiment with the course in one Province for the rest of the year. The attempt to organize at a distance without back-up publicity had resulted in ambiguity and an uncertain response at first. One volunteer working exclusively on adult numeracy in one Province for six months might produce a sufficient result to justify adopting this method of organisation in 1982.
9.5 We could "go firm" on a visit to the Southern Highlands from April 7-24 if everyone agreed. This would tie up with a probable Literacy Teachers in-service at Mendi April 8-11 and an invitation to the Christian Brethren Churches station at Koroba April 16-24. There are at least two possibilities in Mendi for April 13-15.

9.6 Similarly we could go to Popondetta from May 11-15 when we expect to be able to involve Bryan Wilson of the British Council, one of the foremost international mathematics educationists who is particularly interested in our work. We might experiment with a really big 4-day course there, say for 50 businessmen and/or village representatives, using the accommodation which is likely to be available in that town.

9.7 We have already fixed March 9-12 in Goroka and around June 1-11 in Iae leaving the end of March for the East Sepik to complete the first round of our 1981 tours. (Due to pressure of work from other visits it was subsequently decided to postpone the East Sepik visit.)

9.8 On our return to Laloki we found a letter from Jonathan Spector, PFA for Manus Province, enclosing an 8-page course in pidgin for trade store keepers using the calculator, and a cheque for K160.00 for 20 more calculators. He said:

"We put together a 1 week course, adapting some of your materials and introducing a few new ones. Everyone was very pleased with the result, so I'm enclosing copies of the hand outs used, for your information."

"We would be most interested in your comments on them, as we hope to repeat this kind of course many times this year - the demand is huge, from one 2 mins radio announcement we had nearly 100 applicants."
REPORT ON SECOND VISIT TO GOROKA: 9-13 MARCH 1981

(9.3.81)

1 Goroka Women's Investment Corporation

I was met and such of my luggage as Air Niugini had brought was taken to the Business Development Office while I spent an hour or two at the Goroka Women's Investment Corporation offices. My purposes in coming was to find out what number skills women needed and to train a group of women to teach these skills.

Very few would be involved in such advanced skills as were needed at the GWIC office so as a separate operation I offered my services to Margaret Soga (Manager) and Alice Torokina (Accountant). Alice uses a calculator but not the memory. I demonstrated its use in checking an invoice and found one where the total, K361 appeared to be just twice what it should have been. We priced the meat balls they sell: 1 kg of meat (K2.50) and 1 onion make 7 balls. We weighed the onion (100g costing 7t) and estimated the cost of the gas (1136 scones or equivalent in an average day, using a sixth of 4 \times K43.00 worth of gas) and cooking oil and labour were calculated similarly. This left a 40% profit to cover overheads etc. Margaret normally priced food by noting competitors' prices but appreciated the advantages of knowing what her actual markup was. Artifacts are sold at a straight 100% markup.

They pay 7 workers so I asked to see how they worked out the wages. Overtime is given at normal rates, or double rates on Saturday afternoon. The calculation in the wages book consists of hours worked, rate, overtime worked, total, tax, nett pay. I suggested that the total gross pay could be checked as with an invoice (in doing which we found an error of 4t) and less the total tax deducted it should give the total nett pay. They were also deducting Tax as per the line above the correct one in the tax tables. This will make them liable to pay the difference when it is discovered.

Their till does not calculate change so I suggested their staff should use the traditional method of "counting on" when handing over the
change. I gathered they did not always do this. At the end of the
day there may be a shortage or surplus. They write out a "notes and
coins" slip each time they total money so I suggested I might send
them some duplicated slips and they could use the memory to total
them. Easing the process would encourage them to check the takings
more often than once a day and I suggested this was desirable to
combat the shortages.

Betty Ketawu (General Manager) and Bul Dulau (A/PBDO) were both there
at lunch time so we had a useful discussion on the sort of skills
women would be likely to need, especially adding and subtracting
simple numbers.

2 New Exercises

I had decided that being able to compare prices of different sized
units of the same commodity would be a useful skill for housewives.
I therefore prepared three exercises: finding the price per kg given
the price and weight in kg or g, finding the price per litre given the
price and weight in l or ml, and finding the amount saved by buying a
larger quantity. This involved using the decimal point for kg or l
but I do not anticipate difficulties there. I spent some time in BP's
collecting data: the weights or volumes were all clearly stated
except for some American peanut butter which was marked only in ounces.
Bul kindly agreed to get the exercises photocopied.

3 Metrication

I visited Collins and Leahy, and Carpenters where they were still
selling dress material in yards in spite of my last visit. I asked Bul
if he would have a word with the appropriate inspector, although at
Carpenters they said they had just completed a stocktake with a view to
going metric.

4 Fay Moakes, PFA

I was impressed to discover that this Scottish chartered accountant with
long experience in Africa was in fact a VSO living happily on half the
national wage for her job.

We discussed and admired Jonathan Spector's really simple profit and
loss system. This consists of adding the stock value to the "cash and
bank" to give the TOTAL or "Net Worth". Provided there are no
creditors or debtors and other assets are ignored, the change in this Total represents the gross profit or loss (assuming all goods will be sold) and should be meaningful on a fortnightly basis. "Profit" will be artificially augmented while stock is being built up because it is valued as soon as it arrives as if it were already sold. If the "Profit when sold" on each order were calculated the total of such profit during the period could be compared with the "Profit" for the period as calculated above: any difference would then represent leakage or other expenditure. (Now, 23.3.81, incorporated in 3 ANCS 4.2. - 4.7).

(10.3.81)

5 First Day of the Course for Training Trainers of Women

Then arrived altogether, between 7.45 am and 10.00 am. They were all women, including 3 with Grade 10, 2 with Grade 9, 3 Grade 8's, 1 Grade 7, 1 Grade 6 and an expatriate from Germany. They were altogether a very high-powered group, with BDO, a CDO, a coffee buyer, a second-hand clothes dealer, the general manager and manager of GWIC, members of a Business Group and the Provincial Women's Council, one housewife and an (unpaid) promoter of women's groups.

Only one brought a calculator, of which the battery ran down within a few minutes, two bought and the rest borrowed them.

They worked through the introductory totalling and change exercises individually and those who had arrived early tried out the SNAP cards and the SUMTEN game.

We went quickly through the number games (constant function on the calculator) up to finding change from a kina, but without doing the two self-paced exercises or tests as I felt these would be less appropriate as they went round to teach village women. I hoped the new games would provide sufficient motivation and practice without the formal teaching. With Mary's help I tried to initiate a discussion on the appropriateness of these different teaching aids, but they did not seem to be able to evaluate them at this stage.

In the afternoon they did the measuring and "piles of money" exercise individually and seemed to understand the idea, though not knowing
automatically which sign to use to find "how much more". Several had used the memory in the morning to complete the Analysis sheets, now they all did the invoice checking, which was well emphasized by the GWIC members who had got their supplier to give them a credit note for K180.50 as a result of the error I had uncovered.

We went straight on to the pricing without freight, and agreed to start again in the morning at 8.30 am.

(11.3.81)

6 2nd Day of Course

8 of the 10 women came for most of the day, Helen having to go to Kainantu. We started by working individually as they arrived, revising "change" with 1.4, doing "Notes and Coins" and coffee selling with the memory (but without the actual scales). Then Mary went through the new Pricing Sewing unit which seemed to be understood, and I did the new Comparing Prices unit. Finding Price per kg and Price per litre seemed all right and adequate to show which was cheaper. Only in one case did we find the BP's were charging more, pro rata, for a larger pack: Bushell's Tea was 37t for 125g and 77t for 250g. Most Instant Coffee was around K15.00 per kg, eg 75g for K1.18, but for some reason their 150g jar of the same product was only K1.27 or K8.46 per kg. (I checked these prices in the afternoon and found they were correct. We recommended them to go and buy up all the 150 jars they could find).

In most cases therefore the larger packs were cheaper although this might not have been the case if prices in different stores had been compared. In an attempt to quantify the difference we found what price the larger quantity would have been at the "rate" for the smaller quantity. This enabled the actual "saving" to be found on buying the larger quantity. Unfortunately, the calculation, which started with dividing the price per kg by 1000 and finished with subtracting one price from the other, seemed too difficult for them to grasp. It might have been easier to do "straight" proportion using the price per gram (as done in 3 ANCS 5.6, 23.3.81). It may however have helped by giving significance to an otherwise theoretical comparison of prices per kg.

In the afternoon we spent a lot of time pricing scones, which involved including costs of flour, fat, cooking oil and baking powder, all of
these required the sort of calculation we had done in the morning, which was in effect proportion with change of units. We repeated the process we had gone through with GWIC for pricing their meat balls, but this again was complicated, since the cost of cooking oil, gas and labour had to be estimated on the basis of the cost of these items per week for the whole operation.

Again the exercise was appreciated and some of the abler students may have learned from it, but it was well above the level that would be taught in an average village.

We concluded with the Calendar exercise which was again found difficult by about half the students. We tried teaching that you can (usually) add 3 to find the date in 3 days time and can perhaps add 9 to the number of the month to find the date in 9 months' time but the alternative method of counting-on on the calendar was of course also necessary. These alternative methods also apply to the clock, where we shall again teach them tomorrow. We defined "one month from March 11" as April 11, but wondered how this would work for January 31.

(12.3.81)

Final day of the Course

7 came for the day, Betty being sick and Monica being unable to leave her children. The only one who had dropped out completely after the first day was the coffee buyer, who had the lowest educational qualifications, Grade 6, of the group.

Several were late arriving but those who were punctual enjoyed the "Sum-Ten" game.

I did the ⊗ and ⊕ exercises which went down very well, crystallising the vague ideas they had acquired earlier, although they still made many mistakes.

They did the (revised) clock unit, mainly on their own, but several needed a lot of help working out the time in \( \frac{1}{2}, 1, 2 \) or 3 hours.

I taught the stocktaking unit for the first time, showing them how to count by pressing \( 1 \oplus \odot \odot \odot \ldots \) (thanks to Jonathan Spector), explaining how they should include the numbers in cartons and how to
put those on the shelf in piles and count the number of piles. The
rest was a good example of the use of the memory. I underlined the need
to take stock frequently but did not go into Jonathan's "net worth"
method of checking the total of cash and stock (as perhaps I should).

We filled in some items on Cash Sheets and I showed how to find the
balance line by line or, alternatively, by totalling the columns. I
also explained briefly the uses of the Loans and Credits slips.

The course was thus completed at about 10.30 am, and we then went right
through the List of Units (AN8) discussing which were suitable for village
use, which for town use and which to omit altogether. Mary very usefully
"took the Chair" for this ensuring a much more valid response that I
would have got. The following units were to be omitted 1.5 (cross-totalling),
3.7 (timber requirements), 4.2, 4.3 (Markups), 4.5 (PMV's), 5.4 (Stock
Control). I had already omitted the Self-paced addition units 2.1 and 3.1
their tests. Measuring was thought to be only suitable for Town women and
the "Lengths of Sticks" sheet would be re-written with lengths of material
and requirements for garments instead of sticks. They thought the and sheet was "a bit hard" and the Clock only worth teaching in the Town
(villages go by the sun). The Comparing Prices sheets would be very useful
if some sort of Consumer Group were to be set up in Goroka. I promised to
send some copies of blank Notes and Coins slips, including 50t pieces, for
their use. The remaining 13 units described on AN8 were all considered
suitable for use, more or less as they were.

While we were discussing the "Pricing Scones" unit Popsy Viri said that her
mother had just made and sold some tapioc "parcels" on which she had lost
money. After lunch she brought the following details: Tapioc root 40t
from the market. Tin of meat 60t. Packet of salt 30t. She
had made
12 "parcels" (in long leaves), eaten 2 and sold 10 at 10t each. Total
cost K1.30, cash received K1.00. Loss 30t.

We first pointed out that she could only have used less than a quarter of
the salt. Dividing 30 by 4 (as on the sheet) gave 7 so we agreed on
for the salt, giving a total cost of K1.02. Following the sheet we
divided this by 12 and added 80%, giving a selling price of 15t. This
would have been just right, giving receipts of K1.50 which would have
provided a profit of 48t and also covered the "wastage" of the two she
eaten. The result was warmly approved and we promised to provide an
amended Pricing sheet which would, if possible, cover scones, tapioca parcels and other saleable products.

They all indicated their willingness to teach others so we gave them spare copies of each "approved" sheet. All bought calculators except one who "had one in their office": I said that this would pay for their coffee. We offered the snap cards, Sum-ten game, sets of 20 small numbers and metre rules at a straight 20t each and K3.80 worth were sold, including 6 rulers and some of each other item. The rulers are thus being subsidised from the K7.50 per calculator at about 10t each on the cost of the wood, while the receipts for the card should just about pay for their reprinting in due course.

I asked Baunke to present the Certificates (for "teaching numeracy"), which he did with an admirable speech and much applause from the recipients. Group photographers completed the course at 3 pm.

8 Monica Schmidt

We took all our materials up to Monica whose husband teaches at the Tech. She agreed to encourage and support those we had trained, and supply them with materials as required. She bought K5.00 worth of card games and rulers, and we gave her about 20-40 copies of each of the "approved" sheets, and also for the courses she, and a wantok of hers, were likely to run on the once a week or once a month basis. She was not interested in making a small profit by selling calculators at K8.00 but we agreed to supply them to her at K7.50 freight paid provided she ordered at least 10 and they were used primarily for Adult Numeracy. She also kindly agreed to help assess the results of our efforts in due course by enquiring of those we had trained how successful they had been in teaching others. She mentioned the sad fact that there were more than one women's group in Goroka and that they did not always work together.

9 Acknowledgement

I am happy to express my warm appreciation of all the co-operation I have received from the A/PBDO and staff of the Business Development Office at Goroka. I also got the impression that it was one of the happiest and most purposeful Business Development offices I have been privileged to observe.
On return to Port Moresby

10 National In-service Training Week Co-ordinators

On my return to Port Moresby I was able to talk to these co-ordinators at the invitation of Mrs Josephine Laufa of the SDU. This was the end of their conference; they were having a lecture on the use of the calculator when I arrived. I explained some of the items for which I still had exercise sheets with me: finding change, cross-totalling, checking invoices, simple pricing, measuring in m and cm, pricing lengths of material and teaching multiplication tables and change from a kina.

They were obviously interested and would have bought calculators if supplies had not been held up by the Quantas strike. I urged them to consider training teachers so that they could give such teaching to Grade 6 leavers. I had a few words with Matthew, an Inspector from Mendi, who said their NIST week program was already full when Alistair had spoken to him, but he would see whether anything could be done for Grade 6 teachers at Mendi on the 13th or 14th, and for those at Koroba on 16th April. (I have since been asked to teach at the NCD NIST week on 28.4.81)

(17.3.81)

11 Comparing Prices

I had been asked to deal with "the metric system" with the Diploma students. All they really wanted was to know how to convert from Imperial units, which I showed them. I then went on to try out new units on length and comparing prices. The Length unit (5.8) can replace the "Lengths of Sticks" unit when much practical measuring is not required: it includes the usual multiplying, dividing, comparing, subtracting, adding and finding the price per metre which (alone) necessitates the use of the decimal point -"because we don't want the price per cm". They probably do not understand that omitting the point means working in cm (or toea), but at least one says this is what one is doing. Understanding of decimals is a long term aim more suitable for teaching in school, but somehow not very successfully achieved there in PNG.
The new "comparing prices" units start with Price per kg when the weight is in kg even when this includes a decimal point (e.g., the 1.25 kg packet of OMO). Mostly the weights are in grams and the results have to be multiplied by 1000. The second half of the exercise finds the "savings" by calculating what the "better buy" would have cost at the price per gram of the more expensive item. This in effect uses direct proportion, by way of price per gram, instead of trying to use the price per kg as in my earlier attempt at Goroka.

I considered using "mass" instead of "weight" as the metrication people urge, and included it in the heading of the exercise but until we have a separate verb meaning "find the mass of" I don't think the more correct term, mass, is usable in practice.

The new unit on comparing prices in liquid measure proceeded through the same stages only more briefly. Finally, I prepared three sheets showing pairs of cut-outs of advertised goods sold in kg, g, l and ml. In each case the cheaper item was found by working out the price per kg/litre, and the "savings" were found by proportion (or could be found mentally in a few cases). I regretted not being able to use Burns Philps advertisements for this as they do not normally give prices for food items. They only tell how much they have reduced the prices, which is not very helpful. Steamships, Carpenters and Stret Pasin all gave clear prices and weights/measures. The cut-outs came from Post Couriers of 14.11.80, 12.2.81, 26.2.81 (which also contains a typical full-page BP advertisement) and 5.3.81.

The Diploma students seemed to grasp this new approach tolerably well, although its presentation had to be by "chalk and talk" because of the lack of plain paper copying facilities at Laloki.

I suggested to the students that in most capitalist countries the comparison of prices was considered an important part of the economic system. As it was largely lacking here I thought they should be prepared to assist in it, perhaps by encouraging Consumer Protection Societies, but I do not know if this is Department policy. It is certainly something that would be quite impracticable without the calculator.

I was delighted to hear from Bryan Wilson, the British Council mathematics consultant, who has written a number of reports on the
development of mathematics in Papua New Guinea, that he will be accompanying us to Popondetta and is willing to share in the teaching there. He says "As far as I know, the project is unique in what it is attempting to do, and in its methods, and I would value the opportunity to see it at first hand". I feel sure the Department of Commerce and other interested agencies would be glad to receive some sort of assessment of the project from this mathematics Educationist of international repute.

(19.3.81)

13 Revision of Units

The units needing revision have now all been revised, re-numbered in a more logical fashion (3 ANCS ...) and listed. This includes new units on Pricing Kaikai etc, which will be discussed with Helen and Susie, and a new system for trade store accounting based on Jonathan Spector's simple "Net Worth" formula (stock value + cash) to which I have added a "Leakage check" assuming that the profit-if-all-sold on each invoice has been found and other income/expenditure listed.

ALLEN EDWARDS

19.3.81

ANR 9

A127
DEPARTMENT OF COMMERCE
NUMERACY PROJECT

REPORT ON SECOND VISIT TO SOUTHERN HIGHLANDS, 7-24 APRIL 1981

(7.4.81)

1. **Meeting of the Provincial Literacy Committee**

We were courteously welcomed by John Croft and the Chairman, Joseph Ogaie, Provincial NFE Officer. The proceedings were all in Pidgin which Mary was able to follow but I was not. Mary in Pidgin and I in English (translated by John) explained the sort of things that we meant by "numeracy", pointed out that those involving x and ÷ were in practice not without the calculator, and that others (e.g., learning sums of numbers) were easier to teach with it. We asked if we might prepare an appropriate course to include in their Literacy Programme, and submit it for their approval.

All speakers welcomed the idea and some were very keen. We were asked how numbering would be related to the base 4 or 15 systems which were being taught along with the Mendi, Nipa and Huli vernaculars. Fortunately I did not have to answer this as, frankly, I am not convinced that any carry-over is likely to be helpful. What they can do in their own system is fine: I would not denigrate it for one moment. But I see no point in trying to extend a system that will inevitably fail with such basics as "change for a Kina". This sounds ungracious and I was glad to be able to avoid saying it.

Ideas for incorporation in the course included calculation of freight charges at toea/kg, air fares including half and quarter rates, finding the page (ordering numbers), budgetting. Someone suggested using cassettes or the radio.

The proposal was agreed. Afterwards one of the members asked to attend our course in Koroba and Barbara Wadson of APC Mission (Evangelical Church of Papua) invited us to try it out with the 60 or so literacy instructors in Tari. A request to which we agreed for September.
1. **Course for Businessmen at the Business Development Office, Mendi.**

9 men came from a wide variety of businesses. Some had used a calculator before. We overcame the usual tendencies to use decimals, \( \Box \) instead of \( \text{CE} \) and \( + \) instead of \( \equiv \). We taught finding change, cross-totalling, checking an invoice and then, as 3 of them already had cheque accounts I adapted the old self-paced Bank Book unit and got as far as teaching them to prepare a Reconciliation. This was all there was time for in 3 hours but there was little more (except Notes and Coins slips) which would have been relevant to them all. Afterwards one asked me how to work out the total for different numbers of kg at 7.7 or 8.5t/kg (for a government freight contract). I explained that he had only to "mask anything after the decimal point" and then put in the point as usual, 2 from the end. This he quite understood: almost certainly his problem had arisen because he had been trying to work in kina.

(8.4.81)

3. **St Pauls College (UC)**

We had the 17 students including ten who had been taught numbers and change from 10 with the calculator by Mary on our previous visit. 1 had Grade 8, 5 Grade 6 (including 2 women with Vocational Centre training) and 11 without schooling (including 2 women). Most said they did not understand English but we got by with a mixture of English, Pidgin and occasional translations by one of the students.

We started teaching Exercise 1 (totalling cash) and found it somewhat chaotic, so tried to insist on all pressing the same keys at the same time, but this also was not fullproof. After about 1½ hours we had completed it and done the first few of exercise 2. We then let them go at their own pace and several completed Exercise 3 and the Analysis Sheet in the next hour.

ANR 10
4. Aid Post Orderlies

We spent two hours with Dr Janet Hohnen, who translated when necessary, and 25 APOs. We completed the first three exercises as we had done in the morning, but much more ruthlessly, those who failed to get a question right leaving it and going on to the next so that we could all keep together. I also forbade the use of the $\text{C}$ key on the grounds that once they were allowed to use it they would use it whenever they pressed a wrong key, creating chaos in a large class. Instead I insisted on $\text{C}$ being pressed before starting a question if they had not just pressed it. They checked every entry, and were told to press $\text{CE}$ if it was wrong.

On this basis about 15 of the 25 reached the stage where they could do totalling and finding change on their own. A group of 5 at the back of the class were un-schooled and were not able to write Kina and toea correctly. Mary did her best to help them individually but they remained lost.

We spent the last 20 minutes on the new Pidgin version of the calendar exercise. They all seemed to know the English month-names and day-names which was good as we reckon most printed calendars they will see are in English. Mary spent some time introducing it and I then did the first part of the exercise. They had the usual difficulty but several appreciated the use of addition as an alternative to counting on the calendar. At the end Mary asked questions based on the fact that some innoculations have to be repeated after a 2-month interval. The question when they would ask a mother to return if the first was on 6 February produced answers of "March" and "May" before April was suggested. No one seemed confident in this, which one would have thought was pretty relevant to their work. A final question of the date one year after 6 February 1981 also produced alternatives, the most favoured one being January 1982.

*Aid Post Orderlies

A130
A number wanted to buy calculators but unfortunately none had yet arrived as a result of the Qantas strike and an order for 240 being lost in transit. Janet kindly offered to buy and re-sell some. (They are now available from Mogria College of St. Paul's College.)

(9.4.81)

5. Rural Development Officers

Gregory Onesii had arranged for himself and 8 of his staff to attend an all-day session. They included 4 with Grade 10 and a Diploma in Agriculture, 2 with Grade 10 and a Certificate, 1 with Grade 8 and an expatriate woman. All already used calculators in their work so it was not at all clear what we should teach them.

We began by trying to find out what they used calculators for, and whether we could help them to do so more efficiently. We talked about buying coffee (to the nearest ½ kg) and selling eggs by the dozen. Both appeared to be straightforward but I emphasized the use of CE. They then explained how they found the area of a polygonal field for a cattle project by drawing it to scale, dividing it into triangles and using base x height. We discussed how to convert back from cm² on the paper to hectares on the ground. I then showed them how to use the memory to total the areas of the triangles, including checking and the use of CE and H- or C if they had got muddled over the area for one triangle and had not pressed CE.

We proceeded to work out the perimeter and calculate the number of 400m rolls of wire and the number of posts required (small ones every 5m, big ones every 100m plus corners). We found the number of staples required but they are available in 50kg or 25kg boxes. We used the 5g for a 2t piece and 50g for a golf ball to estimate the weight of one staple as 40g but agreed that they should weigh 10 and divide to find the correct weight for 1, and so calculate the number needed. In each case we agreed to add 5% or so to allow for wastage.
We found the number of cattle by dividing the area by 4 (or 2 if good ground) and then drew the plan for a stockyard. Posts were every 3m, or 1m in the "crust" and rails every 2ft on the 8ft high post. We found the total length of rails needed but then decided that we really needed all rails to be at least 6m long and could then divide the number of posts by 2, multiply by 4 and add 5% for wastage.

I asked if they purchased items for their work and found that they never checked their invoices (or money received from the bank etc). So we wrote out a realistic invoice and checked it.

The number of coffee seedlings and shade trees needed were normally found by marking out and counting, but when statistics were required they sometimes used the number of trees to estimate the area. With standard spacing at 1.5m x 2.5m (square) they knew they got 2700 per hectare, but older plantations might be on a 9ft triangular basis. We suggested they measured the spacing between trees and rows and supposed they found them to be 2.7m x 2.4m. Someone produced a formula for the number per hectare but it gave a ridiculous answer so we emphasized the importance of estimating. We solved the problem by areas and then showed how the same method gave the 2700 figure for modern spacing. The method involved multiplying 2.7 x 2.4 and dividing 10 000 by the result: with a little prompting someone suggested putting the product in the memory and pressing 10 000 @ (RCM) @. A later calculation using chillis spaced 30cm x 30cm produced an interesting but not very useful result.

We had decided to do the calendar in the afternoon, and wished to use the "counting on" method. We were aware however that many people made the mistake of including the first item in the count (eg making May 1979 - May 1981 into 3 years). This might be acceptable in the Easter story but would not help in finding an expected date of birth. It had occurred to us that the board-game was a good example of "counting on" and I had with me some
"Car Race Track" games with squares numbered from 1 to 100 and the usual "missing terms" etc. (These were based on the Maths in Community School syllabus). We had not been able to use them for lack of a die: Idubada Printshop were hoping to make some more 5cm cubes soon, but not yet. I wondered therefore if we could use the calculator to produce random numbers and thought of inserting any number 7 and using the last digit. Each subsequent gave a fresh last digit until 0 was reached. A new initial number had then to be inserted. (To prevent cheating by players who noted that certain initial numbers gave high scores we agreed that the "other" player should insert the last digit of the initial number).

The game was a great success particularly as the very first player trying to "count on" 3 from 5 only reached 7. We ruled that the player moving his symbol (a 1t or 5t piece) was always to "count on" and the other player was to "add on" mentally. Any differences were to be argued out. To reach the 100 exactly, to finish, they could work out the number they wanted.

(Note: the method given does not produce truly "random" numbers in that the probability of any particular result is not 0.1, and there are no zeros, but it is sufficient for the game that the results are unpredictable. It is also better pedagogically than the die in that the numbers 7, 8 and 9 are included.)

We spent about an hour on the Calendar, mainly using the gestation periods of pigs (3 months, 3 weeks and 3 days), cows (9 months), ducks (28 days), Muscovy ducks (36), turkeys (29), dogs (48), cats (39), Guinea fowls (26). (In the case of birds the date was from the start of the sitting, not from the laying, the clutch being produced over several days but all maturing together.) In practically every case we were able to find the result in two ways, by "counting on" on the calendar (which they did wrongly until we pointed out why they had been playing the Race Track game) and by "adding on".
We also found we could use the calendar month for the birds, counting it as the number of days in the "starting" month, and then counting forward or backward to give the result.

With cows we tried counting on 9, then going on one year and counting back 3, but suddenly realized that they knew the numbers of the months better than we did because (they said) April is "mun namba 4" in their Pidgin. We were therefore able simply to add 9 to the number of the month, or to subtract 3 from it.

We had done a little measuring and they thought it very useful to be able to calculate the number of corrugated iron sheets needed for a roof. So we finished the day by doing the second page of the "Lengths" Sheet (5.1).

(10.4.81)

6. Various meetings

Alistair had arranged with the Community Development Officer, a day's course with a women's group including National Council of Women representation. This would have been excellent but unfortunately no one appeared to be available either at the place of meeting or at either of the offices concerned. Instead I made a number of useful contacts.

I talked to Vicki Reed, Provincial Nursing Officer, about the arithmetical needs of nurses, a matter which I had already discussed with a rural health supervisor whom we met on the plane.

I also saw Paul Fearnan, District Officer, Training. He had been District Officer at Nipa when we did the course there in October. He took me to see Noel Wright, First Assistant Secretary, Policy Planning and Advisory Services. I had met him also on my previous visit and he remained sceptical about the ability of villagers to maintain and use a calculator.
(which is a very reasonable doubt to express and a challenge to us to provide contrary evidence) but he was quite sure many government officers would benefit from training in the correct use of one. As Provincial Training Officer he would be happy to know when I would next be visiting Mendi so that he could make appropriate arrangements. (I must also ask him to include briefing sessions, so that I can go into each course with some idea of the sort of material they are likely to need.)

I asked John Crofts if there was any material I should see before drafting a Numeracy Course for the Literacy Programme. He gave me a copy of a Kisim Save exercise book with a number square, 20cm measure, time and length data on the back. He said I should try to get hold of a Pidgin Numeracy Course from Sr Kristen Whitehouse at the Brave Catechist Training Centre.

Gwen Collins with whom we were staying at St Paul's College, also showed me a copy of Angal Heneng Hendenui, the Nipa vernacular literacy book. This has a final four-page lesson for teaching place value for numbers up to 1001.

(13.4.81)

7. St. Paul's: Second Session

We started them all on the Revision sheet for finding change (1.5) and used it to sort the quick from the slow ones. Unfortunately 3 of the five Grade 6 students were ill, leaving the 2 others and the one Grade 8 student. The best 7 students continued with the Cash Sheet (4.5) while 6 went over to using the Snap Games, which they found difficult, but enjoyed. Only the Grade 8 student mastered the cash sheet completely, including the check: the others found it difficult to understand that IN meant + and OUT −, and they made many other mistakes.
After the session I concluded the discussion I had had with the Rev Bernie Collins, in which we decided how to operate a leakage check in the College trade store. This version added stock value plus total dinau plus sales money and compared this total with the previous stock plus previous dinau plus value (at SP) of cargo received. The difference would be an "over" or "under" accountable for, perhaps, by spoiled stock, bad debts written off etc. The method could be used alongside the Net Worth process of determining profit, instead of the leakage check prepared as an extension to that process (4.7/6.5).

8. High School NIST Week

We were invited by Keith Fuller of Ialibu High School to spend 2 hours with the "Community Involvement" group of High School teachers. I explained that we had (or would have) material suitable for "basic numeracy" (learning to count etc) in the village and also for those who could already add simple numbers and needed an "intermediate" course. We would warmly welcome any High School prepared to experiment in teaching such programmes as part of their community outreach. We illustrated the course by working through the "introductory" teaching, number games and invoice checking, and by explaining the snap, Sum-ten and Race Track games.

Discussion included: whether Trade Store keepers could remember how to use the memory, how many years it would take to teach basic number to innumerate villagers (answered by someone who had taught many villagers to count up to and down from 20 very quickly), when my "basic" materials would be ready (answered by Mary who said you only needed to prepare obvious items like collections of objects and numbers written on bits of cardboard), whether to "transfer" from traditional to modern numbers or to go straight to the modern, whether the use of the calculator was an admission of failure (which I answered by comparing it to the radio which was an "admission of failure" to communicate over long distances without it).
Each school received a copy of Newsletter No.1 and the List of Available Units.

(14.4.81)

9. **St Paul's College, Final Session**

Mary continued with the 7 weaker students. She started teaching $1 + 1$, $+2$, $+9$ and $2 + 2$, $3 + 3$ etc orally and using the number games. They did both tests, 2 students quickly, 5 very slowly, but mainly correctly. She gave them the Sum-ten game and all enjoyed it though only the 2 quickest were able to do it on their own.

Meanwhile I took the best 8 including 3 Grade 6's who had been ill the previous day. We worked fast in order to complete all the skills needed to run the College trade store. We started with the invoice-checking, then pricing, totalling the stock value and completing the new Leakage checks using the actual figures for the first three stocktakes at the store. Finally I showed them how to put their stock in piles and use multiplication and addition for the "extra". They had bought kerosine and rice in bulk so I advised Bernie to attach a card to each stating how many units ("parcel") the lot was intended to contain, then a mark would have to be made each time a unit was sold. They could then find the number of units left by subtraction. Failure to get the correct number of units out of the lot would appear eventually as a leakage.

The total of 1½ hours spent on all this meant that the students would not of course be able to remember and do it all, but they had had sufficient success to be able to carry out the required calculations with Bernie and eventually no doubt would learn to do them on their own. We concluded with a group photograph.

10. **Basic Numeracy Course**

Mary and I spent the afternoon writing the first 12 lessons for the first draft of the course requested by the Literacy Committee (see #1 above). We had a typical Australian
pre-school text-book to study but decided adults needed a more direct approach. We would have liked to see the Erave Catechist's School Pidgin Numeracy Course first but we had only been able to send a message (and K2.00 for postage) for a copy to be sent to us at Laloki.

We therefore designed the course out of our heads and will look for comments and criticisms to improve subsequent drafts.

(15.4.81)

Alistair was misinformed about the Government Charter flight so we missed it. Instead we were booked on the "Pay Run" the next day. This had to be approved by Noa Kila, the Assistant Secretary, Management Services. So I offered him my services for the afternoon.

Meanwhile I visited the Education Department and asked if our Basic Numeracy draft could be circulated to the 7 High Schools when it was written.

11. Course for ENS Officers

At short notice only four officers were available for training, 2 men and 1 woman with grade 10 and 1 female expatriate. We found they mainly checked invoices and completed wage sheets. With two examples we illustrated the following skills: use of the memory, corrections with CE, M-, C, O ÷ and simply repeating ÷ - × or ÷, checking wage sheets by subtracting column totals, finding a difference with small ÷ big, using the ÷ so that this difference could then be differenced from another total (when amending the total having found a mistake in one entry in the column), using ÷ and the memory when a column of amounts included several of one amount and also several of another amount. They also needed to check a % discount and reduce by a given % (alternative procedures), express one number as a % of another. The constant function might also be useful eg for changing currencies, so we
taught them the number games for good measure. We also showed how to calculate change from a kina in their heads.

After the course they paid for calculators (which Gwen Collins will deliver when they arrive) and Noa Kila promised to be at airstrip in the morning to make sure we got on the plane.

(16.4.81 - 17.4.81)

12. Guala Christian Centre, Koroba

After vacillations by Talair, the BMS representative got us on the Pay Run and we arrived safely, to be met by Ossie and Jenny Fountain of the CMML. Great trouble had been taken to ensure a good response to the course and the expected numbers were 43, about the number we had suggested. Only having 25 calculators meant that we would have to teach one of the 2 groups without them, or share. I completed exercise sheets for the Basic Numeracy Course, on stencils, and worked out two separate courses, one with calculators and one without. Mary and I decided to teach one of these courses each, the students alternating between us for morning and afternoon sessions.

13. Bia Mogo Bulene (= "Helping Hand", in Huli) Trade Store

The Mission Staff managed this trade store with one young Grade 8 boy and an older man without schooling. I taught them totalling and change, checking invoice, pricing (using 34t/kg as the freight, though this was only the subject of a claim, without notice having been given, by the local carrier I recommended frequent stocktaking to check leakage, but the task would be large because the store also acts as wholesaler. The partial opening of the Highway to Mendi had resulted in a sudden decrease in freight costs with problems resulting from local competition. The Missionaries were thinking of withdrawing from the business.

(18-4-81)

14. Non-Calculator Numeracy Courses in Pidgin

Jenny Fountain showed me materials she had used to teach
number, initially using the Huli language, and subsequently in Pidgin. Some of the materials for teaching 1 to 20 were lacking but she did have some "number cards" each one describing the number, its composition and the result of subtracting smaller numbers from it.

Her course, as taught in March 1978, included writing and counting money, the day's date, days of the week, finding page numbers, writing numbers up to 1000. This general course was followed by 40 assignments concerned with adding 2-figure numbers and money, introducing multiplication tables using trade store articles at 20t, 30t .... K1.00 each, writing and totalling invoices for same and finding change. The 2 and 5-times tables were formally learnt. Seven units were on finding change. The last two units enabled invoices to be written with 1, 2 & 5 as the only "quantities", and finding the change.

Jenny emphasised the amount of drill required and I was impressed by the perseverance shown by students who had completed such a course, but one cannot help realising the enormous gap between this achievement and dealing with actual invoices without a calculator. Anyone with a calculator however should have been able to complete the whole 40 assignments after perhaps two days instruction.

Jenny also showed me a 30 lesson course on numbers written by a colleague and spirit duplicated in the form of an exercise book. It started with writing the numbers and addition to 5. Lesson 5 introduced 6 to 10. Lessons 9-10 were on single figure subtraction. Lessons 11 - 19 extended to addition and subtraction in column up to 1000. Lessons 20 - 30 were on adding and subtracting dollars and cents.

She also had a copy of Book 1 of the Erave Catechists Training Centre Mathematics course. This starts with 45 single figure addition and subtraction questions, presumably as revision. Other exercises include time at o'clock and half past, adding with missing numbers, tens...
and units, money including 2 brushes @ 6 cents and 2 pencils @ .5c, presumably to be done by addition, the number line to 20 showing addition and subtraction, the meaning of longer and shorter (not quantitatively), measuring with a metre stick, the meaning of \(2 \times, 3 \times, 4 \times, 5 \times\) (eg \(5 \times 2 = 2 + 2 + 2 + 2 + 2\)), numbers of squares in a rectangle, \(4 \times 2\) on the number line, reading weights as more or less than 1kg, tens and units, counting money, counting in \(2's, 3's, 4's, 5's\) on the number line, volumes as more or less than a litre, hundreds, tens and units in terms of tens and units, and a little more on multiplying.

Subsequently thanks to the Catholic Sisters at Mendi, Sr Kristen of Brave Catechist Training Centre kindly sent me copies of Book 1 and Book 2 of her course.

Book 2 included: number line used for addition and subtraction, revision, subtraction from 10 to 20, hundreds, tens and units expressed with big, medium and small stones and the abacus, addition of up to 3 2-digit numbers, subtraction of 2-and 3-digit numbers, block graphs, counting money, measuring by counting paces, in metres and centimetres and by trundle wheel, miscellaneous problems; missing numbers in sequences, halves, quarters and tenths, calendar, decimals, rectangles, litres, kilograms and grams, telling the time, adding and subtracting times, numbers of days in months and years. Multiplying and dividing and tables are interspersed throughout the book, being done in the order 2, 4, 8, 5, 10, 3, 6, 9, 7.

(20.4.81)

15. **Guala Christian Centre Course: The First Day**

We expected about 43 students but eight from DPI and Non-Formal Education did not come, possibly because this was Easter Monday.

23 students had arrived by 8.30 am (the first from 30 miles away, had come yesterday midday) so I took them to the Bush classroom with the calculators while Mary waited for the
later arrivals with the new Basic Numeracy Teaching materials. My group included a good number of non-English speakers so my pidgin at last started to improve. We completed the usual first three units and a few did the Analysis Sheet with the memory. A few were lost but this was deliberate as we intended re-grouping on the basis of achievement.

Meanwhile Mary with the help of Noreen Lawrence, the Education and Literacy Co-ordinator for the Christian Brethren Churches, had a group of 10 who happened all to be English-speakers. They imagined themselves villagers while Mary was the teacher. They worked through the first draft of the Non-calculator part of the Basic Numeracy Course, as far as the first test (3 ANCS 2.5) except that the "composition of 10 and 11" was done for real, and not as if they were villagers.

To divide them into a fast and slow group I considered anyone taking more than 3 minutes for the Test (2.5) and anyone failing more than about 2 questions on Exercise 2 or 3 (3 ANCS 1.2, 1.3) to be marginal or slow. Where two or three of these criteria coincided the student was "slow". These resulted in 12 slow, 9 marginal and 13 fast students. Out of the 34 students, five took over 5 minutes on the Test (quickest being 1 minute 49 seconds), 3 thought that $0 + n$ was equal to 0, and one subtracted although all the questions were +.

Noreen said she was impressed with the work Mary was doing. She was sure it would fit well into the Literacy programme. The only part that had not appeared to be understood was the "counting down" method of subtracting 1, 2, 3 or 4. We had not previously included any subtraction in the non-calculator part of the course, but it seemed desirable to do so at this stage,

(1) to help develop the concept of subtraction and

(2) to enable the Snap games to be played more effectively: only a few cards required subtracting more than 4 and these could easily be removed.
16. The Second Day

We had one new girl student with vocational centre training. After final consultations we divided them into two groups of 17. I continued the calculator work with the fast group in the morning, doing Number Games, Notes and Coins (1.8), Checking invoices (1.7), Prices and Profit (4.2). Some failed on some of these exercises, particularly the last where I thought I must include freight.

Meanwhile Mary took the slow group, continuing the non-calculator work. She taught the Snap game and Sum-Ten game successfully and also the new self-checking addition game I had made up with strips 2 to 20cm long. During the dinner hour some miscreant child mixed up the sets of snap cards from which specific ones had been carefully removed, so that the afternoon with the fast group was less fast than it might have been, but all seemed to be well worthwhile. She gave the "22" test (3 ANCS 2.7) to both groups. 3 did it in less than 3 minutes, 6 took over 7 minutes. Few made mistakes.

With the slow group on the calculators I had to spend a long time teaching the number games and spent the rest of the time doing the "change" exercises (1.5 and 2.2/2.3). Only one or two attempted the Cross-checking exercise (1.6) which I have decided is too hard anyway. Timothy, one of the Campus Community School teachers, helped Mary in the morning and joined my group in the afternoon to learn about the calculator. He was very sure that Grade 6 students ought to be better taught the simple number bonds and change for a kina such as we were teaching.

In the evening we put on an extra course for those concerned with cheque accounts, most of whom were in fact in the "slow" group. 14 came but I only had 6 copies of AB223 (4.8) so they had to share. We spent 2 hours during which most of them completed the four examples of Bank Book sheets, adding IN's and subtracting OUT's to produce the running balance.
In view of this demand for such teaching I must re-write the material, using smaller and fewer numbers and including a check, perhaps using the memory, by totalling the columns. They asked when I would be returning to give further courses. Jenny asked about assessment of results. I said this was most important and that it depended on people like her being willing to assist in the process. 

(22.4.81)

17. The Third Day

I took about 2½ hours with the fast group to do the Lengths of sticks and Piles of Money exercises. It was the first time I had felt the exercises worked. I set out six sets of 4 objects to measure: material, string, benches and several sets of sticks, each set having a letter to describe it. I taught them how to measure and gave each an exercise sheet. When they had written the 4 lengths at the top they came to me to check they were reasonable and written correctly (with 0 in front if less than 1m). They were then given a second sheet and if quick a third or fourth sheet. I explained what was meant by "longest", "shortest" and "in between" and they filled in the first section on each of their sheets. I explained how to put them side-by-side to find "how much longer" and end-to-end for total length; they returned to the sets for more measurement to complete these answers. I then taught the use of the calculator to solve the same questions and to complete the exercise.

With the piles of money we repeated the process. They were impressed by my ability to tell them when they were wrong, which I explained subsequently when they realized that each set of money totalled K2.00.

The idea of the exercise now seems good and worthwhile, but I must re-write it in pidgin and better arranged.
In the afternoon with the slower group I did the Notes and Coins slips and the Car Race Game because Mary wanted this done before she taught the calendar to-morrow. There seemed some reluctance towards playing more games, but they still had difficulty in adding small numbers to big ones: perhaps this needs more emphasis. To my dismay, 2 calculators appeared to develop faults during the afternoon: the first ever for me.

Mary made them write number sentences to describe stories they made up. She organized this very successfully by inviting each to tell a story after they had passed the chalk on to another to record it as an equation on the blackboard. She found the clock very hard, only the fast group being able to complete the test: of these 17, ten made more than 1 mistake in 12 questions, simply writing down the time. Fourteen made more than 2 mistakes in writing the time in 1, 2, 3 or ½ hours.

18. Miscellaneous

From 7.30 to 8.30 pm I gave an extra class primarily for the Literacy Supervisors, using the Cash Sheets (4.5), checking invoices and finding prices (4.3). The exercise showed that nearly all could now total a list of money correctly. They showed a real sense of achievement.

One of the people with whom we were staying was Sr Jocelyn Stothart who is responsible for the Health work of the Christian Brethren Churches in the Highlands. She queried my suggestion that nurses were over-taught in mathematics. She quoted injecting Chlorophenocol, Penicillin etc and needing to know how much water to draw up. However, she did think the Standard Treatment Book had the necessary information without requiring calculation, but they did not have enough Standard Treatment Books.

(23.4.81)

19. The Fourth (Final) Day

I took the Fast group till 10 am, doing Length (5.1), (5.7) and Car Race Game (7.8). We then changed groups as the
slower ones had complained that they were not having their fair share of calculator time.

With the Slow group and Jenny's assistance I did the Lengths of Sticks and Piles of Money (3.1, 3.2) exercises. I had had a translation of the questions from Noreen but still found it difficult to explain in Pidgin, "How much longer is the longest than the shortest". I decided the easiest way to do this practically was to measure the difference with them for each set and let them write the answers on their sheets. There are however ambiguities in the pidgin and it occurred to us that we might seek Fr Milhalik's advice on a precise choice of words which might subsequently become a more universal part of the language.

I found the later calculations for these sheets quite beyond these students so moved on to a new exercise sheet based on the quarterly return required by the Government from financially assisted Church Health Services. This involved totalling 9 sums of money, transferring totals and subtracting. The students were able to do this with reasonable accuracy so it proved to be a successful conclusion to the course.

Mary meanwhile had had great difficulty in teaching the calendar even to the faster group. They had hardly seen a calendar before and were not convinced of its usefulness. Noreen however confirmed that this was a worthwhile piece of work although clearly it must be accompanied by the distribution of calendars which we must try to obtain somehow, preferably free. We were assured that 1 "mun" = 4 weeks, which makes calculations eg of gestation periods, difficult.

At 3.15 we gathered together for a finale organised by Ossie. It included hymns, prayers, addresses relating numeracy to God and exhortations to pass on to others the skills they had learnt at the course. Certificates were presented and an interesting question session followed in which they asked
how to buy calculators, how to replace them under guarantee, how they would be supported in their work if they were not official literacy teachers and whether we were training nationals to carry on our campaign in case we (who were so old) might die before the whole of PNG had become numerate.

We took the opportunity to emphasize the need to assess the results of this course and were grateful for Jenny's and Noreen's assurance that they would do their best for us in this respect.

It was raining so we took the group photograph indoors. We then had the most surprising response of all. We had thought they were tired of "games" but we pointed out that villagers might enjoy them. After a brief interval while various local loans were arranged, we proceeded to sell 20 rulers at 30t each and K5.65 worth of cards at prices from 5t to 25t, including all the "Car Race" cards we had. We subsequently left a stock of such items with Noreen and two students arrived the next morning before 8 am to buy further supplies.

20. Summary of Guala Christian Centre Course

There were three unique features:

(1) The publicity and organisation had been thoroughly carried out in advance, so that the right number of students came, including some from as far away as 360 miles. They paid K2.50 each, over the K7.50 for the calculator, for their board and lodging for 4 or 5 nights. We remained immensely grateful to Jenny Fountain and the other Centre staff for this magnificent achievement.

(2) Thanks to the Qantas strike and the subsequent loss of 240 calculators enroute, we had to run the whole course with only 26 calculators. This forced us to develop the non-calculator basic numeracy materials (which the Centre duplicated for us), in addition to making full use of our cardboard "games". This also
led to the pattern of organisation whereby the first day was used to differentiate two ability-based groups while the other three days were spent with the groups alternating between Mary and me.

(3) For the first time we were forced to do much of our teaching in Pidgin although there was generally someone present, Jenny, Noreen or one of the local teachers or pastors, who could translate if necessary. This experience will lead to re-writing much of our material in Pidgin.

Statistics of students, all but two of whom stayed for the full 4 days, were as follows: Men 29, Women 5 (4 from a Women's Fellowship) From Guala 8, Kiwi 3, Kundugu 3, Pori 2, Fugwa 2, Jbali 2, and 14 from 14 other villages.

Occupations included: Pastor 4, Literacy Supervisor 3, Literacy Teacher 8, Bible School Teacher 2, Councillor 1, Nurse 1, Student 2.

11 had no specified occupation.

Education: Grade 8 - 6, Grade 6 - 15, Grade 6 equivalent (CLTC) - 2, Grade 2 - 1, None - 10.

21. Return to Moresby

We had expected difficulty in returning from Koroba in spite of scheduled flights GV503 and FX883 leaving us from 12.15 to 4.30 in Mt Hagen. At 12.30 a Wednesday's Government Charter reached Koroba: we persuaded the pilot that he could take us then instead of returning to Mendi first to become the service flight. Five minutes after arrival in Mendi the rain fell in torrents till 4.10 pm when the pilot decided to go up and have a look at the cloud in the Mt Hagen direction. Half way to Hagen the pilot said he thought we would make it, but FX883 would not wait so we watched it take off as we circled to land. Our disappointment however was
tempered when we discovered that the Airport Hotel boasted those rare luxuries for a stranded Pam, fresh milk from CLTC, a full-length bath and marmalade for breakfast.

(29.4.81)

22. NIST Week Course for National Capital District

I was asked to show 360 teachers how to keep accounts for tuck shops. I also emphasized the desirability of teaching Grade 6 leavers to do such things. I had each of four groups of 90 for 1½ hours, which was almost too long for me but not long enough for the task. I based it on Calculations in Trade Stores (5.9), written for the purpose. After teaching about CE, "not 0" and "not decimal points", with finding change, I moved quickly to invoice checking, pricing and profit - if-all-sold (4.2), notes and coins slips and cash sheet (4.5), Net Worth and Leakage (4.7). I only had time to refer to the Number games etc on 5.8.

All four groups showed great keenness, the only few who claimed to be "lost" were a small number at the back of a 20 metre long double classroom.

Calculators. When the 480 calculators ordered to replace the 240 missing ones had themselves gone missing, Mary set off on a trail to hunt for them. She eventually ran all 720 to ground, still at Jackson Airport, wrongly addressed. She also found that the other 240 expected by sea "next week" had in fact arrived 2 days ago but our indent agent was not aware of it. It was very fortunate that another order, for 100, addressed to the agent had arrived by air and had been collected by Mary just as customs closed the day before my NIST week course: without them the course would have had to be cancelled.
Health Education

I continued the discussions I had had on my previous visit in an attempt to find out what arithmetical help, if any, was needed by nurses.

In view of the concern for mathematical teaching in the Schools of Nursing and the considerable numbers of students who had been discontinued because of failure in mathematics, I was surprised to discover that hardly any arithmetic appeared to be needed.

The Standard Treatment Handbook gives precise doses for drugs based on weight ranges, so no calculations should be required except for non-standard treatments, and for these one could expect the implementer to accept responsibility.

What nurses do need is to be able to measure weights, times, volumes, rates and temperatures, and to be able to judge when such measurements are likely to be in error. One informant suggested that nurses needed to be able to work out ages in years and months in order to complete the child's Health Book, but if correctly used even this is unnecessary except perhaps in the case of children who are only issued with the book at a later stage, when estimating the date of birth might present a problem. (I was subsequently told by a nurse that she estimated age by counting the child's teeth).

Another suggested need was to add hours or half hours to a given time to record labour and delivery details. I was assured however, that they only need to be able to tell the time correct to the nearest half-hour.

Occasionally there may be a need to transfer records of weights from grams to kilograms, but with a whole variety of different scales in use any such procedure could probably best be taught on the job.

The only area in which genuine arithmetical skills seem to be required is in the provision of statistical information. Here it would seem that the enquirer could be expected to allow the known arithmetical skills of the respondents to determine the form of the question. Nurses cannot be expected to retain skills which they may once have learnt but which they do not normally use.
In conclusion then, I was left wondering why so much mathematics is included in the Nursing Course if it is not in fact going to be used in practice. Papua New Guinean sisters are required to operate in many ways at a much more responsible level than their western counterparts. In exchange one would think they could be excused from learning arithmetical techniques which may present no great problems to students overseas but which are both difficult, and, as far as I could discover in these conversations, of little use to them in their work here.
DEPARTMENT OF COMMERCE NUMERACY PROJECT

VISIT OF BRYAN J. WILSON, MATHEMATICS CONSULTANT OF THE BRITISH COUNCIL, VISIT TO LAE AND COURSE AT POPONDETTA, 4 TO 16 MAY 1981.

Allen Edwards

(4.5.81)

1. Department of Commerce

Bryan and I had a wide-ranging discussion with Mary Dickie (Assistant Secretary, Training) and Trevor Lipscombe (Senior Training Officer). In the course of it Mary said that in her view the Project had a very high priority, although this might not be the case when it came to political "clout". The need for thorough assessment of results was stressed.

It was felt that when it came to a national "campaign", expatriate skills would almost certainly be needed, on account of the difficulty in finding sufficient nationals who would combine (a) mathematical, (b) pedagogical and (c) organisational skills.

Some alternatives were considered:

(a) training of all volunteers on arrival from overseas in the hope that they would foster the work wherever and whenever they could

(b) nomination of specified volunteers, contract workers and others within the country, who would carry out the work in addition to their normal jobs.

(c) The setting up of an ad hoc temporary organisation under which volunteers (principally) would be employed on 2-3 year contracts, within existing structures, but specifically to carry out the campaign.

On the whole Bryan favoured (c) and thought the unique and grass-roots nature of the campaign was such that it would prove very attractive to outside support.

ANR 11

A152
Mary emphasized the need to work within the current structures and not to attempt to set up a separate organisation.

2. Department of Education, Non-formal Education Section.

We saw the Superintendent, Barry Reeves, who explained the work done by his Section which included Vocational Centres, Village Development Centres and Non-formal Education Officers. The ultimate responsibility was Provincial: his role was mainly to provide training and advice.

He saw numeracy as closely related to literacy, and would welcome an extension of the programme linking the two, particularly where there was some school background. Although he agreed that whereas a certain degree of numeracy might be achieved on courses lasting a week, literacy required something like a year, before pay-off could be expected. (For the completely unschooled, we do not know how long it would take to give basic numeracy.)

Barry mentioned the NPEP quarterly review procedure which could cause embarrassment where a whole year's grant had been erroneously given in the first quarter.

He also referred to a "Practical Mathematics" text book project which might receive NPEP funding this year. Barry would be project co-ordinator and my name had been mentioned as a possible author. The funding would be substantial and Bryan thought it offered an exciting possibility for a continuation of my work.

3. Coca Cola Factory

We saw the Manager, Peter Oatman who had been responsible for my first substantial contribution to Company training. He remembered how, before our arrival, he had observed a training officer's lesson on extending invoices for returned empties and had been quite shattered by the inability of his trainees to subtract. They still used the calculator procedures in which Mary had subsequently trained them. He had been checking all invoices that day and had only found one error, and that had been made by an office clerk and not a driver. The educational levels of his employees had risen somewhat since
the early days and some were confident enough to manage without the calculator but they still carried them, now fixed rigidly to a stool board to reduce the frequency with which they were lost.

(6.5.81) - (7.5.81)

4. **Attendance at Conference at Mathematics Education Centre, Unitech.**

The HEC kindly arranged for the delivery of 30 calculators which I had brought from Laloki for Omili Shopping Centre to sell at £2.00 each.

I gave my paper on "Adult Numeracy with a calculator", emphasizing that the existence of the cheap long-life battery calculator made the fundamental difference between the practicability and impracticability of adult numeracy. I also described how I had decided to resolve five problems: working in toea, ignoring the - sign when subtracting, rounding down except when it was necessary to round up, measuring in m and cm, and teaching "counting on" with the Race Track Game and calculators in place of dice.

There was insufficient time for discussion but Bob Roberts, Senior Curriculum Officer, Mathematics, asked me to clarify my remark that Primary level schooling was not going to solve the village numeracy problem without introducing the calculator. This is because a large proportion of the problems which a villager needs to solve (invoice checking, pricing, stocktaking, calculating the number of sheets of iron or plywood needed) require long multiplication, long division and percentages, none of which are suitable for extensive teaching in school, but all of which are easy with the calculator.

Bernie Wilkins, Principal Research Officer for the Department of Education also asked me to proffer some advice on the relevance of formal education to village life (?) for a report he would be producing shortly.
Bryan Wilson in summing up emphasized the uniqueness and relevance of the work on Adult Numeracy.

(7.5.81)

5. Visits to Provincial Department Heads

Veari Ani was on leave but I saw Elizabeth Robertson, who was shortly going finish, and Singu Wesenzing from Wau who was Acting Assistant Secretary, Commerce. He welcomed my offer to give courses at Wau and Finschafen, confirming the latter with a phone call to Zemo Diwa, DBDO.

I then visited Greg English, Assistant Secretary, Agriculture who was interested in his staff receiving calculator training and would pass on the message to the Assistant Secretary, Forestry. Alan McClay, Assistant Secretary, Management Services, agreed that his staff would benefit, gave an example of pricing for printing/duplicating and passed on to his Finance Officer, Joshua and Personnel Officer, Bob Tookai, both of whom agreed to select groups of their staff for training and to provide me with details of the sort of problem they had to solve. I then visited Elisabeth Hebei, Provincial Training Officer who agreed to co-ordinate the various groups of staff requiring training in the two days I had set aside for it. I saw Ainea Singoro, Assistant Secretary, Community Development and, as the A/Assistant Secretary, Health, Dr Dopenu, was engaged, I saw Louis Sokalantis, Provincial Health Educator. Both these agreed to draw the attention of their staff to all the courses to be run. I finally returned to Singu Wesenzing who approved the arrangements I had made and agreed in principal to a course in Wau which he would confirm with Otto Jenjet, the A/DBDO when he was available.

A notice giving details of the courses agreed is attached to this Report.

ANR11
Mary, Bryan Wilson and I were met by Jefferson Soroda (PBDO) and taken to the Christian Training Centre where we were to stay and where the course was held.

Margaret Williamson, wife of the Warden, and Benson Toroi (AEO) were there to start us off.

Gay Watt, of Rural Life Development (based at CTC) and Ray Ferguson, wife of the Deputy Head of Popondetta High School were there to assist in the teaching. Joachim Olqs, BDO, Romeo Manguerra, A/Manager of the Village Development Centre, and four of his staff, together with six of the staff of the CTC and one of the Sisters of the Visitation all attended as members of the course. Other students consisted five trade store keepers, one oil palm small holder and 4 without employment. The lack of representatives from villages was disappointing. We understood that cost of accommodation may have been one of the deterrents, or it may simply have been a failure to communicate, in spite of efforts made by Jefferson, Benson Toroi, Guma Elijah (Manager of the V.D.C., now on leave) and the Principal Community Development Officer all of whom had been asked to find clients.

We started about 8.30 a.m. with the whole group together and completed 3 ANCS 1.1, 1.2, 1.3, 1.4 (some), 1.7 (invoice checking with memory) and some number games before lunch.

After lunch, with the assistance of the volunteer teachers we divided them into a fast group (5 grade 10 or above, 3 grade 8, 2 grade 6) and a slow group (1 grade 7, 10 grade 6, and 2 "grade 5 at a Mission"). I took the fast group, several of whom had difficulty in subtracting a multiple of 10 toea from K2.00, and completed 2.1, 2.2, 2.3, 4.3 (s.p. without and with freight, as 2 members were specifically concerned with this).

Mary and Bryan took the slow group, completing 2.1, 2.5 (the easy addition test which they did well), 7.4 b (snap game), 1.5 (revision of finding change, which they worked on through the tea break) and 1.8.
7. COURSE AT POPONDETTA: 2ND DAY

In the faster group (of 9) we revised finding change (1.5) and did the measuring and piles of money exercises (3.1, 3.2). It was surprising that some of these were unable to say whether K1.98 was more or less than K1.70. It also proved extremely difficult to explain the concept of "how much longer". With pieces of material the first student put them end-to-end and although the second did put them side-by-side he proceeded to measure the wrong length. He was surprised not to get the answer he had obtained by subtraction. We also did the stock taking exercise (4.6) and "Timber Requirements" (3.4) for both of which most of them enjoyed using the memory. Several did the cross-totalling (1.6) successfully which I had thought was too hard.

Mary did notes and coins (1.8), snap and sum-ten which was much appreciated.

The slow group did the same, excluding stocktaking and timber requirements, but including the clock. (I wrote a simplified version of 3.1/3.2 for them.) Mary got a weighing scale and taught them how to read it but they were not interested, having never knowingly been involved in selling by weight.

8. COURSE AT POPONDETTA: 3RD DAY

I repeated invoice checking and did pricing with the slow group (4.2). They seemed happy with it but later Mary found they had no idea how to work out the price of 1 calculator if 10 cost K80.00. This was a good example of failure to teach the concept in spite of appearing to teach the skill in a particular context. But, as Bryan agreed subsequently, one cannot hope to teach a concept like division in such a limited time: all one can do is to provide as many examples as one can and hope that perhaps some transference may occur sometimes. Failing that, the ability to follow instructions with a calculator (e.g. in pricing) will be a useful skill if it can be taught to someone who will actually use it.
it often enough for them to remember it. Our slower students
certainly would not be able to carry out such a complicated process
simply because they had done it once. But if they should be taught
again, in the context of a trade store, there is every chance that
they will be teachable, which might not be the case if they had
never attended the course.

Mary took the slow group and made up stories about number facts but
they could only manage + and -. To introduce x she persuaded them
to tell her of real situations they met. To introduce +, at Mary Dickie's suggestion, she introduced the idea of buying several
calculators for certain prices and working out the cost of one.
Having the physical objects there helped.

The fast group started various pricing exercises with Mary and
attempted the x and + exercise (5.7) with a brief introduction. I
did Wage Calculations (5.10) with them, and some managed to use the
memory for totalling a long list where there were a lot of similar
amounts of each of two kinds. I then started the Cheque Account
exercise (AB 223) getting as far as finding the final balance by
working out each successive balance and checking it by totalling IN
and OUT.

In the afternoon, while I went to the BDO office, Mary took the whole
class with assistance from Bryan, Margaret and Gay. She did the
Clock exercise briefly. The Race Track game was then played in
pairs, one having a seed as counter, the other a 1 toea coin. After
long explanations about starting to count from the next square, and
a demonstration game between Mary and Bryan, our least brilliant
student still started to count from the square on which his counter
stood. After further explanations by Bryan he and his partner played
happily. At the end Bryan asked this same student if he had won.
He was happy to reply "No, but I came in second".

It appears to be of particular importance in local custom (and, so
we understood, in Milne Bay), that no individual should excell at
anything. A bright student at a local High School had recently died
without apparent cause and this was thought to be the reason. This
suggestion confirmed our own impression that the students here were
less willing to respond to normal teaching techniques than they had
been, for example, in the Southern Highlands.
Mary concluded the afternoon's teaching with the revised calendar exercise which she found very usable as a teaching aid, although few would have been able to answer any of the questions on their own.

9. COURSE FOR BDO's

8 attended for nearly 2 hours. I explained that we hoped all BDO's should be responsible for training their clients in certain simple processes, which I then demonstrated: totalling and finding change, invoice checking and pricing (with and without freight). They agreed that the number of store owners employing "managers" was increasing and that this increased the need for leakage checks. I then explained the three methods I could offer (1) "net worth" giving the profit and comparing this with the expected profit from sale of goods on each invoice, (2) the "Mendi" method of comparing the current stock plus dinau plus sales with the previous stock plus dinau plus value of goods purchased and (3) my original method of finding the number of each item sold and comparing their total value with the sales figure. As a result I felt the third method was by far the easiest to understand and provided we used a separate sheet for each check (instead of 3 checks on one sheet as previously designed) it should be generally acceptable.

In discussion with Mary Dickie it was agreed that we should try to produce materials for these basic procedures at several levels, e.g. for teaching to Laloki students, to help BDO's teach clients, and to help clients remember what to do. Subsequently it was suggested that we needed the services of a graphics artist on a consultancy basis to produce these materials and also those needed for adult numeracy. Bryan thought a request for such a person from the British Council might possibly succeed. (Kirsten Karamfilavie, of the ILO/UNDP Regional Project for Small Enterprise & Entrepreneurship) subsequently agreed to do our layout and illustrations, so long as she has time for it. She is based at H.Q., Dar-es-Salaam, so this is a marvellous solution, for the present anyway.)

10. COURSE AT POPONDETIA: 4TH (LAST) DAY

We had 20 of the original 23 (1 being a BDO, 1 sick and 1 from an Oil Palm block). Bryan took the slow group first, working through about half the x and + exercise (5.7).
He tried to explain which sign to use and which to divide by which. Even having done it correctly they still often would not know whether the answer was people, kina or what. He felt a need for more concreteness, even if only using wooden blocks for bags of flour.

He then did the last half of the same sheet with the fast group, emphasising the need to know what the answer meant so that you could tell whether to round up or down. He found the Comparing Prices exercise (5.6) very popular, but would have liked some tins or bottles to make it more concrete. They still found it hard to interpret the answer, not being sure whether they would or would not buy the big tin for K1.20 if, at the price of the small tin, the big one would have cost K1.30. He thought it might be better to work out the pro rata price before telling them the actual price.

He returned to the slow group for the final revision session, when he concentrated on totalling and finding change (introducing x followed by + for multiple purchases but avoiding similar cases needing the memory), the number games and at their request % mark up.

I revised finding (and checking) the balance in the Bank Book for the benefit of two of the women who ought to have been in the fast group. We then completed two of the three Bank reconciliation exercises in the rest of AB223, which they seemed to understand reasonably well.

I introduced the Snap-20 game with the sets of small numbers to the slow group but they needed to practise the 20 20 20 game first. They wanted to do the Car Race game again and most of them remembered how to use the calculator for it. We did some of the harder snap games and finally I showed them the Pelmanism version of these: put many cards face down and take two, to turn over two, remembering where they are so as to obtain matching pairs. This was surprisingly successful.

Finally I revised 1.3, 1.5, 1.7, 1.8, 2.1, 4.2 (both) and 4.6 with the fast group.

After tea Jefferson Soroda made an appropriate speech and distributed A160.
the Certificates ("Numeracy with a Calculator"). We sold some materials so that they could have them in their hands for the photographs, and they then completed their purchases: K8.75 worth of rulers (30t), snap cards (25t), sum-ten (20t), small numerals (15t), Car Race game (10t). The subsidy on the rulers and the cost of morning and afternoon tea was largely covered by charging K8.00 for the calculators. They paid 50t each for good lunches (subsidised).

11 BRYAN WILSON'S VISIT TO HIGATURU OIL PALM PTY. LTD

On Tuesday Bryan spent the morning at Higaturu with Ken Williamson, Training Officer and brought back a useful account of some of the mathematics involved. When in full production 1400 small holders with average blocks of 5 hectares will produce as much as the core plantation, operated by the management.

The trees are planted on a 9.80 m triangular grid. Fruit is collected fortnightly by a truck driver using a crane with a circular scale marked in 2kg up to 1 tone. An average load is 450 kg for which K10.50 per tonne is credited to pay off the small holder's loan.

At the weigh bridge the weight is found in tonnes correct to 2 dec. places (and recorded to 3). The clerk subtracts empty from full weight manually.

Boss-boys are in charge of 10 - 15 labourers. They are not always able to count their men correctly but can read specified times on a watch.

In the factory the main use of numeracy seems to be in reading at least 9 different types of scale including a Vernier. It was suggested that fertilisers and insecticides required an understanding of %; but it is not certain if this is really so. Clerks have calculators but only use them for + and x. The columns on the Field Check Roll are totalled and so checked but probably without the memory. Field Supervisor has to work out the precise numbers of coins of each denomination he will need for paying the men.
The company tests and pre-tests trainees. We were surprised to note that most of the tests looked as if they were designed for selecting technical officers or managers in Britain.

12. CONSULTATION WITH MARY DICKIE AND TREVOR LIPSCOMBE, WAIGANI 15.5.81

It was agreed that fresh materials should be produced for "Arithmetic for Business", in anticipation that BDO's will undertake an intensive programme aimed at giving all trade store keepers certain basic skills using the calculator.

Provisionally, these would consist of:-

1. Totalling and finding change.
2. Checking invoices.
3. Pricing without freight charges.
4. Pricing with freight charges.
5. Simple Cash Account.
6. Stocktaking
7. Leakage Check.
8. Cheque account and reconciliation.

Unit 1 would include introductory work and would normally be done with all clients. Other units would be independent of each other, if possible.

Subsequently similar materials might be produced for BDO's to teach to other clients. Similar materials might also be produced for use by other Departments in their training and extension programme. The materials may also be used in the Adult Numeracy programme but they will not be designed specifically for this purpose.

The material would consist of:-

(a) A "Client's Workbook" consisting of eight separate units including instructions and exercises for the client to carry out. Parts which the client would be expected to read would be printed in red for the client to read, but the client should be able to understand the rest if he can read, but it would normally be explained to him anyway.
(b) A set of Memo sheets (perhaps in cartoon form) which clients might put up in their offices to remind them of the client points of the unit.

(c) Instructions for a B.D.O. on how to use the above materials in on-the-job training with individual clients.

(d) Instructions for a B.D.O. on using the materials in off-the-job course.

(e) Instructions for a FTO/PFA on training BDO's to use the above instructions.

(f) Appropriate course materials for use at Laloki as part of "Extension I" (Stage 2) and "Extension 2" (Stage 4) with perhaps a reminder at Stage 5.

I have already begun drafting the workbook in Pidgin in the expectation that after trialling, the material will be revised and illustrated by a professional.

An English and/or Motu version will be needed.

(22.5.8)

13. First Draft of Workbook

The above workbook has now been prepared in Pidgin ready for printing. Units 6 to 7 have been combined and 8 is not yet completed.

After use in March it will (probably) be revised, translated into English and illustrated by Kirsten.

14. Follow-up on the Popondetta Course from Christmas letter from Margaret Williamson: Doris Ksaarina (Gr5: cook at CTC) "uses her calculator regularly I know. She often takes it to the market to add her purchases." Mark Nola (Gr6: works at CTC): "I think uses his 'pemulim' for his personal needs." Augustine Sogin (Gr5: works at CTC): "has a daughter who isn't very bright — gets 0/0 for English and Maths —... I gave him a lesson on using the calculator to teach his daughter the basic addition facts and suggested he plays these games if yours with her."
Adult Numeracy

13.1 University-based research is one end of the spectrum of mathematics education, the other end of which is to be found in a thousand villages across the country. Most people in PNG, including nearly all those who live outside the few towns, lack the ability to handle the sort of numbers needed for dealing with money or measurements in a rapidly-westernising economy. The reasons are complex, and this report is not the place for their analysis; the fact remains that inadequate number sense, and the consequent inability to operate with numbers by traditional primary-school methods, is a major brake on effective rural development. Village trade stores go bankrupt, primary produces are inefficient, small businesses collapse, because the people concerned cannot do the elementary arithmetic essential to their operation. The problem is probably more widespread and acute than in any other country.

13.2 Realising the extent to which numeracy is the key factor in rural development in PNG, the Department of Commerce set up a Numeracy Project in March 1980. Initially it sought to explore how number skills could be taught to rural businessmen - a grand term for a multitud of humble occupations in PNG - and in particular to village trade-store keepers, the people around whom much of village life revolves. Mr Allen Edwards, former ACTS in PNG, was appointed Project Director, and immediately set to work to survey the needs and opportunities in five Provinces, and to assess the feasibility of a national Adult Numeracy Campaign.

13.3 It quickly became clear that the needs were perhaps even greater than had been realised, but also that there was great enthusiasm to learn, an enthusiasm that has been confirmed on a series of short courses run by Mr and (voluntarily) Mrs Edwards in widely-separated parts of the country. As well as trade-store keepers, many other small businessmen have come - PMV operators, ice-block makers, crocodile skin dealers, carpenters are typical of many trades in which numeracy levels have been shown to be far below even the modest levels required for efficient operation. If the boss-boys on an oil palm estate cannot count the 15 labourers for whom they are responsible - while being admirable lower-level supervisors in other respects - their efficiency can be greatly improved by giving them techniques to do so; similar examples could be cited from any kind of occupation that exists in PNG.
13.4 Given that the need for numeracy is enormous, though at least partly matched by the desire to attain it, the key question remains: can it be done? Can an adult, who may have survived up to six years of primary schooling while failing to attain to even the most rudimentary competence in the basic processes of arithmetic (we are talking of a situation in which it is estimated that two-thirds of the adult population cannot add two single-digit numbers), be given a number survival-kit which will enable him to operate more efficiently in daily life? It is here that the Numeracy Project takes a step that is at once simple, radical and potentially of enormous significance far beyond the confines of PNG: you base the work on the use of calculators.

13.5 The thesis runs as follows. Many of your clients have already failed to master basic arithmetic at a stage of life when they were more easily able to learn, and where they had daily school arithmetic lessons perhaps for years. There is no way in which an adult numeracy course can teach them in a few days what professional primary teachers have already failed to do over several years. Even with unschooled adults, the time available is far too short to give them a school-type course in arithmetic. Building up understanding is a long, slow process, yet it is on this that traditional arithmetical competency is based. All you can do at the adult stage is to identify specific arithmetical processes that an individual needs to be able to perform, and then to give him the power to perform them. Only within the last few years has such power become available, in the form of a reliable, long-life, cheap electronic calculator.

13.6 The machine chosen is the Sharp EL-8158, a four-function LCD machine with memory, percent and square root, a battery-life of 10,000 hours and an automatic switch-off. The 3-month guarantee has only had to be invoked thrice in over 2000 machines in use in PNG. The Project is able to sell them at 8 Kina (£5.50) each.

13.7 Yet the doubt remains. Even given that recent technological development means that breakdowns, batteries running down, and cost are no longer problems, is there any point in putting a calculator into the hands of a practically-innumerate PNG villager and expect him to use it effectively on the basis of a three or four day course? This is the question on which the present experimental phase of the Project is seeking evidence. It is a crucial question. If the answer is 'yes', one has for the first time in history a resource that could make numerical competence available to everyone.
13.8 To observe the quest for this evidence was one of my main objectives on this visit. I had the opportunity to do so in a series of discussions with Mr and Mrs Edwards, with the Assistant Secretary in the Department of Commerce to whom he is responsible, and to a wide variety of other interested professionals and civil servants. More significantly, I was invited to participate in one of the experimental courses, an invitation I accepted with alacrity. For four days I was working with a group of volunteers from the Popondetta area, most of whom had never seen a calculator before, and none of whom were competent in its use. A few had some small facility with numbers, but the majority had virtually none. Some found acute difficulty in deciding whether 77 was greater or less than 74. Some could not tell the time, and none could read a calendar. Yet all were sufficiently fluent in English for this not to be a serious problem in either direction. Most had had 6 years of primary education. Only one knew how old he was.

13.9 It was a fascinating experience, different from any that I had had before. The interest lay not so much in what they could not do to start with, but in what they could do by the end. Starting from somewhere near Absolute Zero, several could check invoices by totalling across and down (using the memory), find the total cost of several items, and the change from a given sum tendered in payment. These are not skills that are common in village trade-stores (hence the frequency with which they go bankrupt). Other skills acquired included pricing given a government-controlled mark-up percent, currently more honoured in the breach than the observance, through inability to work it out (goods are not infrequently priced below the wholesale price, the trade-store keeper being unaware of it, and often unable to calculate the cost of a single item from the cost of a box of 24 or 48 items). I was convinced by the end of the course that the basic arithmetical skills needed in eg running a small village trade-store could be adequately imparted in a 4-day course; without a calculator it would, of course, be quite impossible.

13.10 There remains the question of retention: will those trained remember the skills they have learned, and be able to use them in daily life? (All but two bought a calculator; 8 Kina does not seem to be a problem, PNG being by no means near the bottom of the poverty league). Some certainly will; on the first evening of the course, someone saw one of the students in a local store, totalling his purchases on his newly-acquired calculator. Yet it is widely held that retention of learning is a major problem in PNG.
The key to remembering is use, and it is likely that those who have, and take, opportunities to use their new skills will retain them; the others will not. The balance between the two groups will determine the value of this sort of work, and indicate the priority that should be given to planning a national Adult Numeracy campaign based on the techniques being developed through these pilot courses.

13.11 It is to assess this balance that the Department of Commerce is planning a strategy for evaluation of this pilot phase. This is likely to prove time-consuming, as trainees are mainly in rural areas, in a variety of occupations, or none, and the arithmetical techniques that they need vary accordingly, ranging from counting to pricing, invoice-checking and stocktaking.

13.12 Meanwhile, the pilot learning-materials are being developed at several levels for use by trainees on their initial course, for use by tutors, and for reference for eg trade-store keepers.

13.13 Can and should British aid be offered to this project, which, as far as I know, is unique in the world? In view of its potential significance for many other developing countries, I am in no doubt that, if sought, it should. But it is less easy to see what form it might take. Obviously, a national campaign would make major demands on national resources in both manpower and money. British input at this stage could include the use of VSO's and I discussed this informally with the VSO Field Officer.

13.14 Meanwhile, a request may be made for a graphics consultancy to assist in the development of the materials referred to in 13.12 above (attention Media Department). The Assistant Secretary responsible in the Department of Commerce will be in London in June, and I hope to take discussions on possible British aid further then.
DEPARTMENT OF COMMERCE NUMERACY PROJECT

REPORT ON THE MOROBE PROVINCE VISIT BY MARY AND ALLEN EDWARDS

1 - 12 JUNE 1981

ALSO: NOTES ON NEW VILLAGE-BASED MATERIALS AND FOLLOW-UP ON SERENI AND NIPALI.

1st June, 1981

1. MENYAMYA: PRELIMINARIES

We arrived about 9.30 a.m. and were taken in a truck by Grindl Dockery the volunteer responsible for the Community Health team based on the Lutheran Church. She delivered our baggage to the home of the District Coordinator, Deryck Thompson, where we were staying and dropped us at his office. He introduced us to Noah Leule, his Assistant, whom I had met in Lae.

The education inspector who had also been involved in the planning had had to leave that morning.

Oscar, Manager of the Vocational Centre took me on his motor bike to see where we would be teaching the course, a spacious double classroom with blackboards at each end, normally used for their sewing class and intended for their proposed literacy work although the funding for this had not materialised. Oscar explained that he had a flexible programme for 58 men and 14 women, with small groups working in their own areas of interest. The carpentry was being done in feet and inches although metres units are also taught. I think a welder had been appointed instead of a carpentry teacher so Oscar was doing this himself.

At the Lutheran Mission Mary was already there with a group of APO's and nurses to whom Grindl was explaining changes in the latest edition of the Standard Treatment book.

After lunch with Deryck Thompson's wife Dymna, a Department of Health Nutritionist who mentioned interesting uses of arithmetic in preparing surveys, I went to the Health Centre where the A.O.C., Micah, said he had received the notice about the course but had forgotten to mention it to his staff that morning and was grateful for my reminder about it. This staff run a number of canteens among other things.

At the Seventh Day Adventist mission the expatriate staff were away but I talked to Dona Waea, Headmaster of their Grade 1 to 4 school. I suggested that some of his Grade 4 leavers who were not going on to the next stage at Gabensis, might benefit from being taught calculator skills.
Kausa Yandruk, in charge of the Forestry unit explained that they sold pine seedlings for 3t each. Trees are not currently sold for lumber but he thought the price in Wau was about K2.61 per . (This was very different from the K45.00 I had guessed in my new unit, 5.13).

I next visited Musa Forenu at the Agricultural station, and three of his staff one of whom was using a calculator to total numbers for a coffee census. Cattle, chickens and sheep are reared, but the newest industry is Cardamom, for which seedlings are being raised and I saw an established plot. They found numerical information about the crop which I converted from imperial to metric measures and used to write a new exercise (5.18).

Musa took me to check on coffee buying. There are three buyers, associated with Talair, Co-Air, a Chinese firm. No buyers were present but we were told that one paid 60 toea/kg while another probably paid more. They weighed with a scale marked in $ kg and confirmed that part kilograms are discounted.

I called on Deryck who explained that he had fixed the course fee at K10.00 including a calculator. He wanted none of the extra K2.00 himself but the Vocational Centre were accommodating some clients and although they had been told to bring their own food the Centre might need some remuneration ("it is run on a shoe-string"). We might also provide them with pens which are in short supply up here. Unfortunately we had not brought any up with us so Deryck kindly lent us some. Finally he suggested a "bung" with food on Friday afternoon followed by films on video in the Community Centre (they could be hired from Lae at K3.00 each). All this seemed an excellent use of the spare funds and would constitute a new feature in our experiment. Deryck had 26 names, all men, when we came and more were being added later in the day. We were anxious to increase the number of women so thought of limiting the number of men to 30 and allowing others only if they were women or had special reasons for coming (e.g. extension officers, teachers etc). We have only 50 calculators and would prefer a maximum of 20 in each of 2 classes.

Our accommodation at the Thompsons proved to be superb, with a Union Jack and a photograph of King George VI on our bedroom wall.

2nd June, 1981

2. MENYAMYA COURSE 1ST DAY

With 35 names on the list of those wishing to attend the course and numbers that I had invited yesterday, we had given much thought to the problem of selection in the case of over-subscription. We had decided to give everyone a short test on adding two single digit numbers together (3 ANCS 2.5), mainly to ensure they could read and write numbers. Out of all those who came, one was unable to do the addition, but could in fact write the numbers and so was accepted. Another got a wantok to complete the test for him, was accepted and paid his K10.00. Where we discovered he
could not write numbers we let him keep the calculator and stay if he wished but we said we could not teach him. His wantok was trying to do his work as well as his own which was hardly satisfactory. A third client went off to his village instead of completing the form and came back an hour later with a wantok who could not write numbers, although the original one could. Again we allowed the non-writer to stay but said we could not teach him.

In the event only 12 of the original 35 actually turned up, together with 20 new clients whose names were not on the list. 24 of the 32 paid the K10.00 for the course on the first day. All but 2 SDA students and 3 others did so before the end. If the numbers had exceeded 40 we had intended explaining that we would give priority to those who were willing to teach others, but as the grounds for this were lacking we decided to do the best we could, basing the work on the Trade Store but trying to persuade them to accept the idea of teaching others, and including some at least of the appropriate non-trade store materials.

About 10 a.m. we started on the new draft Business Arithmetic Workbook (BAW 1-6) with its red and black printing in Pidgin. On the whole I was disappointed with it. It moved too fast and there were too many complications in it for this group. Explaining the difference between $CE$ for a wrong number, $CE$ when a sign had been omitted and $C$, was much too hard and Mary suggested we should give up, allow them to use $C$ whenever they wished at first, and only introduce $CE$ later for longer calculations.

Some of them were in fact able to read the material and use it largely self-paced, but they missed out most of the explanations. The whole approach seemed less satisfactory than the straight exercises and teaching techniques which we had developed over the last 6 months. On the other hand others will need to be taught to teach, and this particular workbook was really intended for individual teaching by BDO's, so this was not a fair test.

After lunch we divided them into two groups, the fast and including the 22 who had successfully completed Unit 1. The other 11 were joined by 11 Vocational Centre girls whom Mary had spent a little time with earlier on. Mary taught most of Unit 1 again. They enjoyed making up stories to illustrate subtraction. When Mary came to the totalling and finding change, they found it very hard even when Mary checked them individually. She therefore spent the next hour continuing with this work, drawing pictures of tinned fish etc. on the blackboard. At the end two of them came and asked her sensible questions which, surprisingly, was more than she had got from the Southern Highlanders.

The Menyama District does seem to have suffered more from neglect than more recently developed areas, and there is no World Bank project in operation here. Aseki for example, has no community health team and has only 3 schools in 2 of its census divisions. There are no schools in the 2 others with a total population of 9,682. Menyama itself is better off but the general level of services in the past
appears to have been low. The new staff appointed to the area in the last year have an uphill battle to wage, with slender resources. The absence of a Business Development Officer from the present team is a serious lack.

One of the "sensible questions" was how to include 11 tins of fish at 45 toea each when working out the total before calculating change. This proved a real teaser. By itself one product can be evaluated and the change found as before, e.g. $11 \times 45 \rightarrow \text{total}$.

A product followed by single purchases can also be evaluated "straight". But if more than one product is involved, or if addition has already been performed, the calculation must use the memory or paper and pencil or repeated addition instead of multiplication. The first might give a good introduction to the memory, but explaining why it was needed here and not previously would be difficult. In practice too there would be the danger of forgetting to clear the memory, particularly if one wished to change over to the memory in the midst of the calculation because a customer suddenly decided they wanted 15 tins of meat after buying a few single items. Mary had already decided to make the exercise realistic and had arranged to borrow cartons of tinned fish, meat and soap, so we decided to leave the problem to her to work out in the course of her lesson the next day.

3rd June; 1981

3. MENYAMYA COURSE: 2ND DAY

2 new Trade Store keepers arrived, one Grade 9, the other 1st year UPNG, so we accepted both. Mary spent the whole morning with tins, soap etc, first multiplying one item only, then multiplying and writing down, followed by adding. Then, with one of these written on the board, they used the memory and obtained the same answer. A lot were done altogether, all with goods on the table, for about an hour. The alternative of adding all items one-by-one was demonstrated. After 3 attempts all but 2 were able to do this on their own. Change was found each time.

When I did the same work with my (fast) group in the afternoon I started with one-by-one, then did multiplying first, I then did the multiplying second and showed that it gave the wrong answer. Finally we used the memory successfully. I was convinced this should become a regular part of the course. We also used multiplying "number: in pile" by "number of piles" and adding extras to find the number of tins, in readiness for stocktaking.

During the rest of the day Mary taught invoice checking and started pricing without freight, while I spent much time pricing with freight, did the cash book unit and started the leakage check unit. More than half of mine seemed to understand the idea of old stock + new cargo = stock now × selling price + (RM) = cash received, to give leakage.
4th June, 1981

4. MENYAMYA COURSE: 3RD DAY

3 more clients arrived, 2 Grade 6 and 1 Grade 3. Our UPNG client was keen they should stay so we let them do so on the understanding we might not be able to teach them. One of them cunningly transferred to Mary's group, who did not know I had said this and she proceeded to teach him. She also accepted another SDA student who had come with K10.00.

Mary did pricing with freight (in simple cases), Cash book (without the check by totalling), which they did surprisingly well after she had gone through question 1 three times, and Number Games. Sum-ten was taught successfully but, being at the end of the afternoon perhaps, was not particularly popular.

I completed the Leakage Check unit and made them write out an extra question because there was not enough practice. With some trepidation, because it did not seem relevant to Trade Stores. I did the revised measuring and money unit (3.8) with its emphasis on "more", "less" and "in between". I did not in fact complete the money part. Instead I did the length exercise (5.1) with its calculations of lengths of walls with fibro panels etc. and found the "in between" idea very useful for casting out "ridiculous" answers. This went well using the blackboard (lacking sufficient copies). Pricing kaikai (5.2) went even better, with quite a number of them beginning to understand when to multiply or divide and how to use the memory to add the amounts we wanted. Notes and coins (1.8) followed easily but I did insist on everybody checking by totalling whether they had used the memory or not ("Wankain ansa tupela taim - em stret").

By the afternoon there was a general feeling of bonhomie, although all had worked very hard and they were tired. To my surprise they were keen to buy metre rules and I had to ration them.

On completing our usual cash and stock check later however, we found we had lost two calculators, and presumed them stolen sometime during the day. It was some consolation however that the cost of them was covered by the excess of K2.00 paid by (nearly) every student. Other payments out of this excess were K12.00 for video and hire of hall, and K40.00 for mumu and use of Vocational Centre premises. (One calculator was subsequently produced and the K40.00 was increased to K50.00 when it was clear that the mumu itself had costs nearly K40.00).

5th June, 1981

5. MENYAMYA COURSE: 4TH (LAST) DAY

Mary introduced the faster group to Number Games and Snap while I worked through the Leakage Check unit with the slow group and some of the fast group who wanted to do it again. The main difficulty of the slow students was remembering which keys were "plus", "minus", "times".
I took the whole group through the whole course, giving them some revision notes which they had to copy down from the board. (Later I wrote these out on two A4 sheets and got them copied at UTECH for use at Finschhafen.) The rest of the afternoon was spent on the new Cardamom Project exercise (5.18) just drafted, the coffee-weighing exercise (3.3) and the Car Race game (7.8), which seemed very popular but they did not want to buy copies of this or of the other games.

The whole of the District Management Team, Grindl and Dympna arrived and Deryck presented the Certificates, emphasising that they should teach others. He hoped that we would return in November for an "advanced course", when we would also assess the results of this one. We did not give certificates to students who had attended for less than 3 days. Two who could not write, but had attended the whole course, had certificates with "successfully" white out: no comment was made on this. Deryck also offered to collect K8.00 from anyone else wanting calculators and to get them from me for them. At about 5.30 the mumu was ready and was much appreciated. A cowboy film (and one of the 1980 Cup Final completed the day for the course members and about 100 other villagers.

6. MENYAMYA: MANAGEMENT TEAM COURSE

Deryck's Management Team of eleven gladly attended an ad hoc course for 2½ hours on Saturday morning. I found some of them a good deal slower than I expected, and suspect that few of them habitually used a calculator. I used "finding change" (BAW 1) to teach the basics, including CE and the "double entry" error due to omitting a sign between two numbers. I introduced the memory with notes and coins (1.8) and checking invoices (1.7) then the percent key with pricing, discounts (- and x), finding % markup.

7. MENYAMYA: CONCLUSIONS

We made little attempt to provide general adult numeracy here. Those whom we taught were almost all trade store keepers or government officers and we felt that meeting their needs was more relevant than attempting to teach numeracy to villagers in general. Mary attended a session of child weighing at Palalye, 9 km out, with Grindl. Every single child they weighed was technically under nourished and many were seriously so. The lack of development combined with the lack of education in the area appeared to us the most significant factor. In such circumstances Numeracy teaching may be better concentrated on those who have shown the ability (or had the good fortune) to rise above the level of general need.

Educational grades of the 37 who attended were as follows: 5 no school, 2 grade 2, 2 grade 3, 5 grade 4, 14 grade 6, 2 grade 7, 4 grade 8, 1 grade 9, 1 grade 10, 1 first year University. They included: 26 Trade Store keepers, 4 DPI officers and 1 of their wives, 1 Nutritionist (the only other woman), 4 SDA school, 1 vocational centre student, 3 of the trade store people also bought coffee.
There was an insistence on teaching being in Pidgin although we felt that many could have understood English as well.

The new materials (BAW) in pidgin proved to be appropriate after all, although some revision will be necessary. They should be trialled with individuals instead of a class, and preferably taught by a BDO.

8th June 1981

8. FINSCHHAFEN: THE FIRST DAY

Zemo Biwa, Business Development Officer, had tried to obtain accommodation with board for us but had been unsuccessful. So we arrived with food supplies and were taken to the Government hostel which was satisfactory apart from the fact that most of the sheets were dirty and the wash-man was in hospital. Zemo personally bought and lent us sheets and pillows.

Most unfortunately the fine weather they had been having had broken last night, and a steady down-pour was expected for the next six months. Business Development normally hired a vehicle for three days a week so we were returned to the Hostel while Zemo went out in it to pick up clients for the course, which would start at 1 p.m.

By 1 p.m. we had 16 clients:

1 no school, 2 ples skul, 9 grade 6, 1 grade 7, 3 grade 10. 10 were from Trade Stores, 2 "Community Hostel" workers, 1 council chairman, 1 vice-chairman of a Savings Society, 1 DPI officer, and 1 was not employed.

One or two requested Pidgin and it seemed good for us to improve our Pidgin anyway so we used it, almost exclusively. The light in the council room was poor but Tom Darwin, District Co-ordinator, came and fixed it.

We worked steadily through Unit 1 (BAW 1) introducing additional questions on the blackboard to keep the faster ones occupied. Everybody kept up reasonably well. I explained the correction procedures with CE, including double entry, and thought this should be included in the course on about page 5. We reached page 6 but had to stop at 3.30 p.m. so that we could be driven back to the hostel and the vehicle returned to D.W.S. by 4.06.

9th June, 1981

9. FINSCHHAFEN: THE SECOND DAY

We accepted 5 more clients, two being from El Com and 3 trade store people. We turned several away, being too late and without a high educational grade. To some of these we sold calculators so that the BDO's could teach them subsequently. Willie Lau in fact worked with us the whole day and was immensely useful. Eric Sternny, the Trainee BDO, was looking after a store while the keeper attended the course. But their willingness to teach others, and Zemo's likewise, was the most significant fact of the day.
Willie clearly found the materials satisfactory and used them to teach clients on the course all day. I pointed out to Zemo that they might well be the first BDO's to use these materials in the intended way, and he seemed keen to achieve this distinction.

During the morning I used cartons of baked beans, rice, soap and calculators to introduce the new work on totalling prices for multiple purchases. I had prepared a draft the previous evening and used the ideas in it but it was good to have the actual objects in front of them. Some seemed to understand when they could just use \( \times \) and \( + \) and when they must use the memory, but clearly others did not. I went on to checking invoices and pricing goods without freight (BAW 2 and 3). At lunch time I collected their papers and used them to divide them into a fast, a slow and a "marginal" group. After lunch I did the rest of Unit 1 (ABW 1) and used this to sort the "marginals". We ended with 10 fast and 8 slow students.

Mary and Willie took the slow group, soon dividing them into 3 sub-groups, one of which was taught Unit 4 (freight) while another were late entrants but good. The three slowest only just managed pricing without freight.

With the fast group I almost completed the pricing with freight and some managed to follow the exceptional cases when, e.g., all the toothpastes were in one box. Zemo observed this part of the lesson and told us afterwards that the BDO's have always had to do the pricing for clients up to now.

10th June 1981

10. FINSCHHAFEN: THE THIRD (LAST) DAY

I did Unit 5 with all and those who finished first completed BAW 3/4 question 7. We all did Unit 6 using \( \square \) in place of \( [\square +] \) at first, making them write their own answers down and checking them by totalling "up" as well as "down": "wankain ansa tupela taim: em stre". I told them how to do the last example in Unit 6 and left them to it. To those who finished first I gave copies of units 3 ANCS, 5.2, 5.3, 5.7, 5.10, 5.12, 5.13, 5.15, 5.17, but pointed out they were in English.

After lunch we went through and completed the "Toksave" I had prepared, which seemed to be well understood. I explained that that completed the tradestore course but that I hoped they might share with their fellow villagers some of the things they had learnt, and the use of the calculator.

I then showed them how to use the metre rule (selling them 5 at 40s each) and how to calculate the number of plywood sheets needed etc. Mary then discovered that some of them in fact sold material by the yard, so we used 3 ANCS 6.3 to teach them how to price the material by the metre and to sell whole and/or parts of metres. We felt the next most important thing they might pass on was the use of the constant function for number games (5.8). We intended its use for conversion from yards to metres etc.
Several people would have liked a unit on Cheque Accounts, but we had no time.

The Chairman of the Council, who had been one of the keenest members of the course, made a nice little speech saying he hoped we could come back in the dry season to teach more of the many trade store keepers around.

I explained that we hoped this would be done on a one-to-one basis by B.D.O.'s, and that perhaps the process might start here. 15 of the 21 on the course stayed to the end. We sold 34 calculators in ones or twos, people often appearing at the door to buy one. We usually gave them a copy of BAW 1 and told them to ask the BDO's if they wanted more help.

11. FINSCHHAFEN: CONCLUSIONS

1. The BAW material seemed basically sound but needed some improvements.

2. We had to teach almost entirely in Pidgin and although the quality of it was no doubt execrable, we got by.

3. We should not need to run any more trade store courses. The material has been sufficiently trialled in this way: it must now be tested in its intended context, being used by BDO's to teach on a one-to-one basis. We should try to do this on our next visits, though we are committed to a trade store course in Wau.

4. It followed that our future visits should concentrate on assessment of previous work and genuine village adult numeracy. The organising of this still presented problems: we had never really repeated the Wewak experiment of November 1980. Our subsequent courses have been based on "organisable" groups. The attempt to get village representatives brought in by BDO's, Adult Education Officer, Community Development Officer, Village Development Centre Staff and Church Extension Officers in Popondetta had failed dismally. We had heard now that the prospect of this in Wau was poor. It seemed that the only way to get genuine village representatives was to go out and get them ourselves preferably with BDO to help. We had a chance to do this in Wau when we would be around and mobile for a weekend before the course started. We had heard however that because of the Queens Birthday holiday the course might not start till Tuesday, leaving only 2 days for it, compared with the 4 days we felt we needed in Wewak.

Making the most of the opportunities offered, and remembering the problem of accommodation that students at courses often experienced, Mary suggested we try an alternative approach. Instead of organising a course in a centre we might simply run a half or whole day course in a village for 10 - 20 adults, on condition that they bought at least 2 calculators.
In such a short course we could probably only hope to show how to use the calculator for addition, finding change and number games (perhaps snap and car race games). This might however be enough to encourage them to become familiar with using the calculator (a time-consuming task) and to send someone to obtain the more advanced skills (x, +, etc) on a later occasion. We wondered if we would be able to try this out in Wau.

5. The early units of BAW appeared to be usable by the more able students on a self-teach basis. If this proves to be the case it could be of great value e.g. for school teachers and C.O.E.S. students. It might even be possible to adapt some of the more advanced 3 ANCS exercises to this format. Perhaps we have the basis for the book which the Superintendent, Non-Formal Education, suggested might be funded in the next year or so.

11th June, 1981

12. LAE: VARIOUS INTERVIEWS

I first went to Elizabeth Hebei, Provincial Training Officer who had most efficiently obtained detailed lists of government officers wishing to attend three half-day calculator courses. They included 8 Health, 15 BMS (Personnel), 8 BMS (Finance & Services), 2 Education, 4 Forestry and several from Commerce.

I talked to Andrew Kamrai, FTO about the current Workbook approach and our hope that this would lead to BDO's teaching individual clients. He said he had himself run a course using calculators in March and found it most rewarding. They had spent two days working on invoices and pricing. He agreed however that teaching a class of people of very mixed ability was difficult. I pointed out that it had taken all the skills of two experienced teachers such as my wife and myself to prevent some students being lost or others bored.

Veari Ani, Assistant Secretary - Commerce agreed to sending his clerk and typist to my course tomorrow. He also asked about the identification of the % that one had to reduce values by to compensate for having increased by 10% etc. I showed them the algebra involved in this calculation, which is the only one where I have found the need for such an advanced mathematical concept.

I also met Roy Harvey, Regional Secondary Inspector, Education to whom I related the interest expressed by High School staff in community work in the Southern Highlands. He said he felt that any such ad hoc involvement was likely to be frustrated by the rapidity with which staff were still being moved around the country. It had taken him 3 years in Enga to break down the barriers that villagers imagined to be between themselves and High School staff. He could only see a future for adult numeracy work in this area if it were part of a larger long term programme. He also recalled the decision which had formally forbidden staff in the full-time education sector from being involved in non-formal education.
He saw some hope for a reversal of this policy in Morobe before long. When that happened the whole area of adult education might open up again and adult numeracy would stand a chance of being included.

He also agreed warmly with the need for the sort of training I was now providing for Government Officers. These was a great demand for further education here and that had been a part of the non-formal education programme whose cessation he had referred to. The present COES programme failed to meet this need because of the lack of local professional help for students involved in these courses. I mentioned that Mary oversaw the COES work being done by Steamships employees; this takes little actual time but is a vital contribution to the programme. Distance - teaching without any personal tutorship being available is I believe increasingly recognised as being ineffective.

Roy also told me of an "Adult Literacy" course being run, for the second year, at Lae High School for Grade 8 "check-outs", using COES Grade 9 and membership of the school for sporting purposes. He thought they might well be interested in including a numeracy unit.

I visited the Division of Information as they had not replied to Elizabeth Hebei's offer and found that they were under-staffed, the two there being unable to spare the time for a course. I also saw Rosemary Elias, Acting OIC, Psychological Services. She had not received the invitation, being national not provincial staff. Her assistant would be glad to attend. I also saw the Public Solicitor who would have liked to attend the course himself. Either he or an assistant might do so tomorrow.

I visited Omili Supermarket whom I had supplied with calculators for sale. (See report ANR 5).

There was a notice saying calculators were on sale at K8.00 but the staff said they had none left. William Corbett said they had in fact one left, and produced it. He was leaving next month and the new manager Wingate had met at Laloki pointed to another 20 still in stock. I explained the arrangement to him (K72.00 for 10 carriage free for selling at K8.00) and he said he would decide whether he wished to continue it or not. The whole operation here had been seriously frustrated by our indent agents mislaying the calculators they had imported for us (see report ANR 10).

13. **ASSESSMENT OF THE FEBRUARY LAE COURSE** (Report ANR 5)

I had previously sent questionnaire forms to Andrew Kamrai to distribute and if possible collect. They asked whether the respondent still used a calculator, and/or skills they had learnt in the course, and whether they had taught them to others.

He had two returned, from two who worked at the Morobe Cultural Centre.
Mary and I visited them to check the reliability of their answers. Both had written that they still used the calculator and this appeared to be correct: one was available in the centre. When asked, one of them, Christina Cooper, said they used it for adding and finding change, and checking invoices. Both had written that they used it for percentages and the memory, but when tested on these they appeared to have forgotten how to do either. We asked to see one of their invoices but none were available, the person who normally dealt with them having gone home (it was near closing time). When I made up a simple one, Christina used (x) to check it, but not (M+). When asked to total and find change from K10.00 for K2.50 and K3.70 she did however succeed. She had written that she taught someone and said it was her niece, but she could not remember how to teach the 2 x table. The other girl Debbie Naisian had written that she had not taught anyone else but now said she had taught her sister who was at school. We did not test her on this however.

Two other course students were Youth Leaders: neither was in Lae but the Provincial Community Development Officer put me on to Mrs. Daniels (typist) who agreed to get them to answer the questionnaires. One, received subsequently, said she still used a calculator but had not learnt of the skills he had learnt in the course. She was planning to teach church in a year.

Two other students had been on the Y.W.C.A. staff: they were both now on maternity leave. One, Pomia Koroma, explained that she had returned the calculator to the YWCA secretary and now wanted to buy another because her father had a small village business. The other, Rondi Getso, said she had used it to work out change and "profit" before going on leave.

Mary tried to find two other ex-students who were now working near the B.D. Area Office but was unsuccessful.

While we were in Finschhafen we also tried to find one who had come to the course from there, but the driver who went twice to find her said at first that she was in the "garden" but on the second occasion, said she was ill. The only other ex-student was Diana Gabriel who had only attended Ples Skul and we did not think would have got much from the course.

14. LAE: FIRST COURSE FOR GOVERNMENT OFFICERS

I had from 1 p.m. (1.15) to 4.06 p.m. with 8 Health Division staff and 2 from Education. I used the "Finding Change Revision Sheet" (1.5) and "cross-totalling" (1.6) to teach the following: use of (CE) for single and double (C) after an unidentifiable error, finding change and use of (±) to remove minuses, use of (x) before (C) for multiple purchases, use of memory instead of (x) after (C), ineffectiveness of (C) on memory, use of (M-) to cancel (M+) when wanting to re-work a line, use of memory for totalling totals. I then offered, and said a little about, checking an invoice (7), notes and coins (1.8), number games
(for teaching their children) and constant function problems (5.15: most of it), change from a kina, calendar including "counting on" and the Car Race Game (7.8) (which two of us played on the blackboard because I had not brought the boards), pricing artifacts and services (5.12), miscellaneous costs (5.13), wage calculations (5.10), church health services form (5.11), and comparing prices (5.6) which they asked me to work through.

They expressed great satisfaction both from the point of view of enjoyment and usefulness of the course.

12th June, 1981

15. LAE: SECOND COURSE FOR GOVERNMENT OFFICERS

I was expecting 8 from BMS, 2 from Commerce and 1 from Psych Services whom I had invited. Only the last turned up at first so I showed her how to work out a standard deviation, using \( \times \) \( \equiv \) to square and the square root function.

When one came from BMS I found he had to total the costs of various numbers of letters with varying postage costs. I showed him how to use the memory for this. I left them some examples to do and went to see the BMS section head Joshua Unau who explained that as it was the end of pay week none of his staff would be available, and neither would those whose names I had down for the afternoon session. As Elizabeth Hebei was away I went to see the Asst. Secretary Management Services, Alan McClay who said he had suggested to the Provincial Training Officer that she should take some action in view of the inconvenient time I had proposed for the course. Unfortunately she had not been able to inform me of the problem or I could probably have changed the time of my visit.

Alan McClay sent another member of his team to join us and we spent about an hour working through questions on the pricing of printing and duplicating (3 ANCS 5.13). We did it both on my Sharps EL 8158 and on their Canon P10-D paper roll machine on which I discovered that \( \text{M} \text{(O)} \) meant "recall memory sub-total" and \( \text{M} \text{(X)} \) meant "recall memory total and clear it". To add a percentage required \( \times \) \( \% \) \( + \). The officer explained to me that one should always put the extra changes into the memory so that the total appears with \( \text{M} \text{(X)} \). It was also set for working to 2 decimal places so we had to work in kina not toea. We worked out sets of instructions for both calculators and, with difficulty, they found the correct answers. I had to give them the price per sheet of duplicating paper instead of their working by proportion from the price I was told, K2.00 for 500. As an after-thought I used the last two questions of 3 ANCS 1.5 to illustrate that they did not need the memory if they multiplied first, but that they did if they multiplied after adding (unless of course it is the sum that one wishes to multiply).
I had 4 Forestry officers and started by illustrating the need for the memory when addition had been done before multiplying (1.5), and illustrated this by "counting deceased trees" some of which might be in blocks (using x). I taught the Number Games and other uses of the Constant Function. We worked through Plantation Areas (5.16) and the lumber question in 5.13. To my surprise they did not appear to know how to find the volume of a tree given its girth and height but the 3 who had been to Bulolo seemed to have some understanding of the algebra I had used to obtain the formula: girth x height / 126. They suggested my guess of K45 per m$^3$ was 12 x too big, but the resulting price of the tree in the example was only 2 x as big as they expected. They told me the sort of calculations they needed for a typical small project (e.g. clearing bush), involving labour and transport.

13th June, 1981

14. THE CALCULATOR AS A RANDOM NUMBER SELECTOR

As we were staying with a mathematics teacher in Wau I decided to test the randomness of the procedure we use in conjunction with the Car Race game. This consists of entering any number, pressing (7), selecting the last digit displayed and pressing (6) successively till 0 is reached. The process avoids 0. Testing it with 15 two- and three-figure entries I obtained the following distribution:


Mean: 17. I had suspected a possible short fall in 3's, 6's, and 9's since these digits do not occur in the recurring decimals obtained when dividing numbers by 7, but this experiment gave no indication that this occurred, their mean frequency being only marginally below the general mean. The procedure is clearly random enough for the purpose although theoretical randomness would be difficult to prove on account of the arbitrary nature of the initial entry.

14th June, 1981

15. VARIOUS MEETINGS AT WAU

I visited Otto Jenjet, BDO, who had names of about 16 businessmen wanting to attend the course on Tuesday and Wednesday. He thought there would be about 20 in all. Clearly this course was important, but I was anxious to experiment with our new idea for organising the adult numeracy. I therefore proposed that we went out together all day Monday, visiting 7 villages which he said were all on the road "at last" from Wau. At each we would offer to return at 4 p.m. on Monday, Tuesday or Wednesday, when the people would be back from their gardens and we could give them a two-hour concentrated course. This would mean leaving the business men at 3 p.m., which seemed reasonable.
We later saw Julian Lee whom we had met in 1979. He helped run a number of trade stores and agreed to study and comment on my Workbook. (He had his own system for assessing freight on controlled price items. He also mentioned that controlled price must take into account damage occurring during transit. He reckoned that for some items this actually exceeded the value of the permitted mark up. He asked for another copy so that he could use the course in both his trade stores.)

We saw Soreia, OIC of Plant and Transport Authority who kindly agreed to let us hire a vehicle the next day, even though it was the Queens Birthday. Mr. Biru offered to lend us his vehicle free of charge. He is a wealthy businessman with mining interests, but I thought it better to retain the arrangement with PTA.

15th June, 1981

19. VILLAGE VISITS: FIRST DAY

1. Otto Jenjet, Mary and I left Wau at 9 a.m. and reached Wandumi about 9.20 a.m. This had a mission school some years ago and Mary was able to teach in English. Otto explained what we were doing and the response was enthusiastic: we had to ration the calculator sales to 4. We lent calculators and Mary taught 6 girls, 4 of whom happened to be High School girls (it is the Queens Birthday). I taught about 4 men and 4 community school boys. We both showed how to recognise the numbers (especially 4, 5, 6). We taught totalling and finding change including x for purchases (but not combining + and x) and number games. I taught sum-ten and Car Race game to the boys and sold one of each.

The village was obviously well-to-do and gave a highly educated appearance with all the children at home. Two men told Otto they could only count to 100 so that the calculator would enable them to count further. We wondered whether they would lend the calculators to others. If not we should really try to sell as many as possible.

2. Kwembu. This was a small village with coffee being dried on sheets outside. This time we only gave out calculators on loan and kept the boxes, so that checking that all were returned at the end was easy. I had a group of 6 men one of whom did not know his numbers and after trying hard he gave up in favour of a boy. I used the "Revision of change" sheet (3 ANCS 1.5) and included x for the last 3 questions but said "you must do the ✧ before the ✦". I then did the coffee selling exercise (3.3) till we had to pack up because of the fear of rain on the coffee. Only 1 or 2 could read the weights.

Mary did adding, multiplying and giving change without a sheet, then 3 girls and a Grade 7 boy (Siwing) did 1.5 largely on their own. Siwing helped his mother who was intelligent but had only a little mission education.
The women knew how much they should have after selling up to 20 heaps of kaukau at 10 toea each but only up to 5 heaps of taro at 20t. So they learnt to do this on the calculator. We sold 3 calculators including one to Sising so that he could teach his mother.

We returned at 2 p.m. feeling exhausted but with a sense of achievement, albeit under abnormal holiday conditions. It will be very interesting to find out if anything remains in a few month's time. Our hope is that we have done enough to stimulate interest so that further courses either in the village or with representatives, will be appreciated.

20. WAU COURSE: FIRST DAY

Otto had the names of 14 wishing to come but only 4 of them turned up, together with 3 others, and 1 more in the afternoon. The L.C. Hall (for which Business Development were paying 10.00) was opened at 9 a.m. and Otto had arranged for coffee etc. to be provided. Only one paid for his calculator at once, one of the two Health Officers. 3 were from Trade Stores, 1 from a contractor and 2 were not employed. However, 1 was grade 10, 2 grade 9, 3 grade 8, 2 grade 6 so teaching was easy and in English. We completed BAI Units 1, 2 and most of 3 before lunch, including the use of the memory when necessary for totalling with multiple purchases. We worked questions like 15 3 16 17 M+ 18 4 19 M+ (RCM) using + whenever we could and M+ only when we had to. We checked the questions by working them all backwards, in this case 19 M+ 8 4 17 M+ 15 3 M+ RCM. This self-checking should be done in the rest of Unit 1, illustrating well the cases when you do and do not need the memory. I also decided to tell them that the procedures when they pressed Σ instead of Σ by mistake was "the answer is right but you must press Σ as soon as you have noted it," instead of "press Σ" which no one understands.

In the afternoon we completed the rest of the course apart from the last question.

17th June, 1981

21. WAU COURSE: SECOND (LAST) DAY

Otto had returned early from the BDO's course in Lae so joined the group. We completed Unit 6. I offered them "length", "cheque account" and "constant function" but one of them asked for percentages. We had already done mark up but I illustrated it with the following, which I must turn into exercises.

Wage increases (Mary's suggestion; the last was 5.57%) but this was the same process as markup. Discount: the health inspector agreed they usually got about 5% discount, so I did this using the Σ and also using Σ and Σ, including 1/2, 1/4, 3/4, 1/3 and 2/3 as decimals (e.g. 33 1/3%). "Meaning of %": e.g. 33 1/3% is one third and can be found by + 3. Finding markup % given cost and selling prices: subtracting the SP from the calculated CP and ignoring the sign.
Finding profit as a % of turnover (Mary’s suggestion again): 20% seemed acceptable in Wau. Interest on Development Bank loans, currently 8% for Commercial Loans and 13% for agriculture; we did an example of a K7000 loan at 13% being paid off by repayments (including interest assumed to be calculated on a yearly basis) of K2000, K1500, K4000 and K2567. I emphasised that all calculations were approximate. As we kept on subtracting from other figures we used the (+/-) to remove the - sign each time it arose.

After this I just had time to complete the old AB223A Mastery Test (3 ANCS 4.9) to teach the use of the Cheque Book, and the Reconciliation Slip. I emphasised the dangers of a cheque account if they did not keep their own bank book and reconciliations, and they seemed very appreciative. One member of the group had had an account in 1978 and brought his old cheque book to show us, which helped.

In the afternoon we spent 1¼ hours going through the Revision Sheet and adding a few additional items, such as the fact that you can press ‘sign’ keys as many times as you like, and how you can calculate freight if you can be bothered to weigh the cartons and know the cost per kg. Everybody got the Leakage Check right first time, obtaining the same total by addition as by (RCM).

22. WAU COURSE: CONCLUSIONS

This was not such a waste of time as I feared it might be, resulting in additional experience in teaching the “Workbook” and a lot of new material on Percentages. The small number of clients did not matter, since they resulted in a different mode of teaching being experienced.

23. VILLAGE VISITS: SECOND DAY

Mary, Otto and I tried leaving at 3.20 p.m. and reaching Kaisenek at about 3.45 p.m. A few men and children met us but said most were still out at the coffee plantation, this being the coffee season (June - September). So we said we would be back about 5 p.m. and went on to Biaweng. Just before we reached the village itself we found several men who told us the people were still out at the coffee. We explained what we were doing and one man, from the village but now a teacher in Wau, bought a calculator at once. I tried to show him how to use it to find change, including the use of @, but when I had done this he said he knew enough and went.

I continued teaching two other men from the village, Patimai, Joseph and Kilimbu Yabi, who were very interested. They asked what my rulers were for so I showed them by calculating the volume of the truck (1.22m³). They seemed to know what this meant, especially when I said it was “just over 1 tonne”. They understood English and said there were many Grade 6, 7, 8 people in the village: “could we come back when they were there as they were still at the coffee gardens (4.15 p.m.)?” We said “when?” and he said “Sunday.” The alternative was 8 am or 8.30 am before they went to the gardens.
I suggested that if we told them by radio (toksave) that we are coming then they might wait for us. He agreed and we said we might do this next time we come, perhaps mentioning his name specially.

On the way back to Kaisenek two men on the back of a truck, from that village, hailed us and bought calculators. We arrived just after 5 pm to find that no one had yet returned. After a while the old man who was there told Otto that even when they did return they would want food and washing before calculators. This was as I had suspected, but the information was given, not sought. We returned to Wau at 5.45 p.m.

Otto suggested that outside the coffee season, the people generally returned to the villages earlier. It also depended how far away their gardens were, those of Wandumi for example were close.

Village Visits: Conclusions

1. We must break through the problem of communication somehow: merely putting out toksave's and inviting villagers to send in representatives will not do. (This follows from our last courses, none of which had any genuine village reps in spite of attempts at second-hand to obtain them).

2. On Monday, when we found a good number of villagers at home and taught them for an hour or so, we did seem to make an impression such that invitations later to send people in for more formal courses might work.

3. On Wednesday there were hardly any people at home by 5.15 p.m. so teaching was not effective. Such a visit could however be used to forewarn them of longer visits early in the day or in the late afternoon if they proved willing to come home early.

4. Two days might be profitably spent thus: Day 1: Village A before 8.30 a.m. for 1 hour's teaching. Villages B, C, D, E to give notice that we were coming on Day 2. Village F at 4 p.m. (if not in the coffee season) for an hour's teaching. Day 2: Villages B, C, D, E for an hour's teaching at each at pre-arranged times.

This might work if it had a good backing on the radio, especially if part of a national campaign. The hour's teaching sessions might be followed up some months later with village representatives' courses if the motivation they had provided was sufficient. But again a personal visit to publicize this might still be necessary.
25. HARDWARE SUPERVISORS' COURSE

This course for 12 supervisors from Steamships and Carpenters had been set up at Laloki by Don Moore and Mary, David Yaninen helping with the teaching. In one 2-hour evening session I went through finding change with and without memory for multiple purchases, and BAM 2, 3, 6 on invoice checking, pricing and leakage check (which seemed to me relevant if they could isolate the sales from a small area in order to check leakage in that area).

After discussion with Alf Yaya and Don Moore I had prepared a unit on Stock Control: this classified stock as Fast, Medium or Slow sellers and showed how to calculate the average sales in an appropriate period and to use this to determine when and how much to order (I was able to use the new plain paper copier very effectively for this, preparing a pro forma, copying it, writing several exercises using it and copying enough of them for the course.) However, they assured me their companies had their own methods of stock control so I did not use the exercise.

The next day they asked me to give them another 2 hour session so I used BAM 1 to revise the work we had done and then (on Alf Yaya's suggestion) did the exercise on length (3 ANCS 5.1) which seemed admirably designed to help them advise customers on the number of sheets of plywood, lengths of pipe etc they would need for a particular job. They were not all sure when to divide and when to multiply, producing answers of over 600 iron sheets for a shed roof and 0.2 sheets for a large hall (having mixed m and cm). I also taught them how to calculate the "gap" if they rounded down an order and then used it to show that they could round down when there was only a small length requiring an extra iron sheet for a roof (because of the overlaps).

Other items I did not have time to tackle were: calculation of areas to find amount of paint needed, conversion from imperial to metric units, the constant function and a suggestion for selling nails in 100g units instead of only in \frac{1}{4} or \frac{1}{2} kg.

26. PREPARATION OF NEW MATERIAL FOR PROPOSED NEW TECHNIQUE OF TEACHING ADULT NUMERACY IN VILLAGES

I am currently preparing single sheet exercises (in my very poor Pidgin) for use in an hour's session at a village. The first (AND 1) includes totalling and finding change with ⚫ and ✖ (not mixed) and cash book balance calculations. On the back is a sheet of examiners' notes and coins slips and checking invoices. AND 3 includes measurement, each ✖ number = total, total ✫ number = total ✫ earn = number, total ✫ number = each, for money and length, and pricing. AND 4 might include time and calendar but is not yet written. Anser sheets have been prepared for each exercise, practice and test, the idea being that someone in the village will hold the answer sheets to the exercises and practice and be able to report when sufficient people in the village are ready to be tested. The idea if having 3 slightly different tests is to discourage copying. Each Practice and Test revises the previous work...
On my original visit (see report ANR 7) I found just enough enthusiasm to justify another visit when it was hoped that Betty Ketauwo would find 6 - 10 women who would be willing to attend a 3-day course and then train others.

After that course (see Report ANR 9) an expatriate volunteer who had attended part of it, Manika Schmidt, reported (AN 11) that none of the women on the course appeared to have any intention of passing on their skills to others. This confirmed the impression Mary had gained at the course.

To check this however I sent questionnaires with reply paid envelopes to the 10 students. Five responded: Mrs. Ketauwo had missed part of the course through sickness but said she had taught her children and two young girls how to "add, subtract and use the memory with calculation". Margaret Soga had found that village women had neither time nor interest.

Maria Wanao however, housewife and member of a Business Group, was most grateful for my "enormous preaching" and wanted us to come again. She had taught her dad to stock-take and some young girls from her village how to sew, cook etc. and run a business.

Helen Kelly, BDO had taught measuring to three friends because they used to waste a lot of material when sewing but can now measure exactly how much they need. She is planning to do a small course on pricing, markup, measuring, scale reading, etc. which she thinks will be useful in everyday life.

Manika Schmidt was already involved voluntarily in teaching groups of women, and I had lent her 30 calculators to use and sell (ANR 9). In a letter of 15.6.81 she reported that she was running the following courses, probably on a one night a fortnight basis.

1. 12 village women who could not write numbers were able after 8 lessons to add and subtract up to 100 on the calculator. Course probably finishing in September.

2. 4 women who will take over businesses next year and do bookkeeping, comparison of prices, percentage etc. Two of them also learn to teach a women's group they are leading. Course: March to August.

3. 5 young women learning to bake and sell at the market; they also learn bookkeeping, pricing, comparison of prices. Course ends in July.

4. 5 school leavers learn to make charcoal cookers, also bookkeeping and pricing. Course ends August.

5. 2 Tech. College six lesson courses on using a calculator business. Course ends August.

6 - 9: Proposed courses.
6. For college workers and their wives.

7. 8-hour "advanced" course for 20 women in a church fellowship.

8. Two village clubs where the people cannot write number, in Ungai and Asaro.

9. A group to learn baking, sandal making (from tyres) with bookkeeping etc.

28. GOROKA FOLLOW-UP CONCLUSIONS

The original attempt was a failure but the spin-off in contacting Manika Schmidt made it all worth while. Teaching village people is a long term personal affair and we must not expect to find easy short cuts even though we may be lucky enough to do so sometimes.

29. FOLLOW-UP OF NIPA COURSE, 30 - 31 OCTOBER 1980

This was a course for 15 Trade Store keepers, as reported in ANR 3. The materials used were the old Arithmetic for Business units designed as self-paced material for good English speakers. The exercises were used for class teaching apart from two older trade store owners who did not know their numbers.

Lunge Rias, District BDO kindly completed a simple form for me in April 1981 giving the following information about 12 of the students at the course. (The answers were all "written in" by Lunge; I did not list any suggestions).

1. Have they still got a calculator that works? Yes - 8, No - 4.

2. What do they use their calculator for? Giving change - 3; costing - 2; Pricing - 4; bookkeeping - 5; adding and subtracting only - 2; adding, subtracting and multiplying - 2; checking invoice - 1.

3. Did they learn anything else from the course that they still use?

   Giving change - 12; costing and pricing - 4; checking of invoices - 5; adding and subtracting - 4; memory recall - 1.


30. NIPA FOLLOW-UP: CONCLUSIONS

There were a number of ambiguities in these responses such as how two of them who have not now got calculators "still use " what they learnt about costing and pricing. But Lunge could probably explain this. The materials used were highly inappropriate compared with what is now available; the request for further training was unanimous.
REPORT ON THIRD VISIT TO KUPIANO, 3 - 12 AUGUST 1981

Note: Summaries concerning the Follow-up of the February Course, Vocational Centres and the new village-based approach are given at the end of this Report in paragraphs 9, 10, 11; proposals for Adult Numeracy Teaching, supplying calculators through B.D.O.'s and a relationship with World Publications (3.8.81) are given in paragraphs 12, 13, 14.

1. Monday: Course in Kupiano and Follow-up of February Course

Due to accommodation problems we had not been able to come earlier so the Kupiano course that had been arranged by Cuthbert Sirisi had to be postponed from the morning to the afternoon. Some knew of the postponement but others had come in the morning. 5 trade store keepers were present for the afternoon.

Two of them had been on the previous course (Report ANR 8) so Mary and I interviewed them with a tape recorder to find out what they had learnt. Warikapani (Tape ANT 1, side A, 0-28 in our Sanyo Radio Cassette Recorder) had been using his calculator for totalling customer's bills but probably not for pricing or checking invoices. Gerega Ravu (ANT 1A, 28-68) said he had been checking invoices and had found mistakes, obtaining refunds. He said he had also been doing the pricing with it and this may have been true, judging from the mastery he showed during the course. He commented that the cost of the calculator was very small compared with the increased profits he now enjoyed.

We used the BAW series (in Pidgin as the English version is not yet ready), Mary and Cuthbert helping with individuals. We started with Unit 2, did the pricing with freight which was easy because small cartons from Port Moresby cost 20t to 30t while big ones cost 40t to 50t. Two of the group said they also owned the transport so did not pay but I pointed out that they ought to include freight in the pricing anyway or they might find themselves selling goods at a loss. We were in the midst of the Leakage Check unit when we decided to leave it till tomorrow afternoon.
2. Tuesday: Courses in Kelerakwa and Kupiano, and Follow-up.

Kelerakwa is on the opposite side of the channel (contrary to what is shown on the map). The canoe operator from it who was supposed to pick us up soon after 8 am did not, but we met him coming for us as Mary, Cuthbert and I were being taken over by a DPI boat at about 9.20 am.

On arrival we found that Cuthbert's messages had not been delivered so we were not expected. There were only some young men and women none of whom presumably had the money for a calculator. While we were waiting Mary interviewed two who had been on the last course. Rigolo Ravu (ANT IA 68-83) said he still used the calculator for totalling and giving change. His brother uses a calculator for invoices and cash book. Ai Wari (ANT IA 83 - 113) uses one for giving change and totalling the days takings, also for ensuring that his orders do not exceed his available cash. He also finds mistakes in invoices and gets refunds. He had bought a ruler and uses it when selling materials. He said too that he had taught school students.

Eventually Mary took a group of 5 Grade 6 girls aged about 15 and taught totalling and change solidly for two hours from AND1. One student surprised her by recognising a wrong answer to the first question 24 + 35, and working out the correct one in her head. But they all found the use of x for several items at the same price quite mystifying. They were happy to use + for such questions but it was something of a comment on their school curriculum that they did not even recognise this basic use of multiplication. (We had not noticed it before: this particular application is new, see ANR 11, page 9, being in AND & BAWE but not BAW).

Eventually 8 young men borrowed calculators and worked at their own speed through AND1/2/3, while I circulated between them. The idea of an A4 sheet printed so that it could be folded into 3 was good: they had to work on their knee, on wooden slats or even on their calculators, so the 3 thicknesses of paper helped. It was also useful to have the "Practice" on the back of the sheet. They could get on with this if they finished an exercise and were waiting for me. The Pidgin was a disadvantage in that few knew it so I had to translate it into English, but this did not really matter till Day 3 Exercise 1: "Each x number = Total" etc.
A few minor improvements would help, such as checking the total by "last first" should be done right from the beginning instead of after 4 examples. The x questions should only be checked by adding instead of commuting the product. There should be more examples to check by doing backwards with the memory. The rest seemed just about right, now that OFF/ON to clear the memory has been replaced by RCM/RCM in the first reprint of AND2.

Of the eight, two (Grade 6's) only completed AND1, and 1 (Grade 8) completed AND2, but 3 (Grades 6, 8, 10) completed AND3, EX2, while 2 (Grade 6, 8) completed AND3, EX 3, all in 2½-3 hours by which time we were all exhausted from unbroken concentration.

It appeared however that these were probably the young educated drop-outs who could not get jobs and had no traditional skills so ended up with no money. Only 1 bought a calculator even though I was able to offer them at the special "on course" price of K5.00.

We returned in good time for me to give a second lesson to the 5 trade store keepers in the Kupiano Council Room. We completed the Leakage Check in BAW6 and the "Net Liquid Asset" which I dictated from BAW 5. 2 or 3 of the group seemed to understand it all but I regretted not having copies of the revised English version, which is currently being typed, illustrated and pasted up by Kirsten.

(5.8.81)

3. Wednesday: Waori, Wanigela and Follow-up.

After the usual sort of negotiations we left at 9.15 for Waori with Pina, the Business Development driver (their vehicle is out of action). In about 45 comfortable minutes on the usual flat-decked, two-hulled Evinrude 25 outboard-motored "double canoe", we reached Waori where we were expected, but where there seemed to be few adults and many children.

The pastor's family (see Report ANR 1) were not there and general organisation seemed lacking. 5 people bought calculators including 1 woman. No one who had attended the February course was present but 3 women had calculators which had been bought at it. Three of the 9 students were "village men" without education. They had children beside them who discretely did the work on their behalf. The others were Grade 3, 4, 5, 6, 10 and "COES Form 2".
After about 20 minutes I started teaching from AND 1 and got right through it, satisfactorily. At the end of an hour and a half they had reached the limit of their concentration and our boat was waiting so we left, feeling that this had not really been a very cost-effective visit but not knowing how we could have known this.

Arriving at Wanigela about 12.20 we were met by even more and noisier children, the older girls playing a net-ball-type game in the large open area while we climbed up to the Council room overlooking them. Children frequently clambered up or walked dangerously on the balustrade and had to be chased off. Raka who had brought us, Gideon Uroni who had been on the February course and various other senior men announced our arrival (using an electric loud-hailer) and urged people, particularly trade store keepers, to attend.

Mary interviewed Gideon while we waited (ANT 1A, 113-140). He uses his calculator to check invoices, price goods and give change. At the end of the day he teaches other trade store people how to use it. He also uses it for his cash book. He remembered the exercise on the distance to Moresby. He has used his metre ruler to measure "electric rubber" (cable?).

15 bought calculators and 2 borrowed them to attend the course. 20 calculators in all were sold, presumably to the astute people at this village who wanted to make the most of the preferential price offer.

I taught the 17 students (about half women but we did not get a list of names etc) for a solid hour and three-quarters, most of them keeping together most of the time. There were two men and one woman who could not manage, one man not knowing his numbers. The rest did quite well and completed all except the second cash-book example at the end of AND 1. Pina helped a lot.

We finished at 2.35 pm and returned to Kupiano feeling that this at last had been a worthwhile operation. We would certainly not have reached this number of women from this SDA village if we had not come out to them.

Barry Reeves (Superintendent, Non-Formal Education) had written to the Manager, Joe Palad, saying they were interested in developing a "numeracy package" for all Vocational Centres and suggesting that we might carry out experimental work at his Centre to provide a basis for it.

Joe himself was busy killing a pig during the morning, and two of his staff were in Moresby, so Cuthbert and I taught 38 lads from the Centre using AND 1. This took about 2 hours and seemed to be quite well understood by the majority of them.

The cooks had been attending the class so the lunch hour was somewhat extended but I was able to show Joe and his agriculture teacher, Chris, what I had done in the morning and what was in AND 2/3. When the lads (about 32 of them) returned, Joe remained while I taught AND 2, in about one hour. Then made the usual special offer and 13 of the students paid K5.00 each for calculators (10 of the K5's were lent by Joe). It was a pity that Chris did not stay also as he would no doubt have learnt something. This may point to a future difficulty: will the staff in fact be able to teach it? Joe (an expatriate) assured me he would, but training other staff may not be easy.

Joe was in general agreement with my suggestion that the content of AND 1/2/3 would probably form a suitable Core to a numeracy course (although it should be amplified by learning the number bonds to 9 + 9, and "change from a kina" and perhaps some "Games"). When the course is translated into English Joe might be willing to teach the rest of it as an experiment. I did not mention the Tests I had written on AND 1/2/3 but clearly these could be useful as part of the package. We discussed measurement briefly: he uses mm for mechanics, mm and m for plumbing, m and cm for agriculture. A basis for the m/cm use is provided in AND3, but clearly specific course units would need to be designed to be associated with each subject, and these could deal with the measurement side of the work.

5. Friday: Bomguina, and Follow-up.

Paul Peniaimo (BDO) accompanied us and joined in helpfully. We arrived outside a trade store about 10.50 am and waited while people arrived. It
was an excellent spot, under an extension to the roof, in full view of passers-by who came over to see what was going on.

Johnson Damai who had attended the February course arrived and was interviewed by Mary, the tape for the tape recorder having been accidentally left behind. Johnson helped his elder brother run his trade store and used to use his brother's calculator but the batteries ran out and could only be obtained in Moresby. The batteries of the one he had bought from us in February had not run out. He now uses it for invoice checking, stocktaking (monthly), cash book (weekly check), totalling and giving change, pricing.

He has shown many people the use of the calculator: Youth fellowship, elder brother and customers when there is time. He has also taught small girls and boys how to play Sum-ten, of which he promptly bought two more sets. He has used all the papers he was given at the course.

We had 13 men at the course, mostly store keepers, most of whom had not used a calculator before and two or three who had the usual difficulty remembering which was which of + - x and =, sometimes pressing one of the numbers instead. However we all kept together to the end of Exercise 3 of AND 1 (finding change), when I suggested that those who were not yet sure of this should continue to work on it. Five did so, Mary taking them through the examples on the back while I completed the cash book examples with the others. It was now about 12.40 so I suggested we should all have a break for 20 - 30 minutes and then if any wanted to carry on with the second lesson we would do so. They were probably as exhausted as we were because there were none of them there to continue at 1.10 although one (a club leader called Moses) came back at 1.15 just as we were going.

On the whole this seemed a very worthwhile exercise although most of the work was in fact with storekeepers. At present any attempt to do adult numeracy work seems to be overshadowed by the needs of the trade store keepers, who tend to monopolise the classes. This is clearly meeting a need but it is one that should really be met by the Business Development Officers. If the training scheme to be launched in August does result in every trade store keeper being taught by a BDO, then the whole situation
will be changed and we should be better able to identify the ordinary adults who by that time should have been stimulated to demand teaching from observing their friends using the calculator in their trade stores: or perhaps the trade store keepers themselves will teach them?

(9.8.81) Sunday: Abau

We left Kupiano at 7.30 am with Cuthbert and attended a service at Cape Rodney where we picked up Cuthbert's friend Philip who was to drive our car back to Kupiano for safe keeping while we were in Abau.

The boat was waiting when we arrived in Domara so we embarked at once, but the boat had to be poled and pushed when we neared Sandbank Point. We picked up the owner of the outboard motor from Durama, the boat itself being a Government one but its own engine was in need of repair.

About 2 hours later we reached Abau. This used to be a main government centre but there is now not even a Community school near enough for the children of the Government Officers (and one expatriate storekeeper) who live on it. On some Sundays however the island is alive with people, several hundred from surrounding villages playing or watching football and netball.

Camillus, the BDO, Andrew, the Rural Services Officer (kiap), Mary and I discussed the best way to use the time available which we had decided to limit to 2 days, largely because of the unpredictable nature of the accommodation. The first problem was transport. The lack of the Government motor meant we had to hire one for K40.00 a day. We then decided we would start early to visit Segili (11 km, by canoe) and Apaeva in the morning and Aneve (2 km) in the afternoon. People from Canai (11 km) and Si'ini (6 km) would have to travel to Aneve.

If the Aneve response was good we would visit them again on Tuesday morning for a second lesson (I was keen to experiment with this).

Having made our decision Andrew and I walked back to the football ground to spread the information around. He found a reliable person, Philip from Apaeva who borrowed my calculator so that he could tell others what it was about. The Peace Officer was from Aneve and promised to publicise it there. Raka from Bam (15 km by road beyond Segili) was specially keen and asked
if I could teach him there and then. We thought of putting on a course in the Business Development office, where we were sleeping, but I decided it would be much better publicity to do it beside the football pitch.

Camillus came with me and noted the names of people to whom I lent calculators and pens. When I had a class of 8 I started and found them surprisingly quick although most had probably never used a calculator before. In an hour I completed Exercises 1 - 3 of AND 1 (totalling with multiplying and giving change), and promptly sold 8 calculators. Mary had attempted to join me to help with the lesson but the crowd was so thick around the nine of us squatting on the ground in the middle, that she gave up. We had refused to take students from the villages we were going to visit, but had 2 from Ban, and also 3 from Canai who were only watching but bought calculators nevertheless. Of the eight taught, 3 were trade store keepers, one a DPI officer and one a medical officer.

Camillus found us mattresses, a Coleman lamp, primus stove and saucepans, while Andrew let us use his office for sleeping in as well as Camillus', so we were all very comfortable.

In conversation with Camillus he mentioned the problems with benzene and kerosene here. Both are price controlled but the margin is less than 6%: K68 for a 200 litre drum plus a K30 deposit on the drum, K11 for freight one way. K6 freight when empty and controlled price 45t/litre. This is such a small return for such a large outlay and such substantial risks, that one felt the Government really ought to find a more realistic way of controlling the price of these most essential supplies in these outstations. No commercial undertaking could be expected to operate under such conditions.

Camillus also mentioned the problem of measuring these commodities and was tempted to recommend the continued use of gallons as only these were understood. He agreed however that 2-litre cordial bottles could be used and I suggested he got two similar ones and divided 2 litres equally between the two, marking the litre level on each container. Such problems of course add to the likelihood of loss in selling the commodities and emphasise the need for some Government solution to the pricing problem.
7. Monday: Segili, Apaeva, Aneve

We left the office about 7.40 am and carried the Stationery Box down to the wharf where the canoe was waiting. An hour or so later after some tricky poling between shallows we reached Segili where Philip (of Apaeva) had arrived early in his capacity of Committee Member for Activities in the Neighbourhood. 21 adults borrowed calculators for the course, Camillus noting their names and educational grades. They were 1 Grade 10, 2 Grade 7, 8 Grade 6, 2 Grade 4, 3 Grade 3, 2 Grade 2, 3 no school. These included 6 women (Grades 7, 6, 6, 3, NS and NS) and only 3 Trade Store keepers. I went rapidly through AND 1 Exercises 1, 2, 3 and part of 4. We then split into two groups, my slower ones joining the late comers whom Mary was already teaching. I continued with AND 2, using the memory for totalling and invoice checking. After about 2 hours we had to leave for Apaeva, after selling 8 calculators and 2 metre rulers (for trade stores selling material). In response to requests, Camillus promised to make some arrangement for selling more calculators when they had the money available. We were asked to use Pidgin here, most of the people being plantation labourers from elsewhere in PNG.

At Apaeva we were impressed by the village which had recently been used for an important SDA meeting. Philip again organised us and again just 21 people attended for a very similar programme. They were: 1 Grade 10, 6 Grade 6 (including Philip), 1 Grade 5, 9 Grade 4, 2 Grade 3, 2 Grade 2, including 7 women (Grades 6, 6, 5, 4, 4, 4, 4) and 5 Trade store people. We again sold 8 calculators (4 being EL8158's) and 2 metre rulers. Mary commented that the weaker members of the class whom she taught after we divided them, could be taught the use of + and x but still found - very difficult.

We reached Aneve about 3 pm and taught a group of 9 men, 1 Grade 8, 1 Grade 6, 2 Grade 5, 1 Grade 4, 3 Grade 3, 1 Grade 2. None of them were trade store people (they presumably use the Abau trade store). No one had come up the coast from Si'ini.

We started similarly here but felt the response was at a lower level so after going through AND 1 totalling and giving change I gave a copy of the Test AND 1A to each and helped them individually. Two completed it fairly soon and did AND 1B but most needed much help and took a long time to finish it. 5 calculators were sold.

ANR 13 A198
Before leaving Abau we left 10 calculators with Camillus to sell on our behalf.

(11.8.81)

8. Tuesday: Duramu

On the way back to Domara we stopped off at Duramu where the owner of the outboard motor lived. They were expecting us and 20 gathered for a lesson. They were 1 Grade 10, 2 Grade 8, 1 Grade 7, 11 Grade 6, 3 Grade 5, 2 Grade 2 and included 8 women (7 Grade 6 + 1 Grade 5) and 3 Trade store people (Grade 6, 5, 2). This time we reverted to doing all the totalling twice (forwards and backwards) but in an hour or so we only completed AND 1 Exercises 1, 2, 3. They were a noisy lot, but keen and obviously enjoying it. 6 bought calculators.

Cuthbert had efficiently found someone to drive our car out to Dorana to pick us up, their own driver Pina having (I understood) been paid off (like the labourers at Abau) because of the lack of Provincial Government funds. We returned to Kupiano safely and filled up with Government petrol using an ILPOC. This was as well since our friendly Guest House keeper who had been losing money by selling petrol last time we came, said he had now handed over the franchise on petrol to someone who was prepared to sell it at about 50% above the controlled price, thus making it a paying (lucrative?) proposition. On the other hand if no one stocked it the position for the local boat operators would be even more serious. Controlled prices do need to be carefully controlled.

9. Summary of Results of Follow-up of the February Course (see ANR 8)

We had taught 26 adults in February and on this tour we interviewed all the people we met who had been on the course.
Details of our interviews are given in the body of this report: the following is a summary of them.

<table>
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<td>1</td>
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10. Summary of Preliminary Suggestions for Vocational Centres.

An account of our visit is in paragraph 4 above.

1. A core course should be prepared and staff instructed in the teaching of it. This should include: totalling and giving change (including use of memory for x and + together), cash book, totalling cash with Notes and Coins slips, invoice checking, pricing (in trade stores, without freight), pricing of artifacts and services (given the rate per hour), learning the number bonds to 9 + 9, mental calculation of change from a kina, clock (to nearest ½ hour), calendar (dates in so many days, weeks etc), measuring in m/cm and comparing, adding, subtracting, multiplying and dividing lengths. Mastery tests should be included with the course.

2. Separate courses should be prepared relating to each subject taught in Vocational Centres. Staff concerned will need training.
3. Arrangements should be made for calculators to be provided in all Vocational Centres, eg a few might be supplied from central funds and Centres could be encouraged to buy them at, say, K55 for 10 from the Numeracy Project and to sell them to students and others at not more than K6.00 each.


1. Spending an hour or two in each village proved to be an enjoyable and apparently effective method of establishing some sort of numeracy base in the village, although only a follow-up could determine how much had been retained. The women in particular (21 out of the 71 adults taught in the 4 visits where this data was noted) could not have been reached otherwise.

2. The span of concentration possible meant that lessons generally had to be limited to 1 - 1½ hours with half-an-hour or so required to gather the group at the start and sell calculators at the end.

3. This meant that the only things one could be sure of teaching were totalling with + or x and giving change: enough were able to master this for one to feel reasonably certain that they would be able to teach others who wished to be reminded of it subsequently.

4. The other skills taught during some of these lessons included (a) the Cash Book, (finding the balance on each line and checking it at the end), (b) using the memory for totalling with + and x, (c) checking invoices, (d) totalling money with a Notes and Coins slip.

Only a follow-up would show whether any or all of these skills were retained. Probably a few would remember them, particularly those who had attended High Schools (9 out of 71 in these 4 visits had attended for 1 or more years).

5. It would have been interesting to try a second visit to give further teaching, but we had the feeling that the response would be for less satisfactory because
(a) only totalling and giving change has universal application, the other skills being only applicable to business people and those who run clubs, projects etc.

(b) Probably less than half of those taught would be able to master these harder skills: one would therefore be visiting a village with a view to teaching only an elite, and only those within the elite who happened to be available on two separate, specific occasions. A second visit could therefore appear as a divisive element in the village instead of one in which everyone was welcome to "have a go".

6. The success of these visits may have depended largely on the good publicity provided, in the background by the BDOs and by our personal contacts on the sports occasion.

7. With 8 calculators in a village and a desire to buy more it is likely that these machines will continue to be available when anyone requires one. It would be worthwhile trying to make some arrangement for continuing to supply these at K6.00 each (after K7.00 at most)

8. If the campaign to be launched through FPA's and FTO's in August 24 - 26 is successful and BDO's generally accept their responsibility to teach every trade store keeper, then there will continue to be an input into each village, although in these villages only 11 out of 71 taught were concerned with trade stores. Such an input would clearly lead to a considerable development in their skills which would probably be passed onto others to a considerable extent.

9. Neither the 2-hour visit nor the BDO input would necessarily include the teaching of number bonds, measuring, clock and calendar skills etc which we have given in previous courses. In time however the background knowledge and availability of calculators might raise the level of numeracy - consciousness to the stage where it would be worthwhile putting on courses in main centres to cover these and similar items (but see below for latest ideas).
12. Proposal for Adult Numeracy Teach-ins

It would seem that the following would be the most cost-effective way of providing a fortnight's adult numeracy in an area surrounding a major "Centre" (of a District or Sub-District perhaps).

First Week

1 Day: The Adult Numeracy Organiser (ANO) travels to the area and checks on local arrangements.

2-3 days: the ANO and a BDO or another extension officer visit 6-12 villages on a pre-arranged and well-publicised schedule, spending 1 to 2 hours in each village using the AND 1 type of programme and selling calculators.

They would also publicise the programme for the second week and try to arrange for local PHVs to special services for it if required.

1-2 days: the ANO trains a team of Government Officers and other volunteers willing to assist in the second week's programme.

Second Week

4-5 days of "come-as-you-can" courses when the ANO would organise students into small groups to be taught by him/herself and by Government Officers or other volunteers on a "come-when-you-said-you-would" basis.

The BDOs would be responsible for running the Arithmetic for Business packages while other units would be prepared along the lines of the 3ANCS series but designed for small group work with teaching by volunteers. This would include the non-calculator work eg clock, calendar and number games.

Less than a fortnight

The above pattern is suggested as a maximum for a well-developed area with an accessible Centre. In other areas it would need to be adapted. A minimum might be one day spent on visiting 3 or 4 villages followed by a one-day course in one of the villages.
13. **Proposal for Supplying Calculators and Arithmetic for Business materials through BDO's**

There is no way in which the proposed teaching of businessmen by BDO's will happen if the only way in which calculators can be supplied is for each prospective student to pay the BDO for one, for the BDO to send the cash to Laloki, for the calculator to be sent back and for it then to be delivered to the student for his/her use. It is essential that calculators should be available immediately in return for cash. At the same time Business Arithmetic course units could be sold at say 10 - 20 toea per unit.

It appears to be impossible to arrange advances from Finance for the purpose so the only people who can accept the risk involved would seem to be the Laloki College, which has already shown a substantial profit from its sales of calculators in the past.

It is therefore proposed that

A. **if the BDO can provide their own capital and pay in advance**
   then the Project would supply calculators at a special price of K55.00 for 10 on condition that they are sold at no more than K7.00 each (and will publicise the fact that they can be obtained from Laloki for K6.00 post free).

B. **if the BDO cannot provide their own capital then the Project**
   would supply them at K6.00 each in advance of payment, for sale at up to K7.00, on the following conditions.

   (1) Every application by a BDO for this facility is countersigned by the PBDO and PFA (but in their personal, not official, capacities)

   (2) The BDO "agent" will complete a reconciliation statement and send it with any cash received every month to the Project.

   (3) There will be a limit of 10 or 20 calculators to one "agent" and an overall limit of 200 calculators unpaid for at any one time in connection with this scheme.
an insurance will be taken out if possible to cover their loss by larceny when in the charge of a BDO. This insurance would only operate if the case were reported to the police and investigated by them.


It is suggested that we provide them with copy for Wantok (in Pidgin) and New Nation (in English) in return for assistance with translation into Pidgin and general publicity including information about purchasing calculators from Laloki.

The copy would probably include detailed instructions for specific adult numeracy skills and after the first few issues a "Beginners" and an "Advanced" item might be offered with each issue. (This idea has not mentioned to Wantok so is strictly confidential.)
REPORT ON THIRD VISIT TO SOUTHERN HIGHLANDS, 5 - 17 SEPTEMBER 1981

(5.9.81)

1. Tari: Course for District Officers

While in Tari we met Ben Probert, ADC who was keen for his Government Officers to receive training: I consulted him about the Field Officers' calculations (3 ANCS 5.20) which I had prepared from material lent to me by Steve Cutlack of the Department of Community and Family Affairs. Steve had suggested a number of topics but had admitted that there was much doubt nowadays exactly what training a Field Officer needed. Ben felt that today's officers do not need to be able to calculate quantities for concrete or sizes of water pipe needed since they get experts in for these jobs. He was keen however that a short basic course be given and this we will do on Friday before we catch the plane for Koroba. He bought a calculator.

2. Discussion with Syd and Meryl Gould

Syd has been here for 15 years and is responsible for the Huli Literacy programme with its 5 Primers currently in use among the 60,000 Huli speakers.

Finance has always been a concern: basic provision comes from the Evangelical Church of PNG, assisted by Pasuwe and at present (but not guaranteed for the future) a kina-for-kina grant from the Provincial Government. Syd's primary concern was for literacy, through which other skills could be taught, so numeracy only consisted in an explanation of base 10 (as distinct from the Huli base 15, still used for counting pigs) in Primer 5.

Syd agreed that our material should begin at the beginning, since it was to apply anywhere but very few Huli's would need to be taught the meaning of numbers up to 20, as in Lesson 1 - $7_1$. The addition and subtraction in Lessons 8 - 37 would all be relevant. We also went through the AND1-3 units as an introduction to $x$ and $\div$ with the calculator: he was fully in sympathy with this approach.

Syd explained that he had had the students on the campus for two days already and had taught the idea of $x$ and $\div$ which is much better described in Huli than in pidgin. He would also be keeping them for 2 days after we had gone so that between them they could decide the best way to incorporate numeracy into their programme.
They had all brought K8 for calculators so would be pleased at only paying K6 or being able to choose the bigger one. I explained that I could contribute K1 per calculator to the cost of the experiment (eg other materials), but this could await their decision after we had gone. I mentioned we could supply them at K55 for 10, to "agents".

We also discussed on- and off-the-job training, an issue with our Business Arithmetic work (see AN21). Syd acknowledged the students' preference for Bible College courses but had for some time doubted their effectiveness. He favoured a sort of "apprenticeship" system such as had worked with many pastors, and with girls learning traditional skills.

(7.9.81)

3. Course at APCM, Tari: First Day

Mary took 21 students who needed translation into Huli, which Syd provided and one who arrived late (by air) who needed it in Pidgin, which either Mary or Syd provided.

I took the remaining 12, who were all competent in English, so the Pidgin translation, though it was issued to each person, was only occasionally referred to. (It was in fact incomplete, the part which had been sent later not having been included).

Mary followed the Course notes carefully. She moved the Number Stories from Lesson 10 to Lesson 9 and the counting of village things from 9 to 10.

Finger counting: after discussion both groups agreed that the method was to use the right hand to fold down fingers of the left hand starting from the little finger and then the left fist to fold down right fingers for numbers 6 - 10.

At Lesson 16 she concentrated on playing Snap with the easiest set till all could do it, while some played with harder cards. Thereafter when Snap cards were called for she referred to them but did not do them again.

In Lessons 18-20, the work was telescoped and -3 omitted to save time. After six and a half hours she had not quite completed Lesson 22, which was more than we had expected. Her main problem was lack of feedback because of the translation but she had the assurance that Syd would have told her if she was going too fast or too slow.
I did not feel I had handled my group so satisfactorily, having a feeling that some of them would be bored if we went too slowly, but realizing that they did really need the teaching. Syd reported afterwards that they would have liked me to give them more time for questions, which was no doubt a fair criticism.

I also found it necessary to telescope several of the Snap exercises, and I think it might be better to mix the Snap exercises with the Calculator number game exercises so that they reinforce one another instead of being ineffective a separate series.

They found the calculator number games a bit frustrating because of the frequency with which someone would press + instead of = etc, and have to reset it. This however was the first time they had handled calculators and we may find them much more confident before the end of the course.

To provide variety I introduced a "Snap Bee" in the middle of the Number Games series. This consisted in arranging the class in pairs "in line", letting them play Snap until someone went out then making each pair decide who had most cards at that time. The winners would then move "up" a table while the losers moved "down" and they would play again. By the end of about half an hour one woman had progressed from the bottom table to the top and the players were becoming well matched. Harder sets of cards were also used at the top.

(8.9.81)

4 Course at APCM, Tari: Second Day

I spent sometime trying to persuade my group to teach themselves by setting their calculators for +1, +2, +10, -1; +9, -2, +8, but not very successfully. We then did "change from 10" and "change from a kina", and the technique came into its own. Most of them understood how to set the calculator for this and most (but not all) knew the "change from 10". Those who did went on happily to change from a kina for multiples of 10t and about half of them enjoyed doing "change from a kina for any amount less, checking their answers by setting the calculator with 100 100 0.

We then worked right through the rest of the Tests, teaching or re-teaching items as required: the procedures appropriate for a once-a-week course cannot be followed in a all-in-two-days course. At the end of the morning we introduced the Sum-ten game.
After lunch Sum-ten was generally enjoyed, followed by the Car Race game similarly. Mary finished my group off with the calendar, which they appreciated. They also understood why they had been taught to "count on" in the Car Race game.

Mary spent the first hour with her group on subtracting 1, 2 by counting backwards but trying to subtract 3 or more using fingers proved to be extremely hard. They had done some of these for homework but even Syd was unable to discover from them how they had done them. My conclusion would be that we would not expect to subtract more than 2 without calculator, and the Snap cards should be reduced to this.

They had no particular difficulty learning to recognize the numbers on the calculator and to give the English for numbers from 20 to 100. (The numbers 0 - 19 had been taught in pidgin because their form is more logical than the "teens", though this was difficult for those used to the English version.)

Problems began when she tried to teach them how to set the calculator to add 1. Both Mary and Syd taught them several times in English, Pidgin and Huli, but they never managed to get them all to keep their calculators set for more than a few seconds. (Perhaps they confused ☐ and ☐, or looked to see which key their neighbour pressed, when possibly he had the other sort of calculator.) They tried setting for +2 and all did do at least some of it: eventually they decided the only way was to keep on making all of them reset them whenever three or so went wrong, but it was time consuming.

They did composition of 10 by setting the calculator first with 10 ☐ 10 ☐, then did it by separating a pile of 10 calculators into two piles, then back again to setting with the calculator. Most managed it eventually.

Change from a kina for multiples of 10 was first discussed (they decided there were 100 toea in a kina) and then done by setting 100 ☐ 100 ☐. There was a lot of talk about the importance of 10 for people in parts of the world other than the Tari basin.

The Sum-ten game went down well and they did use their knowledge of composition of 10 for it. I then came in and taught the Car Race game: they found it tolerably easy just to press ☐ and read the last figure. They also related the counting-on to addition. (There should be no "hazards" in the first 20 squares and those on the rest of the board should be improved.)
Thinking over our experiences of the past two days we came to the simple conclusion that we should abandon the attempt to make students learn all the number bonds up to 20. Instead we should insist on their learning what was 1 more or 1 less than any number, and the composition of 10. They should still learn to add numbers up to 10 using fingers, to add or subtract 10 or 10 and to find change from a kina (this could still include change from any sum under K1.00 if they could manage it). The snap cards would have to be substantially reduced to conform to this although their extension beyond it would be optional. The calculator could still be used, together with other methods, to teach composition of 10 and change from a kina.

(9.9.81)

5 Course at APCM Tari: Third Day

Mary and I both started with the totalling and finding change in AND 1. By mid-morning I had completed this but Mary's group had not started finding change. I therefore consolidated the work using the Practice on the back of the AND 1 sheet, and an assortment of "trade store goods".

By 12.00 Mary was ready and we set the Tests AND 1A/B/C to both groups. Scores out of 12 were as follows: 12-5, 11-2; 10-4; 9-2; 8-2; 7-4; 5-2; 4-2; 2-2; 1-3; 0-6. (Many mistakes were due to confusing 6 and 5 and to whole kina entries.) This conveniently divided them into 19 "fast" and 15 "slow" students, requiring 2 to be transferred from my group to Mary's and 6 from Mary's to mine: several of these latter objected strongly, probably fearing that my group would be taught in English, whereas Mary's had had translation into Huli (Syd for 2 whole days and Dalewa Pipigi, Senior Literacy Supervisor and member of the Provincial Literacy Committee, for one morning). However, Syd helped to start my group on the Cash Book in Huli while Gobe, Non-formal Education Officer, translated for Mary.

My group found it hard to start but eventually got going on their own for the final hour. 3 of them successfully completed all the Cash Book questions in AND1/2/3 while everybody did at least one "practice" question on their own (with help of course). I took photographs while they were working and the class really began to "gel".

Mary's group started again using trade store goods. Syd then introduced the Cash Book, putting bits of paper into a pot and doing it on the board while they all worked it with their calculators.
After the session more copies of Sum Ten and the Car Race were sold and Mary was asked to re-teach some men the song "1 2 mi na yu, 3 4 paitim doa, 5 6 kisim stik, 7 8 lainim stre, 9 10 kisim gen, yu mas kaunim inap 10: 1 2 3 4 5 6 7 8 9 10", which Bernie Collins had found somewhere for us and we had included in the course.

Syd discussed priorities for the final day and out of the AND 2/3 material we selected: 1. Notes and Coins; 2. Invoices; 3. Metre Rule; 4. Pricing cargo; 5. x and ÷. We felt the mixture of x and ÷ when totalling could be left if we told them to work out the multiplying separately and write it down before doing the addition. Perhaps we should give examples of this using AND 2, before leaving them.

One of the problems we have found with the Huli people is their independence. They are unusual in that they have no true villages and not even any family homes, a man living, perhaps, with a male relative, and a woman with a daughter or two, in a hut that bears none of the marks that we would associate with a "home". This may have something to do with the fact that they have an exceptionally high rate of temporary insanity, a condition that is socially acceptable. (The true reasons for this however are currently being researched: one suggestion being the absence of certain trace elements in the soil).

The social intercourse is based on chance meetings by the roadside or at market. At pig-feasts it is only the preparation time that offers opportunities for socialization: once the meat is cooked and cut up they take it away to eat it on their own.

This extreme individualism tends to make them "know-alls". The classic story is of an early missionary lady who was teaching a Huli man to make custard. He had of course never handled a spoon before, let alone custard powder, but in the midst of the explanation he took the spoon and "yes, I know how" and proceeded to do everything wrong.

This attitude has sometimes expressed itself in our classes, resulting in a lot of incorrect working and unwillingness to admit it. Mary at one time stopped everything and said she would not teach them unless they stopped talking, listened, and did as they were told.

I am thinking of using a similar technique in order to cover a lot of ground in the final day.

One of the things we have tried to teach them, as teachers, is that you cannot always keep the whole class waiting while you correct one person's mistake.
you just have to be ruthless and insist on the correct answer being written down even if it is different from the one they have obtained. The fact that we checked all the early examples helped: they had got it right once even if the other time they got it wrong.

(10.9.81)

6. Course at APCM, Tari: 4th (final) Day

I was able to work steadily through the planned programme, doing invoices before "Notes and Coins" because they are easier, and missing out the "x and +" sections (except for one student who had done all the rest).

I decided I must tackle the awkward question of totalling purchases when both + and x are required. So I told them to work out the x and write the result on the paper, then do the addition. Where there was only one "times" they normally did this first and used the result in the calculator to add. I do not think anyone tried to add first then multiply. With a few who had finished all the questions in AND2/3 I showed how they could use the memory when there were both x and +, without specifying when it was or was not necessary. I think this constitutes a reasonable modification of the procedure in AND2, which I shall now replace.

I followed AND3 with the metre rule work and found it quite acceptable. Few had ever done any measuring in metres before. Hardly anyone could remember when to divide.

With the "Notes and Coins" I made them work right through them twice, ticking the extensions when checked. If they did not get the same answer both times with the memory they had to find the total by adding the extensions.

No one in the class had anything to do with running a Trade Store, but they appreciated the use of the 2 key for pricing.

Mary meanwhile spent all morning struggling with the Cash Book and the afternoon checking invoices, which eventually many of them could do. It would probably not have been encouraging to have given them a test on it however.

The work emphasized once again the necessity of having two teachers who can divide the class into "fast" and "slow" groups. Without the testing and re-allocation of students on the third day, there would have been much
frustration and nothing like the successful progress indicated by the second test results. These showed clearly that well motivated students could achieve a very satisfactory level provided they had had some sort of formal schooling: one Grade 2, one Grade 3 and one Grade 5 student all obtained over 90% in the test. Even the one student without any formal education achieved over 70%.

Of course few of them would be able to teach others without a carefully prepared text, but the confidence they had with calculators which hardly any of them had touched before the course, was most encouraging. A fairly quick revision based on a carefully set out course programme would be adequate for these. For Mary's students however none of whom had had any formal schooling, there would be a struggle to enable them to teach more than the simplest totalling and change procedures. These latter included 8 Literacy Teachers and 4 Literacy Supervisors, while my group of whom all but one had had some formal schooling, included 5 Literacy teachers and 5 Literacy supervisors: so both groups were significant. It would therefore seem desirable that the Literacy Programme should include some optional items which the more able teachers could teach, while a bare minimum would be required of the least able teachers.

There was no doubt about the popularity of the calculators: practically every student bought either an EL8158 (K8) or an EL220 (K6), including the one who came with an almost new Panasonic which had cost him K40 and whose battery ran down during the second day's use.

Details of the students are given in the Appendix.

(11.9.81)

7. Course for Government Officers (etc) in Tari

The Education Inspector set up the group of about 12 men for me, which included several from trade stores (including Pasuwe) as there were not many Government Officers available. They explained that they had most of them used calculators to add only and several were produced but their batteries ran out very quickly so in the end, all used mine.

We had quite a discussion on working in toea or kina and I explained the circumstances in which I would use kina for adding mainly whole kina eg in checking the total for AND2 (2), Question 13. But working in toea clearly paid off once one got decimals in the answer. The use of CE and the memory were quite new to them and I also did AND2 on the mixture of + and x, more or less as set. They appreciated invoice checking, together with percentage
discounts and \(\textbf{\text{(ANCS 1.4)}}\) for corrections, notes and coins, analysis sheet and cash book. We finished at noon, although several wanted more and the Inspector (who had been at the NIST week organisers course, see ANR 9) drove me back up to the Mission.

I spent the rest of the day and part of Saturday starting to re-write the course for the Literacy Programme. The main changes lie in the removal of any attempt at teaching number bonds other than \(+1, -1, +0, -0\) and the composition of 10, and in the incorporation of material from AND 1. (The re-writing of the new calculus was finished at this stage, Syd agreed with the idea of inserting optional material for teachers who could manage it. He also pointed out that it might help people to find the right key on the calculator if we explained the way in which the numbers were arranged (left to right and bottom to top).

(12.9.81)

**8. Guala Christian Centre: Follow-up etc: First Day (Saturday)**

Talair had no service Tari - Koroba on Saturdays in spite of expectations but Carl was driving a visitor into Tari so he picked us up. Ben Probert had said the road was closed and it nearly was, but after 5 trucks had tipped loads of stone a bulldozer levelled it enough for us to pass.

On arrival we found that Jenny Fountain had encouraged 18 students to come in for some further teaching, so they could be interviewed about their use of what they had learnt on the previous course. Three Community School Teachers, an Aid Post Orderly and the very bright son of James Agiru, Pastor and Church Secretary, now in Grade 3, also joined the group. I taught them the whole of AND 1/2 in about 2\(\frac{1}{2}\) hours and was astonished at their ability to follow and understand quite new work. They consisted of 3 Grade 10's, 4 Grade 8's, 9 Grade 6's, 1 Grade 3 and 6 with no formal schooling. 9 had been in the Fast group in April and 9 in the Slow group.

The speed and depth at which I worked was comparable with the Government Officers and Trade Storekeepers I had taught in the morning, and no one appeared to be lost although a few had to depart early because they had a long way to go home and accommodation was not being provided. I noted that one had come 30 miles, one 24 miles, one had walked for 5 hours and another 7 hours, to attend this very brief course. I offered them teaching on cheque accounts on Sunday afternoon and most of them agreed to this with alacrity.
Jenny had already completed follow-up questionnaires on the 18 present and 4 others. We selected about 12 to talk to personally and Mary interviewed three who were not staying till Sunday, recording them on ANT 2A.

Jenny consulted me about the Guala Church Centre accounts which she keeps and which she wishes to simplify sufficiently to be able to hand them over to a national. They are exceedingly complicated, with current credit or debit accounts with about 40 people or institutions and a need to ensure that items like fuel and vegetables purchased by the centre and sold internally were being properly priced.

I came to the conclusion that a double-entry system would be the only way to do all this, so not having the expertise myself I offered to work out a system with the help of Laloki staff and let her have materials to operate it, on an experimental basis. It could have applications to businessmen who run a number of enterprises with one bank account and do not wish to employ a professional accountant. (Draft version for experimental use completed 26.9.81, with advice from George Sibiso)

9. Guala Christian Centre Follow-up etc: Second Day (Sunday)

I had twelve students for about 2½ hours during the afternoon and went right through the Cheque Account part of BAWE 4 with all of them including a High School girl (Grade 7) who had never used a calculator before. They all coped adequately with the unit. It is however awkward to use it in a class situation because of the difficulty of finding the right bit of Bank Book or the right Bank Statement or Reconciliation at the right time, especially as they all look very much alike. (This will be remedied before the unit is reprinted). Besides this it is of course all in English, which some of them did not speak. So it is doubtful if they could forthwith open an account, keep a Bank Book and complete a Reconciliation Slip, but the general idea must I think have been assimilated and it would be easy to teach them now in a real life situation. They included 1 Grade 8, 1 Grade 7, 3 Grade 6's, 1 Grade 2 and 6 without formal schooling.

10. Summary of results of Follow-up of those taught at Guala Christian Centre in April.

21 out of the 34 students were interviewed by Jenny Fountain and thirteen of these had interviews with Mary recorded on tape.
The remaining 13 were not interviewed: because they did not attend the refresher course offered, and because Jenny was not able to visit them otherwise. Of this 13, four lived more than 25 miles away, one was on a course and another had married and moved away.

The 21 interviewed were asked the following questions and gave the positive or negative responses indicated below.

Do they now use a calculator? Yes, 20; No. 1.

Do they now use the metre ruler they purchased for measuring? Yes 6, No (or did not buy one) 15.

Do they now use any of the games they learnt at the course (Snap, Sum-ten, Car Race game or Calculator number games): Yes, 13; No. 8.

What did they learn on the course and now use? Positive response, 20; Negative 1.

Have they taught anyone else anything they learnt on the course? Positive, 13; Negative 8.

Do they want to learn any other number skills, if so what? Positive, 17; Negative 4.

The "skills learnt on the course and now used" included adding money for church, Bible school, trade store, women's fellowship, bookshop, medical accounts, wages etc, playing games with a friend and for own amusement, and pricing in a trade store.

Those they have taught include literacy teachers and classes, their own children, trade store boys, a class of 10 learning number skills and nurses needing to calculate mileage and other statistics. One would like to teach "the clock."

"Other" number skills they want to learn are in fact mainly revision of those already taught to them, as one would expect. Some just said "more practice", others mentioned specific items such as the memory, %, cheque accounts and the square root (which Jenny attempted to explain before I arrived.) Some of the taped interviews were in English and others in Pidgin. They generally expressed the enthusiasm of the students: most of them had taken most of a day to walk to
the Mission. One (ANT 2B, No.12) particularly recalled learning to count up to 19 and down to 1 again. He had found learning to add and subtract hard, but easy with the calculator. He did not lend it to his literacy students but used it himself when teaching them. He wanted certificates to be given to those who learnt how to use the calculator. He wanted to know about the square root key which he described as "T-".

One young Grade 8 leaver (ANT 2A, No.3) described teaching the calculator to 7 people in his village. One (ANT 2A, No.4) remembered about the ruler without being asked: he used his calculator to help two old village trade store keepers to count their money, now he would be able to help them keep cash books.

One (no.5) had been teaching his literacy students how to add and subtract. He had forgotten a lot of the things he had learnt at Easter but now he remembered them again. Another (No.6) had forgotten everything about the calculator, which was why he had returned, but he had been using the ruler to measure. A nurse (No.7) had been using the calculator a lot in her job. A woman literacy teacher (No.8) had been teaching women and children to use the calculator. A pastor (No.9) had been teaching numbers to 10 village people and also the calculator to a trade store keeper. He had now learnt to keep a cash book.

The Church Secretary (No.10) had learnt many interesting things including looking after money and "checking up on things" with the calculator. He had taught his children to measure with the ruler and to use the calculator. He knew he must practise if he was to retain his skills. A trade store keeper (No.11) takes his calculator with him to check the invoice before he leaves the bulk store, and uses it to price his goods afterwards. He uses the ruler to measure material for sale. He has taught his work-boys as well. He thought he might be able to remember how to keep a cheque account but would really like another lesson first.

(14.9.81)

II. Mendi United Church Budget: Identifying problems

I met Grê Kornêlius, Regional Treasurer in the Highlands Region of the United Church and we identified the mathematical problems which will be encountered by the 20 or so ministers meeting this week to prepare their budget for 1982.
We found the following:

1. Preparing the monthly analysis.
   They do this already but should learn to use a calculator for it.

2. Total annual wages for minister etc, given different numbers at different monthly rates with extra allowances for children etc.

3. Budgeting for Travel, Rent and office costs.
   Gre thought they would mostly have figures for these expenses for the past few years. A graphical approach seems best.

4. Determining the Levy per Circuit given the total Levy required.

5. Drawing conclusions from the Totals.
   They must decide whether there would be a surplus or deficit and how much must be added to or reduced from income or expenditure.

Adjustments to specific budget items will result in changes in the total. In making these adjustments they must consider (1) the surplus/saving achieved by this adjustment compared with the total surplus/saving required: this involves subtraction and deciding what to subtract from what. (2) correcting the total having made adjustments, and checking the result.

12. United Church Ministers: First Session: Monday evening.

I lent them calculators and explained that if they wished to buy them from me they would have to pay K6 each, but that Gwen Collins was an "agent" who was receiving them at K55.00 for ten and intended selling them to church officers at K5.50, though retaining the K6.00 price for others. This system seems to be working well: Syd Gould, Paswe (Tari), Jenny Fountain are all now "agents" on these terms. They pay in advance.

The group, which included the Bishop and Gre Kornelius, also included some mature ministers with little formal education, so it was very mixed in ability. Mary's presence, as usual, to help individuals was essential.
We did the Analysis sheet (3ANCS(4)) which was on the same principle as their circuit bookkeeping. After doing one example without the memory I showed how it could be used in the second example. Some understood. We then went on to the "Total Wages" budget item and did one example on the board.

(15.9.81)

13. Mendi: Course for District Managers

Paul Fearman explained that lack of finance near the end of the year had meant lack of transport so several were unable to attend while others had had to come in by PMV. They were used to adding with a calculator, in kina. The first example I did for them was an analysis sheet taken from the Mendi Council Cash Receipts Journal. Most items were whole kina so we did this in kina, using the memory. The main problems were their anxiety to use the Clear key (unnecessarily) and their use of + instead of, or after, -. I then worked quickly through AND 1 showing how to work in toea, and did the Notes and Coins, and Invoice checking in AND 2 and AND 3 including the correction of wrong items and pricing, without freight (I did show how to price it if you knew the cost of freight for one carton). Mary assisted continually with individuals two of whom were Council clerks and the other ten were in Provincial Affairs. She also recorded the analysis I had used as the first example, so that I could use it in an exercise if required. Several arrived late and needed Mary's assistance to catch up, which they generally managed to do.

In the afternoon we worked through the Cement and Concrete and Water Supply sections of 3 ANCS 5.20. Some of them found it hard. Paul produced the standard clinometer which was calibrated in degrees and %. Unfortunately the % was the tangent of the angle, so it could not properly be used for finding the head of water given the length of pipe, although for small angles it would not matter. The officers were supposed to have copies of the Handbook anyway, which included a table of sines, so there was no reason why the correct method should not be used. I pointed out that I guessed they would now send for an expert rather than attempt the calculation themselves, but in view of recent reports of cutbacks in government spending, I suggested that the "experts" might well be unable to find the transport to carry out surveys, so the kiap's contribution could become more important.
One interesting difficulty they had, which should not have surprised me as much as it still did, was in the comparison of numbers. The flow rate of the stream was 4500 litres/hour: they needed 1150 litres per hour. Had they enough? The majority thought not, till Paul suggested they think of having 4500 bottles of beer and needing 1150. The same problem arose when the rate of flow had been worked out to be 700 litres/hour. Was this enough to provide 1150 litres/hour and was it enough if a storage tank was installed when the requirement would be reduced to 383 litres/hour? When Grade 10 graduates give wrong answers to such questions one wonders whether it is something that needs more deliberate teaching in the schools here.

The class finished about 4 pm with most of those present buying calculators and Paul purchasing 10 to re-sell to the other District Officers.


We spent from 7 pm to 9.15 pm teaching mainly the use of graphs for budgeting. Gé Kornelius had produced some figures for 1977-1981 for travel, buildings, office expenses etc. Unfortunately they were invented so lacked many of the features that would have appeared had the figures been genuine, but they made the teaching easier and perhaps this was as well, since the principal gain of the exercise was that thereafter one could talk with confidence of expenditure going "up" or "down". Only 3 of the 18 ministers admitted to having learnt about graphs at all, so few of them would actually be able to draw them after one lesson, but some certainly could and the fact that all had learnt meant that the results could be communicated.

I then spent some time explaining what they would have to do if they ended up with a budget in which the only controllable item of income, the "levy" on each circuit, would have to be vastly increased in order to balance it. Having calculated the new amount of levy required (by addition and subtraction), I had expected to be able to divide by the number of church members to give the consequential levy per head. Their system however depended instead on an assessment of each circuit as a whole. I therefore realised that what was needed was a proportional increase of existing levies. We found the multiplying factor from "old" to "new" by division, having illustrated with $2 \times ? = 12$ etc. We checked the factor by applying it to the whole and then applied it to each part. Having looked at the (supposed) consequential circuit levies and decided they were too high we decided what the maximum levy could be for one particular circuit and had another exercise cutting down the total and the other levies proportionally: in this case the
Multiplying factor was 0.87 but this did not worry anyone. I felt that the days of doing proportion by writing a fraction were numbered: another nail in the coffin of school teaching of fractions!

15. United Church Ministers: Third Session.

It had been agreed that as there was to be no local celebration of Independence Day this morning would be set aside for the Ministers to complete their own circuit budgets, with my assistance. It turned out that in spite of our expectations, no one had the figures for expenditure over the last few years (or perhaps they had them but did not wish to use them). So the graphical exercise was aborted and the only budgeting I was able to help them with was the totalling of the wages bills. Several of them did this with their calculators, including one who had clearly had no formal schooling but worked through it correctly with my occasional assistance to remind him at first that he must multiply by 12 to convert wages per month to wages per year, and subsequently that he should not use * whenever / was appropriate. I also noted that he had problems in distinguishing between occasions when he could start with the number already on the calculator, when he had to put a sign next, and occasions when he had to start afresh with a new number without a sign.


It occurred to Bernie that I had only been teaching skills specifically related to budgeting, whereas he had hoped I would be able to deal with other relevant topics. I therefore spent 40 minutes before the plane went, giving them some copies of AND 1/2 and BAME 1/2/4 and explaining how to find change, check invoices, do pricing (ministers should encourage trade store owners to charge the correct prices) use a Notes and Coins slip, and do a Cash Book. The speed at which I had to work meant that only the more able students were able to follow it all, but it seemed to me that there were sufficient of these to justify it.

17. Conclusions

The tour seems to have been very successful overall. The primary purposes of experimenting with the basic numeracy input into the Literacy Programme, and
following-up the students whom we taught at Koroba in April, have both been accomplished successfully. Bonuses include the astonishing response of the Koroba non-school students to further teaching, and the introduction to the problems of church financing provided by the complexities of the mission finances at Koroba and the problems of budgeting for the United Church. A total of 96 students have been taught, including 28 without any formal schooling. 162 calculators have been sold.

Mary pointed out that one of the differences between our April course that had been so successful at Koroba, and other courses, was that we had spent a lot of time teaching the "meanings" of + and - (but not x or ÷), whereas we normally go straight on to using these keys on the calculator. This suggests we should include some such teaching in AND 1, but of course the Koroba results could have had nothing to do with this as there were so many other factors involved.

The following quotations from the wife of the Principal of St Paul's College shows how much the United Church Ministers appreciated their new-found skills. "Bernie and I did a session on Thursday evening with four of the Highland ministers on the use of calculators. Quite a basic level. They are absolutely delighted with their new 'machines'. Probably they'll come to us for more help as necessary."
APPENDIX: STUDENTS ON THE COURSE AT APCM, TARI AND TEST RESULTS: 7-10 SEPT. 1981

The 'Fast' Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Educ Grade</th>
<th>F/M</th>
<th>Village Travel if not reasonably simple.</th>
<th>Job etc</th>
<th>First Test Score out of 12</th>
<th>Second Test Score out of 39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tugume</td>
<td>8</td>
<td>F</td>
<td>Walidege</td>
<td>Typist</td>
<td>12</td>
<td>39</td>
</tr>
<tr>
<td>Matthewly</td>
<td>3</td>
<td>M</td>
<td>Laba</td>
<td>Literacy Teacher (United Church)</td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td>Dalewa</td>
<td>6</td>
<td>M</td>
<td>Walete</td>
<td>Senior Literacy Supervisor</td>
<td>12</td>
<td>29</td>
</tr>
<tr>
<td>Wogoma</td>
<td>6</td>
<td>M</td>
<td>Olabia Walk + 15/20 min flight</td>
<td>Literacy Teacher</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>Wen Wabele</td>
<td>5</td>
<td>M</td>
<td>Walagu Walk +15/20 min flight</td>
<td>Non-Huli, but speaks it</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td>Joshua</td>
<td>8</td>
<td>M</td>
<td>Walidege</td>
<td>Pastor's son</td>
<td>12</td>
<td>39</td>
</tr>
<tr>
<td>Egara</td>
<td>6</td>
<td>M</td>
<td>Tari: PMV or 3 hour walk</td>
<td>Literacy Teacher</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Wabele</td>
<td>6</td>
<td>M</td>
<td>Walagu: Walk + 15/20 min flight</td>
<td>Literacy Teacher</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Mary</td>
<td>6</td>
<td>F</td>
<td>Walidege</td>
<td>Domestic Staff</td>
<td>8</td>
<td>24/30</td>
</tr>
<tr>
<td>Hengene</td>
<td>6</td>
<td>M</td>
<td>Yagoroma: 4 hours walk</td>
<td>Literacy Supervisor</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>Ivagali</td>
<td>6</td>
<td>M</td>
<td>Tari</td>
<td>MAF Staff</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Dosabu</td>
<td>2</td>
<td>M</td>
<td>Orokana: Walk to Mendi + Govt Charter</td>
<td>Literacy Supervisor</td>
<td>9</td>
<td>37</td>
</tr>
<tr>
<td>Moses</td>
<td>4</td>
<td>M</td>
<td>Paiyaka 6 min walk</td>
<td>Literacy Supervisor (United Church)</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td>Balu</td>
<td>NS</td>
<td>F</td>
<td>Gangalu: 1 hr walk + 10 min flight</td>
<td>Literacy Teacher</td>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td>Kove Waiko</td>
<td>Univ</td>
<td>M</td>
<td>Tari</td>
<td>Non-Formal Educ Officer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angobe</td>
<td>10</td>
<td>M</td>
<td>Tari</td>
<td>Church Officer</td>
<td></td>
<td>Missed parts</td>
</tr>
<tr>
<td>Robert Worombu</td>
<td>10</td>
<td>M</td>
<td>Pangia</td>
<td>Non-Formal Educ Officer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andalu</td>
<td>6</td>
<td>M</td>
<td>Walete</td>
<td>Lit. Supervisor</td>
<td>12</td>
<td>39</td>
</tr>
</tbody>
</table>
The "Slow" Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Educ Grade</th>
<th>F/M</th>
<th>Village/Travel</th>
<th>Job etc</th>
<th>First Test Score out of 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andagali</td>
<td>NS</td>
<td>M</td>
<td>Dombite: 17 miles walk/ Part PMV</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Efala</td>
<td>NS</td>
<td>M</td>
<td>Bobole: 6 hour walk + 10 min flight</td>
<td>Literacy Teacher + Pastor</td>
<td>7*</td>
</tr>
<tr>
<td>Tigi</td>
<td>NS</td>
<td>M</td>
<td>Yagiale: 17 miles walk</td>
<td>Trainee Supervisor</td>
<td>8*</td>
</tr>
<tr>
<td>Tayanda</td>
<td>1 year's English</td>
<td>M</td>
<td>Malanda: 1 hr walk + 10 min flight</td>
<td>Literacy Teacher + Pastor</td>
<td>7*</td>
</tr>
<tr>
<td>Maigalo</td>
<td>NS</td>
<td>M</td>
<td>Gobalua: 16 miles walk/ Part PMV</td>
<td>Literacy Teacher</td>
<td>5</td>
</tr>
<tr>
<td>Duluba</td>
<td>NS</td>
<td>M</td>
<td>Doguali: Day's walk + 10 min flight</td>
<td>Literacy Teacher</td>
<td>4</td>
</tr>
<tr>
<td>Dandali</td>
<td>NS</td>
<td>M</td>
<td>Benalia: 10 min flight</td>
<td>Literacy Teacher</td>
<td>4</td>
</tr>
<tr>
<td>Mone</td>
<td>1 year's English</td>
<td>M</td>
<td>Baibaili</td>
<td>Pastor</td>
<td>2</td>
</tr>
<tr>
<td>Anna</td>
<td>NS</td>
<td>F</td>
<td>Benalia: 10 min flight</td>
<td>Literacy Supervisor</td>
<td>2</td>
</tr>
<tr>
<td>Metyu</td>
<td>NS</td>
<td>M</td>
<td>Tege</td>
<td>(Pentecostal)</td>
<td>1</td>
</tr>
<tr>
<td>Ayali</td>
<td>NS</td>
<td>F</td>
<td>Walidege</td>
<td>Literacy Teacher</td>
<td>1</td>
</tr>
<tr>
<td>Tewali</td>
<td>NS</td>
<td>F</td>
<td>Benalia: 8 hr walk + child of 4 yrs (on breast) + 10 min flight</td>
<td>Literacy Teacher</td>
<td>1</td>
</tr>
<tr>
<td>Wabe</td>
<td>NS</td>
<td>M</td>
<td>Walidege</td>
<td>Pastor</td>
<td>0</td>
</tr>
<tr>
<td>Dace</td>
<td>NS</td>
<td>F</td>
<td>Ho</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Benda</td>
<td>NS</td>
<td>F</td>
<td>Bayababwi</td>
<td>Literacy Teacher</td>
<td>0</td>
</tr>
<tr>
<td>Garai</td>
<td>NS</td>
<td>F</td>
<td>Walidege</td>
<td>Pastor's Wife</td>
<td>0</td>
</tr>
<tr>
<td>Bole</td>
<td>NS</td>
<td>M</td>
<td>Benalia: 4 hr walk + 10 min flight</td>
<td>Literacy Supervisor</td>
<td>0</td>
</tr>
<tr>
<td>Libu</td>
<td>NS</td>
<td>F</td>
<td>Gangalu: 10 min flight</td>
<td>Literacy Supervisor</td>
<td>0</td>
</tr>
<tr>
<td>Igiya</td>
<td>6</td>
<td>M</td>
<td>Henganda</td>
<td>Self-invited, for part 12 of course only</td>
<td>0</td>
</tr>
</tbody>
</table>
Notes: 1. NS = No formal schooling.

2. The 3 students marked * were moved into the Fast class on the basis of their scores in the first test, but moved themselves back to the slow class just before the second test was taken.

3. The first test consisted of AND 1 A/B/C Questions 1-6 (Totalling and Changes). The second consisted of AND 1 A/B/C Question 7 and AND 2 A/B (Totalling with x and +, invoice checking, notes and coins slip, cash book)

4. | Score on Test 1 & 2 together | Number | Educational Grades of those achieving this score. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>3</td>
<td>Grades 8, 8, 6</td>
</tr>
<tr>
<td>90 - 99%</td>
<td>3</td>
<td>Grades 5, 3, 2</td>
</tr>
<tr>
<td>80 - 89%</td>
<td>4</td>
<td>Grades 6, 6, 6, 4</td>
</tr>
<tr>
<td>70 - 79%</td>
<td>5</td>
<td>Grades 6, 6, 6, 6 and NS.</td>
</tr>
</tbody>
</table>
Kiunga, the base for the Ok Tedi operations gave the impression of pretty hectic activity. Three planes landed or took off within five minutes of our arrival, and when a Patrol Officer in a Provincial Affairs vehicle had got us to the District Office, John Siau, BDO, was in continuous session with the Deputy Provincial Commissioner Joe Kaiulo and unavailable for an hour.

We hired a government truck, and went to the Montfort Catholic Mission (MCM) to see Sr Imelda in her superb training and production unit where she had 40 women engaged in sewing, baking etc.

Our original plan had been to visit four or so villages on Tuesday and start the course on Wednesday, but John had arranged for the course to start on Tuesday and Sr Imelda agreed that we were unlikely to get a positive response from villagers

(a) because there was only one "proper" village anywhere near Kiunga, (most people are settlers, referred to as "corners")

(b) because anyone interested in business spends their time in Kiunga anyway. So our first attempt to carry out the proposed village-visits plus following-course (see ANR 13) was aborted.

John had invited a dozen or so businessmen for the Tuesday as well as some Vocational Centre students, and had told Sr Imelda, she could only have 10 places, so we decided to retain this arrangement, but to offer the whole of Friday for a course for women at MCM. This Sr Imelda warmly accepted.

She suggested we saw the Headmaster of their Community School, who proved enthusiastic and said he was sure his staff would welcome teaching on Friday after we had finished with the women. The Health Centre people there might want to come too.
We went out to the Vocational Centre where the Manager, Mr Marcus, was keen for his students to be taught though he would like half his students to have one day and half another. He agreed that his staff should attend also.

So we decided on two days of work at the Vocational Centre for all-comers, to see what would happen, and thought of spending Thursday at the APCM mission at Rumginae, about which we had already received a letter from Mrs Merriweather.

We dropped into Paswe store where the manager, Neville Minshull, said he would probably send half his staff to our course on Tuesday and the other half on Wednesday. He also mentioned that Mrs Merriweather lived opposite, which saved us an abortive trip to Rumginae where we thought she was based. She was in the midst of a Bible Class but very kindly agreed to get Dr John Oakley from Rumginae to call on us that evening. Even more kindly she invited us to a meal on Tuesday which we gratefully accepted in view of our problems in self-cooking at John Siau's house where all his cooking utensils had been impounded by the Police as evidence after having been stolen, and where the gas (costing K95 a cylinder) had run out and the pressure stove to replace it needed repair.

Simon Nicholson had suggested we contact the DPI station so we went out to it and met the Officer-in-Charge, Babalela Kalama just as he was driving away. He explained he had 4 non-schooled staff who were probably too old to be taught at this stage, and four Grade 10/College staff who would welcome instruction, particularly if it helped them complete loan applications for rubber blocks. He said he would come himself in the morning.

We called in at the High School but the Headmaster was away and the Deputy engaged.

We had never had any dealings with the Development Bank so seized the opportunity to call on the manager, Demas Huvi (who had sent for one of our calculators earlier). He gave me Application Forms for Commercial and for Rubber Block loans. He said such forms would be completed by some clients themselves in Moresby but not here, though there was no reason why they should not learn. He also told me how the interest was calculated: 8.5% on the outstanding loan on June 30 and again on December 31, irrespective of what the amount had been at other times.
Finally we had a very interesting talk with John Siau who clearly thinks for himself and uses his ability to contribute substantially to improving the involvement of local nationals in spite of take-overs by overseas owned companies. Their loss when he leaves on October 20 because of family pressures, will be great indeed.

(6.10.81)

2. Courses at Vocational Centre: First Day

We had plenty waiting for us at 8 am and the last 3 arrived about 8.45 am making a total of 42 including 21 trainees from the Vocational Centre (all male: they hope to have girls next year), 9 women from MCM and 12 men from various Business Groups.

The trainees were all "Grade 6", the women were Grades 10, 8, 7, 6, 6, 4, 4, 1 and NS and the businessmen were Grades 8, 6, 6, 6, 6, 6, 4, NS, NS, NS, NS: most of the latter bought calculators at once, the rest borrowed them.

We decided we had found the best way of keeping check on calculators when we issued those on loan without boxes while those who bought them (for K6.00) wrote their names on both calculators and boxes. Knowing that we had started with 50 we could check that the number "out" was the total number of students which was also the total of the number of empty boxes and the number of receipts. We found one to be faulty but did not lose any. As we kept the cellophane bags we shall have no trouble selling later those which will have been used and are not bought on the course.

Mary introduced the calculator in English (few speak Pidgin here) and tried to put them at ease although one or two still had trouble with shaking fingers for some time.

I then started on AND 1 (we had not yet printed the revised English equivalent, FCC 1). At 10.00 am we had cups of tea and by 10.30 am I had finished Totalling and finding change and had put them on to doing the Practice exercises on the back. This nicely sorted them out so that by 11.30 am we were able to divide them into a group of 20 who continued the same work with Mary, while I took 22 on to the Cash Book, and completed FCC 2 including most of the practice examples with them by 4 pm.
Mary decided that 8 of the trainees and 1 woman were virtually unteachable in the circumstances largely because they were very slow and not keen enough to work in an adult-oriented class. We also had no teachers from the Centre, so the 8 trainees were sent off leaving Mary with a dozen men, women and trainees. She completed two Cash Book examples but thought it would have been better to explain the idea by putting pretend-money into and out of a pretend-cash box first. A snag with this is that they may not be able to add and subtract mentally the very simple numbers one would use in the illustration: but it is always a case of deciding just how much time one can/must spend on any particular procedure.

We had a delightful meal with Ruth Merriweather but regretfully decided that we could not afford to spend a day at Rumginae on Thursday. The mission leader was away and our own priorities seemed to be to offer a third day to the most promising students here. We might also perhaps offer a short course to the DPI staff, one of whom had brought us a sample of a Development Bank Application Form which appeared to include three errors (multiplying 350 by 11t, finding the cost of 350m of wire at 90t for 30m, and 15% of K400.29).

(7/0.8)

3. Courses at Vocational Centre: Second Day

All the businessmen (ie trade store keepers) and 1 woman from my group yesterday came again and we spent the morning on BAWE 2 (Pricing without freight) and 3 (Pricing with freight) of which 4 needed Method A, getting their goods delivered at K10 or so a load, and 4 needed Method C, being charged 5 toea/kg. Another 4 did not pay for freight at all and the woman did not run a trade store (she did not come in the afternoon). I did not attempt Method B (freight as % of cost) as I felt it was as much as they could do to understand the direct methods.

One who had been in Mary's group yesterday could not do the simplest pricing although 2 others who had been with her just managed it. Only the brightest understood the "all in one carton" thing; so I fairly soon went on to Leakage Check (BAWE 5). Here they seemed happier although the artificiality of the situation made one wish one could have taught them one-by-one in their own trade stores. On the other hand I felt that they were just beginning to handle their calculators competently after 2 days and a BDO spending 2 days with each trade store keeper in the country would take an awful lot of man-hours.
Mary took the remaining 21 Vocational Centre trainees together with two staff (we indicated there would be no teaching otherwise) and 4 businessmen who had not come yesterday. The staff made a lot of difference, being given answer sheets, sometimes doing the work themselves and sometimes learning by helping individuals. Mary occasionally explained points to them (e.g., why we work in toea) and generally they seemed to enjoy the situation.

In doing AND 1 during the afternoon Mary decided they needed more "straight change" examples, such as are in BAWE 1 but have been omitted in the brief AND/FCC course. Mary then did the invoice checking from FCC 2 to provide a rapid introduction to the memory so that the 3 businessmen could be transferred to my set just in time for the Leakage Check. (The fourth businessman had said he was too busy in the afternoon and had sent his un-schooled brother instead, who was not accepted). At this point (3 pm) Mary decided the trainees had had enough and sent them off while she gave me some assistance with the weaker businessmen. There was no sign that the Centre or the trainees were going to buy calculators so we did wonder whether teaching them had not been rather a waste of time, but one cannot expect everyone to be convinced and to have the money available immediately. Marcus was not there so we were not able to discuss it with him.

Having walked the 15 minutes to the Centre in the morning we were delighted when Paul, a Canadian at the High School opposite volunteered us a lift back at the end of a pretty exhausting day. We were glad we could leave our stationery box at the Centre, otherwise we would have had to engage transport for this.

(8.10.81)

4. Courses at Vocational Centre: Third Day

In the morning we just had the businessmen again (all but 1). I completed BAWE 5 with most of them: familiarity with the calculator was beginning to pay off although they still sometimes forgot which key was which sign. I was interested to note that several of them knew their multiplication tables (for stocktaking) but I was still surprised when the ablest of them assured me twice that K284.15 was more than K380.29. This is part of the basic lack of "understanding" of number. If a trade store keeper doesn't know, who would? It was pretty certainly not poor English, as he had no
difficulty with the language normally. I refuse to believe we need to use the - on the calculator to determine which of two numbers is bigger. Somehow we've got to teach them. (We should include it in our Basic Numeracy Course for the Southern Highlands at least). (It has subsequently been included in an experimental addendum to BAWE 2, including using the calculator to check which is greater and by how much.)

Mary met a colleague from Steamships, now managing Cloudlands, and spent some time very usefully explaining what we were doing and telling him how to obtain our materials if he wanted them. She repeated the operation with Pasuwe, who accepted an offer of calculators at K55 for 10 post free on condition they were sold at not more than K7 and asked us to come down at 6 pm to give their staff a lesson.

No DPI people came so in the afternoon I continued teaching the businessmen until at 3.30 pm fourteen people from Rumginae (4 Grade 10, 1 Grade 8, 9 Grade 6) arrived with Dr John Oakley, a message by Sched. having got slightly distorted.

So we spent 2 hours at high pressure teaching them much of BAWE 1 and letting them keep the copies so that they could complete the unit with help when they returned: most of them would be using calculators for health extension, hospital secretary (the one woman in the group) etc.

They bought 9 calculators.

One Vocational Centre trainee had bought a calculator and asked if he could buy copies of the BAWE course. He only had 20 toea but I gave him the complete set as he was quite exceptionally able and mature.

5. Pasuwe Store Staff

We were rushed from the Vocational Centre to Pasuwe and presented with 15 men: 1 was Grade 10, 1 Grade 8 and the rest "Grade 6".

They were to be issued with calculators because the tills were unreliable and do not calculate change anyway. So we concentrated on totalling and giving change with AND 1 and FCC 2. They were a delightfully keen and responsive group or two of whom could subtract K2.72 from K10.00 in their heads quite quickly and nearly all of whom followed our instructions well. So in less than an hour we got as far as showing them how to use the memory to total amounts where "x come after +" and left them with copies of FCC 2 to complete the job.
Subsequently we sold them 30 calculators and also promised to send a couple of metre rules to help them sell material by the metre.

(9.10.81)

6. Courses at Montfort Catholic Mission

Mary had a group of 11 from the Women's Club. They included 4 men (3 Grade 6 and one Non-school, non-English speaker from Irian Jaya) and 6 women (Grades 10, 7, 7, 6, 4, NS). She did FCC 1 with them, introducing the Cash Book with a suitable story.

Meanwhile, I took 4 women who had been to our Tuesday course. Sr Imelda wanted them to be able to take over the cash book for the club. This consisted in an "IN" once a day and an occasional "OUT".

We agreed that they should find a daily balance and check it weekly so I copied 3 pages of their accounts for them to practise this. The work they had done on Tuesday provided a useful basis but they certainly could not transfer it immediately to this situation and had to be taught when to add and when to subtract.

Two mastered it fairly soon: I tried to teach them all how to find an error when it was only in the toea column, and also when it was in the kina column, but I am sure I failed there (it is something Laloki students should perhaps be taught, along with how to correct consequential errors.)

I then showed the two quicker ones how to write out and total invoices for the clothing they sold. When one client had paid part of a bill the brighter student wanted to add the part to the whole to determine what was left.

Finally I showed one of them how to write measurements in m and cm, and to calculate how much cloth was needed for a number of dresses, how much of a bolt would then be left and how many skirts could be made out of the remainder.

After the session Sr Imelda said she would continue the training and bought 10 calculators (for K55) for re-sale. She also bought the five metre rules I had brought with me (for K2.50 total). I left her copies
of 3'ANCS 5.1 (Length), 5.2 (Pricing kaikai), 5.3 (Pricing Sewing), 5.11 (Church Health Services Forms) as well as BAWE.

In the afternoon we taught the 37 Grade 6 students for about 1½ hours with the 6 staff at the back following what we did from BAWE 1. Having to put everything on the board made a difference but we all enjoyed it. We reached the use of x and some of the brightest managed to work out change after multiplying without being taught. Our thought however was that it was really the "leavers" whom we would have liked to teach from the point of view of rural development. But the staff were keen and intended to continue the teaching, saying that the BAWE booklets were clear enough to use. They all bought calculators, though obtaining enough for a group may prove more difficult.

One significant observation made by Mary when she was "finding change", was that they did not know the change from a kina for 75 toea. After a long pause one boy actually produced the right answer: he had worked it out on the calculator without being told how to do so.

Perhaps this is one of the most striking indictments of the Community School mathematics teaching we have met. It was a keen, bright and intelligent group, well disciplined, with an enthusiastic staff and the back-up of a lively and relevant Mission. With all this in their favour not one of the 37 Grade 6 students knew the change from 75 toea. I am reminded of the remark made by a colleague on the Primary Mathematics Syllabus Advisory Committee, that after six years of education the one thing a villager felt he had a right to expect was that the child would know enough to help run a trade store, whereas in fact such a child could not even give change correctly.

7. Conclusions

1. There was a clear need and enthusiasm to learn with everyone we met, practically all of whom were at least nominally Grade 6 and spoke English.

2. The Missions and Pasuwe showed a very real concern.
3. The FCC and BAWE material proved to be satisfactory and adequate: something intermediate between the two would probably be appropriate for the Vocational Centres.

4. Failure to know which is the larger of two sums of money is a serious and continuing weakness. Perhaps some teaching on this should be included somewhere in the course. The distinctions between profit and loss, and between cheap and expensive, are pretty important for any businessman. (A section has been written for insertion into BAWE 2 to cover this.)

5. It is no use basing rural numeracy teaching on villages if there are no villages in the area.

6. Finding and correcting errors in a "balanced" cash book etc is a sophisticated procedure but one which one might at least try to teach at Laloki.

7. The most depressing feature was the apparent failure of an exceptionally good Community School to teach simple mental arithmetic over six years.

8. The keenness of the staff and the Grade 6 students confirmed our hope that somehow they will be enabled to teach the use of the calculator (for trade store business) to the Grade 6 leavers. This should be done on a "club" rather than a "class" basis

(a) because there will not be enough calculators for a whole class and

(b) because priority must be given to the weaker students (those who will NOT go on to High School) and these will be better taught in the absence of the brighter students.
REPORT ON SECOND VISIT TO THE EAST SEPIK, BY MARY AND ALLEN EDWARDS,
15 - 29 OCTOBER 1981

Note: Conclusions are in Section 16, page 16. Appendices include Aims and Objectives for Vocational Centre courses and the text of a Tok Save.

1. Wewak

We were efficiently met off the afternoon flight by John Baure, A/FTO, who took us to Eswa House where Sydne Rich had a "Grade 1" (first six weeks) course on, for 16 women. She had introduced the calculator early but was afraid she would have difficulty with the decimal point when she came to pricing, in the Grade 2 course. I emphasized the importance of working only in toea so that everything after the point could be forgotten. I also urged that lengths should normally be treated the same way, i.e. in cm, for adding, subtracting and multiplying/dividing by numbers/lengths. The one and only (I think) place where the decimal point is needed is in pricing when the price per metre must be calculated (in toea) and the lengths must be expressed in metres (with a point if necessary) when multiplied by this.

Back at the office I met Rich Payne PFA who introduced me to Henry Badiliu, Price Control Officer. Sydne had told me that they were still selling material in yards although she was working in metres. I urged Henry to insist on the change being made. (Mary later found that BP were in fact selling in metres).

Francis Iko had gone home unwell, but I visited Eli Wanera, Assistant Secretary Education who showed me the calculator he had bought from me last November which was still working well. He was pleased to hear the price was now even lower and asked me to bring some up for him tomorrow.

At the Windjammer we met Shirley Giggey, Lorraine Sexton (Education Gazette) and Barry Reeves (Superintendent, Non-formal Education).

2. Gavien: the First Afternoon (Friday)

Luke at ESRDP had kindly arranged transport for us to Gavien, where we
arrived at the Community Centre at about 11.30. The women were bringing in and preparing a feast of delicious vegetables with some highly nutritious shark, as a celebration of World Food Day. Elizabeth Cox ESRDP Nutritionist, had arranged a Food Garden Competition judged by Dr Margaret Quinn with prizes presented by DPI, who were responsible for the Rubber Plantation on the blocks of which the people lived. There were no villages, so the Community Centre which will include a library, canteen and CDO's office when complete, is of great importance and, in the extent of its services, probably unique in rural PNG. The ESRDP has largely paid for it. Apparently there is a great dearth of Librarians, those who are trained rapidly moving into more lucrative fields, and none of them want to leave the main towns where they have been stationed for their training. This fact must reduce the significance of our experiment in so far as relationship with the Library is concerned, but more and more people do seem to be going to live in non-village, resettlement areas, so experience in bringing numeracy skills to such areas does seem to be important. We shall be particularly glad to have Barry Reeves with us part of the time to make some assessment of the role of non-formal education in such circumstances.

When the prize-giving, the speeches and the feast were over we gathered a group of 7 men and 1 woman (including 2 teachers), who were joined later by two more men out of the throng of people who watched. We lent them calculators and taught them from FCC 1, although we did not attempt to write in the answers. They were all quick and rarely made mistakes. We emphasized the need to press keys once, hard and in the middle, which helped a lot. In about 45 minutes we completed two-thirds of FCC 1, and promised we would do the Cash Book and show them how to use the memory if they come again tomorrow (Saturday) between 2 and 5 pm, and/or on Monday between 9 am and 5 pm.

We had left our luggage at Seremundi and were conducted back there by a group of Grade 6 boys. We had suggested to the Senior Master that we might give a demonstration lesson to a group of those who were likely not to go on to High School. If the teachers were to attend such a lesson on Monday they might be able to give such lessons themselves to those who were leaving when these were identified later this month. (This offer was not taken up) A ESRDP architect, who wanted his carpenters taught.

ANR 16

A237
(17.10.81)

3. Gavien: The Second Day (Saturday)

Rain was continuous. During the morning I drafted a course which I felt would be suitable for teaching working carpenters or Vocational Centre trainees in carpentry. I thought in the first stage all measuring and calculations should be in m and cm, to permit transference from the Kina and toea calculations, and should also be performed in m and cm.

At 2 pm we just managed to drive most of the mile to the Community Centre without ditching the vehicle but no one was there. As it was still raining we did not stay more than half-an-hour.

Barry received my first draft for the proposed Carpentry programme and said he would get it duplicated to permit a full discussion at Lae.

(18.10.81)

4. Gavien: The Third Day (Sunday)

After attending church (Assemblies of God) in the Community Centre we were invited to talk to George Warehoka, a very experienced carpenter with his own joinery factory in New Zealand.

He is already committed to the use of calculators off-the-job but at the moment, after 3 months here, is concentrating on teaching his staff to measure in mm when in the past they have only used feet and inches. He assured me that centimetres were not appropriate even if the public and dress-makers used them. I wrote the Second Draft of the Proposed Carpentry Course, working in mm throughout, (except when pricing per metre) but writing results in metres or /m. 

In the afternoon I visited David Week who explained exactly what he wanted his Joinery Foreman and his Shakes - (wooden tiles -) making-Forman's younger brother to be taught. This was to be able to pull out a given total length of planks from racks. These were still marked in feet and David doubted if he would be able to persuade the saw-mill to mark them in metres but I persuaded him in spite of this to re-label the racks 1.800, 2.100, 2.400, .... 3.000 and use a form of jig to place the planks correctly. It would be necessary for the foreman to know how much more he had still to pull out, and how much too much he had pulled.
The problem thus resolved itself into using the memory to find the total length of a "lot" (of about 20 planks), then, having recorded the lengths of several such lots, totalling them and subtracting the total required. A negative result would mean that this much more was needed and single planks would be taken out and added to the negative result till a positive was obtained, giving the excess: if this was more than 3m, some should be removed.

The operation required either an understanding of negative numbers or the ability to follow a routine and to check the result afterwards in case of errors. The simple alternative of adding each length each time till one got an excess could lead to errors simply because of the quantity required: about 200 planks would be normal for flooring.

David was also anxious that at least someone in the Shakes team should know how to work out their wages. This meant multiplying the payment for one shake (currently 2.8 toea) by the number the team made in a fortnight, dividing by the number of man-days worked by the team (of 10 men) and multiplying by the number of days each man worked.

David suggested that they should be able to work out the diagonal of a rectangle to enable them to set out a building true: this would mean \( \text{one side} \times \text{other side} \times \text{RCN} \times \text{RCN} \times \). David agreed there was an alternative: setting out a parallelogram and getting the diagonals equal. So we shall see how they take to Pythagoras before deciding which to use.

I added all these to the Second Draft of the Carpentry Course together with the mental arithmetic I felt they should be taught.

I also had a session with Barry Reeves and Shirley Giggey showing the games etc and Shirley was keen to obtain supplies for her library. Barry suggested using \( \) instead of \( \) for dice games: an improvement.

(19.10.81)

5. Gavien: The Fourth Day (Monday)

We were not looking forward to the half-mile slide over Sepik mud to reach the Community Centre so we gladly accepted Shirley's suggestion that we
should work under Margaret's house (where we were eating) while Shirley went to make sure anyone going to the Centre was re-directed. She produced a table, two benches, a portable chalk-board, also pencils and rubbers which enabled us to discover how much better it was to work with them than with pens.

We had been despondent about getting any response in a place where there were no trade stores. So we were pleased when two women arrived, one being a village development worker. David's two arrived soon afterwards so Mary and I gave them all individual attention.

The Shakes-Foreman's-son's younger brother turned up and Mary enticed him into the group. He turned out to have run away from school at Grade 5 and to be at least as clever as his elder brother. Shirley immediately saw him as someone who could benefit significantly from Library-based studies, and was delighted.

In the afternoon, 5 more women turned up including Shirley's associate librarian, Agnes. Two of the other women did not know their numbers in spite of one being Grade 4 and the other an extension officer. About 3.15 pm seven more men turned up, mainly extension workers, so we sent off some of those who had come first so as to get them going.

We did nearly all FCC 1 with all, and FCC 2 with some. David's two men and the brother worked through the first two units of exercises which I had written for them, based on the Second Draft of the Carpentry Course.

One woman finally turned up about 3.45 pm and some of them had to be sent home at 5.30 pm. Seth, one of the teachers who had come to the Friday class turned up with his wife, an Aid Post Orderly, and bought 2 calculators (at K5).

We had thus taught 18 adults for periods varying from 1 hour to 5½ hours, most of them individually. We decided that class-teaching was probably more productive but less interesting.
6. Gavien: The Fifth Day (Tuesday)

12 of the 18 who had been on Monday came again for part or most of the day, together with 6 new ones, all Grade 6, including one who was supposed to be in Grade 6 at school but who, I was assured, had already dropped out. We did FCC 1/2 except for David's pair with whom I completed the four units covering his requirements, and a short session of Sum-ten till the wind blew the counters away, and then Snap which they much enjoyed. Shirley paid for some of most of the materials we had on offer, including 10 calculators at K55 for re-sale.

During the afternoon I showed Agnes how to do a Bank Reconciliation using the cheque stubs. This was in some ways easier than the Bank Book method used in BAWE 4 but I think the latter is still better for the businessman and is also easier to explain. The rest of the time Agnes helped admirably in the teaching and we were hopeful that she would do this as part of her librarian work, and would continue it when Shirley leaves in December.

Mary enquired of her group about the way they bought materials in Angoram. Apparently it is sold in 2-metre lengths for K2.50. 10 lengths cost K18.50. They thought this meant K2 for a piece. Mary showed them how much profit they were in fact making on their sales.

(21.10.81)

7. Gavien to Maprik

Francis Iko had very kindly sent a vehicle from Wewak which picked us up and got us to Maprik by 3.30 pm. Here we met the DBDO, Pat Imaroto, who was surprised that he had not been asked to arrange a programme for us. We explained that we were working on a special experiment which meant short visits to four villages on each of two days, followed by a one-day course at Maprik on Monday.

We went to PTA and hired a vehicle (with driver) for Friday and Saturday. As our driver was anxious to get back to Wewak we left the details of our programme till the next day and were taken out to Maprik High School where Bob and Ruth White kindly accommodated us.
8. Maprik: The First Day (Thursday)

As it had been too late to get a Tok Save out on Wednesday we gladly accepted Pat's suggestion that we should teach some of the Grade 8 students on the grounds that many of them would be returning to their villages at Christmas and Business Development were very interested in their potential. John Colwell, Headmaster, kindly agreed and Bob organised us into teaching all three Grade 8 classes in periods 1, 2, 3, together with a volunteer group in the afternoon. The periods were restricted to 35 minutes so we had to work very fast but were able to complete the first two-thirds of FCC 1, without writing anything down.

Practically all the students volunteered for the afternoon course, except for some of the Day students who would have up to 2 hours walk to get home after it. We said we preferred those who would be leaving, but this was not known yet so Bob selected simply those with the lowest scores on their Commerce assessments (of which he was subject head).

We were then taken down to the Business Development office where we found that Pat had already arranged for a Tok Save to be put out saying that we would give two sessions on each of our three days. Fortunately it was not too late to alter it so after careful discussion we agreed to visit three villages on each of Thursday and Friday, the nearest one at 8.30 am, the next at 10.30 am and the furthest at 1 pm. We were somewhat restricted because Pat felt we should only go to large villages on the grounds that the response to the Tok Save was unpredictable.

We also explained why we wanted a full day in one place on Monday so that we could make substantial progress with those who were keen, and this was agreed.

Pat took us to see Matthew Tawie, ADC who confirmed Pat's doubts about the efficacy of the Tok Save, but clearly we must simply experiment. If it fails this time one could certainly argue that sustained publicity leading up to such specific notices would be more likely to succeed. As we emphasized to Pat, however, we were interested in contacting ordinary adults and particularly women, who would not be likely to travel far to a course. Introductory Courses in as many villages as possible seemed to be the only way to reach them.
But we shall see, which is what our "experiment" is all about.

From 1.05 pm to 1.45 pm I addressed the High School staff, explaining the significance of the cheap LCD calculator, the Business Arithmetic Workbook, the Laloki Mathematics programme and the difference between the methods used in Wewak in 1980 and, hopefully, here now. I was asked about the Community School programme and expressed the hope that Grade 6 leavers would be taught to use a calculator even if it had to be done in small groups. The same applied to Grade 8 leavers.

I was asked about buying calculators and it was agreed that 10 should be bought at once (at K55) for sale (at K6) by the School Canteen. Several also asked about the scientific calculator.

From 2.45 pm to 5.35 pm we had 38 of the less able Grade 8's. I misjudged their ability, perhaps due to their selection, and went too fast through the Cash Book in FCC 1. We therefore spent a long time working through the Practice on the back of the sheet, to ensure that they could do what we had taught in the morning, and to restore confidence. After about 1½ hours we moved onto B & E 2 which Mary introduced and I completed. I hoped they would know enough to encourage them to help in local businesses and perhaps ask the local BDOs to provide the B & E teaching if it is needed.

(23.10.81)

9. Maprik: The Second Day (Friday)

We were somewhat apprehensive having insisted on following our own ideas rather than those of the local officers, but on the whole we were well satisfied with the result.

At 8.50 am Greg, Mary and I arrived at a trade store at Patigo where we turned for the village 1 km west. There was some discussion whether we ought to go on to the village instead but there were some people around who had heard the Tok Save so we decided to stay: we would have made an extra visit to the village itself but several people had come down from it while we were teaching so we did not stop again (though perhaps we should).
We lent calculators and pens as usual, and gave out copies of FCC 1 to twelve of the 30 or so around, including 3 women. In about 40 minutes we completed Exercises 1, 2 and most of 3 but at this stage a PMV had taken some people off and they seemed a bit restive so we packed up and sold one calculator.

About 5 km on, at 10.05 am, twenty-five minutes early, we found the Wasera Council Chamber very clean and tidy with benches, tables and a chalk board. After a while 13 men and the Council Chamber clerk, a woman, arrived and we worked right through the whole of FCC 1, Mary introducing the Cash Book with actual money being put into or out of a calculator box while I set it out on the chalk board. Soon after, 4 more men arrived, including two Youth group leaders so Mary taught them how to add while I helped the rest work on the Practice (back of FCC 1), which one actually finished. Nearly all must have been Grade 6 but we did not attempt to use English. Greg helped individuals most of the time.

The whole group was most appreciative and they bought 13 calculators.

At 12.15 pm we left for Wombisa arriving 12.40 pm, twenty minutes early, where we waited in a "club" with a billiard table, for some time before a group of 12 men arrived. We repeated the Wasera programme, using paper and thick pen instead of blackboard for Mary's Cash Book, but did not get far with the practice on the back of the sheet before we appeared to have reached the limit of the attention span of some of the students. One man's wife in fact came and replaced him, very successfully considering she had missed all the first part.

As usual we told them about the course at Maprik on Monday, but here, about 30 km away, they said the PMV fare was 70t to K1.00. We sold one calculator, and returned home about 3.45 pm.

(24.10.81)

10. Maprik: The Sixth Day (Saturday)

Our route: 8.30 am, Wingei, 10.30 am, Yangoru, 1 pm, Kusambuk had been announced again on Tok Save, (although we were never able to get a copy of the revised script.) Simon Kinzep, BDO arrived with the truck at 8.30 am and we reached Wingei 20 km down the Wewak road from the High
School (Hay Field Mission) at 9 am. On the way we passed 6 villages which looked as if they would have merited a visit. We found two or three men at the Community School who had heard the Tok Save but they suggested going down the road to the village where we were shown into a large area where some older men were already seated. We lent calculators to 23 in all, including one woman, one grade 8 schoolgirl and a Grade 7 schoolboy. Teaching was difficult. They all broke up into groups and discussed with each other what keys they should press, while the old men carried on a loud conversation at the far end of the hut. I have a good voice and made myself heard but eventually had to insist that one teacher was better than six. We managed to complete Exercises 1 and 2 of FCC 1 and Mary introduced finding change (without totalling first).

It then became evident that the old men really were very annoyed with our presence although the "middle-aged" leaders maintained their interest in what we were doing. We gathered afterwards from the driver that the tok ples had been distinctly rude, as had been one remark shouted by one of the "leaders" in pidgin to someone outside.

Mary had already suggested we should stop but I had wanted to show them that they could do more than just add. We therefore asked if we should leave it there, with the message that anyone wanting more should come to Maprik on Monday. The "leader" explained, in impeccable English, that they were preparing to hold a gathering about some customary business and, regretfully, he agreed we should now leave it. We sold no calculators, but neither did we lose any. Mary bought a couple of good local bilums and we departed at 10.20 am.

Twenty-five minutes and 18 km later we were at Yangoru Council Chamber and found 2 men who had heard the Tok Save and come for the course. Another went off with Simon in the truck to the High School to look for more students while I started with the two. They were running a club for which they bought beer at K10.72 for a carton of 24. They did not know what "freight" was but assured me they had to pay K60 or K70 to hire a truck to bring 15 cartons from Wewak. As they were selling the beer at 60t a bottle I showed them they were losing on every sale.
Simon and Mary returned with 8 other men but one had his own calculator and several thought they knew better than I. This made for slow progress but eventually Mary and I did our now-standard "practical" approach to the Cash Book. We did the first example on FCC1 and left them to do the other, though unfortunately only one bought a calculator. They expressed much appreciation however, of our visit.

When I suggested the course on Monday they assured me that the PMV fare would be about K4 each way. So I suggested that Simon should talk to the DBDO about running a proper course there using BANE. Simon agreed; they were all connected with trade stores.

We left at 12.45 pm and reached the Mission Station at Kusambuk (halfway between Maprik and Wewak) at 1.05 pm. Simon found one person who had heard the Tok Save but the Community School teacher I found had not. He apologised for the lack of response but said all except the very old had gone to Wewak for a big Sing-sing which had also been announced on Tok Save. He also said most people "went bush" in the afternoon. We went straight back to Maprik High School, arriving at 2.30 pm.

(26.10.81)

11. Maprik: The Third Day (Monday)

Having said we would be there from 8 am to 4 pm we arrived in Commerce transport at 8.30 but no clients arrived till 9.00. Soon after Pat Imaroto and his two colleagues Greg Opat and Camillo Molio (Simon being out on a visit) arrived so we were able to give each student the almost undivided attention of one BDO. They had not seen the BANE before; we discovered subsequently that John Baure was planning to do the in-service training with it, jointly with the West Sepik, in November.

The BDOs worked exceedingly willingly and well. Having only one student made it possible for them to keep ahead in studying the Unit. There were never more than 9 students, three of whom had had no schooling. One of these could not write numbers, which he left to a young relative to do at the store. He had come expecting a lecture-type course, so left at 11.00 am with assurances that he would send his young assistant as soon as the BDOs announced that they were running another course like this.
One of the Grade 6-level students had such poor eyesight he could not see the figures so had to give up. Only 1 Grade 8-level student was really able: he ran a store and a club as well as holding a clerical post in local government. He bought all the units (at 20t each) and worked through Units 1 & 2. I introduced him to Methods A (freight \( \div \) No. of Cartons) and B (Freight as % of Total Cost), in Unit 3. He was quite capable of doing either and I pointed out that the % method had less problems with mixed goods in cartons. I also explained the ideas of Unit 5 to him before he left.

Two new students came in the afternoon making the total of: 2 Grade 8, 4 Grade 6, 1 Grade 5, 1 Grade 4, 3 No School. Several of those who stayed the course were exceedingly slow and certainly could not do the memory part of Unit 1. We were particularly impressed by Pat's patience in dealing with these.

Looked at as a training course for Maprik businessmen it was disappointing but as a means of training and enthusing BDOs appeared to be a great success. Before we finished Pat had phoned Francis Iko and had over a quarter of their remaining funds ear-marked to enable him to retain 10 calculators (K55) and 40 BAWE units (K6). I greatly hope they will carry on the work largely on an individual basis and obtain replacements from me as they sell these materials.

In the evening we sold 47 calculators (including 7 scientifics) to Maprik High School for use as prizes (an idea John said had been suggested by another High School head), for sale in their canteen (at K6.00) and for staff use. John also confirmed his agreement with the idea of ensuring that all students be taught to use the calculator before leaving. He intends to obtain a stock of 47 so that they can be used on a class basis, eg in science.

(27.10.81)

12. Wewak (Tuesday)

We left Maprik High School with immense appreciation of their hospitality and co-operation, including the offer of seats in the School truck to Wewak which left at 6.30 am with one of the staff on the back while we enjoyed cab-seats for the 110 km drive on a pretty poor road.
At Wewak we were welcomed by John Baure who took us to see Tang How the large store where they were selling Sharps EL220s at K7.90 and EL508s at K17.50, both good prices compared with the other models on sale at the usual K12 - K30.

We also visited the NBC office on the off-chance that they might like to send someone to tape record our interviews with our 1980 students. They were interested in interviewing us, which I thought might be of use for our Madang publicity, but they did not take up the offer.

We borrowed a Tape Recorder from the office of Information.

We visited the Forestry Department and received an ILPOC for K78 for 6 Scientific calculators (EL508) I had brought with me.

I visited Skul Bilong Stoakipa where Werner told me they did not sell our calculators because they still had a lot of more expensive ones that they were not able to get rid of. They have however now made the calculator an integral part of their course and they use our calculators for this. I left them a copy of BAWE.

13 Follow-up of the November 1980 Course students

After lunch John, Mary and I set out to visit as many as possible of the November 1980 students, who had been asked in a Tok Save to remain at home today.

At Sawarin we found Maria Luck. She had not attempted to teach anyone and had put her calculator away after the course, until her brother found it and took it to Rabaul when he went to a Teachers College. She did however remember being taught about weighing coffee and now watched the scales carefully but could not work out the price without a calculator.

Later on the road side we interviewed Jill Waru. She also watched the scales when selling cocoa and did work out the cost on her calculator (secretly) but found the prices paid were correct.
She had shown two children how to use it to learn multiplication tables etc, she also uses it when shopping to total the value of the goods. She still has her ruler but no one uses it.

10 km further on we were hailed by Peter Lumii and Francis Dombar who were climbing a betel-nut tree while waiting for us by the roadside. Peter was using his calculator to help him do his COES Grade 8 correspondence course. Francis uses his in his friend’s trade store, for finding change and checking invoices. (We later received a letter from Peter written earlier, thanking us for the photographs of the Course group which Francis had sent us later.)

They had not found other adults wanting to learn but had been allowed to help set up a Business Group to dry and sell copra and to improve the plantation. They intended to teach the other members of it when it was in operation:

They also checked the cocoa prices and told their friends that they were being cheated.

On our return to Sawarin, Cathy Mariwa and Benjamin Yenei were there. Benjamin’s calculator is used in the community trade store but not by him. Cathy had taught a Community School girl. She sometimes took her calculator with her when shopping.

This accounted for 6 of the students at the Wewak 1980 course. The other students who were not interviewed, were:-

Alois Paul of Sawarin, now working at the ACI bottle factory at Lae.

Elija Winduo of Japarka, 28 km out on the Maprik road (but we could not keep our driver waiting while we passed through the village the day before).

Paulo Marai of Mandi, out in the bush somewhere when we arrived to see her.

Carl Wallison of Naikandegim, 12 km off a point on the Maprik road 62 km from Wewak. His response would probably have been the most interesting, but this was because he was a Youth club leader. He had not been "chosen by the elders" to learn and teach numeracy as had the other members of the group.
Follow-up on Gavien

Later in the evening we met Shirley Giggey who said she had now handed over the project accounts to Agnes who had handled them all successfully apart from one occasion when she had 55.6 on the calculator and could not see that this was K55.60. I urged her as strongly as I could to get Agnes to work in toea, as she had done when we taught her: working in kina will cause chaos if she teaches it to others. John Baure commented that he had now converted to using toea and found it quicker. I explained that the only time I would use kina myself would be in accounts where the great majority of entries were in whole kina.

(28.10.81)

Wewak to Lae

We went straight out from Lae to St Joseph's Vocational Centre for the Regional Manager's meeting (over 30 of the 90 Vocational Centres in the country being represented), but found we were not needed till the following afternoon so we returned to UNITECH where we were staying. I spent the afternoon preparing drafts for proposed numeracy courses for all Vocational Centre trainees (using ANR 13) and for "garment-makers", for which I largely adapted the Carpentry draft, changing from mm to cm and omitting the 2 x table.

(29.10.81)

In the morning Mary suggested that my "objectives" for these courses would be unintelligible to the Vocational Centre managers so I wrote "Aims" for each course which made more sense. Phil Clarkson at the Mathematics Education Centre kindly made copies of these Aims and Objectives for me. They are in the Appendix to this report.

Regional Conference for Vocational Centre Managers: St Joseph's Technical Training Centre, Lae.

I was not at all sure what mixture of teaching and discussion would be appropriate, and it was unfortunate that Barry had had to leave the day before and Bryan Quinn just before I started at 1 pm. We worked under the chairmanship of Kenny, Provincial Non-formal Education Officer for Madang.
We started by working quickly through FCC 1 including the usual story by Mary around the Cash Book. We then invited discussion and the main issue raised was whether we should work in kina' or toea. There appeared to be full agreement with the Aim of including Trade Store skills in a course for all trainees, and of producing precise directions for the use of instructors, along with worksheets for the trainees. They seemed to think it was quite practicable to teach trainees in small groups, if the size of these should be limited by the availability of calculators.

After a short break we used BAWE 3 to do invoice checking and pricing, without and with freight. I mentioned the % method and said it was all in the Units if they liked to work through them.

They then purchased considerable quantities of materials and 31 calculators, including 1 lot of 10 EL8158s and 1 of 10 EL220s, between 33 managers. The enthusiasm was most gratifying, but it evaporated rapidly at 4 pm when we had hoped to instigate a useful informal discussion, and we were left with Kenny alone. We had postponed our return to Moresby so that we would not have to rush off ourselves at 4 pm, so we packed up our materials at leisure and caught the early flight the following morning.

16. Conclusions

1. A Community Centre or similar institution could provide an excellent base for numeracy teaching provided a staff member or officer was competent and confident enough to teach individuals and a few calculators could be kept, or preferably sold and replaced. The main material would probably be of the FCC type with number games and metre rules.

2. The "Wewak 1980" idea of spreading adult numeracy is not effective: getting village councillors to send youngsters in for training so that they could then teach the rest of the village, does not work.

3. The village-visits followed by a central course appear to be a reasonable direct method of instruction, but

(a) previous publicity is important, preferably a build-up followed by several days announcing specific times and places, together with some communications structure eg schools and women's groups.
(b) Local Events must be noted and either used (as at Gavien) or avoided (as should have been done at Wingei and Kusambuk).

(c) It is possible that afternoons may be unproductive: two people assured as the men would be "in the bush" then.

(d) Courses in Council Chambers etc are easier to manage but may not be such a good way of reaching the people.

(e) We have no evidence yet on whether they will come to a follow-up course after the introductory session except that such a course must not be too far from the village (eg 70 toea on PMV).

4. The training and enthusing of the BDOs in Maprik in using BAWE appeared to be very successful.

5. The immediate problems of buying and selling materials seem to be capable of solution for small numbers, eg for individual tuition, if not for the running of courses. This may be a good thing, particularly in the early stages while BDOs gain experience.

6. We found two numeracy instructors working in kina and having trouble with the decimal point. The need to work in toea cannot be emphasized too strongly.

7. The experience of teaching 33 Vocational Centre managers confirmed us in the opinion that the attached Aims and Objectives are generally appropriate though they will need detailed amendment, no doubt.
PROPOSALS FOR VOCATIONAL CENTRES

It is suggested that materials should be prepared for internal use in the first place. Later they could be adapted for external use when the needs and opportunities of extension work have been studied.

The material should consist of fully detailed booklets for the use of the instructors, and worksheets for the trainees.

Examples are given below of a core course and two others. Further specialist courses would be prepared when a full study can be made of the work being done in the Centres.

Mastery Tests might also be prepared which the Manager could set under reasonably secure conditions, and record the results on the trainees leaving certificates.

CORE COURSE FOR ALL TRAINEES

AIMS

All trainees will be able to:

1. Carry out the basic operations of a small trade store.
2. Work out realistic prices for goods and services in simple cases.
3. Add very simple numbers to larger numbers mentally, without a calculator.
4. Tell the time.
5. Use a calendar.

OBJECTIVES

Using a calculator all trainees will be able to:

1. Total cash and determine change, using +, × and ÷ but not the memory.
2. Keep a Cash Book, with IN, OUT and BALANCE.
3. Total cash using a Notes and Coins slip.
4. Check an invoice.
5. Price goods with given markup % and simple freight charges.
6. Price artefacts and services given the rate per hour.
7. Find the difference between any two quantities and check which is the greater.

Without a calculator, all trainees will be able to:-

8. Determine which is the larger of any two whole numbers.
9. Know the sum of any two whole numbers up to 9 + 9.
10. Know the change from a kina of any multiple of 10 toea, and (if possible) of any whole number of toea.
11. Read the clock to the nearest quarter hour.
12. Find how long it is from one time to another, given a clock face and the times to the nearest quarter hour.
13. Find the day given a calendar and the date.
14. Find the date a given number of days or weeks after a given date, using a calendar.
15. Find the number of days from (noon on) one date to (noon on) another date, using a calendar.

COURSE FOR TRAINEES IN CARPENTRY

AIMS

Trainees in Carpentry will also be able to:-

1. Measure timber in metres and millimetres.
2. Calculate how much timber will be needed for a job.
3. Calculate how much timber will be left after cutting a number of lengths from a given piece of timber.
4. Find the mid-point of a piece of wood.
5. Calculate the lengths needed to make a rectangular frame given the outside measurements and the width of the timber.
6. Price a job given the price of timber per metre.
7. Set out a square building.
OBJECTIVES

Using a calculator trainees in carpentry will also be able to:

1. Work only in mm, putting the decimal point in the answer when it exceeds 999 mm. Know how to enter a whole number of metres eg 5m as 5000.

2. Add and subtract lengths, including subtracting 2 lengths from a given length (eg for a door frame).

3. Find the difference between two lengths and check which is the greater.

4. Divide a length by any number (rounding down to the mm below, ie omitting figures after the decimal point).

5. Find the total length of collections of pieces of wood of the same length eg 4 of 1800, 7 of 2400, 3 of 2700.

6. Find how many pieces of a given length can be cut from a given length.

7. Know how to add 10% or 20% for wastage in estimating quantities of wood required.

8. Find the total cost of given numbers of metres of wood at given prices per metre (in exceptional cases, finding the cost when the length is given in mm).

9. Convert inches and feet to millimetres.

10. Find the cost of non-timber requirements for a job including labour.

11. Calculate the pay for each man in a team based on piece work, the men having worked different numbers of days, the total pay for the team being eg 8570 shakes at 2.8 toea each.

12. Calculate a diagonal using Pythagoras Theorem.
Without a calculator, trainees in carpentry will also be able to:

13. Measure in metres and millimetres.

14. Determine on sight the longer or shorter of two lengths given in metres or millimetres.

15. Know the 2 x table.

16. Divide easy numbers by 2 mentally (eg multiples of 10 up to 2000).

17. Find the midpoint of a piece of wood by dividing its length (approximated to a multiple of 10 mm) by 2, mentally if possible.

18. Add up to 10 mm or a multiple of 10 mm up to 100 mm, to any length mentally.

19. Round off to the metre above a given length.

COURSE FOR TRAINEES IN SEWING

AIMS

Trainees in sewing will also be able to:

1. Measure material in metres and centimetres.

2. Calculate the length of material required for a job.

3. Compare the prices of different pieces of material.

4. Calculate the number of garments that can be made from a given length of material.

5. Price a garment.

OBJECTIVES

Using a calculator, trainees in sewing will also be able to:

1. Work only in cm, putting the decimal point in the answer when it exceeds 99 cm. Know how to enter a whole number of metres, eg 5 m as 500.

2. Add and subtract lengths, including subtracting several lengths from a given length.
3. Find the difference between two given lengths and check which is the longer.

4. Find the total length of a number of similar lengths, using \( \times \).

5. Divide a length by any number (rounding down to the cm below, i.e., omitting figures after the decimal point.)

6. Find how many pieces of a given length cm be cut from a given length.

7. Find the price per metre given the price for a given number of metres.

8. Find the total cost of a given number of metres and centimetres given the cost per metre.

9. Price a garment given the length of material required, the cost per metre, the cost of "extras", the number of hours worked, and the price to be charged per hour.

Without a calculator, trainees in sewing will also be able to:

10. Measure in metres and centimetres.

11. Determine on sight the longer or short of two lengths given in metres or centimetres.

12. Add up to 10 cm, or a multiple of 10 cm up to 1 m, on to any length, mentally.

13. Round off to the metre above a given length.
APPENDIX 2

Copy of Tok Save requested by John Baure on 23.10.81:-.

Tok save igo olsem

Mr Allen Edwards Opisa lainim ol bigpela manmeri long MATH, lainim na kauntim ol numbers na we bilong usim calculators long wok bisnis kam pinis na nau istap long Maprik.

Olsem na ol disla lain mas wetim em long tunde 27.10.81 long ples bilong ol.

Mr Peter Lumi bilong ples Musangan.
Ms Cathy Mariwa belong ples Sawarin.
Ms Maria Luck bilong ples Sawarin.
Mr Alois Paul bilong ples Sawarin.
Mr Benjamin Yenei belong ples Sawarin.
Ms Jill Warn bilong ples Mandina.
Mr Paula Windo belong ples Mandina

Tok Save ikam long Bisnis Developmen Opis.
REPORT ON INVOLVEMENT IN THE MATHEMATICS GROUPS WORKSHOP, PROPOSED RESEARCH AT GRADES 6, 8 AND 10 LEVELS, FOLLOW-UP OF SOME GOROKA TEACHING, VISIT TO MADANG AND FOLLOW-UP/TEACHING AT MENYAMYA, BY MARY & ALLEN EDWARDS, 9 - 23 NOVEMBER 1981


(9.11.81)


The first session reported continuation of many of the activities with which I had been associated in 1978/79, particularly the In-service work with Community Schools. Questions were asked about the Post-Secondary Mathematics Group and I promised to send Reports to the Chairmen of the 9 other Groups. Grant Trewenack told me he had written a new and reduced version of the Basic Skills Course for Technical Colleges, but with the ending of the NPEP on maths teaching in the Colleges he suspected it would gradually fall into disuse. I enquired about their calculator policy but this did not yet seem to be firm.

During the second session I attended a meeting of the Community Schools Syllabus Advisory Committee to which I had contributed in July 1981 (AN 13 & 17). I quoted the minute that "the possibility of including calculator-related material in the proposed Grade 6 textbook should be considered at a later date" and obtained almost unanimous support for a proposal that a small research project should be set up to study the possibility of teaching calculator skills at the Grade 6 level. I made it clear I was thinking of small-group teaching, particularly for those who would be leaving school.

Don Palmer, head of the Measurement Unit being set up under the World Bank Project, explained that he was thinking of preparing tests related to the Grades 4, 5, 6, MaCS course. I urged that these should be postponed till they could be done in conjunction with the new textbooks, but that in the absence of any student-texts for Grades 1, 2, 3 such a contribution from his Unit might provide the best available stimulus to teachers to adapt the new proposed syllabus at that level.
The combination of more effective number-fact learning and a calculator course in Grade 6 should result in a significant improvement in effective numeracy for future Grade 6 leavers.

During the afternoon I also attended a meeting of the Provincial High Schools Syllabus Advisory Committee (though I am not a member of it). I proposed, and it was again agreed, that the research on calculator-use teaching should be extended to include school leavers at Grade 8 and all students at Grade 10. A detailed proposal will now have to be put forward to the Research Unit of the Education Department. It would seem to fit in very well with our current emphasis on co-operation with other Departments which is the idea behind setting up the Numeracy Project Steering Group, which is to meet on 1 December.

2. Follow-up of Courses run by Monika Schmidt

I had provided materials for these courses, see ANR 9 and ANR12 p.20-21, so I discussed the results when I collected the unsold calculators etc.

Monika had taught a village Womens Group for six months. The two most relevant activities would seem to have been calculating the correct money to receive as change or from the sale of coffee. In fact however social reasons meant that neither of these turned out to be practical. Coffee is bought at the roadside by about 8-10 buyers who all travel up the road and back again on one day. Each will weigh the coffee and make an offer for it. There are however different prices for different grades and different rules concerning the weight of the containers in which the coffee has been weighed. Alternately growers with cars will take their crop to the different buyers in Goroka. Either way the buyer is concerned with the total figure offered, rather than the price per kg, so in these circumstances (which may not of course obtain elsewhere) the ability to calculate the price is of no value.

Similarly, although the women were obviously interested in calculating change, in practice they normally shopped either in big stores like Steamships where the change was calculated on sophisticated tills, or in local stores run by wantoks to whom it would be most disrespectful to appear to doubt the accuracy of their calculation. However likely this was to be in error, it would be unthinkable for a woman to take a calculator with her into the store and argue the matter.
The possibility of calculating correct prices for selling vegetables also proved to be inappropriate. If the weather was bad the price would go up. On the other hand if they could not sell them locally and went to Lae to do so, they would not expect to put the cost of the journey on to the price because (a) they would be visiting wantoks, an unquantifiable benefit, and (b) would probably bring back betel-nut for sale anyway. If over a period they appeared to be losing money, they would go to DPI for advice.

Thus Monika's summary of her course was that teaching the women their numbers had been exceedingly useful, but in these particular circumstances the calculator had not proved to be appropriate.

Teaching a group of women who were intending to take over a business next year however had proved highly appropriate. She had taught them Cash Book, Invoice Checking and Pricing (without freight). The business involved child minding so she had taught them how to calculate the correct change for two days given that the charge for five days was K12.00.

She had also taught a group of Art students at the Tech in their own free time. They had been keen to learn how to add money and compare prices (dividing by the number of grams and multiplying by 1000).

Finally, she had also taught a youth group who were involved in a baking business. In this case however she found that they could do all the calculations they needed without a calculator. They had Grades 4-6 and knew how to divide K3.75 by 10 to find the price of 1 kg of flour. They then added $37 + 37 + 37$ to find the cost of 3 kg. They could also divide by 2 to find the cost of half a packet of sugar. Finally, having added all their costs, they knew they must sell their cakes at 10 toea each and that they must sell for double their cost. Thus if the total cost was K4 they must get K8 and they knew this meant making 80 cakes. If they managed to make 90 they were happier. Monika agreed that if they had wanted to charge 12t they could not have managed it, but the story is fairly typical, one feels, of the way in which methods are adapted to match the number skills possessed rather than attempting to increase the skills to tackle a more difficult problem.
3. Proposed Research Project on teaching calculator-skills to School leavers.

I discussed the project briefly with Don Palmer who expressed willingness to help if necessary. We agreed that the most cost-effective research would be provided by limiting it to one Province, doing all the teaching of teachers during NIST week and seeking the assistance of the inspectorate in monitoring and evaluating the scheme.

The Eastern Highlands seemed a suitable locale so I determined to find out whether it would be well received here. At 8 am while wondering how to get transport into town, Tani Karo arrived. We had met when I was involved in setting up the Goroka Mathematics Group: he was now a Community Schools Inspector. I explained my problem. He said the Superintendent was leaving for Moresby within the hour but he took me straight down to see him. Mr R Kilaorou welcomed my suggestion and agreed in principle that if the project were officially approved then he would be happy to co-operate in carrying it out in the Eastern Highlands. The only problem was that I would be on leave in March and April so I would not be able to use NIST week unless it was postponed until May. As it had not yet been fixed there was a chance this might happen.

Tani then took me to see the Senior Inspector, Vali Vagimavi, who also responded favourably, suggesting that a little financial help might even be possible from his funds.

We quickly moved on to Fr Ron Morris, Regional Secondary Inspector, who was also about to depart for Moresby but found time to listen to my proposal and to promise "to do all he could to help". He thought a day of NIST week could probably be made available for training and his Inspectoral visits to all the High Schools in September-November might perhaps provide an opportunity for evaluating the work. I explained that the reason for concentrating on school leavers was that this eliminated the question of any undesirable impact on the normal mathematics syllabus. I explained that if a school choose to carry out the teaching over a long period it would not be possible to avoid teaching some non-leavers along with those who would be leaving. I did not myself fear that this would have any adverse effect on the mathematics teaching, and neither did Fr Morris, but clearly a school would have to consider the possibility when deciding how to co-operate.
A draft for the proposed Research Project is included in the Appendix.

Tani returned me to the College at 8.50 am in time for me to attend a talk by Don Palmer on the setting of multi-choice questions and other problems relating to the end-of-year examination.

4. Afternoon Session at Mathematics Workshop

33 members of the Workshop attended the 2 hour session. I began by working through FCC 1 very rapidly. I then explained the issues in my "Suggested Schools Programme on Calculators" (AN 31). Most of those present had attended of the Syllabus Advisory Committees so were aware of the ideas and there was no criticism of the suggested content of the various courses. Working in toea resulted in the usual response, some people perhaps feeling that it was an opportunity for teaching decimals, but I stressed that at the Grades 6 and 8 levels my first concern was that the leavers should be able to use the skills and to teach others in their villages to do so. The complications of working in kina should be left to the Grade 10 level, as suggested in my paper.

At the end of the session I sold 2 scientific calculators, 4 ordinary ones and 10 copies of the BAWE.

(11.11.81)

5. Goroka to Madang

After attending the "Announcements" for the Conference and selling some further materials I found Ben Avusi, Community School Inspector, who kindly took me down to the Airport and bought a calculator and BAWE. I still had over 100 calculators and many copies of BAWE with me for use in Madang and Menyamya so was 36 kg over-weight (in addition to hand luggage). This cost K12, but with 18 villages to visit and 2 courses to run it is almost impossible to estimate how much will be required.


We had begun our preparations for the visit in September but unfortunately the local organiser had left in October. The Field Training Officer, Kasen Kong said he had been asked to make detailed
arrangements last Friday. He had been interviewed about our visit on Monday for the Provincial News and had sent out an urgent Tok Save to all Directors of the Women Project to come in for a course today. One from furthest away, had arrived about 8.30 am when Rose Kovero, newly appointed counterpart, was out meeting Mary, and she did not appear again. None of the others turned up. Kasen suggested they might be having difficulty getting funds for travel out of the organisation.

At the weekend Rose had contacted the Chairman of Directors, Teresa Besai at Rivo Village who had asked that we come there all day Monday, when she would get the local women's groups to send in their people.

Rose had also left a message for Iruk Malai the Director at Mawan village to say we would be there on Thursday morning and another for the Director at Jopoto, which is the end of the road, for people to gather there on Thursday afternoon. These had been announced on Tok Save.

It had been hoped to make arrangements for Friday and Tuesday through Directors who should have come to the course this afternoon. In their absence Rose, Mary and I studied the map and agreed we should go out a longish way north to Seran on Friday, on the way making arrangements to visit nearer villages on the Tuesday.

Thus our hopes for a well-publicised series of visits to 4 villages a day for four days and 2 on Saturday, once again appeared to have fallen through. Perhaps however, unlike the East Sepik, people here really do listen to Tok Save. Rose suggested she should go to the office early tomorrow in order to arrange for a notice about the Friday visits.

We were met by a reporter from Provincial Radio who wanted an item for their women's programme. It had to be in Pidgin however and I did not feel I could ad lib adequately in that language. As Kasen had already spoken about it, and as Mary and I had already been interviewed for Moréby Radio (PNG Magazine, 7.30 pm tonight) there was little point in repeating that. He therefore said he would wait until he could interview some of the women involved and work into it something I could write for him to translate.
7. Madang: Wednesday: "Course for Directors."

It was fortunate that Kasen and Rose had also invited some local
government officers to the course, as 9 very bright secretaries arrived.
Four were Grade 8 and five Grade 10 or above.

Mary went through FCC 1 excluding the Cash Book which did not seem
particularly relevant and I then went through all of FCC 2 and half of
FCC 3. Most of them seemed to understand the significance of not using
+ before x when totalling, and the use of the memory. After doing the
x and ÷ questions in FCC 3 we tested them on it with the Practice
questions on the back and about half managed them fairly quickly. They
none of them used % in their work but appreciated the pricing items.

At 4.06 we finished amid obviously sincere expressions of gratitude from
the students. They did not however buy any calculators.

(12.11.81)

8. Madang: Thursday: First Day's visit to villages

At 8 am Rose wrote the Toksave (copy attached) and we then went to Mawan,
(about 30 km), in the big Jant Timber felling area, on the way picking up
Iruk from a Community Development course which she was attending. She
said she had heard about our visit in September but the only details she
had received had been an erroneous version of Rose's message left at the
weekend. Her father had in fact been sending away women who had come in respon
to the Toksave, but there were plenty there when we arrived and soon after.

In all we taught 35 women but of these only Iruk had Grade 8, about 8 had
Grade 6, 1 Grade 5, 3 Grade 4 while the other 22 were Ples Skul (Lutheran,
now closed down) or unschooled. They came from 4 or 5 neighbouring villages.

It was as well we were not trying to visit 4 villages that day as Mary spent
from about 9.30 am to 10.30 am teaching them (in Pidgin) to enter and add
numbers. Mary appeared to be frightened of the calculator and although
most of those we taught did actually know their numbers, mis-entries were
common.

We thought issuing the exercising sheets would increase the terror so we
drew numbers on A4 paper and showed them + and = by holding up two large
sticks.
I continued the teaching for about 15 minutes, when we all decided we should divide the group into two. The 13 who had been to Community School came with me: I issued FCC 1 and pencils, and worked through as far as finding change, by which time (11.50) they were beginning to flag. Mary had continued the adding, using stories about the goods she was buying to add realism. In the course of it she was assumed that a teaspoonful of beads was being sold for 50 toea locally whereas it was only 20t in Madang.

No one wanted was able to buy a calculator: they had contributed about K15 per head to the Women's Investment Project and had not yet received any returns, so perhaps they thought they deserved free ones. Iruk and Rose however assured us the exercise had been worthwhile. They were convinced it would take a long time to raise the consciousness of the women to the point where they could actually use these skills, but any attempt which helped to increase their self-confidence was worthwhile. My group were certainly operating their calculators competently by the time we had finished and if any were to come to the course in Madang next Wednesday I am sure they could be taught. The difficulty then would be to persuade the men to allow them to help them: Iruk's brother ran a trade store and would certainly not allow Iruk to help him.

We travelled a further 10 km or so to Jopta but they had not received the message and if any had heard the Tok Save they had not turned up by 1 pm "belo taim" (we gathered that "apinun" here tended to mean 4 o'clock onwards). A little further on we saw the turn-off to Yal and Qwa, but there were 10 minutes drive and at least an hour's walk away so perhaps it was not surprising their women had not come in to Jopta.

We returned to Madang about 2.30 pm, when I went to the Technical College where they wanted some calculators.

(13.11.81)

9. Madang: Friday: Second Day's Visits to Villages

When our visit was planned in September we were to have had the use of the Women's Project car. Then the expatriate officer concerned left Madang and Christine Lefebure thought she would be able to be here for most of the time to drive us around. In the end it turned out that she could not come and neither the counterpart nor I were allowed to drive the UNDP...
owned vehicle. We had therefore to hire own transport, and as our funds had mostly been allocated, economy was essential. We had therefore hired a Rent-a-car instead of using a Government vehicle which would have cost 40% more. As a result however we had a car which would only travel on the main road. This was sufficient for all the places planned except for the most distant, Baskin, which we were due to visit today. Rose had tried to arrange to borrow the Business Development truck but it was in use, and she also rang Christine but the veto on the use of the UNDP Suzuki was confirmed. There was thus no option but to cancel the visit to Baskin which had been announced on Tok Save. (This lent strength to the theory that local people treat Tok Save notices with reserve.)

On the way to Sarang we stopped at Hugil Market to try to see the local Director. We in fact found one of the members, Magdalen and arranged with her that we should spend Tuesday at Kusen village nearby. Magdalen would invite the women from the neighbouring villages. Rose sent a message of apology to Baskin and invited them to Kusen on Tuesday.

At Serang Rose had difficulty in persuading the Director, Hilda, to join us. For some reason she had lost interest in the Women's Project, which accounted for the fact that the BDO who had visited Serang last Wednesday had apparently been unable to leave an effective message. We were thus again virtually arriving "cold", although one or two people had heard the Tok Save. However the local Village Court Magistrate knew Rose who had been (and technically still was) a Social Welfare worker. He gathered together all who were available and we had a good group of 8 men and 8 women including 2 Grade 10, 1 Grade 12 (an army man who had deserted?), 10 Grade 6, and 3 Mission School (2-3 years).

We did all of FCC 1 except the cash book, again using two sticks to remind people of the +, = and x signs.

Again none of them bought calculators, although the Magistrate asked if we could call in again on Tuesday to sell him one as he would have the money then.

We moved on to Karkum, 76 km from Madang, where no message had been passed on by Hilda, although one or two had heard the Tok Save. They were in the midst of preparations for a Singsing tomorrow but the principal member of the Women's organisation (who had not heard the Tok Save) invited us to
teach and about 25 people gathered. We moved fairly quickly on to addition from FCC 1, found they were lost and started again with $2 + 1 = 3$ using 3 children to show what we meant.

At this point someone started shouting at the group. Rose found a friend and insisted on knowing what it was about. He admitted that people were organising a pig hunt and wanted all the men to go with them. Our class were not anxious to go but it was deemed wise to desist. It was as well, because shortly afterwards someone started beating a large garamut and competition would have been impossible.

We suggested they all come to Kusek on Tuesday and the women promised they would. We were reminded of the point noted in our last Report on the need to check local events when planning a tour of an area.

On the way back Rose stopped off at a number of places to leave messages about Tuesday: at Megiar she saw Bernadette, at Birains the Counsellor promised to put out the word when the people reported for community work (in lieu of tax) on Monday. At Kusek Rose found Anna Menung, the local Director, and at Matugar, Pauline Kaduk.

Finally at Riwo Rose checked with the local Director Teresa Bisai who really did know we were coming there on Monday and agreed that we should go to Sisiak in the afternoon rather than get those women to come to Riwo.

At Karkum Rose had had to explain to the people who she was: they knew another Teresa, a woman BDO, and Rose had had to explain that Teresa was currently in prison serving a second sentence for adultery. There are circumstances in which men can go to prison for the same cause but it is relatively rare and a single woman has little hope of avoiding a sentence, in this case one of 3 months.

Madang: Monday: Third Day’s Visits to Villages

Riwo, 18km away, was our first visit where the preparative publicity, as far as the women were concerned, could be said to have been satisfactory. We arrived about 9.10 and Teresa came out with her baby in her bilum about 9.20. There followed considerable uncertainty while Rose went to see the Councillor responsible for organising the Community work that day. He was out so she and I talked to the "Committee" who agreed that they (the men) would join the women for the session.
Women started to appear and by about 9.40 we had about 40 adults. Others drifted in and after working through the first 7 questions of FCC 1 (without writing), we split them into two groups. Mary had 26 women with whom she did more "practical" examples of addition (1 calculator + 2 calculators = 3 calculators) and shopping (1 calculator costs K6 so 3 cost K18). She did not attempt "minus" for change.

Meanwhile I had 10 men and 23 women and worked through nearly all the x and - examples and the first Cash Book one on FCC 1. At this point we decided we needed a ten minute break. After it, all but about 10 returned and 3 women who had only been looking on picked up three of the spare calculators bringing the total of students taught to 62. One, John Bilas was Grade 12 plus Bomana Seminary, but not gainfully employed.

We decided many of mine probably had not really understood the Cash Book so we did one on the chalk board (actually one designed for recording darts scores: we were in the "Club"). As usual Mary made up the story while I wrote the (easy) figures. We worked out and checked the balances mentally. We had done this with everyone, so we then split again and I repeated the chalkboard work with the calculator and then finished off the last question on FCC 1.

In spite of all the enthusiasm however only 2 bought calculators, though several said they would come to the Madang class on Wednesday and buy them there. Before leaving I taught the Car Race Game (using \( \sqrt{\text{}} \)) and Mary taught Sumten. One girl bought a Car Race Game for 5t.

We left at 12.10 and had been intending to go to Sisiak but fortunately Rose had earlier suggested we check with their leader Ruth Hosea who ran the Airport Snack Bar. She assured us there were only 4 members in Sisiak of whom she and Evelyn who assisted her were 2, another was her daughter and the fourth was at work in a Bank.

As this was however the first actual business woman we had met in Madang, we felt it imperative to assist her. So at 1.30 we went to the Airport, drove to the village to pick up the daughter and then found a shady spot where we taught them FCC 1.
Rose had discovered that Ruth was officially in partnership with her husband to whom she had been giving all the takings so that he could bank the money and pay the rent etc. She had however just received a demand for 3 months rent from Air Niugini so clearly her husband had not been paying it.

She had been paying some bills herself and had kept a careful list of the nett payments she had made to her husband. We suggested instead that she kept a proper Cash Book recording all the IN's and OUT's and that she included the rent in the OUT's. Mary prepared an instant sample using Ruth's figures to show how it would work.

Mary also suggested to Rose that she might persuade Air Niugini to charge the rent on a weekly instead of a monthly basis. Rose of course was most concerned to ensure that Ruth's husband should not be made to lose face and we felt that Rose's experience as a Welfare Officer was ideal training for handling such delicate matters. It was probably more important than business knowledge, though that she would have to learn that fast, starting with the use of the calculator to keep a Cash Book.

Ruth bought a calculator and appeared determined to start keeping her Cash Book right away. Her assistant was Grade 4 and her daughter Grade 10, but she herself had been withdrawn from school by her father when she had only completed Grade 1. Her business acumen was astonishing. A friend we met in Madang referred to it as the best run Airport Snack Bar in the country. Had Ruth been born a few years later she might well have reached Grade 12.

(17.11.81)

11. Madang: Tuesday: Fourth Day's Visits to Villages

The latest Tok Save had listed the villages which it was hoped would send people to Kusek for the day's course. On arrival however (58 km, 9.50 am, having waited while Rose gave an affidavit concerning one of her Welfare clients) we learned that Megiar and Birains were both having their yam harvest singsing that day. No one had told us of this when we visited them on Friday, so perhaps it is not so easy after all to "take note of local events".
Twelve women however had walked from Karkum (about 12 km), where our previous attempt, interrupted by the Pijur hunt, had obviously whetted their appetite. Five others had come from Liksai so including the Kusen contingent we had 37 women and 3 men. We were taken down to the shore for shade so we gave our course to the accompaniment of Pacific breakers.

Mary did most of the teaching until we agreed it was time to split the group, which Rose arranged discreetly. Mary got 26 completely unschooled women but they had all learnt their numbers. They all enjoyed it and were in no hurry to stop although in Mary's estimation only about 3 really mastered addition. All her examples were related to practical purchases. An attempt to introduce multiplication baffled them completely so after a lunch break Mary did more addition and had a go at finding change, but with 26 students it was not really possible to overcome the problems produced by frequent mistakes.

I had 15 students including the 3 men and an extra woman who arrived after the lunch break. They were nearly all Grade 6, the brightest woman having subsequently taken Grades 8 and 9 by correspondence. I was able to complete the whole of FCC 1 including a mock-up of the Cash Book idea using pencils as kina. By 1.30 pm they had reached their limit so we gave up, but were pleased to sell 5 calculators.

Everybody thanked us for coming and shook hands with us, the Karkum women set off for their 12 km walk home and the Liksai Five settled down to a meal before returning. Just as we were about to drive off the President invited us to lunch and we found she had prepared three large platefuls of kaukau, yam, banana, "tulip" (green leaves from a tree, which we had not eaten before) and some chicken.

(18.11.81)

12. Madang: Wednesday: Course at Madang

The Tok Save had indicated that the all-day course in the Regional Training Centre was for businessmen and others, so we had expected local trade-store keepers etc, as in most other places, but nearly all who came were people whom we had already taught in villages. The exceptions were one Trade Store keeper from Rempi, a Welfare Officer and his younger brother, and a Councillor from Siar who came just to see what we were doing but who in
fact joined in most appreciatively. In all, those who came were 5 men (John Bilas Grade 12, one Grade 8/St Joseph's Technical Centre, another Grade 8, a Grade 6 and 1 Tok Ples Skull) and 9 women (1 Grade 9, 1 Grade 8, 5 Grade 6, 2 Grade 5) plus Rose who both learnt and helped teach. 5 came from Mawan (30 km), 5 from Riwo (18 km), 1 from Rempi (30 km), 1 from Siar (10 km) and 3 from Madang.

Mary started teaching them all with parts of FCC 1 finding that most of those who had done it before remembered the + and x work, but were less sure of the -. At this point I taught the men and Rose using BAWE 2 (Invoice checking and Pricing). The only trade store keeper present paid for freight at 20t per carton so we did that, including the cases where eg all the toothpastes were in one carton.

Mary then did a Cash Book question on the board, putting real money in and out of a box. They enjoyed this, even though they had done it before, and everyone agreed it was most important.

Mary's group then completed the Practice questions on the back of FCC 1. When the brightest woman Betty, had finished, she joined my group and we all did the new "More or Less" questions designed as an extension to BAWE 2. They were all so competent that only one person, Betty, made any mistake. She thought K26197.25 was more than K26804.13. I hoped she would realise her mistake when she saw the - on the display after subtracting, but she was just puzzled. We broke for lunch before doing the last question (comparing costs per gram, using decimals of a toea).

After lunch John Bilas and the Councillor returned first so I made them struggle with the problem of A before X when totalling. Eventually John thought of using the memory and I did FCC 2 with them and 6 women (including Rose), omitting the Invoice Check. 2 women were very slow (both Grade 6) but most managed the Notes & Coins slip after several attempts.

I then worked through the Pricing Kaikai sheet (ANCS 5.2) as I thought this was the sort of business the women should be running and Rose at least should have some idea of pricing for it, in spite of the difficulties. With much discussion we did versions of all four questions including halving and quartering and dividing the electricity bill by 570 (assuming it had been used only for making scones). Several
managed this, including doubling the cost to find a good selling price and also adding 80% instead to find a more reasonable one.

On the whole we found it difficult to produce enough relevant material for women who had no real idea of what sort of business they would be likely to be involved in, but we were impressed by their keenness to travel long distances and struggle with difficult concepts.

(19.11.81)

13. **Madang to Lae**

The overnight at Lae was necessary in order to reach Menyamya to follow up the June course and to offer a more advanced course (as a means of enticing those who had attended before, to come and be interviewed). Mary returned direct to Port Moresby.

We left 50 calculators and 80 BAWE units at Madang with Business Development, to be paid for (at K5.50 and 15t) or be returned by December 31. This was the only way to enable them to run courses in November and December: a letter from the PBDO formally agreed the arrangement. It differs from the Experimental Scheme initiated following the PFA/FTO workshop, in that it is for a limited period only with a definite cut off point whereas the "experimental" scheme is for an indefinite period but is limited to 10 calculators so is of no use to an office wishing to run an off-the-job course.

At Unitech the Audio Visual Centre kindly lent me a tape recorder with hand held microphone which should greatly ease the work in Menyamya.

(20.11.81)

14. **Menyamya: Friday: First Day of Interviews/Course**

Arriving at 10.00 am I was given a cup of coffee by Sr Dockery (Grindl) at the Lutheran Mission where I was to stay. Deryck Thomson and Dympa had had to go away but Derek had left the plans to Noah Leule his second-in-command. There was some doubt whether we were to start the course today or tomorrow, but Deryck's notice had said today and that suited me so Grindl took me to the Vocational Centre where Mrs Oscar the wife of the manager provided a lunch which I ate while I started the interviewing and the teaching.
9 students from the June course turned up and 2 new ones, a trade store keeper with Grade 6 and a DPI officer with Grade 4. Each of these paid their K10 for an EL8158 calculator and "the course" which included BAWE, some food and the film shows for which I had brought 2 video tapes from Lae. Old students were expected to pay K2 for "the course", but interviewing them was really the most important part.

Details are given in an Appendix but the general impression was that they had used and remembered how to total money and find change. The rest, checking invoices and pricing etc had been forgotten but they quickly remembered it on being re-taught.

A lot of Vocational Centre students hung around so I told Mrs Oscar that if one of their teachers would come I would help him to teach the students. Mare Koreng came. He distributed 17 calculators, copies of FCC 1 and pens, to most of the students present. I then started them off with the first two questions (doing each both ways to check), gave Mare an answer sheet, went over Ex 2 and 3 quickly with him and left him to supervise and help them as they worked at their own speed. Hardly a sound arose from them for the next hour or so by which time one or two had even started the Cash Book questions.

This was most encouraging in that we should only have to set the work out a little more clearly and write the instructions in red perhaps to enable their teachers to do this work themselves.

(21.11.81)

15. Menyamya: Saturday: Second Day of Interviews/Course

Grindl took me to the Vocational Centre at 9 am. All except one of yesterday's students came again, with one other "old" student whom I interviewed, and two trainees from the Centre to whom I gave copies of FCC 2 but who probably learnt as much by watching Benjamin Philip. Benjamin was an exceptional trainee who had somehow got on to the course in June and had worked hard again this time. Later on in the afternoon he walked to the Mission to see if there was any way he could get a calculator without money: I said no, but sent one to Mr Oscar for the Centre in return for accommodating the course, and suggested he let Benjamin practise with it.
The 11 students and I worked solidly till 12.50 pm. One, Silas Maika, completed nearly all of BAWE (omitting Unit 4 which is being revised). I stopped the rest at about 11.50 and taught them all the Leakage check in Unit 5, which most understood, although whether they could now immediately operate it in a store without help is another matter. Up to that point several had completed Units 1, 2, 3 (method C for freight) successfully. Others had reached various stages in this during the 7 hours or so they had spent over the two days.

Apart from Unit 5 they worked on their own all the time and it was pleasing to see how confident they were now with their calculators and to find that the BAWE examples were sufficiently clear and well-graded for them to do this with occasional help and answer - checking from me.

At 12.50 pm I took photographs of all the students I had interviewed and gave them copies of the group photograph I had taken last time. This applied the final pressure to make the last of the "old" students pay his K2.00 for the course. I sold a second calculator to another and offered them at K55 for 10 for resale at up to K7 each. Obed Malje was keen to accept the offer and went off to get the permission of his store-owner.

It was disappointing only to have been able to interview 10 of the 37 who had attended the previous course. Grindl thought it would be easy to contact most of them through the Saturday market, and tried to do this, but no one came as a result of it. When one remembers that most of them would have had to walk 10-18km each way to come and be interviewed (or I would have had to be driven scores of kilometres over very poor roads just to get to most of their villages) one must regretfully accept the fact that follow-up in such a situation cannot be expected to be 100%.

As it was, counting my accommodation and fares from Lae only, the average cost of each interview was about K7.50.

While walking back from the course a lad offered to carry my heavy bilum. He said he looked after a trade store in a local (8 km away) Community School and was paid K5 a fortnight. He had heard about the course too late to come to it so I offered to teach him a little if he could find the K6.00 for the calculator. He went off (in a heavy rain storm) to borrow the K2.00 more he needed, but could only get K1.00. So I sold him one at the "special " price of K5 and gave him a half hour's lesson with FCC 1. There must be a lot of keen and potentially able businessmen in this
Kukukuku country, if only a BDO could be stationed here and the base level of the economy could support some development.

But while 66% of the children here are malnourished (70% in Aseki and 35% elsewhere in PNG) and some breast-fed babies show signs of it as early as 2 months, and while the men want to prove their virility by having as many children as possible, which means having several additional "non-favourite" wives simply to produce babies, one must continue to think that basic health education and help with subsistence farming should perhaps come first.

(22.11.81)

16. Menyamya: Sunday: Third Day of Interviews

At Church I was introduced and the congregation was asked to get old students of the June course to come and see me. After the service I found, interviewed and photographed the OIC Forestry and his wife and Mare Koreng (who had been on the final morning's course in June for Government Officers: I also talked to him about the trainees he had taught yesterday.

During this interview one of the Community School teachers lost control of a truck he was driving down the track towards the bridge, hit a corner of a Store house, and almost turned over. Afterwards we just had time (1½ hours) to bring the cows in before lunch.

After lunch Grindl kindly drove me, with Sr Linda Manning VSO, up to Hakwange to interview 5 people who had been on the June course: only one was in the village when we got there. It was 12 km of extremely rough road. On the way we called in on the SDA mission and at Palalye where there were other "old students". Details are given in the Appendix but the most interesting case was of Abaida Guiyoni who said he used the calculator for stocktaking but not for anything else. This seemed so unusual that I did not believe it, but we checked with the Schoolmaster who confirmed that Abaida was in fact an excellent storekeeper, well able to total amounts and find change without a calculator. So we followed it up by calling at his store and getting him to describe exactly how he used the calculator (but not the memory) to find the total value of the stock every week. He wrote it in a book which was kept by the owner who apparently used it to determine profit, and probably leakage. This was a direct application of what he had learnt in June.
The schoolmaster bought 2 calculators for his school, the SDA missionary bought 10 for his, and 10 were bought for the Lutheran Mission Store for re-sale.

The Schoolmaster also confirmed that his Grade 6 students would not have been able to tell us the change from K1.00 for 25 toea. This, as in Kiunga (ANR 15), was a school with an excellent reputation, they just did not think it was their job to teach this sort of mental work.

Conclusions

On the Mathematics Workshop

1. If the proposed research project is approved and produces positive conclusions it could result in a significant introduction of calculator skill teaching in formal education at 3 levels. This might well prove to have relevance elsewhere in the world.

On Follow-up to the Teaching of Goroka Women

2. A six-month attempt to teach village women led the teacher to conclude that teaching them numbers was very useful, but that there was no calculator-skill that was appropriate for them in their particular situation.

3. Where there is an expectation of operating a business however the Cash Book, invoice checking and pricing are all seen to be relevant.

On the Visit to Madang

4. In dealing with a women's organisation plenty of advance preparation is required, including a detailed itinerary and a planned meeting with the leaders of the organisation.

5. If a joint Women's Organisation/Business Development operation could have been mounted, it would probably have been possible to have had groups more evenly balanced between men and women.

6. The extraordinarily low level of calculator purchases, (10 for 192 adults taught) in spite of willingness to walk long distances to attend the courses, may have been due to (a) the high proportion of women, (b) the lack of any business experience in the women, (c) the current financial depression or (d) some other cause.
7. A large proportion of non-schooled women meant that division into fast and slow groups (mainly schooled and non-schooled) was essential. This was correctly done after an initial introductory period when the more competent students helped the less able.

8. A consequence of this need to divide meant that a longer teaching period was required. 2½-3 hours would be best.

9. The Cash Book remains a most important part of the course, applicable to most people. It is best explained by putting real money in and out of a real box.

10. Apart from Cash Book, totalling and giving change (ie FCC 1) it was difficult to find applications that felt convincingly worth while for these village women.

11. As distinct from teaching usable skills however, the course may have had an unquantifiable value in conscientization. No one really knows how women suffering from male domination can be given the confidence and capacity to run their own businesses. Merely once being taught how to use a calculator could contribute to the process. If so, the purchase of a calculator by the women's group might be justified, in addition to the teaching.

On the Visit to Menyamya

12. The follow-up of experiments of this type is very expensive. Only 10 out of 37 "old" students could be enticed by the offer of a further course to come and be interviewed. 6 more were found elsewhere. It would have been uneconomic to search for others.

13. In general those whom we had taught in June were now confident in handling their calculators, having used them for totalling and giving change. Further teaching was then easy.

14. One of the Vocational Centre Teachers taught a group of 17 students very well with FCC 1 and only a little help from me.

15. The general level of development in Menyamya suggests that health education should probably take precedence even over numeracy teaching.
Appendix 1:

FOR THE RESEARCH COMMITTEE OF THE DEPARTMENT OF EDUCATION

A Proposal to Research into the ways, means and possible benefits of teaching the use of calculators to those about to leave Papua New Guinean schools at Grades 6, 8 and 10, by Allen Edwards, Director, Department of Commerce

Numeracy Project: 27.11.81.

1. Background and Aims of the Experiment

Considerable experience has been gained by the Numeracy Project during 1980-81 in teaching the use of the calculator to men and women in towns and villages of PNG, most but not all of whom have been concerned with business. A Business Arithmetic Workbook in five units has been produced to enable Business Development Officers to teach clients business skills using the calculator.

Teaching such skills on a one-to-one basis, or through off-the-job courses is expensive for the country. The key personnel in rural businesses are likely to be Grade 6 and Grade 8 school leavers. Teaching them while still in school would be much more cost-effective. It could also provide such leavers with a skill which would be readily appreciated by the villagers who had sent them to school in the first place.

The Research is intended to investigate the truth of these assertions and the feasibility of such teaching being incorporated into the schools' programmes on a permanent and nation-wide basis.

The rationale behind teaching the Grade 10 leavers is different, as few of them at present return to their villages to live. The majority of them however continue their training in industry, commerce or further education and the calculator is likely to be an asset in any of these cases.

If it were desired to study the value of the skills to these students subsequently, then the Committee might wish to make provision to extend the research into 1983 or beyond.

For 1982 however it is proposed that the calculator skills taught to Grade 10 students would be those which appeared to be most appropriate in relation to the current High School Mathematics Syllabus.
2. Preliminary Approvals

(1) The Primary Mathematics Syllabus Advisory Committee agreed at their Conference on July 30, 1981 that "the possibility of including calculator related material in the proposed Grade 6 textbook should be considered at a later date".

(2) Both the Primary and the Secondary Mathematics Syllabus Advisory Committees at their meetings on 9 November 1981 expressed their support for the above research project, more or less as proposed here.

(3) The Superintendant, Senior Inspector and Regional Secondary Inspector for the Eastern Highlands have already intimated that they would be happy to co-operate if the research were located in their Province.

3. How the Research would be carried out.

For the sake of economy it is suggested that the actual teaching and follow-up enquiries should be carried out only in one Province (e.g. the Eastern Highlands).

Materials, probably consisting of detailed teachers' instruction books, with worksheets for the students, would be prepared in January-February 1982 (if approval were received by then) and would be taught to all interested teachers in the Province during NIST week (provided this operation could be postponed until the author returned from overseas leave near the end of April). Teachers and Head-teachers who were interested in experimenting either at the Grade 6, 8 or 10 level, would be invited to consider the possibility of co-operating in the research, in consultation with the Inspectorate. It is assumed that the teaching would be carried out in small groups, limited by the number of calculators available, and outside formal teaching times. It would be up to the school to determine when to start the teaching and how long should be devoted to it. The school would also determine how to select the students, subject to the condition that in Grades 6 and 8 such selection gave priority to those who were most likely to be leaving school at the end of the year.
Printed materials would be supplied to the schools. The supply of calculators would present a problem as it would be a desirable consequence of the teaching that students should buy their own calculators before leaving school. It is hoped however that each school would be able to buy at least 10 at K5.50 each and sell them at (or before) the end of the course at say, K6.00 each. Many schools appear to run canteens or trade stores which could undertake the buying and selling, but as payment would have to be made for the calculators before they could be supplied (by Laloki Co-operative College) it may be that the Province could provide loans of up to K55 to schools lacking available funds of their own.

4. Evaluation

It is important that much of the evaluation should be carried out independently of the author and director of the project. The Provincial and Regional Inspectors would provide the most appropriate personnel for the work, if their services could be made available, but it would be desirable that the whole evaluation should be overseen by a professional researcher who would visit some at least of the co-operating schools to assist in the assessment.

The principal evaluation would consist of observation by the evaluators and questions directed by them to the teachers and students involved. A certain amount of follow-up would be desirable to observe the subsequent effects of the teaching in the villages. This however would be an expensive process and would initially be limited to a few villages near to co-operating Community Schools. Such enquiries might however be extended, and be supplemented by enquiries of Business Development or other Extension Officers, if the research were continued into 1983 or beyond.

5. Presentation and Implications of Findings.

The initial evaluation should be completed before the end of 1982 and a report based on this should be presented to the Research Committee and the two Syllabus Advisory Committees early in 1983.
It might then be possible for the Committees to make appropriate recommendations for voluntary action on a national scale in 1983. Mandatory inclusion of such teaching in the curriculum would present difficulties, principally because of the cost of the calculators, but if the present downward trend of calculator prices continues it might become possible to overcome this problem, in the High Schools at least, within a few years.

6. Questions that would be addressed in the Research to be carried out during 1982.

1. Is it possible to devise courses in calculator skills that are appropriate for PNG school-leavers at Grades 6, 8 and 10? If so, what materials should be provided for them?

2. Is it possible to organise the teaching of these skills at these levels with the limited number of calculators that would be likely to be available?

3. What training of teachers would be necessary?

4. How favourably would the courses be viewed (subsequently) by
   (a) the students,
   (b) the teachers,
   (c) the subject Masters for Mathematics and Commerce,
   (d) the Head teachers
   (e) the Inspectors?

5. What would be the immediate reactions of some village communities to these skills being possessed by school-leavers? Would they intend to make use of the skills?

6. It is possible that some schools might wish to give the teaching at Grades 6 or 8 before it was known definitely which students would be leaving. In such cases what would be the effect on such students as received the teaching and subsequently continued in full-time education, in the opinion of
7. Questions which might be addressed by a continuation of the Research into 1983 or beyond if, subsequent to their receipt of the Report early in 1983, the Committee then wished to make provision for the research to be continued.

1. What would be the longer term effects of students who had been taught these skills continuing to live in the villages? Would the skills be (a) used, (b) passed on to others?

2. In the cases of students who had been taught the skills and then did not leave school, what had been the effect of the teaching on them and on their fellow students, in the opinion of:
   (a) the students,
   (b) the teachers,
   (c) the Subject Masters,
   (d) the Head teachers,
   (e) the Inspectors?

3. What would be the effect of the teaching of the Grade 10 students on those of them who continued in some form of education or training?

   How should the recommended Grade 10 course be modified to improve the benefit received by such students?

8. Cost of the Research (to be completed during 1982)

<table>
<thead>
<tr>
<th>Fares from Port Moresby and accommodation at Goroka:</th>
<th>Fares</th>
<th>Accommodation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 visits of 4 days each for Project Director:</td>
<td>K474.00</td>
<td>K300.00</td>
</tr>
<tr>
<td>2 &quot; &quot; &quot; &quot; &quot; &quot; Chief Evaluator:</td>
<td>K316.00</td>
<td>K200.00</td>
</tr>
</tbody>
</table>
Local travel for Director and Evaluator in Eastern Highlands (if not funded by Provincial Education Division): K100.00

Local travel for Director in Port Moresby area (for meetings with Evaluator, Curriculum Officer and for travel to airport etc): K100.00.

Payment to Laloki Co-operative College for time, materials and facilities for writing, typing, photocopying, preparing printed matter, postage and telephone: K100.00.

Honorarium for the Director who would be carrying out the work while on leave (costing him the equivalent of K270 per week) ...........

It is assumed that the paper and printing will be provided without charge by the Department of Education. The following are maximum estimated requirements:

10 worksheets for each of 40 students at Grade 6 in each of 10 schools: 4,000 sheets
15 worksheets for each of 80 students at Grade 8 in each of 5 schools: 6,000 sheets
20 worksheets for each of 80 students at Grade 10 in each of 5 schools: 8,000 sheets
Materials for teaching 200 Community School teachers during Inservice: 1,200 sheets
Materials for teaching 30 High School teachers during Inservice: 300 sheets

19,500 sheets

Note: it is anticipated that only half the total requirements of worksheets will be printed initially, to permit revision following early feedback, before the rest are printed for those using the materials later in the period.

TOTAL COST, Based on these assumptions: K1590, plus any honorarium considered appropriate for the Director.
Dear Sir

RE: TOKSAVE

Toksav hia igo long olgeta meri em ol i memba bilong Madang Womens Investment Co-operation Insait long Madang.


Long apinun long dispela dei yet bai ol igo long Jopoto na bung long Jopoto, bilong ol ples Jopoto, Gomaru, Val, Berin, Gonoa, Baisereh, Sup, Bemal na Usu.

Long Fraide 13 November bung long ples Serang No 1 long 9.30 long moning taim, bilong Serang 1 na 2 na long 11 kilok bai ol ikamap long lukim ol meri long Baken na apinun long 2 kilok bai ol laik lukim ol meri long Karkun 1 na 2 wantaim Mirap.

Long Nande 16 November bung long ples Ruvo bilong ol meri Ruvo na Matal. Apinun long 1 kilok bai ol ikamap long Sissiak 1 na 2.

As tingting bilong dispela wokabaut em bilong ol ilaik helpim yepela ol meri long Bisnis gup long kisim kos o save long wok bilong kautim namba (Numeracy Course) long wok Bisnis long yepela yet.

Naratemem asim tu em tupela ilaik long lukim sampela man tu long ol dispela peles em ol igat wok bisnis o negat. Bai dispela kos iken helpim ol yet long wok bisnis bilong ol.

Long Trinde 18 November bai igat naratempem bikpela bung ken insai long PSC Training Senta long Klasrum 3 na dispela em i oraite tasol long olgeta man na meri yu husat laik kisim halivim o kos long dispela bain iken kamap. Na dispela kos bai istap ful dei, long moning inap igo long apinun.

Em tasol na tenkiu tru.

KASEN KONG
Field Training Officer

DEPARTMENT OF MOROBE PROVINCE

To: All Residents,

Menyamya District.

NAMBA TU KOS BILONG KALKULATA.

Dispela tok save i go long ol man husat i bin atap insaiit long dispela trenin kis bilong ol kalkulata ol i bin holim long Menyamya long mun June,

Na harim, dispela tisa nem bilong om Allan na tu meri bilong em, ol i laik i kam bek na kirapim naratempem kos bilong kalkulata long namba 20 na 21 de bilong mun November.

Husat man i bin kam long namba wan kos ken baim kos long K2 (kaikai na piksa) na el yupela man i ken baim kos long K10 (kalkulata, kaikai na piksa).

Yupela ken givim nem long Inspekta Mr Ken Ila.

Deryek Thompson,
District Co-ordinator.
FREE TRANSLATION OF THE TAPE OF INTERVIEWS AT MENYAMYA, 19-22 NOVEMBER 1981

Interview 1: 000-049: James Malje, Kwaplalim (15 km), TS (= Trade Store keeper), F (= Fast Group in June), Gr 4 (= Community School Grade 4 education).

Q (= Questioner.) You find your calculator all right? R (= Respondent): Yes. Q: How do you use it now? R: For buying coffee and running a trade store. Q: How do you use it when buying coffee? Using \( \times \)? R: Yes. Q: In a Trade Store? R: Using \( + \). Q: To check invoices? R: Using (RM). Q: You use it to find change? R: Yes. Q: If you sell one thing at K1.25 and another at K6.15, how much is it altogether? R: (Working it on the calculator) K7.40. Q: Then change from K10.00? R: (Working it correctly) K2.60. Q: Suppose you have an invoice, can you use the calculator to check it, using \( + \) and \( \times \)? (He multiplies the number of cartons by the number of tins instead of the cost of a carton). No. I will teach you this, this afternoon: you have forgotten it.


Q: You use your calculator in your trade store? R: Yes. Q: To check invoices? R: Yes. Q: Will you check this one now? R: Yes. (He makes the same mistake as James did). You have forgotten this. Q: Suppose you want to total K3.72, K5.85 and K7.43? (He works it correctly). R: K17.00. Q: Change from K20.00? (He works the whole sum again). R: K3.00. Q: You pressed \( - \) instead of \( + \), but it gave the same result. You use this in your Trade Store? Do you use your calculator for anything else? R: No. Q: You use it for totalling and change only? R: Yes. Q: I will teach you more this afternoon. Q: You learnt how to use \( \times \)? R: Yes. Q: You can use \( \times \) for this one? (He works only 40 \( \times \) 6 \( = \) \( - \) 1000 \( = \)). This gives the change? R: Yes.


Q: You will talk in English? R: Yes. Q: You use the calculator in your Forestry work? R: I use it when I sell plants to the people. To find the number I first count the number of lines and find the total amount. I subtract to find how many live ones. Q: Do you use the calculator any other way? R: No. Q: When selling do you use \( \times \)? R: Yes, I wrote it in the book.
Interview 4: 126 - 162: Kemen Patiea: Panikwa (?), S (= Slow Group in June), No school.

Q: Do you use your calculator now? R: Yes. Q: How do you use it in your trade store? R: Using ∘. Q: Using ∘ for change? R: Yes. Q: Any other use? R: No. Q: Can you work this question using ∘? (He makes a mistake. Then adds 49t and 24t correctly.) Then finds change from K1.00 for 35t. He uses ø instead of ∘. He tries again. He uses ø again in spite of hints.) You find totals only. Try this one, and write the answer here. (Result not recorded).


Q: Your calculator still works? R: Yes. Q: How do you use it in your Trade Store? R: I use ø to find change. Q: Can you do this: K1.25 and K6.15? R: (He works it out) K7.40. Q: Now find change from K10.00. (He works it, with some mistakes, then does it in his head.) Now work this: 68t four times. How much altogether? R: (He works it using ø) K2.72. Q: Now find change from K5.00. R: (He adds to K2.72 what he thinks is the answer, and gets it right at the third attempt). Q: You work it in your head and check up with the calculator. R: Yes.


Q: Do you remember what you learned last time? R: Not really, I have forgotten it because I was working on carpentry etc. Q: You forgot it because you did not use it? R: Yes. Q: Have you a calculator. R: No. Q: I will lend you a calculator for use now.


Q: You bought a calculator? R: I bought it when you came and it works all right. Q: What do you use it for? R: Finding how many acres in a plot of land; adding and subtracting money in a Cash Book for a small trade store and club. Q: Do you find change with the calculator? R: Yes. Q: You check invoices? R: I use it to work out prices. Q: How do you do this? Like this, dividing the cost of the carton? R: Yes. Q: Plus 10%? R: Yes or 5% or some other %, depending on what the members want. Q: Do you
want to learn more this time? R: Yes I want to learn more about this calculator business.

Interview 8: 264 - 315: David Tiyapongo: Menyamya, DPI Officer, F, Gr 8.


Q: You use your calculator in your Trade Store? R: Yes. Q: What for? R: To help me to add, to calculate air freight, and pricing, but I do the easy ones in my head. Q: You learned it this time? (He was the only student who was not interviewed before starting the November course). R: I learned a little then. I have been looking forward to your coming a second time. Between the courses I used it for adding, finding change, markup, landed cost, adding 10% or 40% - 80% on other things. The Missionary's wife helps me.

Interview 11; 436 - 480: Lydia Paul, Menyamya, Assistant Nutritionist, F, Gr 8.

Q: What have you used your calculator for? R: For making market surveys. Q: Is this just adding? R: Working out the price for a kilogram. Q: Did the Senior Nutritionist show you how to do this? R: Yes. Q: Do you use it for anything else. R: Adding numbers. Q: On market surveys? R: Yes. Q: You have used it a lot and it still works well? R: Yes although at one time, once or twice, it stopped working. Q: It's good it is all right now because it is out of guarantee, but it may help sometimes if you take the back off and just twist the batteries a bit.
Interview 12: 480 - 511: Mrs Kausa: Menyamya, Wife of OIC Forestry.

Q: Do you still use the calculator you bought at the course in June?
R: Sometimes. Q: What do you use it for? For play or for work?
R: To teach my daughter. Q: You teach her + and x? R: Yes.
Q: Does your husband use it? R: Yes sometimes.


Q: Did you buy a calculator last time. R: No. (Part of conversation not recorded) Q: You use your wife's calculator? R: Yes. Q: What do you use it for? R: Finding the number of seedlings, monthly reports, money added and subtracted in my ledger book. Q: You work out the labourers' pay? R: Yes. I take the pay for a fortnight for one man K28.02 and divide by 10 for the amount for one day and multiply by the number of days. I also use it when going to a trade store and to check up on my pay.

Interview 14: 622 - 718 (end of Side 1), 000 - 083 (on Side 2): Mare Kovero: Menyamya Vocational Centre Teacher, Port Moresby Teachers College. (He was not on the 4-day course in June but did come on the final Saturday morning of that visit, with other Government Officers. This time he taught a group of 17 trainees, see above, page 16).

Q: You had used a calculator before that course. What did you learn then? R: I learned to use the memory. (At this point a run-a-way truck nearly overturned.) Q: What about the teaching you did here on Friday? R: Some of the trainees could understand very clearly. In this remote area we have to be very flexible in speech and use a mixture of English and Pidgin. Q: The material I gave you was in English, but that was all right because you could put it into Pidgin when you needed to? R: Yes. Q: Could they have been taught more, the Cash Book for example? R: Some were very fast in learning these things but the rest found it hard because they had not used calculators before. Most learned well. Q: Perhaps after they had been using the calculator for a little while, like the rest of the people on my course, you could teach them anything, because it is getting used to using it that counts at the beginning isn't it? R: That's very true. Q: Have you anything else you would like to say? R: It would be better if you and other Government Officers would spend more time in an area like this. Q: I have been asked to help with Vocational Centre Teaching if I can. If we gave you instruction sheets like the ones you had on Friday, could you teach straight from those or do you need
to be taught in a course yourself first? R: If you give me the basic ones you have prepared that is easy. Otherwise if it is harder, as when you were teaching the trade store keepers, that would have to be taught to me before I could teach it myself. Q: That is very fair. Are there other Vocational Centre Teachers who can do this, or is it just that you have been interested? R: It will depend on the individual teacher. Q: What do you teach yourself? R: Welding, agriculture, building. Q: When did you start using the calculator yourself? R: I have been using it since I left school though not a lot until I went to the Port Moresby Inservice College for training. That was when I bought my own calculator at K8 from the College last year (not one of the Numeracy Project ones). We learnt a bit about store-keeping there because many Centres have stores. Q: Even where you have no trade store, as at Menyamya, do you think most of the trainees would still like to be taught about trade stores? R: Yes. That is what we want to be taught in an area like this. Q: Do you think there is any way round the problem of buying the calculators? R: We actually had 3 for the students. (Mr Oscar told me later two had been stolen). Q: Do the batteries run out? R: Mine is still all right since last year. Q: It must be the right sort of calculator then. You can work percentages on it? R: Yes but you are not really taught how to do it on that one. Q: You need special teaching on the right calculator? R: Yes.


Q: What do you use a calculator for? R: Stocktaking. Q: How do you do that? (Sr Dockery helped with the questioning). R: I use \( x \). Q: Do you count the numbers of piles on the shelves? R: Yes. Q: Do you use the calculator for anything else? R: No. Q: How do you find totals, like 78t and 39t? R: I use my head. Q: And finding change? If a customer buys something for K1.40 and gives you K2.00? R: 60t Q: Do you price your goods in 20t, 30t, etc or 24t, 37t etc? (I tried to find out if all his prices were multiples of 10t but failed. I saw later that most, but not all, were.) How often do you take stock? R: Once a week. (Later, in the store, the first part of the interview was not recorded. He bought coffee and had a scale for weighing it, but he did not use the calculator for working out the price.) Q: What price do you buy the coffee for? R: 50t for 1kg. Q: That is easy. Suppose you put the price up to 55t? Would you use the calculator then? R: At first I would use the calculator, later I would use my head. Q: The owner has the stocktake book? R: Yes. Q: Can you describe how you use the calculator to do the stocktake? R: I count the tins first then multiply by the price of each. Then I add all the amounts together.
on the calculator. I do it every Saturday. Q: What happens when you have worked out the total stock value? R: I wrote it in the book for the owner. The owner checks the totals to see if they are making money or not. Q: You learnt this in the June course? R: Yes. Q: Good. I did not believe it was possible!

Interview 16: 148 - 177: Obed who had been taught by Tom Ikawaiyakuli (Hakwange but "in the bush" at present, TS, F, Gr 7).


Interview 17: 259 - 294: Russ, Palalye (interviewed there: he works for Womatoye - S, no school - who was not available.)


Interview 18: 293 - 296: Smith. Student at Menyamya SDA School (interviewed there). Gr 4. (He did not buy a calculator at the course). Q: You have not used a calculator at all since June? R: No.


Q: You have used your calculator since June? R: I use it occasionally for my school work. I keep it in my suitcase. Q: Do you expect to use it when you leave school? R: Then anything can happen. Q: You have remembered how to use it? R: Yes, some things. Q: You remember how to use the memory? R: Yes. Q: When would you use it. R (after thought). For Costing.


Q: Have you still got your calculator? R: No, it was paid for by the missionary's wife. (We had seen it being used in the house earlier.)
List of Photographs of Interviewees:

P1L, (first photo, on my left: Interviewee No. 10); P1R, 5; P2L, 1;
P2R, 2; P3L, 9; P3R, Dominik Guye, Hakwange, Gr 6, not on June course;
P4L, 3; P4R, 4; P5L, Gutain Laviak, DPI, Gr 4; P5M, 6; P5R, 7; P6L?,
11, P6R?, 12; P7, 13; P8, 14; P9 & P10 Men's House at the Centre of the
Universe, near Hawwange; P11, 15; P12, the Hakwange road; P13, the Centre
of the Universe, according to local belief; P14L, 20; P14M, 19; P14R, 21.

APPENDIX 4

SUBSEQUENT COURSES IN MORESBY

1. Visit to Goldie River Community School: 25.11.81

Mary and I taught an appreciative Grade 6 class and several teachers who
had joined in. We were pleased to discover that here several children
knew what the change from K1.00 for 65t was immediately. We told the
staff we would only come once so if they wanted to do it again they would
have to do it themselves. They were very attentive. We worked through
BAWE 1, including the memory, from about 1.15 to 3.15 pm.

2. Workshop for Vocational Centre Managers, Papuan Region: 26.11.81

About 10 teachers from the Inservice College joined to make a group of
about 40. We worked through BAWE 1 (without writing anything) and the
first Cash Book example in FCC 1 on the board. We then discussed the
proposed Core, Carpentry and Sewing Course Aims as in ANR 16.

The usual objection: that it would make the students lazy was raised twice,
one manager thought that K6.00 was a lot of money for a villager to pay
and another thought the courses would be no problem in urban or semi-urban
areas (eg Marshall Lagoon or Kiunga) but not in the really rural ones.
Everyone however supported the idea of experimenting with the courses next
year, after I had explained that this would mean (1) buying at least
6 calculators (2) teaching in small groups, probably about 6 hours to
each group, (3) getting someone on the staff able to teach it with the
aid of a detailed teachers instruction book, including appropriate exercises.
NUMERACY PROJECT

SUGGESTED SCHOOLS PROGRAMME ON CALCULATORS
for consideration at Mathematics Education Groups Workshop, Goroka 9-13 November 1981

NOTES:

(1) All these courses will require students to have calculators. It is difficult to teach a large class all using calculators. It is therefore suggested that all teaching should, in the first place, be carried out in small groups of 5-10 students. It would presumably be done in after-school sessions or during work parade.

(2) I would not consider myself currently competent to put forward any programme for the use of calculators in any part of the present formal teaching syllabus. This would have to be approached carefully so as not to make the learning of tables and written algorithms appear pointless. It would also require the availability of at least one class-set of calculators. I am convinced there is such a place for calculators, eg in science teaching as well as in mathematics, and I hope those responsible for the formal education field will authorise responsible experimentation in it.

A. Suggested Programme for Grade 6, particularly for those who will NOT be continuing their schooling.

A course consisting roughly of the content of:

BAWE 1: Totalling and Finding Change but excluding the use of the Memory for this.

BAWE 2: Checking invoices and Pricing without freight. Finding the larger of two numbers and the difference.

BAWE 3: Pricing with Freight: simple cases where the total freight cost is divided by the number of cartons.

BAWE 4: Cash Book only.

(If the syllabus currently recommended by the SAC is implemented it should be possible to go a lot further than this.)
A detailed Teachers guide would be needed, including plenty of exercises and answers. Perhaps worksheets for the students would be useful but it may be possible simply to write the questions on the chalkboard and for students to write answers on paper.

B. Suggested Programme for Grade 8, particularly for those who will NOT be continuing their schooling.

A course consisting roughly of the content of:

All of BAWE 1-5, ie as above together with the use of the Memory for totalling with + and x, pricing with other forms of freight charge, Cheque Account (including a reconciliation), Leakage Check and Net Liquid Assets.

A detailed Teachers Guide and perhaps worksheets, would be required as in A.

C. Suggested Programme for Grade 10.

1. As for Grade 8 if not covered at that time.

2. Any similar materials that may be produced (probably in 1982) for use in Vocational Centres and for extension work through Non-Formal Education, Community and Family Affairs, Primary Industry.

3. When and how to work in Kina rather than toea.

4. The Vocational Mathematics Problems, or similar:
   
   (a) Results should be written direct from the calculator.

   (b) Writing down of intermediate results should be discouraged, and methods sought of using the memory or the reciprocal etc instead.

   (c) Every result should be checked by one of the following methods:

   1. Using the answer and an inverse process to work out an item in the data, eg checking a difference by adding it to the smaller number.
2. Transforming and re-working the problem to check the final result (if not intermediate ones), eg totalling the IN and OUT columns to find the final balance in a Cash Book.

3. Estimating the answer by approximating the data and using (preferably) mental arithmetic.

4. Repeating the calculation.

NB Any written work by the student should indicate clearly which method of checking has been used (and the answer in the case of 3, or whenever it is not as expected.)

REPORT ON A VISIT TO NORTH SOLOMONS AND NEW IRELAND 10-20 DECEMBER 1981

1. BOUGAINVILLE COPPER LIMITED

Nick Spencer, Superintendent, Planning and Staff Development, and his wife Jenny had arranged our programme. We first visited Simon Tornado, Business Extension Development Supervisor. He fully agreed with everything we had to offer, particularly with the importance of having calculators of which the batteries would not run out (BCL issue staff with EL 210 calculators, with the usual 100 hour battery life). He thought there would be no difficulty in getting these calculators through B.C.L. Supply department, on requisition and then selling them to clients. He also agreed that he and his two extension officers might share in any training course being put on by the Government B.D.Os. I stressed the importance of BCL setting an example to other companies engaged in big projects and hoped for an official programme which would include numeracy teaching and the sale of calculators to people in the community. Simon however explained that the Business Extension work was in process of being reorganised and I got the impression that until the administrative structure was clarified it was unlikely that any positive policy would be promulgated. I left him a set of Business Arithmetic Workbooks and he promised to let me know when he had studied them, if he decided to see them.

In the afternoon after a tour of the mine and viewing the Euclid trucks which we were told weighed 25 tonnes and carried 155 tonnes ("170 tonnes in all") we met Severinus Ampoi, Manager, Community Relations. He agreed with everything we said, the importance of leaving behind something good for the Community when the Company withdrew in 5-20 years, the permanent value of numeracy to the community and its adaptability to new situations, the practical possibility of his Business Extension Development Officers teaching numeracy skills and supplying calculators at cost and the effect that BCL could have on other companies operating in PNG by setting an example.

But Severinus, after 15 years service with the Company was retiring early in 1982 and could not at this stage initiate any sort of policy.

We tried to find out who would be taking over responsibility for the Business Development Officers, but this was apparently not yet determined and it was probable that it would no longer be directed by anyone primarily concerned with community relations.
Some people seemed to feel that in a time of retrenchment, this particular service to the Community might well be handed over to the Government Officers who were now far better able to provide the service than they would have been in the early days of the Company's existence.

An attempt to see the Supply Department person responsible for ordering calculators failed but we were assured that if anyone wanted to order our calculators, there would be no difficulty in their obtaining them.

An alternative possibility of trying to sell them through the Supermarket at the mine site was abandoned because they would be unlikely to sell our goods at a mere 25% markup. (11.12.81)

2. ARAWA BUSINESS DEVELOPMENT OFFICE

Jenny had arranged for us to see Elspeth Stiven the Women's B.D.O., but we first talked to Paul Mitu, the P.B.D.O. He confirmed our impressions about the position at B.C.L. and mentioned that he had in the past tried to set up a meeting where they could discuss a common policy, but that this had not taken place. I asked his views on Women's work which he agreed was difficult because of their lack of business involvement. He thought however that Women's Group secretaries should be given numeracy teaching.

Paul also asked us to meet the P.F.A., Neil Thomson who explained that the training of BDO's to teach calculator skills had not yet started in their office, probably because the Field Training officer who had not attended the Laloki PFA/FTO workshop was not convinced of the value of the work. Finance had been made available for purchasing calculators but he was not sure if the order had actually been sent off.

Neil stressed the importance of reporting on the effectiveness of calculator training if doubters were to be convinced. I explained that I had been more concerned to follow-up teaching of non-businessmen but that in Menyamya for example we had had fairly positive results with trade store keepers.

The whole process of FTO's teaching BDO's and BDO's teaching clients could not be expected to produce reportable results very quickly. I promised to seek some further information however and to publicise it. (See Appendix 1)

Neil and his associate, Andrew, agreed with Mary's suggestion that the most likely means of propagating the work was through individually enthusiastic BDO's. BDO's were not trained teachers and they were unlikely to sell the ideas unless they were personally committed to them. The important thing was to provide such enthusiasts with the materials and calculators they would need. Neil agreed that the intention was for the 10 calculators being ordered to be used in this way.
As the FTO had not been at the Workshop however they had apparently not received any copies of the Business Arithmetic Workbook apart from two bought back by the PFA. I gave them six sets (apart from Unit 4).

Elspeth talked about the needs of her women's groups and said that one of the main difficulties they experienced lay in their treasurer's lack of skills and the fact that even if they did keep the accounts correctly the other members would not know enough to recognise it. Officers also changed rapidly and re-training was needed. We suggested that both these facts pointed to the need to provide numeracy teaching for a wider range of women than those who were actually expecting to use the skills immediately.

Elspeth mentioned the commonly held fear that providing a calculator would result in the loss of such arithmetical skills as the women already possessed. She referred to one Secretary who had changed from mental addition to the calculator and had then started making more mistakes than she had made previously. Elspeth agreed that she had not been given specific training and in particular had not been taught to check results. Elspeth agreed furthermore that now that she could handle the calculator the range of uses open to her was usually vastly wider than it had been before, even if the price paid for this (as in my own case) had been some slight reduction in fluency in "column" addition.

We visited Willie Monda, who had been in charge of the Village Industry Research and Training Unit for the last two months, and Bill, a CUSO volunteer. Both thought training in the use of the calculator would be very valuable for the students in the Unit and also for those who were using the drum ovens that had been made and sold as a result of their work. I mentioned the likelihood of such teaching being carried out in Vocational Centres and gave Willie copies of the BAWE, the First Calculator Course and 3 ANCS 5.2. We explained that if he were to work carefully through the whole of the BAWE he would probably then be able to use the FCC to teach others.

He bought a calculator and mentioned that Peter Piruke, in charge of the Kietta Cultural Centre, had difficulty with his accounts. We therefore went to see him and told him that Willie would teach him how to use the calculator. So he bought one.

Elspeth had not been able to arrange for us to teach a group of women, so we returned to the Spencers with whom we were staying.

(KIETA TO KAVIENG: (Monday)

When we had fixed our programme there had been no way to fly from Kietta to Kavieng without overnighting at Rabaul, so we were not expected at Kavieng till Tuesday.

ANR18
A300
We had discovered on Saturday however that a new schedule would operate from today which enabled us to fly straight through. We were warmly welcomed by the PBDO, Robin Meleke, Greg Luk, the trainee FTO, Joan Luka, the Women's BDO and Greg Hranka, FFA who was just off for a course. The FTO, David Silakot, had been on a course in Rabaul almost all the time since the FTO/ PFA workshop in August so no training had yet been given on the use of the Business Arithmetic Workbook.

Robin showed us a copy of the programme that Magdalena Khouw ILO Project Officer had prepared and one of the Toksava which had been put out (see Appendix 2).

We were taken to the Kavieng Club where we were staying and were joined for lunch by Magdalena and Saperi Daniel, Magadelenas counterpart.

We received a full account of the Women's Project, which had started in 1980 with the New Ireland Women's Investment Co-operation.

The Aims of the NIWIC were:

1. to run a business,
2. to teach women business skills
3. to give women employment
4. to help women to raise money.

Magadelenas emphasised the long way that the women here would have to go before they could run their own businesses. Even when they were members of mixed Business Groups the men tended to keep the business to themselves. They had therefore decided to start with a cooperation of which the Shareholders would all be Women's Fellowship (mainly United Church) or Clubs (mainly from Catholic origins) or Business Groups. (The main SDA work is on the smaller islands where NIWIC has not yet penetrated). Each buys at least 200 K1 share in NIWIC. The Business Groups have to arrange for each member to pay the same amount towards the share, to avoid complications. Seven Directors are appointed by the AGM and are given area responsibilities but are not area representatives as in Madang.

So far the only business operated by NIWIC is a Mobile Snack Bar, which is at present towed from site to site during the day by the Project Officer in her UNDP vehicle. Saperi is being taught to drive. They have also agreed to take on an agency for Village Equipment Supplies but are waiting for suitable premises.

The hope is that in time the local clubs and business groups will initiate their own businesses but Magdalena emphasised that there was no prospect of this happening quickly.
Simon Nicholson had toured the groups teaching the basic principles of business and our programme clearly fitted in to the preparatory phase of opening the women's minds to the possibilities of business. The only financial activities of the groups at present consisted in money-raising.

If so, then the calculator may be seen to be relevant for simple account keeping, but Magdalena held out no expectation that the women would rush away from our courses and use their calculators for running businesses next month. She also mentioned that December is a bad month for women's activities as their normal full-time occupation (as village women) would be increased by their children being on holiday.

Reviewing the preparations so far, the current state of the organisation and the good relationship with the Business Development office, the whole set-up seemed to promise a profitable opportunity for teaching numeracy, although the main objective, "consciousness-raising", would be virtually unassessable.

(15.12.81)

4. KAVIENG — (Tuesday)

We were able to get more background to the situation in New Ireland from Magdalena and from the manager of the Malangan Lodge (95% Provincial Government owned). The island has been so pleasant for so long that there has been little motivation to do anything. Fish, kaukau and greens have been plentiful and copra, cocoa (and now rubber plantations) provided a cash income for those who wanted it. Large scale fishing was done by the Manus people, trade stores were run by Chinese, plantations by other expatriates. Local people with initiative tended to leave the Island.

Problems were just beginning to arise now and could escalate over the next few years however. Young people wanted employment which was unavailable. Education had been good, even the girls forming a fair proportion in the schools, but few of the skills learnt even at the Vocational Centre were converted into money-earning activity, we were told.

Communication on the island was better than in most places, the East Coast road being the first national highway in the country and most of the west coast now being accessible. But the fall in commodity prices and the cuts Government expenditure would mean local reductions probably starting with the road programme and labourers generally. BP had actually given a plantation on Nusa island to the villagers, so one cynically assumed it was no longer profitable. (When a village look over a plantation we understood each family would have a certain number of trees to look after) Local businessmen who had taken over stores started by Chinese tended to fail.
There would soon be even less money around to support business enterprises. Long term expatriates (many of whom had no doubt done very well financially in the past) were now talking of leaving. Most had VIDEO TV sets which meant they could stay at home and suffer break-ins. There was no significant tourist trade. There was not even an artifact shop. Subsistence farming was very affected by an unwillingness to work as hard as in the past: the women complained that gardens was being spoilt by pigs. The men, whose job it was to fence the ground, want to get electric fences which were less trouble to erect.

In the long term the local people would probably have to face the consequences of retrenchment and loss of "development" facilities. In the short term however there might be some increased motivation for business which might enable those with initiative to retain some of the benefits of development for themselves at least.

OMO - (Tuesday Afternoon)

After picking up Seperi and the Director (who was SDA) we went out to the Women's Fellowship that met in the United Church building at Omo. The village was not visible from the church and only two other women were there when we arrived at 2.55 p.m. After a while we started with the four we had, one being unshooled and finding it hard, the others being grade 5 or 6. When we had reached question 7 in FCC 1 another small group of women and one man (a trade store keeper who had heard the toksave on the radio) arrived so I started them off while Mary continued with the first lot.

When they had reached a similar point a third group came in, including two grade 10 girls with places at Kerevat so I put both the other groups on to writing in the answers from the beginning while Mary taught the new group. We all did "Change" together while Mary took the last arrivals through the earlier work very quickly. We did our usual joint demonstration - story with the Cash Book and then went through the first of these example on the sheet. By this time it was 5.20 p.m.. Magdalena arrived and it was getting too dark to read the calculators so we stopped. We told them about the course on Saturday and sold three calculators at K6.00 each (1 to the Trade storekeeper). The girls with places at Kerevat said they enjoyed mathematics and wanted to go on to Higher education so we recommended UNITECH, although one of their aunts had been the only woman on her course there and had given up. Mary gave them a pep talk about being prepared to fight all the way and I pointed out that my own aunt had read mathematics at Cambridge in 1906 but had had to go to Ireland to get a degree then and that even in 1945 women could still only qualify for the "title" of a degree at my University.

The Fellowship was in no hurry to disperse but we packed up and left at 5.40 p.m. with many expressions of good will and assurances that some would come again on Saturday.
6. KONOS & KAFKAF – (Wednesday)

We picked up Greg Luka in Kavieng at 7am in the pouring rain and then Menmen Bens and Wilmer at Fatmilak. Menmen is the President of the NIWIC and much involved in United Church activities. Wilmer is a Laloki student who is going to do her practical work at Kavieng next semester. We reached Konos about 150 km from Kavieng just on time when the course was due to start. Only Saimi, President of the local branch of the Provincial Council of Women (a shareholder in NIWIC) was there. She said she had not been told about the course by Clara who is the Director responsible for liaison with her (being also in the Provincial Council of Women but being on the West coast so having no direct means of communication with her). Saimi also said she had not heard any of the Tok Saver. We suggested going out at once to collect women from nearby villages but Saimi said they were not cooperative. Those from further away needed transport which could sometimes be arranged but not at short notice.

Saperi later told us that they had in fact gathered a lot of women together once before for a business course, but on the wrong day. She said they had had plenty of failures when running meetings to set up NIWIC, one village requiring 8 visits before a suitable number of women could be gathered. Greg said that in his experience 10 was a good turnout for a village course.

In the case of Konos we heard also that there was friction between the officers of the PCW branch and Menmen expressed considerable concern about the situation generally.

None of the local trade store keepers had responded to the Tok Save either, so we bought 2 gallons of petrol at K2.11 a gallon (their manual pump had a glass cylinder calibrated in gallons) and returned to Kafkaf (c.100km from Kavieng) about noon where we were given coffee and biscuits. We reminded people of the course and we picked up some people for it at Fatmilak.

At 1 o'clock the bell was rung and we moved into the Church (catholic) for the course. Most came fairly promptly and the great majority proved to be well schooled, including 4 current Grade 10s. One of the few unschooled women knew her numbers and did well. I was able to work practically non-stop through FCC1 as far as the Cash Book. Mary, Greg and Wilmer all helped individuals, particularly three or four people who arrived late.

We then did our joint "practical introduction" to the Cash Book and went over the first example with the calculator. By this time it was about 2.30 and they were pretty exhausted so we did not attempt any writing - in of answers, except in the cash book question. We publicized the Kavieng course on Saturday and I told my usual story about taking a plane to Moresby and getting one of our calculators from Steamships at K8.95 - or just buying one off us at K6.00.
We sold six calculators, four to the 20 women and two to the 9 men. This pleasing response had been almost entirely due to Menmen's enthusiasm; Greg was told that no one at either village had heard the Tok Save or the interview which he, Greg, had given and which had been broadcast twice.

We drove back to Fissoa (c 90 km from Kavieng) where we stayed the night with Apolonia, the past President and current Secretary of NIWIC, the "biggest" businesswoman (having 7 trucks) and one of the "two most respected women in the Province". She made us most comfortable and gave us delicious mumu-ed taro with the evening meal and tinned fish cooked with onion and rice for breakfast.

In the evening her son Richard in grade 7 bought a calculator and as he would be looking after the children instead of attending our course I gave him a lesson on his own, working through the whole of FCC 1 and 2 in about an hour. It was a pleasure to teach a keen and intelligent youngster and made me all the more keen to get a good calculator course into the schools. The sooner teachers appreciate the skill needed to use a calculator properly, as distinct from just being able to perform the basic operations, the sooner they will be willing to incorporate it into the curriculum and the sooner the "making them lazy" stupidity will be forgotten.

(17.12.81.)

7. MADINA & LEAFU, (Thursday)

We reached Madina just after 8 am, Apolonia and we having picked up various people in our trucks on the way. We had a delightful group with about 2 men and 13 women and, starting a little late with Mary's help 5 young Grade 6-8 lads whom the big man asked us to include. Apolonia estimated 9 non-schooled but this probably included 5 or 6 lookers only; there were probably about 3 with grades 1-5, 5 grade 6, 4 grade 7 - 9 and 4 grade 10.

With plenty of able students to help those who had difficulty we made excellent progress. The big man had difficulty in seeing the figures but persevered to the end. I did most of FCC1 in Pidgin (as in all our New Ireland courses) although we suspected that this was demanded as a courtesy rather than a necessity. Mary used English for her group of lads until they caught up with me. We did our usual joint Cash Book introduction, turning a big table on its end to provide an excellent blackboard. She had used reasonably difficult multiples of 10 in her example which only a few could add and subtract mentally, so we went through the whole example with the calculators as well. I then took them through the two FCC1 examples and they were just about exhausted by the time I finished them, about 10.30 am.
Everybody was very enthusiastic: we sold 5 calculators and took a group photograph.

We left for Laefu on the other side of the island which meant going 25 km back towards Kavieng, 10 km across the hills and then 15 km to Bolifu where Greg enquired of a trade store keeper and was told that a big funeral was on. We went another 20 km in torrential rain before enquiring again and finding we had overshot Laefu by 10 km so we returned to Laefu about 12.30 pm and found one man Leslie who assured us that everyone knew about the course but was at the funeral. The man they were "planting" had died the day before and there was no way anyone would be in a fit state to study numeracy. We therefore gave up and returned to Kavieng where we were glad to have time to get petrol and arrange to meet Saperi early the next morning.

I had met Lawrence, the Principal of Kavieng Fishery College earlier at the Club and mentioned that we were going to Djaaul Island on Friday. He pointed out that a local boat had foundered on the way there about this time last year (though Magdalena said it had been in September) and a few people had drowned. The son of a Djaaul Island planter joined in the conversation and said a trip in a fast motor boat had taken 5 hours instead of the expected 50 minutes and he had been very glad of his life jacket. Lawrence had then offered to lend us three life jackets for the trip so we were glad to be back in time to pick them up also. This was not so easy as they were not at the college nor at the waterfront, but on a boat some way from the shore. We left two of the staff and Greg at the jetty trying to attract the attention of those on board who had the only dinghy. When we returned someone else with an outboard had gone over and picked the jackets up for us.

Meanwhile we were further warned by a Yorkshire staff member at the College that it really was risky at this time of year. He was somewhat relieved however when we assured him we would be driving over to Kaut and waiting there till we were picked up by the islanders. They would presumably not take unnecessary risks and we did now have life jackets even if these would give little protection from sharks.

(8.12.81)

8. KAUT & SUMUNA (Friday)

We took the forestry road across the island until about 3 km from Kaut where we branched off along a village maintained road from which we could see Djaaul Island. We wished we had 4 wheel drive. We needed 4 attempts to reach the top of one hill with Mary and Saperi both pushing we must made it. Before the next steep hill down I decided it would be foolish to proceed so we walked down about 300 m to Kaut. The boat from Sumuna had not arrived and we were told it was unlikely to come: the island 12 km away was completely hidden by rain. I asked to see the Trade Store which purported to belong to the Womens' Fellowship, but a man opened it up and showed me the...
invoices. I checked a few mentally and found one where 2 dozen tins of Ideal Milk at K2.37 had been had been charged at K9.48 but when I checked the total it was less than it should have been anyway. I decided to fetch the calculator etc from the car and suggested we taught a class. They rang the church bell (a shell?) and people gradually gathered. Eventually we taught 26 people including 3 schoolchildren, 14 men and 9 women. Most had some schooling: 2 had grade 8.

We had worked through Fccl as far as giving change when the boat arrived from Sumuna. We did one more question, sold a calculator, took a quick photograph and got into the handsome 7m long canoe with Yamaha Enduro 25 outboard motor. We sat on boards in the bottom of the canoe. It travelled at a good speed, the spray spreading out finely from the vertically cut prow, part of the single trunk from which the canoe was cut. There was a fair swell but we shipped little water and our only worry was once when we appeared to strike a log of wood, but all was well. We saw several true flying fish a few centimetres above the surface. One travelled 20 or 30 metres touching the sea only once on the way and rising up to avoid the waves.

At Sumuna we were taken to the Pastor's house while the women came together. I found and talked to a group of men, showing them how the calculator could be used for finding change and checking an invoice.

We went to the (UC) Church to give the course and started with 6 women, 12 men and 2 boys. Another 7 women came later, making 27 people in all. We understood there about 4 grade 8 to 10 and 4 non-schooled. We completed the usual work with FCCL, all except the very last example. No one bought a calculator for about 5 minutes after that but 5 men bought them during the next half hour. We were offered a meal of sago (the first time for us) with greens and some tinned meat and were given a pineapple as a gift.

By now it was 2.30 pm and when we got to the boat we were told it was too rough to return. Instead we sat in the First Aid Post which was pleasantly clean and dry and I wrote up my report before settling down to read, not now expecting to be able to leave till morning.

However about 4.20 pm the boatman decided to try the crossing so we put our spectacles, watch, etc. into the brief case, packed that, like the calculators into big black plastic bags, donned our life jackets, said fond goodbyes to those we were leaving behind and set off. The wind had dropped but the swell was still heavy, coming at us from the port bow. Sometimes we went fast and sometimes slow, but we generally shipped water and always wondered just how much it took to capsize a 700mm wide 7m long canoe, and whether if it did capsize it would sink or float.

About a quarter of the way across the boatman decided to turn back. We were accompanied some of the way by a
school of big dolphins. On our return we were happy to change into dry clothes. The same friends brought us another delicious meal of greens fried in butter, with rice and to our astonishment produced an excellent mattress with super-clean sheets smelling of camphor. We slept well but were ready as planned to leave at 5 am. At 5.30 we were off and again had the company of twenty or so dolphins for part of the way. The rest of the time the boat went so fast we sat in a continual spray and saw nothing. Saperi paid the boatman on behalf of ILO and we reached the Club by 7.45 am in time to start the class at 9 o'clock. Gregg was there already in case we did not arrive and Magdalena came for the morning.

7 women and 2 men came, all of whom had been to classes before and most were interested in trade stores if not, running them. We did BAWE 2 on invoice checking and pricing then I did BAWE 4 with Apolonia. Richard and one other woman, the only ones concerned with a cheque account. They did this well but I noted that they could not subtract K2 from K455.86 in their heads. Meanwhile Mary did BAWE 3 with the rest. All were delightfully easy to teach having got over their initial difficulties in the village classes. One who arrived late had quickly caught up, with Mary's assistance. 4 had already bought calculators, 2 more did so.

Magdalena seemed pleased with the work and said she thought it should be continued; several had not had the money to buy calculators and others had not been able to come to the course so she bought 10 calculators (@ K5.50) and my remaining stock of BAWE for re-sale.

9. ARTIFACTS IN NEW IRELAND

We were struck by the lack of artefacts. The only ones we were offered for sale were a pair of painted sing sing batons (over-large for the average tourist), a very inferior and Sepik-type mask, a well made sago leaf handbag in Madina, some unsymmetrical mats with multicoloured wool tufts down the side and three fabric pots decorated with tiny shells and beads — one of which, shaped like a teapot, was offered to us for K25 although the maker had asked K55. The only artefact which seemed genuine and pleasing was given to us by Magdalene before we left. It consisted of a pair of place mats made of banana leaf materials dyed and woven on a traditional loom. This was the only example of genuine traditional weaving we had found in PNG. Magdalena said she had tried to encourage the work, which was done on one small island, but the women, who hold the weaving beam on their laps, get backache from it and do not seem interested in trying alternative procedures. They also underprice their products drastically and so do not feel the work is worth while. Magdalena had failed so far to persuade them to increase their prices.
10. THE NIWIC EMBLEM

The bird is the black Paradise Drongo from the Provincial flag, found almost exclusively in New Ireland. The word Pisin for bird also means business and refers too to the clans which have different birds as their symbols. The shell money is still used for bride price. The fruit in the bird's mouth is the 'fruit' of the labour which "yumi ken wokim". New Ireland society, Magdalena told us, is matrilineal, patrilocal and patriarchal; the traditional patterns are of course beginning to break down but it is unlikely that the change will favour women.

11. CONCLUSIONS

On Bougainville Copper Limited.

1. The idea of a "large project" company providing numeracy teaching to the local community as a service would have been good a few years ago but the present financial climate, the availability of Government Officers to provide the same service and particular reorganisation problems in BCL made the idea here inappropriate at this time.

On Calculator teaching generally

2. The belief still exists that teaching the calculator will destroy numerical skills that already exist. In the Papua New Guinean situation one may well ask "what skills?". But even in the Western world it is surely true that skills they continue to use when they have no calculator will be retained anyway. Thus in general "mental" skills are unlikely to be affected. "Paper and pencil" skills may well be slowed down, but this should easily be compensated for by the far greater skills that became available for the first time once the calculator is mastered.

3. The response of an intelligent Grade 7 student to calculator teaching was most pleasing. As a lesson in the application of mathematical laws it was highly significant. The commutative rule, the relation between x and +, negative numbers, the significance of "order of operation" and the use of the memory in this connection were all touched on in a single one-hour lesson. It must surely be possible to integrate such material into a genuine concept-based mathematical curriculum.

On the Use of the Business Arithmetic Workbook by BDOI

4. Evidence of the usefulness of the BAW course needs to be publicized. A draft questionnaire seeking information on this is in Appendix 7.

On Numeracy for Women

5. Treasurers of women's organisations need to be able at least to keep a cash book correctly. Other members need to know enough to understand that the cash book is
being kept correctly. They also need the skill so that they are available to become treasurers themselves if necessary. A wide knowledge of such skills is therefore desirable and each group should have at least one calculator available.

6. The number of women who will turn out for a course depends mainly on the strength of the local organisation. All those whom we taught expressed pleasure and interest in the course but few bought calculators, either because they had no money or because they saw no immediate use for them.

7. The First Calculator Course Unit 1 (FCCI) is just about right as a single lesson introduction for the generally well-schooled groups in New Ireland.

8. The FCCI course provides a sufficient introduction to make further teaching easy a few days later.

FOLLOW UP ON POPONDILLA COURSE, 11-14th MAY 1981
(see ANR 11.6-10)

Margaret Williamson, in a Christmas 1981 letter, reported that Doris Kaimina (Gr 5, cook at C.T.C.) "uses her calculator regularly I know. She often takes it to the market to add her purchases". Mark Nole (Grade 6, works at C.T.C.) "I think uses his 'personal one' for his personal needs". Augustine Sogiri (grade 5, works at C.T.C.) "has a daughter who isn’t very bright — got 0/10 for English and Maths — I gave him a lesson on using the calculator to teach his daughter the basic addition facts and suggested he plays these games of yours with her".
QUESTIONNAIRE FOR FIELD TRAINING OFFICERS & PROVINCIAL FINANCIAL ADVISERS.

1. Did you attend the Workshop at Laloki from 24th to 26th August, 1981?

2. Do you believe it is important to teach businessmen in your Province how to use the calculator properly?

   Reasons?

3. Do you believe that the Business Arithmetic Workbook is a suitable course for teaching businessmen the use of the calculator?

4. Have you yourself used the Business Arithmetic Workbook to train businessmen? if yes, please give details.

5. Have any of your B.D.O.s used the Business Arithmetic Workbook to train businessmen? if yes please give details.

6. Have you talked to any businessmen SOME TIME AFTER you or any other Business Development Officer has taught them to use the calculator? if yes please say whether they were taught individually or on a Course and what skills they learnt and are STILL USING. Please give as much detail as possible, including names of businessmen interviewed and the actual skills they still use.

   (continue on back if necessary)

7. (For F.T.Os) Have you trained any of your Business Development Officers to teach the Business Arithmetic Workbook to their clients?

   Number of B.D.O.s trained

   Number of B.D.O.s in Province

   Have you made any arrangements to do such training in the future?

   Have you been able to arrange for calculators to be sold to clients?

   Do you want any help to enable you to do so?

Whenever you run a course for clients using the Business Arithmetic Workbook and write a report on it, please will you let me have a copy? It will be most helpful.

Thank you for your cooperation

ALLEN EDWARDS
Numeracy Project
PO Box 1864,
Boroko.
TOKSAVE IN NEW IRISAND

The Manager
Radio New Ireland
P.O. Box 44
KAVINGI. NIP.

Dear Sir,

Dispele toksave igoo long olgata nemb ba iblon: New Ireland Women's
Investment Corporation, na long ol papa bilong ebon insait long
Tikana na Central New Ireland. Program bilong ol kos bilong Maim
Kekuleta, o nasin bilong wokim ol wok namba, bai olsem:-

Tundei namba 15 long 3 kilok long apinun, Gso long Hus Love.
Treadei namba 16 long 10 kilok long honing, Long Kones na long 1 kilok
long apinun, long Kafaf.
Fondei namba 17 long Honing long 8 kilok, Kodina, na long 1 kilok long
apinun long Lefu.
Fraidei Namba 18 kos baig stap long Samuna. Toksave ikena long Ofis
bilong Eiins Divalopment long Kavingi.

Napapela toksave ngoroch ol Baira bila bilong New Ireland Women's
Investment Corporation Menagers Saperi Killion i askin yupela long
redim gutpela kamp bilong ol grup long kos bilong Kekuleta na long
stap wantum long tuim bilong kos. Toksave ikena long Menagers
Saperi Killion.

G. Luka
Business Development Officer

ANR 18
APPENDIX 3

Samples of Materials produced by the Numeracy Project

CONTENTS

Laloki Commercial Mathematics Course, See 5.2
(The first calculator course produced by the Project)

List of items available: 17.7.81

Some exercises from the "ANC" series, See 5.10
Calculators in trade stores
The constant function on the calculator
Comparing prices
Pricing artefacts and services
Miscellaneous costs
Cattle project
Constant function problems
Cardomom Project
The use of the calculator for some standard nursing problems
Use of the calculator Elsimate EL-1114 for wholesale customers (A course written for the Steamships Trading Company by Mary Edwards, Training Officer)
The "First Calculator Course" (Unit 1), See 5.11 (written for use during 1-2 hour visits to villages)
The Business Arithmetic Workbook (Unit 5), See 5.12 (the "standard work")
Pasin Bilong Lukautim Buk Mani, See 3.5.7 ("method for looking after Book Money," the information sheet for the course put on by Jenny Fountain in 1982)
TO STUDENT

The answers are given under the line at the end of each question.

KEEP THE ANSWERS COVERED UNTIL YOU HAVE FINISHED THE QUESTION.

Check your answers.

When you find a deliberate mistake put a circle round it.

THE CALCULATOR

Using a calculator does not mean that all your answers will be correct! It is easy to press the wrong keys. The calculator can go wrong too: if it does, try a new battery first, if it still does not work correctly return it to the shop where you bought it (unless you have had it a long time or have misused it.)

When a calculator gives a wrong answer it is likely to be very wrong. So if you know the correct range for the answer you can usually spot when the calculator answer is wrong.

IN THIS COURSE WE SHALL ALWAYS ASK YOU TO FIND A RANGE OR A ROUGH ANSWER, WHENEVER YOU USE A CALCULATOR.

In finding the range or rough answer you must NOT use the calculator. You should always do it in your head if you can.

1. To find a possible range for the sum of a set of numbers, first total only the numbers in the first column: put any necessary O's after this total. This is the beginning of the range. Add 1 to the total for each of the numbers you are adding together. Put O's on again and this gives you the end of the range.
Examples

(1)  
435  
259  
96  
74  
182  

Range = 700 - 1200  

(2)  
5312  
671  
3056  
1894  
8408  

Range = 17 000 - 22 000

In example (1) the 4, 2 and 1 give 7 and they are in the hundreds column so the start of the range is 700. Count on from the 7 saying "8" for the 435, "9" for the 259, "10" for the 96, "11" for the 74, "12" for the 182; so the end of the range is 1200.

In example (2) 5, 3, 1 and 8 give 17, so the start of the range is 17 000. Count on from 17: "18" for 5312, "19" for 671, "20" for 3056, "21" for 1894, "22" for 8408; so the end of the range is 22 000.

Now use your calculator to add the numbers in example (1): you should get 1046. Check that this is in the range you found, 700 - 1200.

Use your calculator to add the numbers in example (2): you should get 19 341. Check that this is in the range 17 000 - 22 000.

Do the following similarly.

(a)  
291  
38  
705  
9  
420  

Range = .......... - ..........  

(b)  
7317  
284  
9095  
16  
2718  

Range = .......... - ..........  

By calculator: ..........  

By calculator: ..........
When you have decimals be careful to put the correct number of O's. Stop putting O's when you come to the decimal point.

Example:

\[
\begin{align*}
\text{Range} & = \ldots \ldots - \ldots \ldots \\
\text{By calculator:} & \quad \ldots \ldots \\
\end{align*}
\]

\[
\begin{align*}
65.34 & \\
712.57 & \\
54.48 & \\
\text{Range} & = \ 700 \ - \ 1000
\end{align*}
\]

\[
\begin{align*}
\text{(e)} & \ 4.39 \\
& \ 17.54 \\
& \ 32.16 \\
& \ 85.09 \\
\text{Range} & = \ldots \ldots - \ldots \ldots \\
\text{By calculator:} & \quad \ldots \ldots \\
\end{align*}
\]

\[
\begin{align*}
\text{(f)} & \ 45.79 \\
& \ 8.06 \\
& \ 302.15 \\
& \ 74.38 \\
\text{Range} & = \ldots \ldots - \ldots \ldots \\
\text{By calculator:} & \quad \ldots \ldots \\
\end{align*}
\]

\[
\begin{align*}
\text{(g)} & \ 435.71 \\
& \ 80.94 \\
& \ 873.15 \\
& \ 902.00 \\
& \ 576.32 \\
& \ 47.85 \\
\text{Range} & = \ldots \ldots - \ldots \ldots \\
\text{By calculator:} & \quad \ldots \ldots \\
\end{align*}
\]

\[
\begin{align*}
\text{(h)} & \ 1924.71 \\
& \ 8031.75 \\
& \ 3924.00 \\
& \ 63.65 \\
& \ 4231.76 \\
& \ 5555.21 \\
\text{Range} & = \ldots \ldots - \ldots \ldots \\
\text{By calculator:} & \quad \ldots \ldots \\
\end{align*}
\]
(a) 1300 - 1800, 1463
(b) 18,000 - 23,000, 19,430
(c) 30,000 - 90,000, 56,893
(d) 10,000 - 16,000, 12,092
(e) 120 - 160, 139.18
(f) 300 - 700, 430.35
(g) 2600 - 3200, 291.59
(h) 21,000 - 27,000, 23,731.08

(Did you find the deliberate mistake in one of the answers above, and did you draw a circle round it?)

When the numbers are given in line instead of in column you must think carefully which figures would be in the "first column" if the numbers were written in column.

Example:

$321 + 5170 + 25 + 1432$

Range = 6000 - 10,000

By calculator: 6948.

5170 and 1432 are the only numbers with "thousand" figures, so the start of the range is 6000. Count on "7" for 321, "8" for 5170, "9" for 25, "10" for 1432, giving 10,000 for the end of the range.

(a) 47 + 319 + 621 + 84
   Range = ...... - ......
   By calculator: ......

(b) 106 + 24 + 307 + 100 + 576
   Range = ...... - ......
   By calculator: ......

(c) 2030 + 70 + 1500 + 94 + 120
   Range = ...... - ......
   By calculator: ......

(d) 45.82 + 71.58 + 0.97 + 2.95 + 8.82
   Range = ...... - ......
   By calculator: ......

(e) 90.87 + 302.73 + 200.65 + 35.55 + 83.25
   Range = ...... - ......
   By calculator: ...........

(f) 80.57 + 133.38 + 90.22 + 457.25
   Range = ...... - ......
   By calculator: ...........

A319
To find the possible range when you are subtracting, first subtract the figures in the first column. Then look at the figures in the second column: if you are going to have to "borrow" or "regroup", reduce the figure you got from the first column by 1. Put the right number of 0's on and you get the start of the range.

To find the end of the range simply add 1 to the figure you had before, then put 0's on again.

Examples

(a) 9 - 3
(b) 8 - 2

8239
967
3714
232

Range = 4000 - 5000 Range = 700 - 800

In example 1, 8 - 3 = 5 but 7 is bigger than 2 so you must reduce the 5 to 4.

In example (2) 9 - 2 = 7 and 3 is smaller than 6 so you just get 700.

Do these similarly. Always check that your calculator answer is in the range you have found.

(a) 5684
(b) 985
(c) 8030
- 2985
- 453
- 1959

Range = - - - - Range = - - - - Range = - - - -

Calculator: - - - - Calculator: - - - - Calculator: - - - -

(d) 8 480 000
(e) 7.29
(f) 844.83
- 2 671 125
- 2.98
- 705.46

Range = - - - - Range = - - Range = - - - -

Calculator: - - - - Calculator: - - Calculator: - - - -
4. If there is no figure under the first figure of the top number you do not have to subtract anything from it. But you may still have to reduce it by 1 if the bottom figure in the second column is bigger than the top figure.

\[
\begin{array}{ccc}
\text{(a)} & \text{(b)} & \text{(c)} \\
42791 & 19.37 & 843.19 \\
- 8562 & -7.48 & -57.24 \\
\end{array}
\]

Range = ....... - ....... Range = .... - .... Range = .... - .... 
Calculator: ....... Calculator: ....... Calculator: .......

5. When the figures in the second column are the same, look at those in the third column. If they are the same too, look at the fourth column, and so on.

\[
\begin{array}{ccc}
\text{(a)} & \text{(b)} & \text{(c)} \\
8321 & 249.72 & 28.26 \\
- 4365 & -48.14 & -8.29 \\
\end{array}
\]

Range = ....... - ....... Range = .... - .... Range = .... - .... 
Calculator: ....... Calculator: ....... Calculator: .......

---

(a) 30000 - 40000, 34229 
(b) 10 - 20, 11.89 
(c) 700 - 800, 785.95
6. If the first figure comes to 0 the start of the range is just 0. The end of the range will be a 1 followed by the correct number of 0's to give it as many figures (before the decimal point) as in the top number.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>4324</td>
<td>(b)</td>
</tr>
<tr>
<td>- 3615</td>
<td>- 907</td>
<td>- 79 386</td>
</tr>
<tr>
<td>Range =</td>
<td>. . -</td>
<td>Range =</td>
</tr>
<tr>
<td>Calculator:</td>
<td></td>
<td>Calculator:</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(d)</td>
<td>46.31</td>
<td>(e)</td>
</tr>
<tr>
<td>- 37.28</td>
<td>- 4204.76</td>
<td>- 93.17</td>
</tr>
<tr>
<td>Range =</td>
<td>. . -</td>
<td>Range =</td>
</tr>
</tbody>
</table>

Calculator: | | Calculator: | | Calculator: |

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>0 - 1000, 709</td>
<td>(b)</td>
</tr>
<tr>
<td>(d)</td>
<td>0 - 10, 9.03</td>
<td>(e)</td>
</tr>
</tbody>
</table>

7. If there is no figure in the second column of the bottom number, treat it as if there were a 0 there.

Example: 3214 Treat as 3214
- 67 - 067
Range = 3000 - 4000

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>4719</td>
<td>(b)</td>
</tr>
<tr>
<td>- 28</td>
<td>- 147</td>
<td>- 2.91</td>
</tr>
<tr>
<td>Range =</td>
<td>. . . . .</td>
<td>Range =</td>
</tr>
</tbody>
</table>

Calculator: | | Calculator: | | Calculator: |
Here is a mixture for you to practise on.

(a) 4000 - 5000, 4691
(b) 20000 - 30000, 26036
(c) 100 - 200, 146.82

<table>
<thead>
<tr>
<th>(a) 615.72</th>
<th>(b) 8324</th>
<th>(c) 74298.15</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 49.31</td>
<td>- 6153</td>
<td>- 43173.27</td>
</tr>
</tbody>
</table>

Range = ... - ... Range = ... - ... Range = ... - ...
Calculator: ... ... ... Calculator: ... ... ... Calculator: ... ... ...

(d) 8.76
(e) 426153
(f) 967.31
- 7.59 - 27046 - 882.74

Range = ... - ... Range = ... - ... Range = ... - ...
Calculator: ... ... ... Calculator: ... ... ... Calculator: ... ... ...

(g) 6231
(h) 85.27
(i) 702
- 3279 - 15.14 - 4

Range = ... - ... Range = ... - ... Range = ... - ...
Calculator: ... ... ... Calculator: ... ... ... Calculator: ... ... ...

(j) 7624
(k) 31.64
(l) 8.63
- 3178 - 18.72 - 5.69

Range = ... - ... Range = ... - ... Range = ... - ...
Calculator: ... ... ... Calculator: ... ... ... Calculator: ... ... ...

L(1)
(m) 735,279
- 24,231

Range = 

(n) 106.95
- 93.17

Range = 

(o) 3,000
- 2,315

Range = 

(p) 61.37
- 31.74

Range = 

(q) 49.271
- 9,173

Range = 

(r) 8073.20
- 71.95

Range = 

(a) 500 – 600, 566.41
(b) 2000 – 3000, 2171
(c) 30,000 – 40,000, 31,124.88
(d) 1 – 2, 1.17
(e) 300,000 – 400,000, 399,107
(f) 0 – 100, 84.57
(g) 2000 – 3000, 2952
(h) 70 – 80, 70.13
(i) 600 – 700, 698
(j) 4000 – 5000, 4446
(k) 10 – 20, 12.92
(l) 2 – 3, 2.94
(m) 700,000 – 800,000, 711,048
(n) 0 – 100, 13.78
(o) 0 – 1000, 685
(p) 20 – 30, 29.63
(q) 40,000 – 50,000, 40,100
(r) 8000 – 9000, 8001.25

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DEPARTMENT OF COMMERCE NUMERACY PROJECT

LIST OF ITEMS AVAILABLE: 17.7.81

Note: items on the previous list dated 1.4.81 and now omitted, could still be reproduced if required.

BASIC NUMERACY

First Draft of Course submitted to Southern Highlands Literacy Committee. (see ANR 10).

Part 1: Without calculators.
Lessons 1-22: counting up to 20 objects, using the figures for adding two numbers totalling up to 20; subtracting 1, 2, 3 from numbers up to 20. (written May 1981).

Part 2: using number games on the calculator to learn number bonds as above, subtracting from 10 and change from a kina. (written late June 1981).

(Part 3 is likely to follow the lines of AND (see below))

Exercises and Tests for BN 1.

ADULT NUMERACY: DAY-BY-DAY

First draft in Pidgin, of course designed to be used in villages in a series of 1-hour lessons. Each day's exercises are on one side of A4 with Practice exercises on the back to be done between visits, each also revising the earlier work. (Written June 1981, see ANR 12).

AND 1

Totalling and finding change including multiple purchases (not mixing x and +); Cash Book balances and checking by totalling IN and OUT. (C) used at first but (CE) introduced at the end.

AND 2

Mixing x and + with purchases using memory where necessary; notes & coins slips, invoice checking.

AN 12 A326
AND 3
Each \( x \) number = total; Total ÷ number = each;
Total ÷ each = number, applied to money;
Pricing cargo; measuring in m/cm; comparing
and +, -, \( \times \), ÷ with lengths.

AND 1A/B/C
Three very similar tests on AND 1.

AND 2A/B/C
Three very similar tests on AND 2 and AND 1.

AND 3A/B/C
Three very similar tests on AND 3, AND 2, AND 1.

AND 1/2/3/A/B/C/T
Answer sheets for the above.

---

BUSINESS ARITHMETIC

BAW
First draft, in Pidgin, of Workbook designed for
teaching individual clients, particularly Trade

BAW 1
Unit 1: Totalling & giving change (+ & - only)

BAW 2
Unit 2: Invoice Checking.

BAW 3
Unit 3: Pricing Cargo (no freight)

BAW 4
Unit 4: Pricing Cargo (with freight)

BAW 5
Unit 5: Cash Book

BAW 6
Unit 6: Leakage Check

BAM 1
Memorandum, summarising the work (written June 1981,
see ANR 11).

BAWE
First English Draft of workbook, revising the
materials used in BAW above. (written early July

BAWE 1
Unit 1: Totalling and giving change. Multiple
Purchases. Mixing \( \times \) and \( \div \): use of memory.
All answers checked by working backwards. Use
of \( \text{RCH} \) twice for clearing memory.

AN 12
A327
<table>
<thead>
<tr>
<th>Unit 2: Invoice Checking and Pricing Cargo without freight.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 3: Pricing Cargo with freight: Part A dividing Total freight by number of cartons, Part B using freight as a % of cost, Part C multiplying weights by freight per kg (including decimal of a kg).</td>
</tr>
<tr>
<td>Unit 4: Cash Book and Bank Book: checking the balance by totalling IN and OUT; Cheque Account and Bank Reconciliation.</td>
</tr>
<tr>
<td>Unit 5: Leakage Check and Net Liquid Assets: Stocktaking with and without cartons in store-room; finding value of all stock sold in period. Estimating value of stock at cost adding cash and subtracting unpaid bills to find net liquid asset as a means of assessing the business.</td>
</tr>
</tbody>
</table>

**MISCELLANEOUS EXERCISES**

<table>
<thead>
<tr>
<th>Cross-totalling on an Analysis Sheet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ANCS 1.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revision Sheet: Finding Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ANCS 1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cross-Totalling on a table.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ANCS 1.6</td>
</tr>
</tbody>
</table>

Finding the change from K2, K5, ..., K30 for 2, 3, 4 items.

Four rows and six columns of money are totalled and the grand total checked using the memory.
Checking an Invoice
3 ANCS 1.7

Notes and Coins' Slips
3 ANCS 1.8

Number Games
3 ANCS 2.1

Simple totals and change without the calculator.
3 ANCS 2.2

Harder totals and change, without the calculator
3 ANCS 2.3

Test on Addition (1)
3 ANCS 2.5

Test on Addition (2)
3 ANCS 2.7

Weighing coffee/cocoa
3 ANCS 3.3

Timber Requirements
3 ANCS 3.4

The Clock
3 ANCS 3.5

Full instructions including correction of errors and two examples using the memory.

Examples of completed Notes and Coins slips, to be totalled using the memory.
(For blank forms see 6.2)

The way to use the calculator to practise +1, +2, -1, 10-, 100- etc are set out.

Totalling 2 or 3 multiples of 10t and giving change from K2.00 without the calculator.

Change from K1.00 or K2.00 for any number of toea and totalling two numbers of toea without the calculator.

57 questions testing +1, +2, and number bonds for 10 and 11.

57 questions testing addition of all pairs of single digit numbers.

It is intended that actual scales be used to demonstrate correct principles of weighing.
The exercise enables the prices of bags to be totalled using the memory.

Listing requirements for each size of wood, totalling the length with the memory and costing it.

This is a 6-page Self-paced unit teaching the time (o'clock, quarter past, 20 to etc.) and what it will be in 1, 2, 3, ½ and 1½ hours.
<table>
<thead>
<tr>
<th>Test on the Clock</th>
<th>Single sheet testing 3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calendar</td>
<td>A calendar is provided, dates asked in so-many days, weeks, fortnights and months. Days on given dates. USE BY dating. Numbers of days, weeks, fortnights between given dates. Numbers of Sundays in a month. Ages on given dates. Counting on the fingers encouraged. (Pidgin version written in April 1981)</td>
</tr>
<tr>
<td>Lengths &amp; Money</td>
<td>Measuring, comparing, totalling, differencing lengths of 4 sticks, 4 strings etc. Comparing, totalling, differencing 3 piles of money (written late April 1981, see ANR 10)</td>
</tr>
<tr>
<td>Finding Selling Prices</td>
<td>Finding SP given markup %, with and without freight (dividing total freight by number of cartons).</td>
</tr>
<tr>
<td>Finding Markup %</td>
<td>Finding markup % when the Selling Price is known (with freight only).</td>
</tr>
<tr>
<td>Stock Taking</td>
<td>Instructions are given for counting (by 1 ☺ ☺ ☺ ☺ ) and for counting by piles and cartons. The Value-if-all-sold is found using the memory.</td>
</tr>
<tr>
<td>Bank Book Test</td>
<td>This is a Mastery Test (AB223A) on use of Cheque Account and Reconciliation.</td>
</tr>
<tr>
<td>Length</td>
<td>Working in m/cm it reviews, with a calculator, the work in 3.8 and includes price per metre, the use of this to find cost of a given length of material, the length left over after making a number of garments from a given length, lengths and widths of numbers of plywood/fibro sheets and number required; similarly for corrugated iron.</td>
</tr>
</tbody>
</table>
Pricing Kaikai
3 ANCS 5.2
Costs are calculated by the "batch" using multiplying, halving, quartering, estimating and dividing. 80% is added for unpaid labour, profit etc.

Pricing Sewing
3 ANCS 5.3
Cost per metre is found and used to cost material for a garment etc. Costs of "extras", and "making" include labour and profit.

Local Distances and
PMV charges
3 ANCS 5.4
Charge per km is found in toea to 1 decimal place. 'Longer', 'shorter' and 'half-way' are identified. Proportion is used to estimate other charges.

Estimating Lengths
3 ANCS 5.5
Lengths are to be estimated in m/cm and judged on whether they are between half and twice the true length.

Comparing Prices
3 ANCS 5.6
Four pages include comparing costs by costing the bigger one at the price per gram of the smaller one, and finding the "savings".

and
3 ANCS 5.7
Three exercises involving miscellaneous problems.

The Constant Function.
3 ANCS 5.8
A single sheet summarises the use of the constant function for Number Games, Converting units (miles to km) and changing the maximum for a set of marks. (Intended for School Teachers.)

Calculation in Trade Stores
3 ANCS 5.9
A single sheet summarising the principles required by Trade Store keepers for correcting mistakes, totalling & finding change, checking invoices, finding selling prices and profit, stocktaking, net worth and leakage. (The last parts are now superseded.)

Wage Calculations
3 ANCS 5.10
Checking and correcting a Wage Sheet with deductions for tax and rent. (written late April 1981, see ANR 10)

AN 12
A331
Church Health
Services Form
3 ANCS 5.11

Pricing Artifacts
and Services
3 ANCS 5.12

Miscellaneous
Costs
3 ANCS 5.13

Cattle
Project
3 ANCS 5.14

Constant Function
Problems
3 ANCS 5.15

Plantation Areas
3 ANCS 5.16

Miscellaneous
Problems
3 ANCS 5.17

Cardamom Project
3 ANCS 5.18

Standard Nursing
Problems
3 ANCS 5.19

AN 12

Adding, subtracting and transferring figures
according to instructions on the form
(written late April 1981, see ANR 10)

Finding how long from one time to another
(to a quarter of an hour) multiplying by rate
per hour and adding other costs (written
May 1981)

Calculations involving costs of eggs, calculators,
printing, second-hand clothing, travel, lumber,
air freight and rice by the cupful. Conversion
from stock valued at SP to valuation at CP.
(written May 1981)

Calculating area, perimeter, numbers of posts,
lengths of wire, weights of staples, numbers of
head of cattle, sale of steers. Test on the
same. (written May 1981).

Conversion yds/m, kg/lb, K/$A and in reverse by
division. Adjusting school marks proportionally
(written May 1981).

Numbers of trees per hectare. (written May 1981).

Numbers of truck loads needed, finding the page
(or hymn number), giving a customer change.
(written May 1981).

Area of rectangle and conversion ha/m², numbers of
plants in a field, yield, number of workers needed,
selling the crop, (written June 1981, see ANR 12)

Calculating amount to draw up a syringe, numbers
that can be vaccinated with one viol, proportion
of IV fluid run in, drops per min. Use of (%) and
(M+) keys.
Certificate
3 ANCS 6.1

Notes & Coins
3 ANCS 6.2

Cash Sheet
3 ANCS 6.3

Stock Taking
3 ANCS 6.4

Bank Book Sheet
3 ANCS 6.7

Analysis Sheet
3 ANCS 6.8

Fixed Asset Valuation Sheet
3 ANCS 6.9

Trading Statement
3 ANCS 6.10

Balance Sheet
3 ANCS 6.11

Stock Control Card
3 ANCS 6.12

BLANK FORMS

Certificates for issue on completion of Adult Numeracy or Business courses.

Blank forms: see 1.8, printed both sides.

Blank forms: Two IN columns, 1 OUT and balance.
Instructions are on the back.

Blank forms.

Blank forms including space for Bank Reconciliations. Instructions are on the back.

Income for a Trade Store is analysed into 6 columns, expenditure into 11. Instructions are on the back.

As appropriate for a Trade Store.
Instructions are on the back.

Instructions on the back assume the use of 6.3, 6.4, 6.7, 6.8, 6.9.

Instructions on the back assume the use of 6.10.

Blank form for one item: see 4.11
### APPARATUS & CARDS

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calculators</strong></td>
<td>Sharp EL220 are sold on behalf of the Laloki College Canteen currently at the following prices:</td>
</tr>
<tr>
<td></td>
<td>By post - K6.00; by collection from Laloki - K5.50; for specified Adult Numeracy work - K5.00;</td>
</tr>
<tr>
<td></td>
<td>by special agreement to those undertaking to sell them at not more than K5.00 each as part of a</td>
</tr>
<tr>
<td></td>
<td>follow-up operation, K55.00 for 10, carriage paid.</td>
</tr>
<tr>
<td></td>
<td>(Scientific (EL508) calculators are also sold at K13.00 each)</td>
</tr>
<tr>
<td><strong>Metre Rulers</strong></td>
<td>In 50mm x 12mm plywood, marked in cm, labelled .01, .02, ..., .99 and polyurethaned.</td>
</tr>
<tr>
<td></td>
<td>Not generally for sale. Price on Adult Numeracy Courses 40t.</td>
</tr>
<tr>
<td><strong>Sum-Ten</strong></td>
<td>A game on a square card (256mm x 256mm) using counters marked 1, 2, 3, 4, 5, 6 and 7, drawn</td>
</tr>
<tr>
<td></td>
<td>on a similar square card ready for cutting out. Object is to get four counters in line totalling</td>
</tr>
<tr>
<td></td>
<td>10. 20t.</td>
</tr>
<tr>
<td><strong>Snap Cards</strong></td>
<td>There are four versions having cards showing sums or differences of single digit numbers,</td>
</tr>
<tr>
<td></td>
<td>(a) from 0 to 5, (b) from 6 to 10, (c) from 11 to 15, (d) from 16 to 19. Supplied as sets of 8,</td>
</tr>
<tr>
<td></td>
<td>10, 10 or 8 half squares, each to be cut into 5 cards.</td>
</tr>
<tr>
<td></td>
<td>30t</td>
</tr>
<tr>
<td><strong>Small Numerals</strong></td>
<td>Sets of numerals 0 to 20 on 63mm square cards, supplied as 3 half squares</td>
</tr>
<tr>
<td></td>
<td>20t</td>
</tr>
<tr>
<td><strong>Big Numerals</strong></td>
<td>Sets of numerals 0 to 10 on 193mm x 128mm cards.</td>
</tr>
<tr>
<td><strong>Adding up to 20</strong></td>
<td>Sets of number cards 2cm to 20cm long provide self-checking practice in adding numbers up to 20.</td>
</tr>
<tr>
<td><strong>Car Race Game</strong></td>
<td>Single sheet for game on track with spaces numbered 1-100</td>
</tr>
<tr>
<td></td>
<td>10t</td>
</tr>
</tbody>
</table>
REPORTS

Note all other reports can be copied if required: the following are readily available.

ASA

Arithmetical Skills of Adults in Papua New Guinea: A Subjective Enquiry (September 1980)

AN 2

Teaching Games with the Calculator (use of the constant function only).

AN 5 (part)


ANR 3

Report on Visit to Southern Highlands,
29 October - 8 November 1980.

ANR 4A


ANNL 1


ANR 10


ANR 11

Visit of Bryan Wilson, Mathematics Consultant of the British Council, Visits to Lae and Popondetta, 4 to 16 May 1981.

ANR 12

Visit to Morobe Province, 1-12 June 1981, also followup on Goroka and Nipa courses, etc.

ANNL 2


AN 12

List of Units Available, 17.7.81. (This list)

AN 12

List of Units Available, 17.7.81. (This list)

A335
CALCULATORS IN TRADE STORES.

1) Correcting Mistakes:
   If wrong no. has been pressed → press CE
   IF wrong sign (+, -, x, ÷) has been pressed → press right one.
   IF + or - has been pressed instead of ÷ or ×, press 0 ÷ or 0 ×.

2) Totalising and Finding Change:
   Item + Item + Item + ... + Item = TOTAL
   Cash offered = CHANGE.

3) Checking Invoices:
   OFF ON to clear memory, then:
   QUANTITY × PRICE (M+) → check extension
   at end: R.C.M → check grand TOTAL.
   N.B. To repeat a line: IF (M+) has been pressed, press M-.
     IF (M+) has not been pressed, press C.
   If there is any doubt, check grand total by adding extensions.

Pricing and finding Profit: if all sold, if NO FREIGHT COSTS

   Cost of carton ÷ No. in Carton ÷ Unit Cost Price (U.C.P.)
   Markup % → round up for maximum price.
   Write in Actual S.P. (selling price) then OFF ON and:
   Quantity × No. in carton × Actual S.P. (M+) → S.P. extension:
   check this is more than the extension on the invoice.
   When finished: R.C.M → TOTAL S.P. and:
   TOTAL on Invoice = Profit if all sold.

4) Cash Sheet:
   Balance ÷ IN items ÷ OUT items = Balance.
   Notes & Coins Slit; No. x Value (M+) Added (R.C.M) → TOTAL.

5) Stock taking:
   To count items press 1 @ then ÷ for each item.
   Piles on shelf: No. in pile × No. of piles + extras ÷ → No. on Shelf.
   Cartons in store: No. in carton × No. of cartons ÷ → No. on Shelf.
   OFF ON Then Marked Price × No. in stock (M+) and R.C.M → Value if all sold.

6) Net Worth and Leakage:
   Value of stock ÷ Total cash ÷ Net Worth if all sold.
   Net Worth last time ÷ = Actual Profit if all sold.
   Total Profit if all sold on each invoice ÷ other sales IN ÷ other OUT
   ÷ = What Profit if all sold SHOULD have been.

Net 5.9 ø Actual Profit ø → leakage. [Should be ZERO]
THE "CONSTANT FUNCTION" ON THE CALCULATOR

You can set the calculator by pressing any number, the same number.
Then whenever you press a number followed by = it will add the
number on to it. The calculator can be set for or in the
same way. If you set it for and press a bigger number it will give
the bigger number - the number it is set for, but if you press a
smaller number it will give the number it is set for - the smaller number
with a - after it.

Example:

A Teaching Games: Teach Yourself or Teach Someone Else

Set with 1 = 1 =. Press 7 and say "What is 7 + 1?" Anne & Press = and say
"And so on, pressing other numbers followed by = until they know how to add 1 to a number"

Set with 2 = 2 =. This teaches "adding 2". And so on for adding 3 etc.

Set with 1 = 1 =. This teaches "take 1 away from"

Set with 10 = 10 =. Press only numbers less than 10 and it teaches
"what makes a number up to 10"

Set with 100 = 100 =. Press any 2-digit number and it teaches how to
get "change from a kind"

Set with 2 = 2 =. This teaches the 2 x table. Similarly for other Times Tables

Set with 2 = 2 =. This teaches "halving"

Set with 10 = 10 =. This teaches "dividing by 10"

B Multiplying Many Numbers by One Number

Set the calculator by pressing the "One Number" = the same number.

Example 1: You have a lot of lengths in miles to convert into km.
1 mile = 1.61 km. So set with 1.61 = 1.61 =. Then put in each of the numbers of miles and pressing = will give the number of km.

Example 2: To change a set of marks out of one total to a set of marks out of another total. Suppose you have marks out of 60 and you want marks out of 80. Press 80 = 60 =. This tells you what the marks must all be multiplied by, in this case 1.3333333. So press 1.3333333 = on the calculator is set so that when you press a mark out of 60, pressing = will give you the mark out of 80. You should get the nearest
COMPARING PRICES.

To find what one packet would cost at the price per gram you pay for another:

Cost of one packet ÷ its weight in g → price per gram

× weight of other in g → what the other would cost

Exercise 1.

1. A small 190g tin of Sika Corned Meat Loaf cost 43t.
   What would a 340g tin cost (at the same price per gram)?....
   If it actually cost 63t, what is the saving?.....
   (you can press 63 $= $, or do it in your head)

2. 250g of Ajax cost 48t; what would 500g cost?.....
   If you can buy the 500g for 71t, what is the saving?.....

3. 440g of Edgell Green Peas cost 51t, what would 825g cost?....
   If the 825g cost 92t, what is the saving?.....

4. 50g of Nescafé cost 85t, what would 150g cost?.....
   150g cost 1.27: what was the saving?.....

You do not always save by buying a bigger packet. If the actual cost is MORE than what it *would* cost there is NO saving. You should buy the smaller ones!
5. 125 g of tea cost 37¢. What would 250 g cost? The 250 g packet cost 77¢. What was the saving (yany)?

6. 200 g of Milo cost 80¢. What would 375 g cost? The 375 g tin cost K1.30. What was the saving (yany)?

7. 175 g of Kellogg’s Rice Bubbles cost 75¢. What would 375 g cost? 375 g cost K1.31. What was the saving (yany)?

8. 235 g of Vegemite cost 92¢; 455 g cost K1.52. What would the big one cost at the price for the small one? What was the saving (yany)?

9. 425 g of Pear Halve, cost 50¢; 825 g cost 82¢. What would the big one cost at the price for the small one? What was the saving (yany)?

You can compare prices the same way if the packets are marked in ml (millilitres) or L (litres) or kg (kilogram) if both are marked in the same units.

10. 330 ml of Sunquick Orange cost 86¢; 840 ml cost K1.76. What would the big one have cost? What was the saving?

11. 150 ml of Ideal milk cost 21¢; 375 ml cost 33¢. What would the big one have cost? What was the saving?

12. 2 litres of Peanut Oil cost K5.14; 4 litres cost K9.58. What would the big one have cost? Saving?

13. 25 kg of OMO cost K2.21; 3 kg cost K4.96. What would the big one have cost? Saving?
Decide which is the SMALL one; find what the BIG one would cost at the price for the SMALL one. Decide if there is any saving, and how much.

14. Chum Dog Food

410 gm

48¢

Big one would cost

Savings?

15. Big one would cost

Savings?

16. Tanubada Icecream
Assorted Flavours

2 Lt

K1.95

17. Cadbury Dairy Milk
Chocolate

75 gms

Big one would cost

Savings?

V8. The Cheapest is Not Always the Best.

3 ANCS 5.6(3)
Remember: The CHEAPER one is NOT ALWAYS the BEST.
PRICING ARTEFACTS AND SERVICES

Exercise 1: How long?

Example: How long is it from 8 a.m. to 11.30 a.m.?
You should be able to use 2 different methods, and get the same answer each time.
Method 1: Count on, saying 8 a.m. (to yourself), 9 a.m., putting down one finger, 10 a.m., putting down another finger, 11 a.m., putting down another finger. Count the fingers down: 3 hours to 11 a.m.
11 a.m. to 11.30 a.m. is ½ hour. Answer 3½ hours.
Method 2: Subtract: 11 - 8 = 3 so it is 3 hours from 8 a.m. to 11 a.m. (You can press 8 @ 11 © instead if you like, on the calculator.)
11 a.m. to 11.30 a.m. is ½ hour. Answer 3½ hours.

1. 9 a.m. to 11.15 a.m.? ... hours (15 minutes is ¼ hour)
2. 10 a.m. to 12.30 p.m.? ... hours
3. 8 a.m. to 10.45 a.m.? ... hours (45 minutes is ¾ hour)
4. 2 p.m. to 5.30 p.m.? ... hours
5. 4 p.m. to 9 p.m.? ... hours
6. 1 p.m. to 5.15 p.m.? ... hours.
7. 3 p.m. to 4.45 p.m.? ... hours
8. 6 p.m. to 10.30 p.m.? ... hours.

N.B. Method 2 will not work when you go from a.m. to p.m. unless to use the 24-hour clock (as the airways do) and add 12 hours to the p.m. time first. You do not need to do this when you use Method 1.
9. 8 a.m. to 5 p.m.? .... hours
10. 10 a.m. to 1:30 p.m.? .... hours
11. 9 a.m. to 2:15 p.m.? .... hours
12. 8 a.m. to 3:45 p.m.? .... hours
13. 11 a.m. to 4:30 p.m.? .... hours
14. 12 noon to 2:45 p.m.? .... hours

If you do not start from an o'clock time you can still use either method to find how many hours it is to the same time past or to the hour. Then you must work out whether to add \( \frac{1}{4} \) or \( \frac{1}{2} \) or \( \frac{3}{4} \) hours to reach the time you want.

N.B. If the time past or to the hour at the end is less than the time past or to at the beginning, you must stop at the hour before the last one you want.

Examples:
A. 8:30 a.m. to 11:45 a.m.?
   Method 1: (8 to yourself) 9:30 one finger, 10:30 another finger
   11:30 another finger. 11:30 - 11:45 is \( \frac{3}{4} \) hour. Answer 3 \( \frac{3}{4} \) hour
   Method 2: 11 - 8 = 3, 11:30 to 11:45 is \( \frac{1}{2} \) hour. Answer 3 \( \frac{1}{2} \) hour
B. 7:45 a.m. to 10:00 a.m.?
   Method 1: (7:45 to yourself) 8:45 one finger, 9:45 another; then stop because 10:45 is too far for 10:00.
   9:45 to 10:00 is \( \frac{1}{2} \) hour; so answer is 2 \( \frac{1}{2} \) hour.
   Method 2: 9 - 7 = 2 so it is 2 hours to 9:45 a.m.
   9:45 to 10:00 is \( \frac{1}{2} \) hour; so answer is 2 \( \frac{1}{2} \) hour.

15. 7:30 a.m. to 11 a.m.? .... hours
16. 6:15 p.m. to 9:30 p.m.? .... hours
17. 4:45 p.m. to 8 p.m.? .... hours
18. 7:15 a.m. to 12 noon? .... hours
19. 8:30 a.m. to 11:45 a.m.? .... hours

3 ANCS 5.12 (2)
20. 9.15 a.m. to 11.15 a.m. ........ hours
21. 11.30 a.m. to 2.45 p.m. ........ hours
22. 10.45 a.m. to 3 p.m. ........ hours
23. 8.15 a.m. to 10.45 p.m. ........ hours
24. 11.15 a.m. to 5 p.m. ........ hours

Exercise 2: Pricing Services

When you are pricing a "service" (what you do for someone) you can find out how long it takes you and multiply the number of hours by the "rate" you could expect for doing 1 hour's work at the job.

This rate should include any profit you like to make. It will vary with the sort of work and how skilled you are at it.

A child in a village might say 20 toea per hour.
A woman doing sewing might say 50 toea per hour.
A skilled carver might say 80 toea per hour.
The minimum rural wage is 25 toea per hour.
The minimum urban wage is 50 toea per hour.
A qualified Community School teacher gets 250 toea per hour.

Example. Find the charge for 3½ hours at 50 toea per hour.
Press 3525 x 50 = giving 1762.

Find the charges for:
1. 2 hours at 25 toea per hour ........
2. 4 hours at 30 toea per hour ........
3. 7½ hours at 50 toea per hour ........ (2 is 55075 + 785)
4. 10¾ hours at 60 toea per hour ........ (4 is 2550 + 8025)
5. 12¾ hours at 80 toea per hour ........ (5 is 7555125 is 12275)
6. From 8 a.m. to 11.30 a.m. at 40 toea per hour ........
7. From 1 p.m. to 3.45 p.m. at 50 toea per hour ........

3 ANCS 5.12(3)
Exercise 3: Pricing Artefacts.

To find the price to charge you must add together the cost of the materials and the cost of your time.

Put each part of the cost in the memory of the calculator: \(	ext{R} \text{C} \text{M} \text{C} \) will then give you the total price to charge.

1. To make a bilum Martha bought 6 lots of thread at 10 toea each lot, and spent 13 hours making it at 50 toea per hour. Price: ...
   
   (Press \( \text{OFF} \ \text{ON} \ 6 \times 10 \ \text{M+} \ 13 \times 50 \ \text{M+} \ \text{RCM} \))

2. To make a necklace Paul bought a cup full of beads at 50 toea, which was enough for 8 necklaces, and a lot of nylon thread costing K1.50 which was enough for 40 necklaces. It took him 3 hours to make one necklace, at 30 toea per hour. Price: ...
   
   (Press \( \text{OFF} \ \text{ON} \ 50 \div 8 \ \text{M+} \ 150 \div 40 \ \text{M+} \ 3 \times 30 \ \text{M+} \ \text{RC} \))

3. It took Mary 4 hours travelling, at 30 toea per hour, and PMV fares of K2.50 to buy a bolt of material for which was enough for 15 dresses. She spent 3 hours at 60 toea per hour to make one dress and buttons for it cost K0.80. Price: ...

3 ANCS 5.12 (4)
MISCELLANEOUS COSTS

1. Eggs are sold at K1.70 per dozen. How much for
   (a) 2 dozen ........................................
   (b) 3 dozen ........................................
   (c) 5 dozen ........................................
   (d) 10 dozen .......................................
   (e) 1 dozen ........................................
   (f) 12 dozen .......................................

   Check your answers by using the 'Constant Function'.

2. Four-week old chicks cost K1.50 each.
   How many will I get for K20.00?
   How much will I actually have to pay for
   this number of chicks at K1.50 each?
   How much change will I get?
   If the price goes up to K1.70 each:
   How many will I now get for K20.00?
   How much change will I get?
   Check your answers by working back from your answer.

3. I bought 9 calculators from Store A for K171.
   In Store B I bought 5 calculators for K105.
   The calculators were exactly the same kind.
   Which store A or B, charged most?

   If I had bought all 14 calculators from
   haluki College for K8 each, how much would
   I have saved?

   Check your answers by working it out again.

4. Printing costs are worked out as follows:
   1.25 per sheet of paper. 404 per plate.
   Add 25% for other expenses. How much
   is charged for
   3,500 copies of
   3 sheets printed both sides. (This will need 6 plates)
   [You must find the cost of each part and put
   it in the memory. Then (RM) and add 25%]

   Answer: K

   Also find the charge for 950 copies of 4 sheets printed
   with 5.13(1) both sides and 1 sheet printed (side K)

   Check your answers by working it out again.
5. Duplicating charges are worked out as follows: £2.00 per 500 sheets, 10p per stencil and add 2.5%. In this case you will have to use proportion, that is, work out the price of 1 sheet and then multiply by the number of sheets you need. Find the charges for:
(a) 3500 copies of 3 sheets printed both sides,
(b) 950 copies of 4 sheets printed both sides and 1 sheet printed 1 side.
Check your answers by working it out again.

6. We bought the following second-hand clothes. Prices include freight from Australia etc.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Price per each</th>
<th>Total for 30% markup</th>
</tr>
</thead>
<tbody>
<tr>
<td>650 Skirts</td>
<td>416</td>
<td></td>
</tr>
<tr>
<td>1300 Summer Blouses</td>
<td>246</td>
<td></td>
</tr>
<tr>
<td>1000 Light-weight Jumpers</td>
<td>236</td>
<td></td>
</tr>
<tr>
<td>200 pairs Ladies shoes</td>
<td>364</td>
<td></td>
</tr>
<tr>
<td>300 Handbags</td>
<td>406</td>
<td></td>
</tr>
<tr>
<td>600 Paperback Books</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>500 Mens jackets</td>
<td>605</td>
<td></td>
</tr>
<tr>
<td>650 Mens trousers</td>
<td>406</td>
<td></td>
</tr>
</tbody>
</table>

Total cost of order ________

(a) Work out the total cost of the order (using the memory).
(b) Find the Selling Price for each item, given a 30% markup.
(c) Use the memory to work out the Total amount received if all goods are sold at the prices you have given.
(d) Find the total profit on the order if all goods are sold.
7. Fares to and from London cost £12. 00. When I am there I can buy 35 coconuts for 20t each and bring them all back on the plane. What must I sell each coconut for if I am just to cover the cost of the trip?

Find the total cost of the coconuts and add on the £12. 00. Divide by the number of coconuts to find the S. P. for each. Check by working back from the answer.

8. We usually do our stocktaking at Selling Price values. For tax purposes it is better to value them at Cost Price. If goods have been marked up at 10% the cost price can be found by reducing the S. P. by 9% (i.e. Selling Price = Cost Price - 9%)

If the value at Selling Price of some of these goods is £1173. 50, what is their value at Cost Price?

If the mark-up is 25% you must reduce the value at S. P. by 20% to find the value at Cost Price. If some of these goods are valued at £874. 90, find their value at Cost Price.

Similarly if the mark-up is 50% reduce by 33.3%. If the mark-up is 80% reduce by 44.4%.

Use the memory to find the total value at cost price of these goods:
- Markup 10%. Value at SP: £970. 60
- Markup 25%. Value at SP: £415.23
- Markup 50%. Value at SP: £764.21
- Markup 80%. Value at SP: £938.55

Total value at Cost Price: £...

Check by repeating the calculation.
9. You can find the value of a tree for lumber if you know the height of the trunk, the distance round the trunk about halfway up (called the "mean girth") and the price per cubic metre.

The value can then be found (approximately) by:

\[
\text{mean girth} \times \text{mean girth} \times \text{height} \div 12.6 \times \text{price per cubic metre}
\]

N.B. Since the price is per cubic metre the lengths must be put into the calculator in metres, using the decimal point if necessary, not in centimetres as usual.

Find the value of the wood in each of these trees and the total value of all the trees if the price per cubic metre is K85.00

A. Mean girth 1.35 m, Height 9.50 m K .......  
   \[\text{Value} = 1.35 \times 1.35 \times 9.50 \div 12.6 \times 85.00 \text{ K}\]
B. Mean girth 1.84 m, Height 7.43 m K ..........  
C. Mean girth 1.63 m, Height 5.62 m K ..........  
D. Mean girth 2.12 m, Height 13 m K ..........  
E. Mean girth 1.27 m, Height 4.83 m K ..........  

Check by repeating the calculation. Total Value K .........

10. I bought five artefacts from the people who made them for K3.00, K5.00, K3.50, K7.50, K4.20. What was the total cost price of all these goods K ..........

If I sell them at a mark up of 100% what do I sell each for? (Do it without the calculator if you can) K ......, K ......, K ......, K ......, K ......

3 ANCS 5.13 (4)  What is the total Selling Price? K .......

What is twice the Total cost Price? K .......
11. (a) If air freight costs 57 t per kg plus an airway basic charge of K2.00 find the total freight cost for 2kg. (Do the multiplying first then add the K2.00, otherwise you will have to use the memory.) K

(b) If the freight is 89 t per kg plus K2.00 basic what is the freight cost for 3kg? K

(c) If the freight is K1.19 per kg plus K2.00 basic what is the freight cost for 17kg? K

2. Children (between 2 and 12 years of age) are charged half fare. Students are charged 3/4 fares.

   Two quarters make a half. Two halves make a whole.

   Four quarters make a whole.

If the fare from Mosby to Mendi is K102.00 find the cost of
(a) Three whole and one quarter fare (Press 102.00 \times 3 \times \frac{1}{4})

(b) 2 whole and one half fare ......

(c) 3 whole and 2 quarter fares ......

(d) 5 whole and 3 quarter fares ......

(e) 1 whole, 1 half and 1 quarter fare ......

(f) 2 whole and 2 half fares ......

(g) 3 quarter fares ......

(h) 7 half fares ......

(i) 6 quarter fares ...........

(j) 1 whole return fare (multiply by 2) ......

(k) If the single fare is K65.00 what is the cost of 1 whole and 1 half fare? ...... (singles)

(l) If the single fare is K87.00 what is the cost of 1 whole and 1 half return fares? ......

(m) If the single fare is K93.00 find the cost of 3 whole and 2 half return fares ......
13. Sometimes (in contracts) freight charges are in decimals of a tonne. If so you must use the decimal point. The answer is in tonnes as usual.
(a) Freight is 7.5 tonnes per kg. Find the charge for 295 kg.
(b) Freight is 8.3 tonnes per kg. Charge for 7325 kg. K...
(c) Freight is 9.5 tonnes per kg. Charge for 52,000 kg. K...
(d) Freight is 7.8 tonnes per kg. Charge for 1 tonne (= 1000 kg) is K...

Freight is charged at 27 tonnes per kg. The carton cost K13.58 in the bulk store.
(a) What is the Landed Cost (Freight + Price) K...
(b) What is the Cost Price for each tin? ...
(c) With a 30% mark up, what is the Selling Price?

15. A 25 kg bag of rice costs K9.29. You are going to sell it in cupfuls. 26 cupfuls of rice weigh 3 kg.
(a) To find how many cupfuls you will get out of the 25 kg sack you can use "proportion" like this:
No. of cupfuls you know about (3) ÷ the weight of these ...
No. of cupfuls you want to know about (x) ........ cupfuls.
(b) Check this by doing it another way:
If 3 kg makes 26 cupfuls how many will 1 kg make?
If 1 kg makes this number of cupfuls what will 25 kg make? .... (Use the number you got on the calculator)
(c) What is the cost of 1 cupful? .......
(d) If you add 10% to this for the Selling Price, what do you get? ........
(e) What will you get this way by selling the whole bag? K...
(f) What would the profit be on this one bag? ........
(g) If you have sold 38 cupfuls how many cupfuls will be left? ........
CATTLE PROJECT

Exercise 1
1. Field A
   \[ \text{560m} \quad \text{435m} \]
   \[ \text{560m} \]
   Field B
   \[ \text{7320m} \quad \text{8190m} \]
   \[ \text{7320m} \]

If your block of land is this shape (a rectangle), you can find its area in hectares by:

\[
\text{length} \times \text{breadth} \div 10,000 \Rightarrow \text{area in hectares}
\]

So, the area of Field A is: \[ \text{hectares} \]

The area of Field B is: \[ \text{hectares} \]

To find areas of other shaped fields, you will need a proper survey map.

Field C
\[ \text{1982m} \quad \text{1750m} \]
\[ \text{3125m} \quad \text{3040m} \]
\[ \text{2315m} \]

Field D
\[ \text{827m} \quad \text{535m} \]
\[ \text{250m} \quad \text{586m} \]
\[ \text{395m} \quad 484m \]
\[ 421m \]

2. The "Perimeter" is the distance all the way round a field, to find the perimeter you add all the sides together.

   Perimeter of Field A = \[ \text{m} \]
   Perimeter of Field B = \[ \text{m} \]
   Perimeter of Field C = \[ \text{m} \]
   Perimeter of Field D = \[ \text{m} \]

3. Small posts (or iron "pickets") are needed every 4m, so you can find the number needed by dividing the perimeter by 4. But you should get some spare ones, so add 5% for this. So the rule will be:

   \[
   \text{Perimeter} \div 4 + 5\%
   \]

   Number of small posts needed for Field A = \[ \text{dots} \]
   Field B = \[ \text{dots} \]
   Field C = \[ \text{dots} \]
   Field D = \[ \text{dots} \]

3A1 C5 14 1
4. Big strainer posts are needed every 100 m and also at every corner. You will have to count the number of corners by looking at the pictures on page 2.

To find the number of big posts use:
Perimeter + 100 + number of corners
(Round up, to the number 1 more than you get by forgetting everything after the decimal point.)

Number of big posts needed for Field A

Field B

Field C

Field D

5. If you need 4 strands of wire for the fence you must multiply the perimeter by 4 to find the length of wire needed. If the wire comes in 400 m rolls you must then divide by 400 to find the number of rolls needed. Add 5% for safety and round up as in question 4. So you will use:

Perimeter x 4 x 400 + 5% and round up.

Number of rolls of wire needed for Field A

for Field B

for Field C

for Field D

6. If you have 4 strands of wire you will need 4 staples for each post, and add 5% for safety. So use:

Number of small posts + number of big posts + 5%.

Number of staples needed for Field A

for Field B

for Field C

for Field D

7. Staples are sold in boxes of 50 kg or 25 kg. To find the weight of staples needed you must divide the number you want by the number you get in 1 kg. (To find this you can weigh out 1 kg and count them.) To find the number of boxes you need you must divide the weight by the weight in 1 box. So use:

Number of staples needed + Number of staples in 1 kg + Number of kg in 1 box

Then round up. If they are 25 kg boxes and you get 3 50s

3 ANCS 5.14 (2) for 1 kg find the number of boxes for Field A

Field B

Field C

Field D
8. The number of head of stock you can carry depends on the quality of the grass. Suppose you can have 3 cattle per hectare, then use: area \( \times 3 \)
Number of cattle you can have in field A ...........
in Field B ........... in Field C ........... in Field D ...........

9. You will have to reduce your stock before the dry season begins. If it is now February, how many months is it till June? (Don't count February)
If it is now May, how many months is it till December?
If it is now November, how many months is it till May?

10. Suppose the butcher will give you K4.25 per kg dressed weight. How much money will you get for each of the following steers and how much will you get altogether (you could use the memory for this):
Dressed weight: 95 kg: K ........... 137 kg: K ........... 243 kg: K ........... 98 kg: K ........... 112 kg: K ...........
Total cash for all 5 steers: K ...........
Check this by working out: Total dressed weight: kg
How much for this weight at K4.25 per kg: K ...........

Exercise 2
This will test whether you understood Exercise 1.
These questions are all like those you had in Exercise 1 but the numbers are different. Look back at the question in Exercise 1 with the same question number to find how it was done there.

Field E: 157 m
Field F: 157 m

1. Area of Field E: .......... hectares
3. How many small posts if they are placed 3 m apart and you add 10% for safety:  
Field E:  
Field F:  

4. How many strainer posts placed every 80 m and at every corner for Field E, Field F:  

5. You are going to put 3 strands of wire. The wire comes in 400 m rolls. How many rolls will you need if you add 5% for safety: Field E:  
(Round up)  
Field F:  

6. If you have 3 strands of wire and add 5% for safety how many staples will you need: Field E:  
Field F:  

7. Suppose you get 400 staples per kg and a box contains 50 kg. How many boxes for E:  
Field F:  

8. If you can carry 4 head of stock per hectare, how many cattle can you have: Field E:  
Field F:  

9. If the dry season begins in May and it is now December, how many months have you in which to reduce your stock?  

10. If you get K.10 per kg dressed weight what will you get for each of these steers, and the total:  
Dressed weight: 113 kg: K: 390 kg: K: 154 kg: K: 88 kg: K:  
Total cash for all 4: K:  
Check: Total weight of 4 steers: K:  
Total cash for this total weight: K:  

3ANCS 5.14(4)
CONSTANT FUNCTION PROBLEMS

1. If you want to multiply a lot of numbers by the same number you can "set" the calculator (as in Number Games) by pressing: the number ÷ the number ÷. Then when you press any other number and ÷ you will get this number x the number the calculator is set for.

To convert yards into metres you must multiply by 0.914. So set the calculator by: 0.914 ÷ 0.914 ÷ (do not forget the decimal point)

Fill in the metre equivalents for the following, writing them with 2 figures after the decimal point.

2 yards = ........ m. 3 yards = ........ m. 10 yards = ........ m.
17 yards = ........ m. 24 yards = ........ m. 100 yards = ........ m.
220 yards = ........ m. 440 yards = ........ m. 500 yards = ........ m.
1760 yards = ........ m. 1½ yards (1.5) = ........ m. 4½ yards = ........ m.
3½ yards (3.25) = ........ m. 2½ yards = ........ m. 1½ yards (1.75) = ........ m.

1 lb = 0.454 kg so to change pounds into kg you must multiply by 0.454. Set your calculator for multiplying by 0.454.

Fill in the kg equivalents for the following, writing them with 2 figures after the decimal point.

3 lb = ........ kg. 14 lb = ........ kg. 28 lb = ........ kg.
112 lb = ........ kg. 2240 lb = ........ kg. 2½ lb = ........ kg.
12½ lb = ........ kg. 9½ lb = ........ kg. 4½ lb = ........ kg.

£1 K1.00 = £1.2905, set your calculator to multiply by 1.2905. Work these in kina, i.e. use the decimal point and write the answer with 2 figures after the decimal point. When you are working in kina you can miss out .00 with 5.00 etc.

3 ANCS 5.15 (f)
3. (Cont.)

\[ \begin{align*}
K\ 3.00 & = \$A_1 & K\ 10.00 & = \$A_1 & K\ 9.50 & = \$A_1 \\
K\ 13.75 & = \$A_1 & K\ 184.50 & = \$A_1 & K\ 47.03 & = \$A_1 \\
K\ 500.00 & = \$A_1 & K\ 2000.00 & = \$A_1 & K\ 6000.00 & = \$A_1
\end{align*} \]

With whole numbers of kg, you use the numbers as they are, and give answers to these big numbers in the same way, forgetting anything after the decimal point. Example: \( K\ 7588 = \$A\ 9792 \)
\( K\ 4360 = \$A_1 \quad K\ 21,000 = \$A_1 \quad K\ 1,500,000 = \$A_1 \)

4. You can set the calculator to divide by a number similarly by pressing: the number \( = \) the number \( \div \).
To convert metres back into yards you divide by 0.914.
Set your calculator and do these (include decimal points):
\[ \begin{align*}
5 \text{ m} &= \ldots \text{ yards} & 100 \text{ m} &= \ldots \text{ yards} \\
17.31 \text{ m} &= \ldots \text{ yards} & 500 \text{ m} &= \ldots \text{ yards}
\end{align*} \]
To convert kg back into lb you divide by 0.454.
Set your calculator and do these:
\[ \begin{align*}
3 \text{ kg} &= \ldots \text{ lb} & 10 \text{ kg} &= \ldots \text{ lb} & 17 \text{ kg} &= \ldots \text{ lb} \\
4.23 \text{ kg} &= \ldots \text{ lb} & 9.13 \text{ kg} &= \ldots \text{ lb} & 1.38 \text{ kg} &= \ldots \text{ lb}
\end{align*} \]
To convert \( \$A \) back into Kina, divide by 1.2465 (approximate)
\[ \begin{align*}
\$A\ 5.00 &= \text{ K} & \$A\ 46.53 &= \text{ K} & \$A\ 14.84 &= \text{ K} \\
\$A\ 71.34 &= \text{ K} & \$A\ 310.00 &= \text{ K} \\
\$A\ 7000 &= \text{ K} & \$A\ 124,000 &= \text{ K}
\end{align*} \]

Give these with whole number of K as in question 3.
\[ \begin{align*}
\$A\ 7000 &= \text{ K} & \$A\ 124,000 &= \text{ K}
\end{align*} \]

5. If school marks are out of 40 and you want them out of 85, work on
85 \( \div \) 40 \( \div \). Then multiply by what you get. Set your
calculator and change these marks out of 40 into marks out of 85
39 out of 40 \( \rightarrow \) out of 85; 21 \( \rightarrow \) out of 85; 7 \( \rightarrow \)
40 \( \rightarrow \); 23 \( \rightarrow \); 5 \( \rightarrow \);

6. Use the same method to change marks out of 80 into marks
out of 50 (work out 50 \( \div \) 80 \( \div \)) and set your calculator.
32 out of 80 \( \rightarrow \) out of 50; 65 \( \rightarrow \) ; 24 \( \rightarrow \) ;

3 ANCS 5.15 (2) 46 \( \rightarrow \) A357 80 \( \rightarrow \)
1. Find the areas of these two rectangular fields. Use \[ \text{length} \times \text{breadth} \to \text{area in m}^2 \text{(square metres)} \]
\[ \odot 10000 \odot \to \text{area in hectares} \]

Field A: \[ \ldots \ldots \text{m}^2 = \ldots \ldots \text{hectares (with 0.\ldots)} \]

Field B: \[ \ldots \ldots \text{m}^2 = \ldots \ldots \text{hectares} \]

2. Find the area of field C in hectares.
\[ \text{(use } \frac{\text{area in m}^2}{10000} \rightarrow \text{area in hectares}) \]

Find the area of field D in m².
\[ \text{(use } \text{area in hectares} \times 10000 \rightarrow \text{area in m}^2 \text{)} \]

3. Cardamom may be planted 2 to 3 m apart in rows, 2 to 3 m apart. You can find the area needed by one plant by:
\[ \text{distance apart} \times \text{distance between rows} \rightarrow \text{area needed by one plant} \]

If they are 2 m apart in rows, 2 m apart, area per plant:

- 3 m
- 2.5 m
- 2 m

\[ \text{Area, in hectares, of one plant} \]

Write the full answer with the decimal point.
4. **You can find the number of plants in a field by:**

\[
\text{Area of field in } m^2 \Rightarrow \text{area needed by 1 plant} \Rightarrow \ \ \ \ \rightarrow \ \text{number of plants in the field.}
\]

Find the number of plants in Field A if they are 2 m apart in rows 2 m apart (use answers to 1a and 3) ........

Find the number of plants in Field B if they are 3 m apart in rows 3 m apart ................

Find the number of plants in Field C if they are 2 m apart in rows 3 m apart ............... (use 2a and 3) - note

Find the number of plants in Field D if they are 2.5 m apart in rows 2.5 m apart .............

5. **A healthy plant will produce about 0.2 kg per year. How much will you expect from the plants in Field A (question 4)? ....... kg.**

\[\text{Number of plants} \times \text{weight from each} \Rightarrow \text{total weight} \]


6. **A man can pick about 4 kg a day. How much will he pick in 5 days? ....... How much in a fortnight (10 days)? ....... How much in a year (20 fortnights)? .......**

\[\text{Number of days} \times \text{weight per day} \Rightarrow \text{total weight} \]

Can you expect 1 man to pick all the cardamon produced in Field A in one year? (kg/yr) .......

Field B? .......... Field C? ........ Field D? ........

How many men would you need to pick all the cardamon from Field B? .......... (Use: \[\text{Number of kg to pick} \times \text{Number picked by man}\]

7. **If Cardamon is sold at K5.00/kg, how much will you expect to sell the crop from Field A for? ....... Field B? ....... Field C? ....... Field D? .......**

If you have to pay each man K714.00 a year to pick Field B....

\[\text{Number of plants} \times \text{weight of each plant} \times \text{price per kg} \Rightarrow \text{total money earned} \]

\[\text{Number of men} \times \text{cost per man} \Rightarrow \text{total cost} \]

\[\text{Money earned} - \text{Total cost} \Rightarrow \text{Net income} \]

\[\text{ANCS 5.18(2)} \Rightarrow \text{how much will you have left?} \ldots \ldots \ldots \ldots \]
THE USE OF THE CALCULATOR
FOR SOME STANDARD NURSING PROBLEMS

I. The doctor orders 15mgms of Omnopon I.M.I.
The ampoule of Omnopon contains 20mgms in 2mls.
How much shall I draw up?

CALCULATOR: Press 15 ÷ 20 × 2 = Answer 1.5mls.

EXPLANATION: "What you want" ÷ "what you have" gives you the number of mgms (strength).
This (strength) × the amount of fluid in ampoule (stock) gives you the amount of fluid you must draw up.

Ia. Dr. orders 7.5mgms Ampoule contains 10mgms/ml
CALCULATOR: Press 7.5 ÷ 10 × 1 = Answer 0.75mls
N.B. You could have missed out the × if you wished.

2. The vial of Gamma Globulin contains 10mls.
The dose ordered for each child is 0.5ml.
How many children can I vaccinate with one vial?

CALCULATOR: Press 10 ÷ 0.5 = Answer 20 children.

EXPLANATION: "What you have" (stock) ÷ "what you want" (dose per child) tells you the number of doses of 0.5ml you can get from the 10ml vial.

2a. Dose per child is 0.4ml Vial contains 5mls.
CALCULATOR: Press 5 ÷ 0.4 = Answer 12.5 children.

3. 1000mls of L.V. fluid is ordered to run in over 8 hours.
How many mls will the patient have had after 3 hours?

CALCULATOR: Press 1000 ÷ 8 × 3 = Answer 375mls.

EXPLANATION: No. of mls of fluid ÷ no. of hours gives the no. of mls through in one hour.
This ÷ the no. of hours it has been running gives you the no. of mls the patient has had.

3a. 500mls in 4 hours. How much in 1 hour?
CALCULATOR: Press 500 ÷ 4 × 1 = Answer 125 mls.
4. 500mls in 4 hours. Giving sat administers 15 drops per ml. How many drops per minute?

**CALCULATOR:** Press 500 + 4 + 60 x 15 = Answer 31 drops.

**EXPLANATION:** No. of mls of fluid + no. of hours gives the no. of mls of fluid through in 1 hour.
This + 60 gives the no. of mls of fluid through in 1 min.
This x 15 gives the no. of drops in 1 minute.

a. 1000mls in 24hrs. Rate as above. How many drops per minute?

**CALCULATOR:** Press 1000 + 24 + 60 x 15 = Answer 10 drops.

---

**SOME NOTES ON THE SHARP EL8158 CALCULATOR**

1. The calculator switches itself off automatically after 4 minutes without use and it is claimed the batteries last 10000 hours.

2. If you make a mistake and press the wrong number, press CE and then the whole of the right number. If you make any other mistake it is best to press AC and start again.

3. To find 79% of 137: Press 137 x 79% =
To find 84 as a % of 193: Press 84 + 193 =
To increase 53 by 10%: Press 53 + 10 =

4. The M+ key is useful for totalling bills:
   E.G. 7 at £1.45 plus 13 at £0.67 plus 1 at £49.50.
   Press: 7 x 1.45 M+ 13 x 0.67 M+ 49.5 M+
   Then press M- and you get the total bill: £68.36
   N.B. If you have been using the memory and want to start again, Press OFF then ON to clear everything.

Refer to the booklet that came with the calculator for further suggestions.

A361
USE OF CALCULATOR ELSIMATE EL-1114 FOR WHOLESALe CUSTOMERS.

1. Goods on the shelves are marked with Retail Price.
   \[ R/P = \text{Retail Price} \]
   This is the price an ordinary customer pays.

2. The trade, and those who buy in bulk, and some customers about whom your Manager will tell you pay Wholesale Price.
   \[ W/P = \text{Wholesale Price} \]

3. When you look up prices in the files, be sure that you know whether you get the W/P (Wholesale Price) or R/P (Retail Price).

4. When you write out a bill for a Wholesale Customer the W/P must be on the bill.

5. If you only know the Retail Price, find the Wholesale Price on the calculator.

6. Work out the whole bill on the calculator, using the Memory for the total.

7. IF YOU ARE NOT SURE WHETHER THE PRICE YOU HAVE IS RETAIL OR WHOLESALE ASK YOUR SUPERVISOR OR MANAGER.

USE OF CALCULATOR: Put Decimal Switch on 2 and Power Switch ON.

This is how you find W/P. Put R/P on calculator. Press \( \boxed{20} \% \).

The W/P will be shown.

Example: R/P of Spade is K10.95.
Press 10.95 \( \boxed{20} \% \).
You should now see 8.76.

Try these for yourself:

<table>
<thead>
<tr>
<th>R/P</th>
<th>W/P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>6.50</td>
</tr>
<tr>
<td>Hammer</td>
<td>4.70</td>
</tr>
<tr>
<td>Screwdriver</td>
<td>1.30</td>
</tr>
<tr>
<td>Wheel Barrow</td>
<td>80.75</td>
</tr>
</tbody>
</table>
This is how you write your docket.

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Wheelbarrows</td>
<td>50.40</td>
<td>403</td>
</tr>
<tr>
<td>16</td>
<td>Spades</td>
<td>4.16</td>
<td>66</td>
</tr>
</tbody>
</table>

This is how you work it.

R/P of Wheelbarrow  K63.00
R/P of Spade        K5.20

Enter K63.00. Press \( \text{\(\%\)} \) 20 \( \text{\(\%\)} \). You should see 50.40. Enter this under Price. Press \( \times \) 3 \( \text{\(\%\)} \). You should see 403.20\(^M\). Enter this under Amount.

Now enter 5.20. Press \( \text{\(\%\)} \) 20 \( \text{\(\%\)} \). You should see 4.16. Enter this under Price. Press \( \times \) 16 \( \text{\(\%\)} \). You should see 66.56\(^M\). Enter this under Amount.

Now press \( \text{\(\%\)} \). This means Recall Memory. You should see 469.76\(^M\). This is the total. Enter it in the proper place. Now press \( \text{\(\%\)} \). Has the small \( M \) gone? If so, the Memory is now clear.

Repeat this, trying not to look at the instructions.

Now try this. The R/P of these goods are:

- Cement         K6.00
- 3" Pipe        K37.80
- Nails          K0.80 Kg.

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Bags Cement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3&quot; Pipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Kg. Nails</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOW PRESS \( \text{\(\%\)} \) to Clear Memory.

A363
Here is another.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; Chisel</td>
<td>3.25</td>
</tr>
<tr>
<td>½&quot; Chisel</td>
<td>1.55</td>
</tr>
<tr>
<td>Large Screwdriver</td>
<td>4.75</td>
</tr>
<tr>
<td>Small Screwdriver</td>
<td>1.30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Hammers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1&quot; Chisels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>½&quot; Chisels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Large Screwdrivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Small Screwdrivers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HAVE YOU PRESSED CM?  
Sometimes there is ONE ONLY OF ONE ITEM. This is how it is done.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumbo Wheelbarrow</td>
<td>80.75</td>
</tr>
<tr>
<td>Cement</td>
<td>6.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wheelbarrow</td>
<td>64.60</td>
<td>64 60</td>
</tr>
<tr>
<td>2</td>
<td>Cement</td>
<td>5.20</td>
<td>10 40</td>
</tr>
</tbody>
</table>

Put in 80.75. Press - 20 %. 5.20 is the Price.  
Enter 64.60 as Price and Amount.  
Enter 6.50 - 20 % 5.20 is the Price.  
Press x 2 5.20. Enter 10.40 as Amount.  
Press +. Enter 80.75 as total.  
Press CM to clear Memory.
Now do this one.

1 only Wheelbarrow R/P K48.50
7 Cement R/P K6.00

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PRESS CM.

Sometimes you have already been given the W/P. If all the prices are W/P, just work out the answers, using the Memory, but no percentage reduction is necessary.

You would do it like this.

2 Wheelbarrows U/P K38.80
4 Spades U/P K8.76

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Wheelbarrows</td>
<td>38.80</td>
<td>77  60</td>
</tr>
<tr>
<td>4</td>
<td>Spades</td>
<td>8.76</td>
<td>35   04</td>
</tr>
</tbody>
</table>

Enter 38.80 × 2 AN. Put 77.60 as Amount.
Enter 8.76 × 4 AN. Put 35.04 as Amount.
Press RM. Enter 112.64 as Total. Press CM.

ALWAYS REMEMBER TO PRESS CM WHEN YOU HAVE FINISHED.
Now we come to some complications. Sometimes you have the R/P of some goods and the W/P of others. BE CAREFUL.

Look at this one.

<table>
<thead>
<tr>
<th>Product</th>
<th>W/P</th>
<th>Price</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumbo Wheelbarrow</td>
<td>64.60</td>
<td>64.60</td>
<td></td>
</tr>
<tr>
<td>Spade</td>
<td>10.95</td>
<td>10.95</td>
<td></td>
</tr>
<tr>
<td>Screwdriver</td>
<td>2.95</td>
<td>2.95</td>
<td></td>
</tr>
<tr>
<td>Chisel</td>
<td>1.24</td>
<td>1.24</td>
<td></td>
</tr>
</tbody>
</table>

First, write out the docket, entering those W/P that you know. This will help you to keep it all right.

Then proceed thus.

Wheelbarrows - Enter result in AMOUNT.
Spades - Enter Price \( \times 4 \) \( \text{M+} \).
Screwdrivers - Enter Price \( \times 8 \) \( \text{M+} \).
Chisel - Enter AMOUNT.

Press (RM) for Total. Enter this. Press (CM) to cancel Memory.

Do these for yourself. Notice that some prices are Wholesale, and some are Retail. THINK.

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Only Jumbo Wheelbarrow</td>
<td>R/P</td>
<td>80.75</td>
</tr>
<tr>
<td>2</td>
<td>Spades</td>
<td>W/P</td>
<td>8.76</td>
</tr>
<tr>
<td>8</td>
<td>Bags Cement</td>
<td>W/P</td>
<td>5.20</td>
</tr>
</tbody>
</table>

A366
<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 Large Screwdrivers</td>
<td>R/P 4.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 Medium Screwdrivers</td>
<td>W/P 2.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 1&quot; Chisels</td>
<td>R/P 3.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 ½&quot; Chisels</td>
<td>R/P 1.55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 Hammers</td>
<td>R/P 4.70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Large Screwdrivers</td>
<td>R/P 4.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 Medium Screwdrivers</td>
<td>R/P 2.95</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 Small Screwdrivers</td>
<td>R/P 1.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Jumbo Wheelbarrow</td>
<td>W/P 64.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18 Bags Cement</td>
<td>W/P 5.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Kg. Nails</td>
<td>R/P 1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7 Spades</td>
<td>R/P 8.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Shovel</td>
<td>R/P 7.50</td>
<td></td>
</tr>
</tbody>
</table>
First press 29 + 29 + 29 is called TIMES
Then press 29 x 3. Same answer?

First press 56 + 56 + 56 + 56 + 56 + 56 + 56
Then press 56 x 4.

Exercise 1. Totalling in a Trade Store

Write answer as 1,2,26.

Check your answer with 23 + 87 + 16.

Check with 70 + 49 + 34.

4. DO NOT press the point.

Check as usual.

Exercise 3. Finding Change, is called MINUS

Check the change by pressing 50 + 30 = 100.

Check: First Balance + Total - Out = Final Balance.

Note the CE key. If you press a wrong number just press CE then press the right number. If you press CE you don't have to start again, but if you have pressed a sign (+ or x or ÷) the CE will not work. Try it and see!

Date | In | Out | Balance
--- | --- | --- | ---
2.7.81 | Brt Feed | | 13.95
2.7.81 | Sales | 54.60 | ..... 
3.7.81 | Work Boy | 12.00 | ..... 
4.7.81 | Cargo | 48.26 | ..... 
4.7.81 | Freight | 6.50 | ..... 
4.7.81 | Sales | 57.91 | ..... 

Calculators - K8.00 each, posted free from N.E.D.C. Project, Box 1864, Port Moresby. Tel. 281060/281064. Send cash, cheque, postal order or ILPOC.
UNIT 5: LEAKAGE & NET LIQUID ASSETS
The BUSINESS ARITHMETIC WORKBOOK consists of:

- Unit 1: TOTALLING & FINDING CHANGE
- Unit 2: CHECKING INVOICES & PRICING WITHOUT FREIGHT
- Unit 3: PRICING WITH FREIGHT
- Unit 4: CASH BOOK & BANK BOOK
- Unit 5: LEAKAGE & NET LIQUID ASSETS

Copies of this Workbook can be obtained from the Numeracy Project, Laloki College, P.O. Box 1864, BOROKO, Papua New Guinea (telephone 281060/281064) for 20 toea per unit (K1.00 for the set of 5), post free.

Trainer's Notes and Memo Sheets are also available.

Calculators (Sharp EL-220) can be purchased from the same address at K6.00 each, post free.

These are the prices at 25.8.81 and might change in the future.

TEXT:
Allen Edwards
Numeracy Project, Dept. of Commerce

LAY-OUT, ILLUSTRATIONS & COVER:
Kirsten Karanfilovic
ILO/UNDP Project for Small-Scale Enterprises and Entrepreneurship in the South Pacific

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UNIT 5: LEAKAGE & NET LIQUID ASSETS

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--- | ---
1    | Leakage check
2    | One week later
6    | Two weeks later
8    | Three weeks later
10   | Four weeks later
13   | Net Liquid Assets
LEAKAGE CHECK

If you do not want to lose money from your store you must find out whether or not you are getting the right amount of money from your sales.

If the value of the cargo that goes out of your store is K500 and you take K499 in sales money you do not need to worry. But if the value of the cargo that goes out is K500 and the money you take is only K400 you will quickly go bankrupt if you do not do something about it.

The only way to know what is happening is to do a Stocktake frequently. If you use a calculator this does not take too long. It is good to look over all your stock regularly anyway: piles of dusty goods at the back of the store do not make money for you. If you cannot sell them as they are reduce the price and put them in the front of the store.

This is how you do a stocktake with a calculator.
Count the number of tins of Fish in each of the piles on the top shelf here. There should be 5. Press 5 on your calculator.

Count the number of piles. There should be 7. Press \( \times \) 7 \( = \). There are 35 tins in these 7 piles.

There are also 2 "extra" tins. Press \( + \) 2 \( = \).

Write the answer in this list after "Fish".

Do the Rice similarly:

- How many piles? Press \( \times \) 3
- How many extras? Press \( + \) 2 \( = \)

Write the answer on the list.

Do the Meat similarly: if you do not get 28 find your mistake.

You can just count the Milo. Use the calculator for the rest, or just count them if there are only a few.

2. ONE WEEK LATER: 8. 6. 81

You have kept your Cash Book carefully so you can find out how much money you have taken in Sales since last time.

You must also know how much new cargo you have brought into the store since last time: your invoices should show you that.

Then you must do another stocktake to find out how much cargo has gone out of the store, either sold or stolen.
LEAKAGE CHECK: DATE: 8/6/81

<table>
<thead>
<tr>
<th></th>
<th>Number Last Time</th>
<th>New Cargo</th>
<th>Number Now</th>
<th>SP</th>
<th>Value of Cargo that went out of store</th>
</tr>
</thead>
<tbody>
<tr>
<td>FISH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RICE</td>
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<td>MEAT</td>
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<td>BISCUITS</td>
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<td>SOAP</td>
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<tr>
<td>MATCHES</td>
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</tr>
<tr>
<td>SUGAR</td>
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</tr>
</tbody>
</table>

Total Value of all Cargo that has gone out of the store. (RCM) (RCM)

Cash taken in Sales

LEAKAGE (Money lost)

First copy the numbers from the last stocktake (question 1) into the first column of this table: "Number Last Time".

Now enter the New cargo which has come into the store since last time. Suppose you got:

24 Milo, 48 Coke, 25 Rice, 30 Sugar, 48 Fish.

Write these in on the correct lines in the column headed "New Cargo".
Now take stock again as before.

For the Fish press 3 \( \times \) 3 \( \pm \) 1 \( \equiv \) and write the answer under "Number Now" opposite Fish. For the Rice press 4 \( \times \) 5 \( \pm \) 1 \( \equiv \) and so on to the end.

The selling Prices are marked up beside the goods. Fill them in in the column headed "SP".

Now you have to work out the value of all the goods that have gone out of the store since last time.

Press 37: this is the number of tins of Fish you had at the beginning of the week.

Press \( \pm \) 48 \( \equiv \): this adds on the numbers you brought into the store. If you had none left now this would have been the number that went out: 85?
Press ⬇️ 10 ⬆️: but you had 10 left. These did not go out of the store so you must take this number away to find out how many did go out: .75?
Press ⬪ 42 ⬆️: this is the value of the 75 tins of Fish that went out of the store: K31.50? Write this in the column headed Value of Cargo that went out of store.
Press ⬇️+: this will put the K31.50 into the memory so that you will be able to find the total value at the end.

Do the Rice in the same way except that you do not need to press the ⬇️ at all:
Press 14 (what you had at first) ⬇️ 25 (new cargo) ⬆️ 21 (what did not go out) ⬪ 40 (giving the value) ⬇️+: Write what you get in the Value column: K7.20? (If you did not get 720 press ⬇️- and do the line again).

Carry on similarly: the sign at the top of the column will remind you each time: for the Meat press 28 ⬇️ 22 ⬪ 65 ⬇️+: it should come to K3.90, the Milo should come to K14.45, the Biscuits to K3.40 and so on. When you have finished the Sugar ⬇️: Write in the total where it says "Total Value of all Cargo".

Now you must check this total by adding the "extensions" together: 3150 ⬆️ 720 ⬆️ 390 ⬆️ 1445 and so on to ⬆️ 3740 ⬆️. (If you do not get the same total make a note of the new one and go on adding them up till you get the same answer twice then write that in.)

Note: It is really better to check by doing the whole calculation again, using the memory as before.

Suppose your Cash Book shows that sales since last stocktake totalled K109.65. Write this in the space for "Cash taken in "Sales".

If this figure is less than the value of the cargo that went out of the store then you have lost money. To find how much you have lost press ⬇️ 10965 ⬆️ and fill in the answer as "LEAKAGE".
You should get K8.10: this could be because money has been stolen, or because goods have been stolen, or given away, or sold for less than the marked price or too much change may have been given.
If you have reduced the price on any goods since last time (perhaps because you could not sell them) this will give you a "Leakage" equal to the reduction in price times the number of items.

If you give credit, the credit amount given will appear as a leakage and any credit amount collected will make the leakage smaller. (It could even mean that the "Cash taken in Sales" was more than the "Total Value of all Cargo that has gone out of the Store").

3. TWO WEEKS LATER: 15, 6, 81

<table>
<thead>
<tr>
<th>LEAKAGE CHECK: DATE: 15/6/81</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>New Cargo</td>
</tr>
<tr>
<td>Last Time</td>
<td>+</td>
</tr>
<tr>
<td>FISH</td>
<td></td>
</tr>
<tr>
<td>RICE</td>
<td></td>
</tr>
<tr>
<td>MEAT</td>
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<td>MILO</td>
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<td>BISCUITS</td>
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<td>COKE</td>
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<td>SOAP</td>
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</tr>
<tr>
<td>MATCHES</td>
<td></td>
</tr>
<tr>
<td>SUGAR</td>
<td></td>
</tr>
<tr>
<td>Total Value of all Cargo that has gone out of the store</td>
<td>RCM</td>
</tr>
<tr>
<td>Cash taken in Sales</td>
<td></td>
</tr>
<tr>
<td>LEAKAGE (Money lost)</td>
<td></td>
</tr>
</tbody>
</table>

A379
Fill in the "Numbers Last Time". They were the "Numbers Now" on 8/6/81 in question (2). Copy these figures from the Leakage Check in question (2) on page 3: Fish 10, Rice 21 and so on (NOT Fish 37, Rice 14: they were from the time before).

Suppose the new cargo was: 50 Rice, 60 Sugar, 48 Biscuits, 96 Fish. Fill these in the correct lines in the "New Cargo" column.

Use your calculator to take stock as before using the pictures below. Fill in the "Number Now" and "Selling Price" columns.

Use your calculator as before to find each "Value of Cargo that went out of Store" and total these using the Memory. Check with + and =, or by repeating the whole calculation.

Suppose the Cash Book shows the Cash taken in Sales was K104.67. Write this in and work out the LEAKAGE. Do you think this amount of Leakage is serious?
4. THREE WEEKS LATER: 22. 6. 81

<table>
<thead>
<tr>
<th>Item</th>
<th>Number Last Time</th>
<th>New Cargo (+)</th>
<th>Number Now (-)</th>
<th>SP (x)</th>
<th>Value of Cargo that went out of store (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FISH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RICE</td>
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<tr>
<td>SUGAR</td>
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</tbody>
</table>

Total Value of all Cargo that has gone out of the store (RCM × RCM)

Cash taken in Sales (-)

LEAKAGE (Money lost) (-)

Fill in the "Numbers Last Time". They were the "Numbers Now" on 15/6/81 in question (3) on page 6, (starting Fish 25).

Suppose the New Cargo was: 48 Meet, 24 Milo, 60 soap, 96 Coke. Fill in these on the correct lines.
Use the pictures below to fill in the "Numbers Now", and the SP.

Complete the LEAKAGE CHECK as usual, making sure you get the same answer twice for the total value of all cargo that has gone out.

Suppose the Cash taken in Sales was K61.08. Fill this in. Is the Cash taken less than the value of the goods that went out of the store? (If the cash taken is more than the value of the goods you have either made a mistake, or marked up one of the prices or too little change has been given or some money has been put in the Till that did not come from Sales.)

Find the LEAKAGE. Is this amount serious?
OUR WEEKS LATER: 29.6.81

<table>
<thead>
<tr>
<th>LEAKAGE CHECK: DATE: 29/6/81</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number Last Time</strong></td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>FISH</td>
</tr>
<tr>
<td>RICE</td>
</tr>
<tr>
<td>MEAT</td>
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<tr>
<td>MILO</td>
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<td>BISCUITS</td>
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<td>COKE</td>
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<tr>
<td>SOAP</td>
</tr>
<tr>
<td>MATCHES</td>
</tr>
<tr>
<td>SUGAR</td>
</tr>
</tbody>
</table>

Total Value of all cargo that has gone out of the store (RCM) (RCM)

Cash taken on Sales

LEAKAGE (Money lost)

Fill in the "Number Last Time" column using the "Number Now" figures from Question (4) for 22.6.81 on page 8.

Suppose the New Cargo was 144 Fish, 100 Rice, 192 Coke, 864 Matches, 120 Biscuits, 24 Meat. Fill these in.

This time we are going to count the cargo which is on the shelves first then add on the cargo that is still in cartons in the storeroom. So write the numbers from the pictures on the next page in small figures in the "Number Now" column so
that you can cross them out later when you add on what is in
the storeroom. This is what you found in the Storeroom:

This is what you found in the Storeroom:

- Fish: 48 x 15 oz
- Rice: 20.25 kg
- Biscuits: 20 x 225 g
- Milo: 85 t
- Canned goods
- Matches: 5 t
- Sugar: 1 kg
For the Cokes: you have one crate of 24: add this to the number you had on the shelf, cross out the old number and write in the new.

For Fish you have 2 cartons with 48 in each and there were 14 on the shelf so press: $48 \times 2 + 14 =$. Cross out the 14 and write this answer.

For the Rice you have three 25kg sacks waiting to be parcelled up into 1kg lots. Press $25 \times 3$, add on the number you had on the shelf, cross that number out and write in the new one.

For the Biscuits you have 3 cartons of 20 and some extra packets: count these extra ones in the picture on the previous page. Press $20 \times 3$ then add these extra ones in the Store room, then add those on the shelf. Cross out the old number and write in the new.

Be careful with Matches. They may cause a fire! They also came in packets of a dozen (12) boxes and in cartons each holding 12 of these packets of 12! Press $12 \times 12 =$. This gives you 144, the number of boxes in a carton. 144 is called a "gross".

Look at the picture on the previous page. You have 5 cartons and 4 boxes. You will have to use $\times$ twice so you will have to use the memory or it will give the wrong answer. Press $144 \times 5 \text{ M+}$: this puts the number of boxes in the cartons into the memory. Now press $12 \times 4 \text{ M+}$: this puts the number of boxes in the packets in the memory. Add on the number of boxes on the shelf by pressing this number and $\text{ M+}$. Find how many boxes altogether with $\text{ RCM} \text{ RCM}$: cross out the old number and write in the new.

Find and check the Total Value of all cargo that has gone out.

Suppose the Cash taken in Sales was K117.75: find the LEAKAGE.

Have you any comment on the answer?
6. NET LIQUID ASSETS

To find what profit your business is making you have to take account of any "fixed assets" you have, like a building or a truck. Your Business Development Officer will help you work out accounts like that, but you can do the most important part of it yourself by working out your NET LIQUID ASSETS. If you do not have any "fixed assets" or loans, this will enable you to work out your profits yourself.

Your NET LIQUID ASSETS are the total of all the money you have plus the value of all your stock minus any unpaid bills. The form below will help you to work it out.

<table>
<thead>
<tr>
<th>NET LIQUID ASSETS AT 8/6/81</th>
</tr>
</thead>
<tbody>
<tr>
<td>FISH ..........................</td>
</tr>
<tr>
<td>RICE ..........................</td>
</tr>
<tr>
<td>MEAT ..........................</td>
</tr>
<tr>
<td>MILO ..........................</td>
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<tr>
<td>BISCUITS ..........................</td>
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<tr>
<td>COKE ..........................</td>
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<td>SOAP ..........................</td>
</tr>
<tr>
<td>MATCHES ..........................</td>
</tr>
<tr>
<td>SUGAR ..........................</td>
</tr>
</tbody>
</table>

Fill these in by: Number Now

Check from the Leakage
Check

Check the Total
Using + and =
or repeating the calculation

Total Value at Selling Price (RCM) (RCM) ..........................

Approximate Value at Cost (\(\pm\)) 15 3 ..........................

Cash in Till +
Cash in Safe +
Cash at Bank +

Less Bills not yet paid (\(\pm\)) ..........................

NET LIQUID ASSETS (\(\pm\)) \(K\) ..........................

Turn back to the LEAKAGE CHECK in Question (2) page 3. Find the
columns labelled "Number Now" and "SP": they start with 10 and 42 for the Fish. Press 10 ± 42 M+ and fill in the K4.20 on the form on page 13.

Look at the Rice, press 21 ± 40 M+ and fill in the K8.40 on the form on page 13. Continue till you reach the end then press RCM RCM and fill in the Total Value at Selling Price.

Now you must check this by totalling the amounts as usual using + ... + ... and =, or preferably by doing the whole calculation again, using the memory as before. If you do not get the same answer do it again until you do get the same answer twice. Fill that in.

What you have found is the value of your stock "at Selling Price". But it is not really worth that till you have sold it. The true value is what it cost you. Your Business Development Officer may be able to help you find the Value at Cost more accurately, but if you subtract 15% from the Value at Selling Price you will not be far out.

So press ± 15 ± and fill in the "Approximate Value at Cost" (forget the "bit of a toed" after the decimal point). Suppose you have K20.00 in the Till: write this in on the form and press + 2000. Suppose you have K59.86 in the Safe: write this in on the form and press + 5986. Suppose you have K325.48 in the Bank (your Bank Book will tell you how much you have): write this in on the form and press + 32548. Suppose you have a bill for K173.56 for Cargo which you have not paid yet: write this in on the form and press ± 17356.

Then press = and fill in the answer, your NET LIQUID ASSETS (again miss out anything after the decimal point.)

Now start again from the Total Value at Selling Price, press ± 15 ± + 2000 + etc till you get to the end. If you do not get the same result as before do it again till you have the same answer twice: fill that in.
7. Turn to the Leakage Check for Question 3; on page 6: find the "Number Now" and "SP" columns. Press 25 \( \times \) 42 \( \text{M} \)\( + \), write the answer in the form below and continue as before till you have completed the form. We have filled in the Cash and Bills for you.

Remember to check the Total Value at Selling Price and the NET LIQUID ASSETS, and just forget the figures after the decimal point.

<table>
<thead>
<tr>
<th>NET LIQUID ASSETS AT 15/6/81</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fill these in by:</strong></td>
</tr>
<tr>
<td>Number Now</td>
</tr>
<tr>
<td>( \times ) SP ( \text{M} )( + )</td>
</tr>
<tr>
<td>from the Leakage Check</td>
</tr>
<tr>
<td>Check</td>
</tr>
<tr>
<td>Check the Total</td>
</tr>
<tr>
<td>Using ( + ) and ( - )</td>
</tr>
<tr>
<td>or repeating the calculation</td>
</tr>
</tbody>
</table>

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FISH</td>
</tr>
<tr>
<td>RICE</td>
</tr>
<tr>
<td>MEAT</td>
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<tr>
<td>MILO</td>
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<td>BISCUITS</td>
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<tr>
<td>SOAP</td>
</tr>
<tr>
<td>MATCHES</td>
</tr>
<tr>
<td>SUGAR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Value at Selling Price ( \text{RCM} ) ( \text{RCM} )</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Approximate Value Cost ( - ) 15 ( \times )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash in Till ( + )</td>
</tr>
<tr>
<td>Cash in Safe ( + )</td>
</tr>
<tr>
<td>Cash at Bank ( + )</td>
</tr>
<tr>
<td>Less Bills not yet paid ( - )</td>
</tr>
<tr>
<td>NET LIQUID ASSETS ( = )</td>
</tr>
</tbody>
</table>

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( = ) ( \times ) 20.00</td>
</tr>
<tr>
<td>( + ) ( = ) ( + ) 186.25</td>
</tr>
<tr>
<td>( + ) ( + ) ( + ) 140.32</td>
</tr>
<tr>
<td>( - ) ( = ) ( = ) 41.36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NET LIQUID ASSETS</th>
<th>( = )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( = ) 41.36</td>
<td>( = )</td>
</tr>
</tbody>
</table>

Are the NET LIQUID ASSETS at 15/6/81 bigger than they were on 8/6/81 in the last question? How much bigger? Use the \( = \) on the calculator and fill in the answer below:

NET LIQUID ASSETS went UP by \( K \) \( = \) \( = \) from 8/6/81 to 15/6/81.
8. Turn to the LEAKAGE CHECK in Question (4) on page 8. Complete the form below in the same way as in question 7.

NET LIQUID ASSETS AT 22/6/81

Fill these in by:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FISH</td>
<td></td>
</tr>
<tr>
<td>RICE</td>
<td></td>
</tr>
<tr>
<td>MEAT</td>
<td></td>
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<td>MILO</td>
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<td>BISCUITS</td>
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<td>SOAP</td>
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</tr>
<tr>
<td>MATCHES</td>
<td></td>
</tr>
<tr>
<td>SUGAR</td>
<td></td>
</tr>
</tbody>
</table>

Check the Total
Using + and -
or repeating the calculation

Total Value at Selling Price (RCM)

Approximate Value at Cost (-) 15

Cash in Till (+) 38.14
Cash in Safe (+) 236.19
Cash at Bank (+) 8.54
Less Bills not yet paid (-) NIL

NET LIQUID ASSETS (=) K.

Are the NET LIQUID ASSETS at 22.6.81 more or less than they were on 15.6.81.

How much more or less? (use - but start again without the figures after the decimal point.)

Do you think this is serious?
9. Turn to the LEAKAGE CHECK in Question 5 on page 10 and use it to complete the form on below.

<table>
<thead>
<tr>
<th>NET LIQUID ASSETS AT 29/6/81</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill these in by:</td>
</tr>
<tr>
<td>Number Now</td>
</tr>
<tr>
<td>X SP M+</td>
</tr>
<tr>
<td>from the Leakage Check</td>
</tr>
<tr>
<td>Check</td>
</tr>
</tbody>
</table>

Check the Total using + and -

Total Value at Selling Price (RCM) (RCM)

Approximate Value at Cost + 15 #

Cash in Till +   20.00
Cash in Safe +   45.38
Cash at Bank +   324.69
less Bills not yet paid - 31.76

NET LIQUID ASSETS = K

Are the NET LIQUID ASSETS more or less on 29/6/81 than they were on 22/6/81? ....................................

How much more or less? .......................
If you know about graphs you could plot points on the one below to show what your NET LIQUID ASSETS have been. The points should be joined together by straight lines.

NET LIQUID ASSETS

<table>
<thead>
<tr>
<th>DATES</th>
<th>ASSETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/6/81</td>
<td></td>
</tr>
<tr>
<td>15/6/81</td>
<td></td>
</tr>
<tr>
<td>22/6/81</td>
<td></td>
</tr>
<tr>
<td>29/6/81</td>
<td></td>
</tr>
</tbody>
</table>
HUSAT INAP LONG WOKIM DISPELA KOS?

1. Dispela kos bai i kamap long tok Pisin, olsem na man o meri bilong tok Inglis o tok Pisin i ken wokim.

2. Dispela kos em i bilong helpim man o meri i mekim wok insait long sios bilong yumi, olsem:
   - man i lukautim mani bilong sios
   - man i lukautim mani bilong Baibel Skul,
   - man i lukautim mani bilong literasi
   - man i lukautim mani bilong Kristen Senta,
   - man o meri i lukautim mani bilong medikal,
   - man i lukautim mani bilong komuniti skul,
   o arapela man o meri i wok insait long sios bilong lukautim mani.

WOK BAI I GO OLSEM WANEM?

Dispela wok bai i gat tripela han long en:
(1) Bai yu skul long pasin bilong lukautim buk mani;
(2) Bai yu skul long pasin bilong yusim kalýuleta bilong helpim yu long wok bilong yu;
(3) Bai mi painim we bilong raun long helpim yupela wanwan long wok yupela mekim bilong lukautim mani bilong sios o Kristen Senta samting.

BAI YU SKUL WE?

Bai yu skul long ples bilong yupela yet. Na bai mi salim ol pepe samting i kam long yu. Wampela wampela taim, sapos God i laik. bai mi raun long hap bilong yupela bilong givim stia.

Bilong mekim dispela kos, mi mas wokim planti lesor i ataim or o homwok long en. Yu yet i wokim long ples. Yu wokim wampela lesor pinis, orait salim i kam bek long mi na bai mi skelim. Yu wokim gatpela pinis, orait, bai yu go het long narapela lesor. Na bai yu mekim olsem i go i go, inap long yu win pinis long kos bilong mi.

DISPELA KOS BAI I GAT WANEM PE LONG EN?

Sori, mi no holim wampela mani bilong baim ol pepe samting bilong wokim dispela kos. Na mi ting i mas i gat fi bilong ol manmeri wan wokim dispela kos. Fi bai i stap K2.00

PE BILONG BAIM KALKYULETA

Mi holim sampela Kalkyuleta pe bilong ol K6.00. Sapos yu laik kisim kalkyuleta, yu yet i mas baim.
PASIN BILONG LULAUTIM 4UK MANI BILONG SIOS
OL KRISTEN BRATA SIOS LONG SATEN HAILANS

APLIKESIN

nem bilong mi____________________ PLES____________________

Kristen Senta____________________

Mi laik wokim dispela kos. na dispela em i tok save bilong mi.
Wok mi mekim insait long sios____________________

Mi holim wanpela Kalkyuleta yes/nogat (rausim wanpela tok no

Mi skul liklik pinis long we bilong yusim kalkyuleta yes/nogat

Mi bin skul olsem: (putim tik ✓ insait long bokis, olsem ✓
  sapos yu bin mekim)

Komyuniti skul inap long gret ______
Hai Skul inap long gret ______
Kisim Save skul
Rit na rait long tok ples
Baibel skul long CLTC
Baibel skul long tok Pisin
Baibel skul long tok ples
arapela skul (raitim hia)____________________

Mani yu putim wantaim eplikesin i olsem:

Fi K
Kalkyuleta K
Olgeta mani i stap K

Salim dispela pepa i kambek long

Jeni Paunten
Guala Kristen Senta
Korobê.

** ** ** *
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