AN ENQUIRY INTO THE VALUE OF PROGRAMMED LEARNING IN THE TEACHING OF READING TO SLOW-LEARNING CHILDREN

by

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A thesis submitted to the Council for National Academic Awards for the degree of Master of Philosophy

JULY 1973 SHEFFIELD POLYTECHNIC

ACKNOWLEDGEMENTS

I would like to express my thanks and gratitude to all of the many people who have assisted me in various ways in carrying out and bringing this study to a conclusion.

In particular I should like to thank Dr, M.F.Cleugh, Reader in Education at the University of London, who so obligingly undertook to direct my studies, a task which necessitated that, apart from other things, she had to make some long and no doubt tiresome journeys to Yorkshire to see my research in progress. Also to Mr, J.Salt, M.A., Head of the Department of Modern Arts at Sheffield Polytechnic, who assisted Dr,Cleugh and who went to great pains to get the C.N.A.A. to accept my thesis as a suitable one for a higher degree study.

Next I should like to thank Mr, J.Payne, M.A. Headmaster of the Rossington Special School who welcomed me when I asked his permission to carry out the research for my main study in his school and who did all in his power to facilitate my research. To Mrs H.Purdy of Rossington School and the seventeen children of her class, the latter being the willing subjects of my study, I would also express my thanks.

To Mr,J.T.Buist, B.Sc., Principal Of the Mexborough College of Further Education, who permitted me to carry out some of my subsidiary studies in the college and allowed me access to the college records, I would record my thanks.

Lastly and especially I would record my gratitude to to my wife who assisted me at the Rossington School in the testing and recording, who typed and re-typed not only this thesis but also the numerous short programs used in the study, and who, above all, supported me in my purpose throughout.

P R E F A C E.

This thesis was conceived as the result of the impression made on me, on my staff at the Milton E.S.N. Special School, and to some extent on the hundreds of visitors who came to the school, following the introduction of programmed instruction in the teaching of reading.

Our pragmatic approach to this, then novel technique, proved so effective that I felt that I should like to see it experimented with more widely in the field of special education for the educationally sub-normal, and with slow learners generally.

I sought to further this in a limited way by supplying local teachers, who were interested, with photo-copies of my programs, by describing my methods in articles in educational journals, by lecturing to teachers and to teachers in training, and in organising courses for teachers. In the last I was assisted by the Education Department of the West Riding. Later, under the auspices of the National Association of Remedial Teachers, I was enabled to publish a short book describing my methods and experiments in some detail. (1)

The thesis is arranged in three parts; Part 1 is the basis upon which the study is founded and seeks to outline the work at the Milton E.S.N. School which led to the two evaluation studies with which this part concludes. Both studies are described in detail with some supporting statistics. The first is vis a vis a teacher and the second, a long term comparison with our normal teaching methods.

Part 2, is a review of some of the theories which underlie programmed instruction. It also considers in some detail some of the recent research into programming variables, particularly research wherein the subjects were mentally handicapped or slow learners.

Part 3, covers all the original research carried out by me since May 1970, commencing with my main study at the Rossington E.S.N. Special School. This is followed by a further " rate of learning" study at Nexborough College of Further Education and then a series studies into some of the variables considered in Part 2.

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PART 1.

INTRUDUCTION

BASIS OF STUDY

" We believe in these methods, but whether they are good or bad need not be left to any pedagogue's opinion: they are open to scrutiny and amendment. If they do not work they must be rejected or modified, and one thing is definite - the objects of the procedure can be specified and we can find out if they have been achieved."
(Teaching Machines and Programmed Instruction." H. Kay. Pelican, 1968.)

This inquiry into the effectiveness of programmed learning in the teaching of reading to slow learning children will stem from the experience I gained in The Milton (Special E.S.N.) School, from the study of records gathered during the period 1958-66 and to certain experiments and studies I made during that period and during which I was the Head-teacher of that school.

In my book, "An Experiment in Programmed Learning with E.S.N. Children,"(1) I briefly described how we literally stumbled on the technique of linear programming during the course of an intense and protracted effort to remedy a weakness in the teaching of reading in the school curriculum; how we studied this technique and applied it in a controlled and systematic manner and with what success. Within a year of adopting the technique we managed to create a graduated series of programmed texts aimed at teaching the beginnings of reading and developing the skills up to a reading age of 7+.

All the children in the school, with the exception of the reception class, who scored a reading age on the Schonell Standardised Tests (8) below the age of seven were submitted to a daily period of study with these programmed texts. Each child was tested to find out at what point in the series it should commence, this included completing the criterion test for its initial program. When it had completed the program it was again tested. Records were kept on wall charts (renewed terminally) showing the date on which each program was satisfactorily completed. This visual recording, we found, tended to increase the motivation of the programs. It did not seem to introduce any competitive element; but kept before both pupil and teacher an easily understood graphical record of the progress of each child and it enable the teacher to set each child to the correct point in its individual study in a matter of moments at the commencement of each daily period.

When we had established our library of programs and completed the building of six teaching machines, we instituted certain rules concerning their usage. These were conformed to reasonably well by both teachers and pupils throughout the time under review. The rules were :-

1. That programmed study be limited to one thirty-five minute period for any child in one day.
2. That programs were not to be used by any child outside its allotted period.

3. That only teachers would issue and replace programs.
4. That on completion of a program the child must be tested.
5. That on the satisfactory completion of a test the teacher marked and initialled the record.

After a settling down period the rules worked very well with possibly the exception of number 3; here the children in their eagerness to start work at the beginning of a session would seek to take their own programs from the shelves. This we checked but did not entirely eliminate.

When a pupil failed to make an acceptable attempt to read the test after finishing a program, it was sometimes difficult to induce him to re-work the program again. After a time we solved this problem by making an approximately parallel series of programs which enabled us to switch the child who failed a test to a comparable program in the parallel series. Still later we introduced a third series aimed at helping children with individual problems at varying levels of attainment. Eventually we had some five hundred or so short programs, varying in length from ninety-six frames to twelve frames, in the library.

During this period the school had a hundred children on roll, aged from seven to fifteen, of both sexes in the proportion of approximately sixty boys to forty girls. The upper three-fifths of the school followed this pattern of programmed reading study through-out the period. The lower two-fifths, consisting of the reception class and class 1, followed a somewhat different curriculum. Class 1 had its own series of programs and used them daily, the reception class did use programmed material but not in the regular periodic manner of the remainder of the school so that in the statistical studies I shall put forward, they are not included.

The pragmatic response to the question whether any new technique for learning has virtue is 'Suck it and see.' When B.F. Skinner decided to submit his psychology students to the learning methods he had used successfully with rats and pigeons, he did just that. At the Milton School we were not quite so drastic because we had used linear programming methods quite unaware that Professor Skinner and others were using similar techniques to teach animals. When we became aware of the enormous amount of research that had been done we sought to find out all we could about the subject and applied our learning in the classroom.

It cannot be repeated too often that Programmed Learning is not a subject but a technique that can be employed for the teaching of any subject. Further, and more important, it is a technique that can be employed to apply, more efficiently, other teaching techniques. This was our main line of approach at Milton and before going on to exemplify the effectiveness of programmed learning as such, I will consider a range of the accepted methods of teaching and learning, particularly those advocated and employed in the education of slow learning children and how they were or might be applied via the P.L. medium.

Programmed Leanning and Traditional Teaching Methods.

An original and effective method of teaching reading to slow learning children was devised by Fernald (2). The essentials of the technique are:-

1. The discovery of some means by which the child can learn to write correctly.
2. The motivating of such writing.
3. The reading of the printed copy of what he has written.
4. Extensive reading of other material.

When Fernald wrote this she might have been about to introduce the P.L. methods and library scheme we employed at the Milton school. However, she was in fact presenting her own very individual ways of teaching reading but she was also outlining the problem of all teachers of reading to slow learning children.

From 1947 to 1949, with a class of 9 - 11year old E.S.N. children in a special school in London, I employed Ferndld's techniques daily in the teaching of reading. Many years later when writing reading programs I consciously and probably unconsciously incorporated some of the subtleties of her teaching methods therein.

Teachers always have, and human nature being what it is probably always will, motivate their teaching on the 'carrot' and the 'stick'. Enlightened opinion and the lengthy and profound studies on which these opinions are based have lead teachers to stress the carrot at the expense of the stick, nevertheless we shall never eliminate all aversive stimuli from teaching method.

Hilgard, commenting on Thorndike's "Law of Effect" says: "that rewards or successes further the learning of rewarded behaviour while punishment or failures reduce the tendency to repeat the behaviour leading to the punishment." (3) Holland & Skinner's extended research in animal behaviour, related in some detail in "Analysis of Behaviour" (4) confirm this.

Whatever a teacher may do to motivate learning in her pupils, the environment will always provide a plethora of carrots and sticks. We live in an authoritarian system and school often provides an even more intensely authoritarian venue.

Social and scholastic rewards go almost entirely to the clever and successful. The strongest argument for the existence of special schools is probably that they can provide opportunity for success and the consequential rewards within the school environment. This success, it is hoped, will help to balance or offset the continuous, though often unintended punishment, which is experienced by slow learners in the environment outside school.

In the process of learning to read the slow learning child needs almost continuous success reinforcement of the kind that can be given by individual attention. No teacher of fifteen or twenty slow learning children can give each of his pupils a pittance of their requirements in this respect. It is my contention, which I hope to evidence here, that if he will put his teaching technique

into suitable linear programs, whether using books, machine programs or any other method of presentation, he can ensure that every child in the class will get all the effective individual tuition he needs in regular daily sessions. Once such a regimen is established the teacher is freed to apply his attentions where they are most needed.

That such a learning regimen is a necessity for slow learners is advocated by widely separated educationists, separated both in time and philosophy. Ingham says: "The learning process for a child at school age may be stated:- the individual first realises need for adjustment to the elements present in the environment, (there is a condition of awareness.) This need directs him or guides him as he makes responses. Second, as the individual progresses, consciousness of success, or recognition of the right response, makes him more definitely and understandably aware of his goal. Third, there must be sufficient recurrence for the learner to become at ease in his new form of behaviour." (5)

Over a quarter of a century later, the behavourist and advocate of programmed learning, Broadbent suggests : "First emphasise the particular behaviour that is wanted by praising and approving every instance of it which appears. Once the general connection has been established, make the praise infrequent and irregular. It must not be given at a constant average interval of time but ought to be responsive to the child's own actions so that the more frequent occurrence of the behaviour will obtain more frequent reward." (6)

Ingham from her study of the slow learning child defines its learning needs. Broadbent, in his exposition of behavioural psychology applied to learning, outlines a process through which the child's needs can be met.

Teachers of reading to slow learning children are faced with wide ranging problems, but the primary and basic one is lack of intelligence. Disputation as to whether intelligence is mainly a genetic inheritance, or arises as a result of environmental interaction following birth or maybe conception, will do little to further the objects of teachers of the slow learning child. The teacher can only apply his methods within the environment, he can do little or nothing to change the child's physical or mental equipment and his task is to help the child to make the most of that with which he has been endowed.

The teacher can, however, analyse the child's learning problems, possibly along the lines suggested by Burt. (7) "Ensuring that any sensory defects such as defective eyesight and deafness are remedied sufficiently well to make the child viable to the teaching methods available. Also speech defects should receive attention." To what extent the teacher should personally attempt to remedy bad environmental factors outside the school is a matter which only he or she can decide. The teacher should, however, try and find out as much as possible about the child's intellectual equipment. Burt (7) outlines these as " sensation, perception and attention; memory whether short or long, mechanical or logical and whether the child is a visile, motile or audile." Isolating these qualities in a child can indicate the best approach for a teacher to adopt when preparing material for teaching, whether programmed or otherwise.

Schonell (8) describes the physical, psychological and intellectual deficiencies to be found in the slow learning child; but again it is obvious that there are considerable limits as to what a teacher in a classroom situation can do to remedy these. Nevertheless, the more aware he, the teacher, is of his pupils defects, the better he can create lessons to offset them. To know that a child has a weakness in one or more aspects of his make-up such as his span of perception, span of recognition, perceptual maturity, auditory analysis, reversed laterality or far point fusion of vision, are in varying degrees important to the teacher.

Schonell asserts that " to teach a child to read requires a pedagogical skill of much greater degree than need to establish the groundwork of number." (8) It is, therefore, fair to say that to teach reading skills to a slow learning child, who for various reasons has become resistant to the subject, must call for even greater pedagogical skills. It is my purpose here, not so much to demonstrate new teaching skills for the teacher to learn, or even to improve on such skills as he may possess, but to show how he can apply his own skills more effectively and also to show how he can apply the multitude of skills and techniques that teachers in this field have recorded.

Schonell (8) outlines his pattern for teaching slow learners to read as follows:-

1. Detailed diagnostic information.
2. Types of error etc.
3. The nature of past teaching.
4. Direction of present interests, educational and private.
5. Inhibitions and conflicts to be dispersed.

This is, of course, good diagnostic technique. However, from experience I would assert that it is never possible to disperse a child's conflicts and inhibitions..... both the teacher and the child have to learn to accomodate them. It is in this important aspect of remedial teaching that I hope to demonstrate how P.L. can assist by enabling the pupil to learn by evading the discriminative stimuli which elicit the activation of these inhibitions and conflicts.

Schonell (8) says that psychological failure can be caused by reading failure but I would suggest that inherent psychological weakness precedes the learning failure and failure to learn to read reinforces it. However, whatever the order of the causes, when the child reaches a special school or a remedial centre its inability to make any progress will arise from previous painful failures, failures which are recalled by the very tools (books, paper, pencils etcetera) which the teacher employs. Indeed, the very teacher, himself, may well be an 'S^d' for the painful response of his pupil. Through the medium of P.L. the teacher can, to a considerable extent, even eliminate himself from the pupil's learning processes.

One objection to P.L. that has been put forward is that it is a return to 'rote learning.' This is despite the fact that there are few, if any, schools at any level which do not employ rote learning in some form however disguised. Morris (11) remarks on the excessive use of 'drill and rote' learning made by teachers of slow learners and says "much would be gained if the teacher placed less

reliance on drill and devised learning situations to let the dull child organise insight." This is, of course, what a conscientious and enlightened teacher is constantly doing, unfortunately the demands on the teacher in schools or classes for slow learning children are such that unless teachers do employ some kind of rote learning or other educationally non-productive occupation, they are unable to keep up with these demands either mentally or physically.

When slow learning children have learned to copy script of one form or another, and with them this skill invariably comes before any purposeful skill in reading is achieved, they seem willing to do it for long periods of time without showing any objection to it or making complaint. That they gain some reward, satisfaction or re-inforcement from it must be accepted. That it is probably a specious reward does not detract from its effectiveness. It is probably no more or less valuable than the diligent copying of the teacher's notes by the student in the grammar school.

It is quite possible to insert learning situations into copy writing or note taking for that matter, by using programmed learning techniques. If a child is presented with a copying task of short duration and in the course of performing it is asked to make a response calling for an intellectual effort or decision, however simple, then having made the response is rewarded by knowing that he has made a correct one, a learning sequence has been achieved. This is, of course, over-simplified and needs some qualification, a matter I will deal with at some length. It does, however, exemplify my point that rote learning, so useful to teachers in relieving them of class pressures, can be employed to give a child, or rather help a child to achieve 'insight.' Properly prepared copy-writing can effect learning, purposeful learning.

"If the teacher is successful in presenting problems in so simple a way that the relations involved are not beyond the learner's powers of mental organisation then the learner will be able to exhibit direct insight and his behaviour will be recognised as intelligent learning." (11) One linear program frame can obtain just such a prepared learning situation in any subject or at any level of attainment the creator may desire. A connected series of such frames can provide a self-motivating lesson which will meet the requirements of any individual.

Considerable research has been and is being done in the field of 'attention' but it is mainly concerned with the nature of attention, its span in time and space and whether we can attend to one , two or more things at a time. Out of such research may come, in the future, new ways or new understandings of how we, as teachers, can capture and contain attention in our pupils. Simone Weil defines attention thus : "Most often attention is confused with a kind of muscular effort. If one says to ones pupils: 'Now you must pay attention,' one sees them contracting their brows, holding their breath, stiffening their muscles. If after two minutes they are asked what they are paying attention to, they cannot reply. They have been concentrating on nothing. They have not been paying attention. They have been contracting their muscles.

We often expend this kind of muscular effort on our studies. As it ends by making us tired, we have the impression that we have been working. That is illusion. Tiredness has nothing

to do with work. Work itself is the useful effort, whether it is tiring or not, this kind of muscular ~~WRK~~ effort in work is usually barren, even if it is made with the best of intentions. Good intentions in such cases are among those which pave the way to Hell. Studies conducted in such a way can sometimes succeed academically from the point of view of gaining marks and passing examinations, but that is in spite of the effort and thanks to natural gifts; moreover such studies are never of any use."

Will power, the kind that, if need be, makes us set our teeth and endure suffering, is the principal weapon of the apprentice engaged in manual work. But, contrary to the usual belief, it has practically no place in study. The intelligence can only be led by desire. For there to be desire there must be joy and pleasure in the work. The intelligence only grows and bears fruit in joy. The joy of learning is as indispensable in study as breathing is in running. Where it is lacking there are no real students, but only poor caricatures of apprentices who, at the end of their apprenticeship, will not even have a trade." (12)

If one has stood daily over a period of many years, as I have, before assemblies of slow learning children, observing their behaviour, it becomes patently obvious that a common feature of all these children is their inability to give attention to any matter for more than the briefest period of time, unless they are strongly and continuously motivated. It is, of course, understood by all teachers with experience in this field of education that in their teaching they employ all the subjects, methods and techniques which they find do capture and hold the minds of their pupils. Like the employment of copying, many methods used are self-defeating in that they seem to have the power of holding attention but no purposeful learning is contained within them. I have in mind a conscientious teacher of many years experience who found that 'centre cane work' achieved attentive effort on the part of his pupils. Having taught them a simple pattern they would go on producing table-mats or baskets ad infinitum, but it was not learning, it was not education.

In the course of this study I shall be continually using the term 'learning'. I have already stated that a child employed in copying (happily, if not purposefully employed) must receive some reward to motivate him to continue. The teacher is not, however, concerned with just re-inforcing this copying behaviour, he wishes to impart in his pupils continual new behavioural changes. He is concerned that the pupils engage in purposeful, beneficial learning and must arrange their activities to that end. Copying may be used to further beneficial learning and this is in itself beneficial, it is a function of that learning process. Copying for copying sake is, however, a time wasting process and a slow learner, above all, has little time to waste. Therefore, when I use the term 'learning' unless I explicitly indicate otherwise, I mean the beneficial learning that a child is expected to acquire in school not the Behaviourists' 'Acquired change in behaviour.'

Frazer outlines the units on which the beginnings of reading may be based: (13)

a. The Letter
b. The Word
c. The Syllable
d. The phrase or line
e. The sentence...

There are many methods of teaching reading but all of them must be founded on one of the above. Most teachers use combinations of methods though they tend to stress the phonic or look and say approach. Despite the advocates of particular methods all children do not succeed more easily with any particular one, therefore, a rigidly applied classroom technique will ensure that a proportion of children will fail to learn just because the approach does not meet with their needs. An obvious example are those children who register at the extremes of the Audile-Visile scale. The best method for any given child at any given stage in their development can only be decided at that moment by the teacher concerned. It must be a clinical decision.

A teacher who has created and accumulated a carefully organised and graded collection of prepared programmed texts, such as were contained in our program library at Milton, is in the happy position of being able to ensure that every single pupil in the class, no matter how varied their attainment or ability, can be simultaneously engaged in a purposeful learning situation appropriate to that particular child. In our programs we covered a variety of teaching techniques and I am convinced that any approach to reading can be embodied in a program.

Kirk and Johnson (14) offer long lists of activities to initiate the beginnings of reading and to improve reading at both primary and secondary levels:

"Excursions, labelling collections, centres of interest, story telling by both teacher and by children, story reading, discussions, word associations with pictures, drama, booklets and scrap books, care of books, reports on activities, making stop and go signs, playing language games and preparing for birthday parties."

They go on to advise in some detail how to approach the teaching of the beginning of reading;

"The children tell a story. One day it is dictated by the children and the teacher writes on the blackboard. Next day in chart form, the children read from the chart."

This is offered as one specific method of teaching slow learning or retarded children. Unfortunately neither this nor the above mentioned activities are enough. By the time most children reach the special school or remedial class, at the age of seven to nine, they have experienced two to four years of such teaching and have still failed to learn to read. There is nothing wrong with the foregoing but it must be supported or backed up with carefully prepared follow-up lessons, lessons which offer suitable individual studies to meet each child's needs at its particular level. In short, each child must receive individual attention from some source at regular daily periods. This is not a requirement that can be met by putting a child in a special group, a group small enough for individual attention for a matter of a few weeks or even a year; the slow learning child needs this kind of tuition throughout its school years but the normal staffing in special schools or special classes does not and cannot provide it.

In the case of the teaching method suggested by Kirk and Johnson or any similar method, a follow-up can be created in program form so long as the story dictated confines itself strictly to the

children's language and the program is also based on it. With regard to the later activities, programs can be created to provide follow-up studies and I will later describe and demonstrate how this can be done and, indeed, was done.

Gates, using a word based approach, offers this advice:(15)

"The setting for each new word should be carefully worked out so that the word is surrounded by such an abundance of contextual clues that the child will figure it out easily and correctly."

Here Gates stresses the basic requirements in preparing learning situations for slow learners 'to achieve relatively easy success to offset their excessive experience of failure.' It is also a feature of Skinner's (4) linear programming technique. Incidentally Gates goes one step further towards linear programming by suggesting multi-choice question reading units, e.g:

This is a house
This is a hat
This is a hut.

Had he further proposed putting such units into graduated series, each unit followed with the correct answer, they would have been complete teaching programs. Teaching programs are like a series of carefully arranged puzzles but, like puzzles, unless the puzzler receives a reasonable amount of reward for his efforts in the form of successful elucidation, little effort will be made in pursuing them. The programmer, like the puzzler, must know immediately after making his effort, the result and the program must be so prepared that there is a high proportion of successful results. It is the reward of knowing which leads him on to make further intellectual effort, whether it is to solve another clue in a crossword puzzle or complete the response demanded in the next program frame.

The basis of all teaching is a one to one situation - I know so I teach (tell, demonstrate) that which I know, to you. This is the ideal and this is what is meant by individual teaching. The multitude of pupils and the scarcity of teachers negate any possibility of achieving this in 'public' education. Individual attention, or rather individual teaching, cannot be provided in schools, except for extremely short periods or else by teachers neglecting the few for the many. Attempts are being made by using what is called 'group teaching' and the greater use of audio visual aids to release teachers from the chore of class teaching and enable them to give more personal attention to individuals. My experience leads me to question whether these methods do achieve much real learning on the part of the students. In any case, vast sums of money are being expended on these approaches and their necessary equipment but very little is being done to ascertain their relative efficiency.

Despite the near impossibility of giving all pupils individual teaching, even in the small classes customary in special schools and classes, most of the advice given by writers on the subject of teaching slow learning children, advocate individual attention.. The methods they suggest are excellent but because of what I have said their application is dependent on the teacher personally and physically applying them to each child in a class situation, and this by its very nature must fall down unless the teacher can find a way of applying her individual methods through a secondary

medium.

Consider the logic of the situation. A teacher with a class of twenty slow learning children, teaching them reading throughout the period of an hour. Supposing that by some extraordinary feat of organisation she could give each child its fair share of three minutes of her time, there would still be the need to contain each child in fifty-seven minutes of self-tuition. The sheer impossibility of it becomes apparent when one considers it in this way and it is little wonder that these unfortunate children, despite the time and enthusiasm expended by thousands of conscientious teachers, make so little progress.

Nevertheless, only an individual approach can succeed if diagnosis as suggested by Schonell (8) is to be the basis of a remedial method. He re-iterates what others in this field of remedial eduaation are repeatedly saying:-

" Thus progress in reading in the infant and junior classes becomes a basic intellectual and emotional failure..... resulting frequently in general scholastic backwardness and emotional maladjustment." (8)

Like Burt, Schonell advises the teacher to look for what are psychological and physical failures such as 'span of perception', 'span of recognition' and disproportionate right and left eye movement. Like Fernald he confirms the need to impress word patterns.

"The first obvious factor in the reading of a word is its total pattern. Early words should have variety of structure." (8) My own experience is that early words should be derived from the verbal language of the child itself. In creating my early reading programs I found that the most effective beginning words were those nouns which could be presented with a simple line picture. Names of very familiar objects, particularly toys, probably because of their emotional content. One had to be very careful to use the name the picture would elicit when the child looked at it and responded. Word shape patterns can be used to assist slow learning children to differentiate easily but they are essentially subordinate to word familiarity and usage. What is of primary importance is that teachers must know and understand the childrens' basic speech language and found his teaching of reading on this. Schonell makes this point: (8)

"It is safe to say that unless the printed word is linked with the sound which finds place in the speech experience of the child, then it will not be retained." With the slow learning child of seven, eight, nine or upwards, it is past the time when it is advisable to wait until a wider speech vocabulary has been acquired. The teacher must use what the child already has, no matter how meagre, and employ it.

"The short cut between visual symbols and meaning does not really develop until reading experience is considerable." (8) This may be so for all children as Schonell's statement implies; it is certainly the case with slow learning children. There are at least two ways in which this development can be assisted and possibly accelerated. First, there must be much repetitive reading, much more than is usually considered necessary. As soon as a child has achieved a little reading ability he must be given plenty of opportunity to enjoy the skill. In creating the first series of 'Milton Programmed Readers' (16) we employed some twenty nouns, (names of toys mainly) and presented them in four series each of ninety-six frames.

The second process which we found helped the child in this aspect of its development can be best grasped if one considers the way in which a child learns to respond to an object with its name, as when it names a ball or a dog. The second step, so often in the case of deprived children, is when the mother, usually, shows the child pictures and asks it to name them. At this point we found that it was better to associate the word not with a realistic picture or photograph but with a very simple line drawing, something very similar to that which the child might try to draw. These drawings should be such that they can easily be copied by the child.

This need to help a slow learning child to express itself, to put its conceptual ideas on paper by giving it pictorial symbols which it can recognise and copy long before they can be expected to understandably copy script, became evident to me in the course of studying E.S.N. children's art in some London schools during 1956 -57. (27) I found that where a normal child in the primary school asked, say, to draw a horse will produce an easily recognisable drawing, few children under the age of ten in E.S.N. schools could do so.

Earlier in this introduction I outlined the organisation of our programmed reading scheme at Milton School. I have stressed that P.L. is not a subject or an educational philosophy, but a tool. Taking our methods, together with some of those proffered by A.I. Gates (15) it might seem that we were applying his methods via the medium of P.L. , and to some extent I suppose we were. "We learn by means of re-acting; we learn the re-actions we exercise." Here is the very behaviour of a student applying himself to a program frame. But Gates goes on to suggest some card activities, the weaknesses of which are exemplified in that they fail to meet Gates' next dictum....."The need of definite, refined, foolproof guidance of the young learner in such complex and subtle skills as reading." Any card system by its very nature fails to be foolproof - too much is demanded of the teacher in ensuring that the right card or set of cards in the correct sequence is presented to each individual child at the moment it is required. If a system is not foolproof then it can be neither definite or refined because both these qualities are lost if the system does not ensure absolute orderly presentation at the right moment.

Gates advocates "graphic progress charts," he asserts that nothing succeeds like observed success. We certainly found that graphic wall charts recording progress had considerable motivating effect and used them, but the real evidence that "nothing succeeds like observed success" was the inherent motivation of the programs, wherein the children felt and enjoyed their success at almost every step.

He outlines what he calls the 'characteristics' of teaching non-readers: (15) "The presentation of each word in a variety of contexts." I have emphasised the need for much repetition and also that such repetition must not result in boredom. Through the medium of P.L. this can be done in a variety of ways. This I shall deal with in some detail later both in text and illustration. "Avoid errors by mastery of each step." (15) Success in this matter will depend on the careful preparation of suitable programs, such factors as the program length, the clarity of the response demand and its re inforcing answer. Further the teacher must know that the pupil

has achieved mastery of each step (each frame). Most teaching machines provide this by one method or another; in the case of book programs we found it necessary to insist that the pupil recorded its response, checked it with the answer and corrected it when wrong.

"Provision for individual differences - reserve material for slow readers." (15) Our carefully organised library of programs was designed to cater for individual differences and supplementary programs together with alternative series provided forthose who could not adjust to the pace of our basic graduation. There were occasions when we found it necessary to write a special program to meet the needs of an individual. These sometimes provided points of growth in our series.

"Provision for development for all phases of silent reading without oral directions and without phonetic or other auditory or other oral methods." This was fundamental tc our scheme and had much to do with our success. Each program was written and illustrated in such a manner that a child could read and respond to its demand with practically no assistance from the teacher. The small steps which led one frame to the next were such that it was almost impossible for the pupil to fail. The non-reading child was enabled to read and to know that it was reading. It was led to acquire a reading skill matching a substantial portion of its speaking vocabulary. Later, by means of illustrations, it was possible to introduce words which were known to the pupil but seldom, if ever used. It was also possible to extend the child's vocabulary but here, because we were unable to afford to purchase the expensive audio teaching machines which were coming onto the market at that time, it was necessary to integrate the programming with orthodox teaching rather more closely than usual. In adapting one series of my programs for publication to make them suitable for remedial teaching in normal schools I solved the problem in the following manner. The series comprised six books. Each book was sub-divided into seven sets or short programs of twenty-four frames. At the commencement of each 'set' any new words introduced in that set which could not be clearly illustrated, were listed. A symbol of a hand directed the child to seek the assistance of the teacher who would then teach the child verbally the one or two non-illustratable words before he essayed the set.

Today, student teachers are instructed, even exhorted, to allow children to learn at their own pace. On the other hand the amount of knowledge necessary to become viable in society and to maintain one's place therein, becomes greater daily. This leads even teachers of slow learning children to seek ways to accelerate the speed of their pupils' learning. In this paradoxical situation Levinson (17) sounds a note of warning. " The child should not be forced beyond his capabilities or absorbtive powers. Too much pressure may produce an emotional block that will interfere with mental development."

A linear program with a slow rate of introduction of new words and concepts, its long repetitive sequences and continuous re-inforcement, frame by frame, is an ideal medium or tool for the education of slow learning children of all categories. The only pressure that need arise can be that self-generated by the child's interaction with the program. This we found was more

than sufficient, indeed, in some cases children had to be restrained from giving more than the allotted time to programmed material.

"The principle of self-activity - to act for oneself and to find out for oneself, is in the lower stages of special teaching the sole means of making children educable." (18) To present a child with a short series of demands, each of which requires the child to look at a picture, a picture which will surely elicit the word subscribed to it, is to provide the child with a series of opportunities of acting for itself. By confirming each act as it is completed makes each a learning situation.

" The feeble minded child re-acts but slightly to external stimuli, stores up few images and lacks sufficient power of attention to create them clearly and vividly." (18) Descoudres defines in one sentence, a fundamental deficiency to be found in all slow learning children, in varying degrees. A deficiency of which all teachers of these children soon become aware but one which they do not find it easy to remedy.

If one takes a group of normal, lively children on a learning expedition, say, into a park for tree recognition, one can return to the classroom with a few leaves and fruits and be sure of a lively discussion. Enough will have been learned to ensure this fruitful consequence. Such is not the case with slow learning children. To achieve a comparable amount of learning the expedition would have to be repeated many times. This, in effect, deprives the dull child of learning experience because of the time element. However, the expedition photographed and turned into a simple linear program can repeat the experience as often as the child can accept it. At Milton we found that such programs, especially where the photograph included the children, were highly motivated.

"We act as masters and lead the child, whereas it is he ought to lead us. We set up methods we desire to remain fixed and immutable and we forget that it is impossible since there is no single type of intelligence and capacity. Teaching methods, ought on the contrary, to be elastic, to submit to modifications, to adapt themselves to all kinds of mentality, but especially to the least fortunate - those who are afflicted with some defect or deficiency - with more consideration and more careful handling. We are clumsy, therefore, we are on the wrong track. If we are to reach our goal we must take another road: we must study the child systematically; we must find out the mechanism by which he acquires knowledge; we must track down the difficulties he experiences, we must search for the causes and try what remedies will cure them." Dr. Decroly. Pedagogy de la Lecture. (Quoted.) (18)

This unquestionable advice is impossible to follow in the educational situation of slow learning children as it is to be found in present day organisations. If one visits a special school or class for slow learners, one sees much the same going on as one would find in a normal school. Teachers standing before their classes talking and demonstrating or trying to keep each of the pupils in an active learning situation by going from one to another. With such children the first method is very inefficient and can only maintain even a low standard for very short periods. The second, as I have already shown, is a near impossibility. New methods and organisation must be found and, here, I aim to show that these can be effected through the medium of P.L.

It has been asserted by many educationists that in learning the child should follow its own path and that the teacher should co-ordinate his efforts to enable the child to achieve his, the child's, often unknown goal. Decroly says as much. However, if the teacher is to help the slow learner to find a way through the dense jungle of learning then he must be prepared to cut paths so that his pupils can advance fast enough to reach some sort of social viability by the time that their formal education ceases.

In the field of reading each suitable program will provide a short pathway for some child. To pursue the analogy, the child steps onto the pathway at frame one, and even though it is a so-called non-reader, finds out that it can read. It is led from one frame to the next by its curiosity and success. The first step rewarded leads to the next and so on, and providing that the steps are suitably arranged, there are no limits to the success. Of course, because no program can be perfect for every child, things do not follow quite such a smooth course as this, nevertheless, I have established the effectiveness of this approach over and over again.

With a variety of programs available, a teacher can provide a path to follow for each child, at its own speed, can observe the child systematically as it learns, can see when it fails and track down its difficulties and put them right. This the teacher can do for every child in the class, neglecting no-one.

In creating programs a teacher must not only consider the content, the matter to be learned; the mechanics of reading must be considered too. Harrison defines such things as: "narrow view, recognition of printed and written word, accuracy, rate and span of recognition, rhythmical eye movement and sweep of eys to the next line." (19) The teacher relieved of class attention can give attention to individuals and can, in a detached manner, see where failures occur and prepare programs to correct them.

"It is not open to the teacher to take his choice and say either 'my pupil will learn by association of ideas' or 'my pupil will learn by perceiving relations.' In the last resort any learning will be done by the pupil..... by gaining some insight into the situation." Morris (11) Just so, but if one considers the slow learner at the beginnings of reading, presented with two pictures, it is possible that he will perceive relationships or find associations between them and hence gain insight but it does not follow that learning will take place. He still needs to be rewarded by knowing that he is right. If insight is to be followed or accompanied by learning, then the child must be aware that insight is a rewarded activity. Further, in a school situation such rewarded activity must occur with unfailing regularity. This can only be done if the teacher has access to a great deal of prepared material of considerable variety. Its preparation, maintenance and organisation is a considerable task, as any teacher of slow learning children is well aware. The use of P.L. can reduce this problem to manageable proportions

Morris says, " the teacher is too active and the child too passive..... provide the situation, stimulate with questions." (11) Decroly, quoted by Descoudres preceededhim with "present eachchild with a situation, stimulate each child with a question, and follow each child in its insightfulness." (18) To complete either of these learning advices we need Skinners' dictum, "reward each child for its particular and peculiar success." (20)

In an attempt to justify rote learning and drills for teaching the slow learning child, Burt and Lewis assert : "Repetition changes the tyro to the old hand." and advise "Keep drill separate from reading." and further "to distinguish between repetition as an improvement process in learning and repetition as part of the achievement process." (21)

I have already explained how it is possible to ensure that copying and repetition can be prepared so that real learning can take place and I cannot think how activities as suggested here can be separated. As a learning process, repetition without the possibility of improvement (which is achievement) and awareness of improvement (which is reward and the source of motivation) are really inseparable.

A golfer who feels that he is not making improvement under instruction from the professional, is unlikely to persist. The child set to study the piano becomes unwilling to practise when he gains no reward from experienced success. Good teaching, of any subject, aims to provide a schedule of study whereby the student is ensured of progress and aware when it takes place.

"Enumeration, description and the interpretation is the sequence of responses made to a picture by a young child." (20) The slow learning child's response is unlikely to follow this pattern, it will probably not proceed beyond enumeration. However, the sequence is commonly used by teachers, they lead children through by question and answer. In a class situation where it is most commonly used, the lesson will tend to follow the responses of the most intelligent children. Here again we see the need for the progressive, individual presentation to which the pupil can make its response and know of the result at once; a need which a program can provide better than anything else, excepting, of course, continuous attention from a teacher. Even here the teaching program has advantages, it does not tire and it will not be interrupted.

"It is clear that when an individual is about to construct or invent something, he cannot work entirely in the void. His constructions will be determined by certain pre-formed cognitive 'schemata'. The particular 'schemata' utilised he may select at his own whim: or more commonly he will employ those he made use of previously in similar situations. Thus he must combine perceptual awareness and cognitive understanding of the present situation and its requirements with the production of certain features which cannot be immediately cognised; they may be supplied rather slavishly from his recollections of previous experiences which were found to be appropriate, or they may involve a re-combination of parts of previous responses with new material reconstructed in a new and more or less integrated whole." (13)

To write a simple sentence will often demand 'imaginative construction' of a very high order from a slow learning child. How can one lead such a child into acquiring the ability of creative effort required even to write a simple letter, certainly not by the usual text book and chalk and talk techniques. Only after many hours of intensive study will he be likely to acquire the necessary modicum of 'preformed cognitive schemata' upon which to draw the requirements with which to construct new integrated wholes. If he is to succeed his learning steps must be infinitely small and

presented at his own speed in continuous succession and each one immediately confirmed. Such teaching, even on a one to one basis, would produce unacceptable boredom for the teacher. The only solution to this problem is to provide these children with daily periods of study with suitable pre-prepared self-teaching material

FIRST EVALUATION STUDY.

In 1963 I made the first attempt to evaluate the effectiveness of P.L. vis a vis normal teaching methods with slow learning pupils.

Among the various untaught songs my pupils at the Milton School were accustomed to singing in the school buses was the round "Ten Green Bottles." They sang it very indifferently and from a little enquiry I was quite certain that very few, indeed not more than one or two, would be able to make even the most indifferent attempt to read it at length and all would be unable to write it at length. Therefore, for the following reasons and after due consideration, I decided to make it the subject matter for a study. My reasons were:
that it had a very limited word content; by its nature as a round it embodied much repetition;
All the older children whom I proposed to use in the study had some verbal knowledge of the song and, as I have said, could neither write nor read it except in a very indifferent manner;
it would lend itself well to simple line illustrations;
such verbal knowledge and writing ability as the pupils did possess would provide an easily measurable basis against which I could easily measure any gains.

I created a program in six short (eighteen frame) sets. Each set comprised one complete repetition of the round. Each frame included a coloured line drawing which was repeated in each set. By using a fading technique, first of initial letters and finally of whole words, leading to a complete verse construct being demanded. Pictures and lines to indicate the words were left as clues on the final pages. See appendix 1.

These programs were hand written and drawn and reproduced on a 'Banda.'

Having created so much P.L. material for the children who were to take part we felt that no validation was required, we were sure it would function.

Our next step was to select the pupils and arrange the conditions for the experiment.

We chose two matched groups, each of ten children. They were matched for age, I.Q. and reading age. Then at a staff conference they were re-arranged with regard to the teachers' estimates of their relative learning capacity. The resulting groups were as shown in Appendix 2.

Two classrooms were allocated to the groups for ten successive school days for the first morning thirty-five minute period; i.e. for two five day weeks from 9.30 to 10.5.

The first period was devoted to the pre-test. This demanded that each child wrote from memory as much of the complete round as he or she could remember. No assistance was given at all. There are twenty-five words in the song and the results were scored on the number spelt correctly.

The words are as follows:-

Ten, green, bottles, hanging, on, the, wall, if, one, should, accidentally, seven six five, four, three,

two, no, bottle.

The pre-test scores are shown in Appendix 1b.

It became immediately clear that we had underestimated the pre-test knowledge of number 5 and 7 in the control group. Nevertheless, we decided to let the test go forward including these two pupils for two reasons; firstly, because they were keyed up and would have been disappointed and secondly, they were both in the control group, their superior knowledge would probably favour the control group and ensure that, if there was any inbalance in the matching it would be to the advantage of the control.

On the seond day and for the eight subsequent days the pupils in the P.L. group applied themselves to the study of the programs for the period of thirty-five minutes each morning. Irrespective of ability or their score on the test they all commenced on set 1, and they were required to write out the text at length. When a pupil had completed a set, it was examined by the teacher to ensure that it was complete and the pupil was then handed the next set in the series. No tests were made at this point.

There is little comment one can make about the procedure of the experiment or the conduct or attitude of the pupils. They, the pupils, approached the task each morning willingly and with keenness throughout but this was what we had found to be the normal conduct of children at Milton school engaged in P.L.

The teacher of the control group was permitted to use any teaching method or technique that she wished, except, of course, P.L. In the course of the experiment this group copied the text several times, recited it daily, sang it, acted it, and even painted it.

On the tenth day both groups were re-tested exactly as in the pre-test. The resulting scores are as shown in Appendix 2. Three months later the test was repeated and these scores also are shown in Appendix 2.

On first glance these scores seemed to indicate clearly that the P.L. group had achieved a markedly higher average result than the control group. However, a fairer appreciation can be made if one extracts numbers 5 and 7 from the control group and number 3 from the P.L. group. This because the margin for possible gain was so small. Also numbers 8 of the control group and 9 of the P.L. group should be extracted because of absence.

These adjusted average gains of 10.9 and on re-test 6.4 for the P.L. group and 8.1 and 4.6 on re-test for the control group show a clear margin for the PL group both on test and re-test.

I do not claim any statistical significance for these results of a very brief study obtained with a very small sample, but it was a very reassuring outcome at a time when although P.L. seemed to be an excellent technique we were very worried that we might be wasting our pupils valuable learning time.

Appendix 2.

TEN GREEN BOTTLE STUDY.

Programmed Group.

	Age.	I.Q.	R.A.	SCORES. Pre-test	Post-test	Gain	Re-test	Gain
1	12.3	75	6.6	5	14	9	9	4
2	12.9	75	8	5	20	15	14	9
3	15.9	71	7.9	18	25	7	20	2
4	14.3	69	5.9	0	5	5	3	3
5	14.2	64	6.3	0	8	8	4	4
6	12.7	72	7.9	10	24	14	21	11
7	14.11	69	8.3	11	24	13	19	8
8	13.9	70	6.	4	19	15	14	10
9	14.4	73	6	2	10	8	Absent	
10	13.9	59	6.4	5	13	8	7	2
		Total		60	162		111	
		Average Score		6	16.2		12.3	
		" Gain			10.2		6.3	
	Adjusted	Total		40	127		91	
3 & 9		Average Score		5.0	15.9		11.4	
omitted.		" Gain			10.9		6.4	

Absences No.2 1. No.5 2. No.4 3.

Control Group.

	Age.	I.Q.	R.A.	Pre-test	Post-test	Gain	Re-test	Gain
1.	13.9	70	6.7	12	22	10	13	1
2	13	78	7.7	6	17	11	19	13
3	13.9	74	5.9	2	9	7	5	3
4	12.7	68	6.3	3	15	12	Absent	
5	13.8	70	7.9	22	23	1	14	0
6	14.2	72	7.9	16	21	5	16	0
7	14.11	69	8.3	23	24	1	24	1
8	15.2	71	5.8	7	not included.	Course not completed		
9	13.1	71	8.5	14	22	8	16	2
10	15.6	61	6.9	9	14	5	12	3
		Total		107	167		119	
		Average Score		11.8	18.6		14.9	
		Gain			6.8		3.1	

Absences No.8. Failed to complete course
4 Absent on re-test.

	Adjusted	Total	62	120		8.1
5 7 & 8	Average	Score	8.9	17		13.5
omitted	"	Gain		8.1		4.6

SECOND EVALUTATION STUDY.

This second study came about following the suggestion made by the Department of Psychology at the University of Sheffield, that the Milton school records might provide statistical material for a long term study into the effectiveness of Programmed Learning.

When I became head-teacher of this school in 1958 I took it upon myself to examine the attainment progress, individually, at the commencement of each year. To examine most of the children in the reception class I used the 'Holborn Vocabulary Test for Young Children' (24). With the remaining children in the school I used various standardised tests for reading and comprehension but all of these children essayed the Schonell Graded Word Reading Test. (66) It is from the annual records of the pupils' scores on this test that the following study is based. (Appendix 11a.)

The study included the whole population of the school, less the reception classes. It compared their progress in reading, as measured on the Schonell Test (66) for the year 1961-62, before P.L. was used in the school, as against the progress for the year 1964-65 when P.L. had been well established and was in daily use.

The population of the school for the years under study was ; 1961 -2, 76 and for 1964-5, 69. See Appendix 3.

The Schonell Test (66) measures attainments in tenths of a year. Distributing the reading gains and losses on a scale from -7tenths to +18tenths with an interval of 1 tenth of a year for both years under review, (See Appendix 3.), we arrive at the following:

1961-2 M = 2.83 with a S.D. = 3.72

1964-5 M = 4.87 with a S.D. = 3.99

It would, therefore, seem from these figures that by employing Programmed Learning techniques in the teaching of reading we had by 1965 nearly doubled the rate at which the children were learning to read. It would seem that this was clearly a significant improvement. Submitting these comparative Means to a test for significance, we find:

The standard of the difference M (1964-5) -M (1961-2) is + .643 (26)

Therefore $\frac{x}{\sigma} = \frac{2.04}{.643} = 3.17.$

Applying this to the Table of Areas of the Normal Curve beyond the given values of $\frac{x}{\sigma}$ (26), 3.17 lies between 3.1 and 3.2. Interpolating gives a percentage exceeding this $\frac{x}{\sigma}$ .08.

The negative values of M(1964-5) -M(1961-2) would occur less than once in a thousand and the Mean Gain in Reading Age for the year 1964-5 can be said to be significant.

The scores (Appendices 3 and 5) were then submitted to the Department of Psychology, The University of Sheffield who verified that they were significant and further statistically analysed them. (See Appendix 4.)

Using the same records, it is possible to examine the effectiveness of P.L. from another point of view.

In 1961 my annual tests of the pupils exposed the fact that there were substantial numbers of them who, bearing in mind their I.Qs and their potential learning ability as estimated by their teachers, should have already been reading at a level not less than four years below their physical age and who were not so doing. Further, they should have been making a steady advance in reading ability of 3 to 6 months a year. The histogram (Appendix 5.) shows in 1961-2 thirty-three pupils made either a loss or no gain at all, whereas in the year 1964-5 only three children made no progress whatever - when P.L. was in daily use.

THE POPULATION OF THE MILTON SCHOOL (Less Reception Class) 1961-1962 AND READING GAINS IN TENTHS OF A YEAR AS MEASURED ON SCHONELL GRADED WORD READING TEST.

	Age	I.Q.	Gain		Age	I.Q.	Gain.
B.K.	15.8	66	.6	T.S.	13.1	58	0
J.P.	15.11	45	0	A.C.	12.0	71	1.1
S.W.	15.1	67	.2	D.E.	12.11	73	0
E.M.	15.1	69	- .1	T.G.	12.9	72	.6
J.C.	14.11	70	1.1	D.K.	11.4	74	- .1
H.H.	15.3	71	.6	D.W.	11.4	70	.7
M.H.	15.8	44	0	I.T.	12.1	72	.2
J.M.	15.1	55	1.1	J.S.	14.4	64	0
C.C.	15.2	49	- .1	B.E.	13.6	69	.4
M.A.	14.11	67	.1	S,H.	12.4	69	- .1
E.B.	15.9	61	.5	M.M.	13.7	59	.4
L.G.	15.7	65	0	A.W.	12.11	60	.1
P.H.	15.9	56	.5	M.F.	12.7	74	.3
J.D.	14.6	69	.5	S.L.	12.7	60	1.1
I.E.	12.0	66	.4	K.D.	12.11	61	.9
K.R.	14.7	69	.7	J.B.	11.10	70	.3
A.B.	12.9	69	0	L.P.	12.7	71	.6
E.J.	13.9	52	.2	K.U.	13.3	62	0
L.J.	12.3	68	.6	S.A.	12.4	72	.8
J.J.	14.8	69	0	E.B.	11.9	76	0
E.B.	15.8	50	0	J.P.	11.8	69	.4
R.M.	15.1	76	- .2	C.J.	10.9	75	0
W.B.	15.1	54	0	G.O.	11.6	78	0
J.R.	14.9	74	.7	T.S.	11.4	68	0
M.S.	15.8	60	- .2	J.C.	12.5	71	0
J.H.	14.9	65	0	C.S.	10.3	75	.5
D.H.	15.11	68	0	D.J.	11.0	76	0
L.G.	14.10	66	.4	M.E.	10.0	68	.1
M.G.	14.0	69	.7	G.H.	9.8	74	.2
J.D.	14.0	70	.3	B.H.	9.8	65	0
P.B.	13.8	63	1.0	V.O.	11.9	66	0
M.W.	14.1	65	.3	J.C.	9.11	72	.4
D.N.	14.0	74	.4	C.B.	10.0	67	.4
M.P.	13.8	58	0	S.H.	11.4	59	0
F.P.	13.5	76	.9	M.S.	11.3	61	0
P.G.	13.1	71	.3	A.D.	11.9	73	1.0
M.H.	12.8	77	.4	A.W.	10.2	71	0
J.I.	13.8	70	- .7	H.L.	12.0	68	0

THE POPULATION OF THE MILTON SCHOOL (less Reception Class) 1964/65 AND READING GAINS IN TENTHS OF A YEAR AS MEASURED ON SCHONELL GRADED WORD READING TEST.

	Age	I.Q.	Gain		Age	I.Q.	Gain
S.A.	16.2	72	.7	S.K.	14.6	72	.5
E.B.	14.9	76	.3	D.K.	14.3	74	.1
J.B.	14.1	70	1.6	M.L.	13.0	61	.6
D.B.	12.9	54	.4	H.L.	15.0	65	.3
D.B.	12.6	69	.6	S.L.	15.6	60	.3
H.B.	12.8	65	.8	M.M.	9.6	54	.1
C.B.	13.1	57	.1	I.M.	11.10	79	.5
A.B.	15.9	58	.3	S.M.	15.3	69	0
A.C.	15.1	71	.5	G.O.	14.5	78	.2
J.C.	10.6	69	1.2	J.O.	12.4	72	.4
E.C.	14.2	70	.1	V.O.	14.8	66	.6
J.C.	13.0	72	.7	L.P.	15.6	71	.2
J.C.	15.5	71	.4	J.P.	14.7	69	.2
J.C.	11.0	59	.4	B.P.	13.4	78	.7
P.C.	11.7	59	.7	M.R.	12.10	69	.3
A.D.	14.9	73.	1.0	L.S.	11.5	71	1.0
K.D.	15.11	61	.5	I.S.	9.10	73	.2
M.D.	12.3	67	.5	S.S.	11.6	68	.3
A.D.	12.4	70	.7	E.S.	12.9	72	1.1
S.E.	11.8	71	.8	G.S.	11.9	75	1.2
S.E.	13.5	73	.2	T.S.	16.2	58	.4
M.E.	13.0	68	.8	B.S.	10.6	71	.4
M.F.	15.6	74	.2	C.S.	13.2	75	.4
T.G.	15.8	72	.3	W.T.	14.5	74	.3
E.G.	13.8	75	.3	I.T.	15.2	66	.1
P.G.	16.2	71	.5	E.S.	12.11	71	- .2
C.G.	16.3	71	.2	E.S.	12.5	71	- .4
S.H.	14.3	59	1.6	A.W.	14.1	71	.2
M.H.	15.8	77	.1	G.W.	12.5	74	.9
K.H.	11.6	58	.5	P.W.	11.0	88	.7
B.H.	12.8	65	.2	H.W.	10.0	74	.5
G.H.	12.8	74	.2	A.W.	15.8	60	1.8
P.H.	14.10	72	.9	D.W.	14.3	58	.8
D.H.	14.8	79	1.0	D.J.	13.0	76	.1
L.J.	15.3	76.	.2	S.M.	13.7	70	.3

Appendix 4.

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A. E. Marshall, Esq.,
Headmaster,
Milton School,
Swinton,
MEXBOROUGH.

Dear Mr. Marshall,

I am sorry to have been so long analysing the data you sent to me in February, but I think you will agree that the picture which finally emerges is an interesting one. Firstly differences in reading age gain between the programmed and the non-programmed group are statistically significant. On the basis of the figures given we can say that programming is having a markedly beneficial effect. I noticed while looking through the data that younger children in the programmed group seemed to have greater R.A. increases than older children, whilst this was not true for the non-programmed group. A dichotomous test was decided upon which has the great advantage that conclusions derived from it can be generally relied upon, despite a possible large element of unreliability in the data.

There are 70 scores in the P group and 76 in the non-P group. Each group was divided in two, a low age group and a high age group and each age group was again divided into those with increases of five months and above, and those with increases below five months. Thus it was possible to obtain two matrices, one for the P group and one for the non-P group, as follows:

	Programmed Group		Non-Programmed Group	
	Low age group	High age group	Low age group	High age group
Increase in R.A. of 5 months or more	19	13	10	12
Increase in R.A. of < 5 months	16	22	28	26
Totals	35	35	38	38

It is immediately apparent from this table that the proportion of those in the low age P group with increases of 5 months or more is considerably greater than that in the low age non-P group whereas the high age groups do not differ. Testing the difference in low age group proportions by the χ^2 statistical test we have $\chi^2 = 5.95$ $P < .02$. In other words, if there were no real difference between the low age groups the chances of finding a difference of the magnitude shown above would be less than 1 in 50. We may conclude with a fair degree of confidence that the low age group benefits more from programmed instruction than the high age group.

The same procedure was repeated dividing the P and non-P groups into low and "high" I.Q. rather than low and high chronological age and the following matrix was obtained:

	P Group		Non-P Group	
	Low I.Q.	"High" I.Q.	Low I.Q.	"High" I.Q.
Increase 5 months or more	16	16	8	14
Increase < 5 months	19	19	30	24

Again the same pattern emerges. The low I.Q. P group is significantly better that the low I.Q. non-P group ($\chi^2 = 5.02 : P < .04$) whereas the higher I.Q. groups do not differ significantly.

(This finding is independent of the finding on chronological age since I.Q. and C.A. are not correlated; different individuals appear in the low I.Q. and low C.A. groups).

In view of the above it might be expected that a division on the basis of mental age would yield even more marked differences, and this is indeed the case. Since mental age does not appear in the data, an estimate has been calculated by the formula $MA = \frac{I.Q. \times C.A.}{100}$. Using this estimate as a further basis for dichatomising the groups we have:

	P Group		Non-P Group	
	low M.A.	'high' M.A.	low M.A.	'high' M.A.
Increase 5 months or more	19	13	9	13
Increase < 5 months	16	22	29	25

Difference between P and non-P: low M.A. groups
$\chi^2 = 7.22 : P < .01$
" " : 'high' M.A. groups
No significant difference.

To ensure that these demonstrated differences were not peculiar to the arbitrary cut-off point of 5 months R. A. increase, the same analysis was repeated with a 3 month cut-off point. Results are shown on the attached sheet and can be seen to follow exactly the same pattern.

It would seem that, although children in the high M.A. group derive some benefit from programming the main effects are confined to the low M.A. group. Whilst the overall difference in gain between the P and non-P groups is statistically significant the significance can be seen to be contributed mainly by the low M.A. group:

Mean difference in gain between low M.A. P and non-P groups = 2.8 months ($t = 2.613$: $P < .01$): between "high M.A. P and non-P groups = 1.6 months (non-significant).

These differences may all be due to the nature of the programmes used. It could, of course, be true that whilst there is much to be learned from the programmes by the lower group, the higher group may be closer to the maximum to be achieved and hence have less 'room' for improvement. It would be interesting to have some information on this point. If there is good evidence against it then the findings here could possibly generalise to all programmed learning for E.S.N. children and such facts would be of theoretical importance. In any case it is of interest to note that mental age may possibly be the best predictor of the extent to which a child may benefit from programming.

I do hope these findings will prove useful and look forward to hearing from you.

Yours sincerely,

J. K. Clarkson.

J. K. Clarkson.

Appendix

Results with cut-off point at 3 months and above increase in R.A.

Chronological age

	Programmed		Non-programmed	
	low	high	low	high
Increase 3 months & over	26	23	18	18
Increase < 3 months	9	12	20	20

Difference between low C.A. group: $\chi^2 = 5.51$. $P < .02$
Difference between 'high' C.A. " : non-significant.

I.Q.

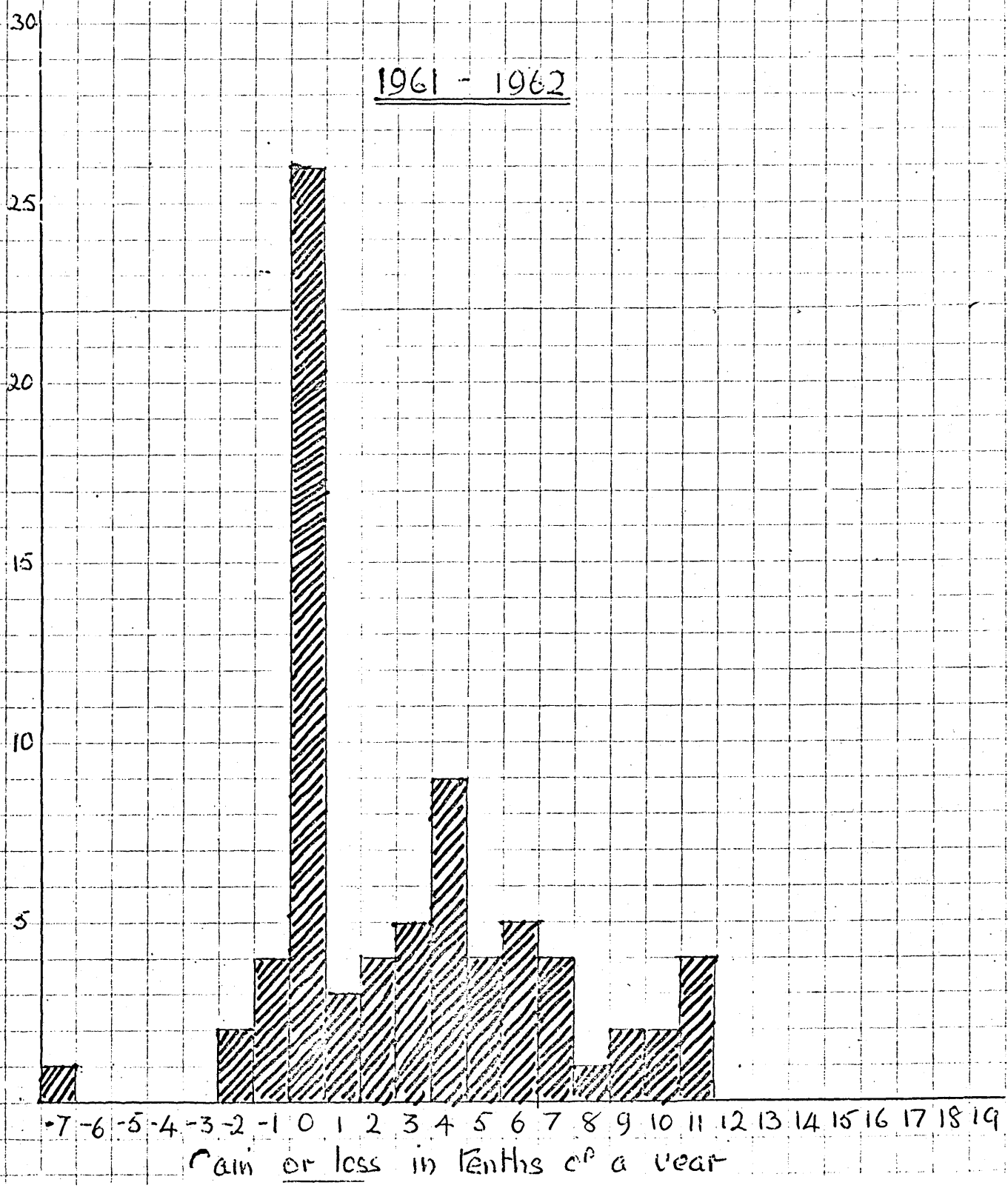
	Programmed		Non-programmed	
	low	high	low	high
Increase 3 months & over	26	23	14	22
Increase < 3 months	9	12	24	16

Difference between low I.Q. groups: $\chi^2 = 10.31$ $P < .005$
" " 'high' " " : non-significant.

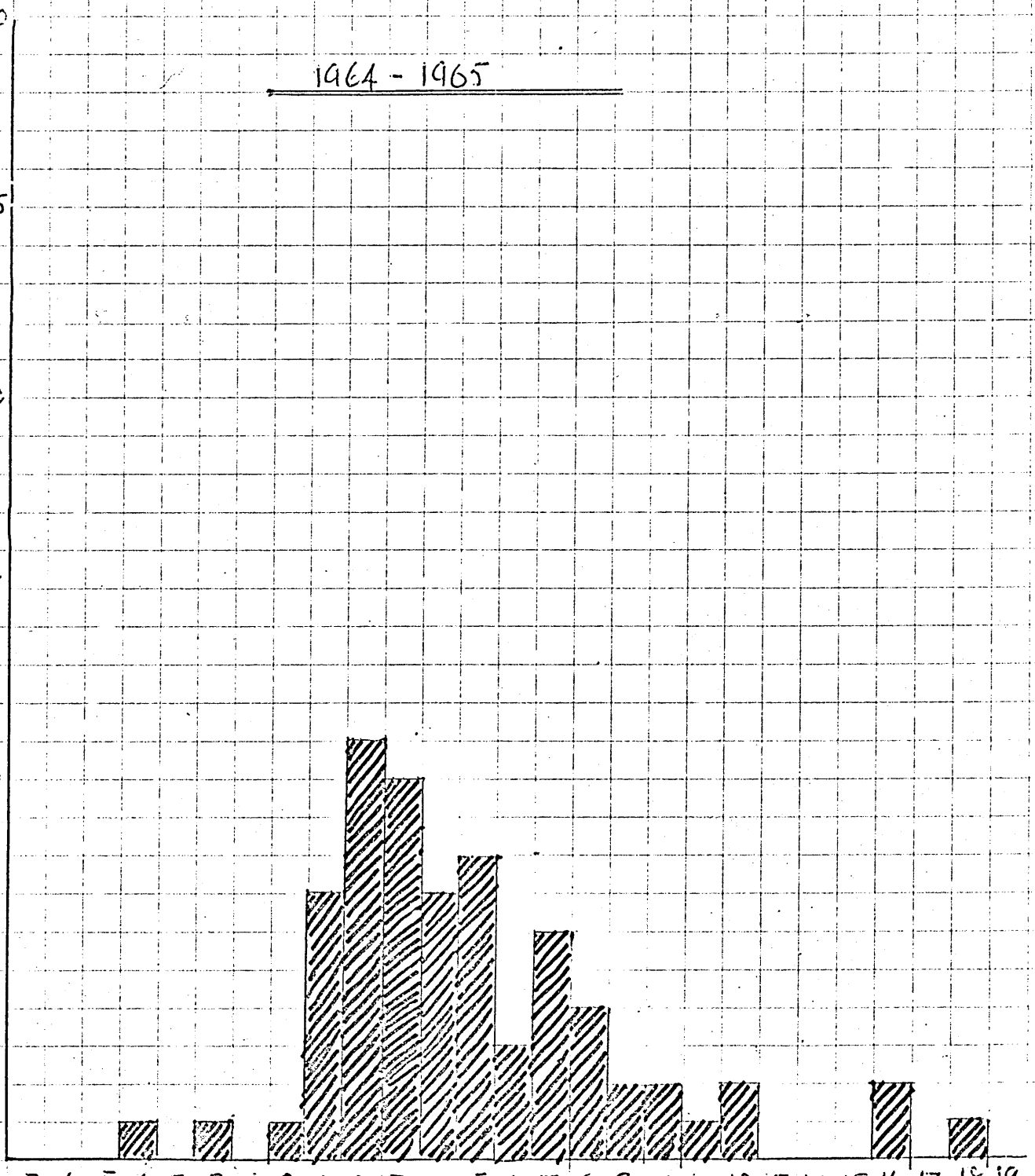
M.A.

	Programmed		Non-programmed	
	low	high	low	high
Increase 3 months & over	28	21	15	21
Increase < 3 months	7	14	23	17

Difference between low M.A. groups: $\chi^2 = 12.36$ $P < .001$.
" " 'high' " " : non-significant.


1961 - 1962
30
25
20
15
10
5
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Gain or loss in tenths of a year

1964 - 1965



APPENDIX 6.

Selection of Programs used in the Evaluation Study 2.

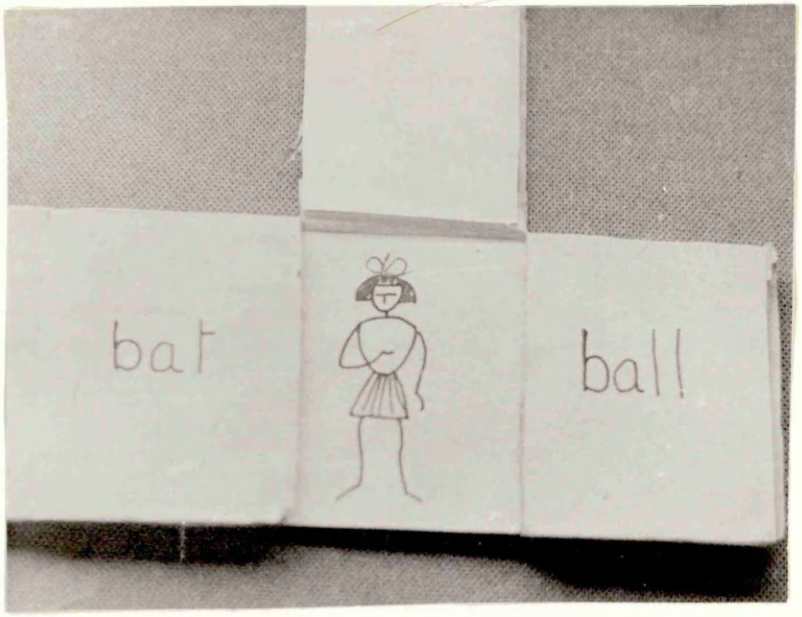


Fig 1. Flap Card. This was developed from a class lesson in which four words were written on the blackboard and which the pupils were asked to draw. Vice versa, the drawings were put on the blackboard and the pupils asked to name them. The flap cards enabled th pupils to work at their own speed.

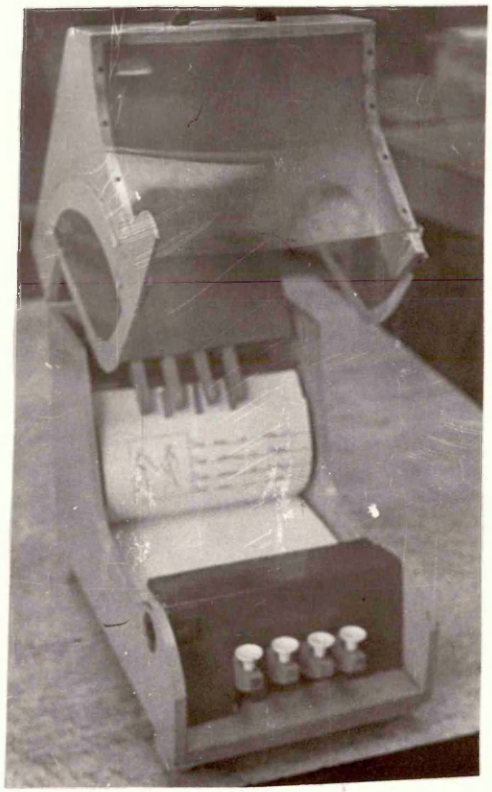
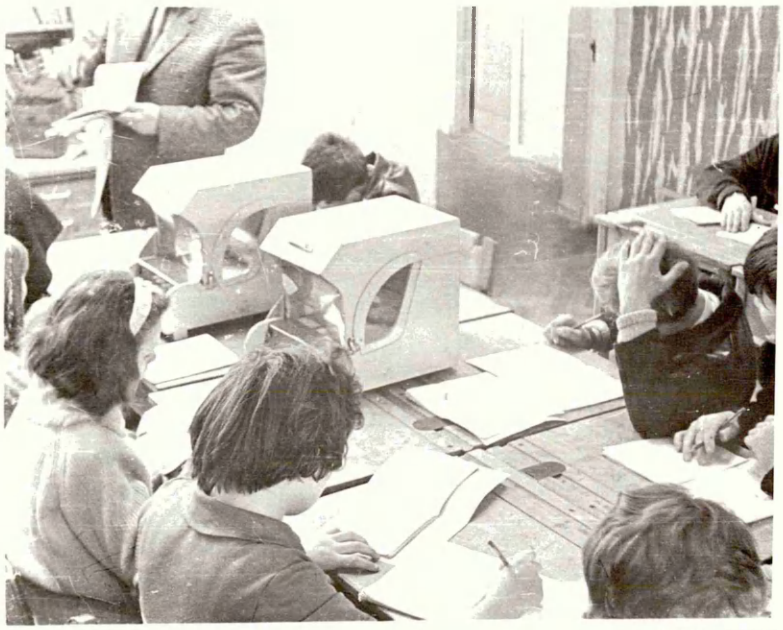


Fig 2. The Oldborough Teaching Machine.

. This machine was developed in the Oldborough School, Kent, the designer supplied us with the drawings and gave us permission to copy them. The programs were written and drawn in ordinary exercise books. The book is lad on its spine and the outer edges of the pages cut away to leave tabs. These taps are held by pegs which release the pages when the correct key is pressed. At the fron to the machine is a counter which records the number of responses made.

Fig 3, Classroom showing programs in use and at the rear the library of programs which eventually contained some 600 short programs arranged in three parallel series.



Fig, 4. Oldborough Teaching Machines in use.

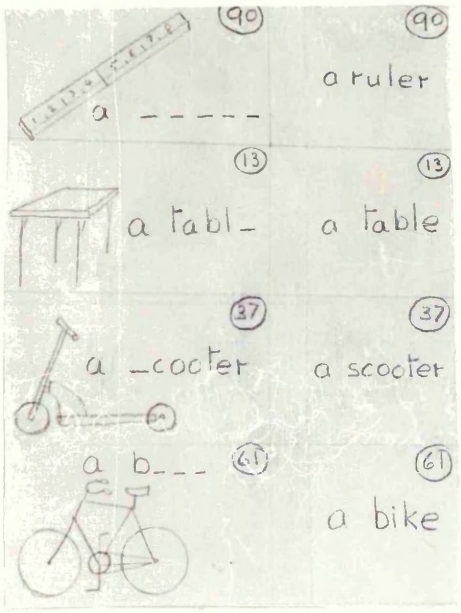
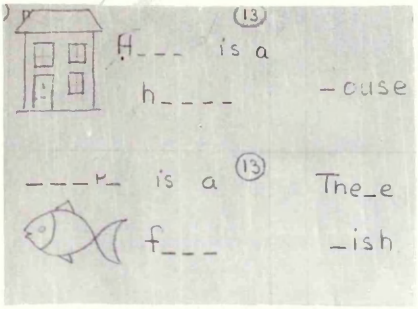
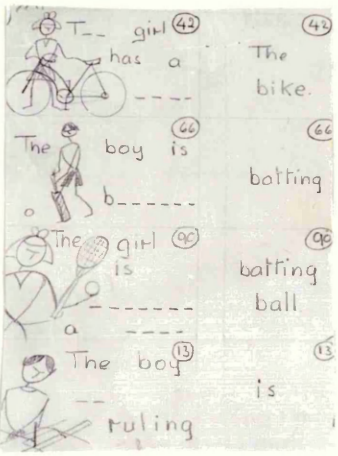
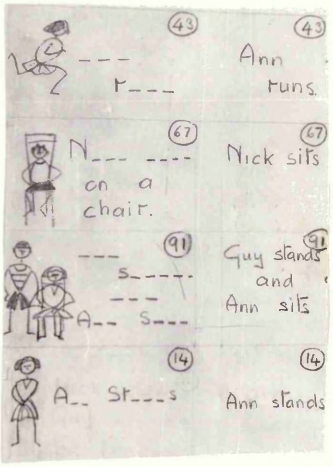
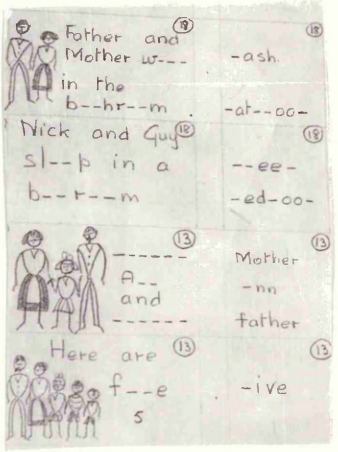


Fig 5. A page from the Book 1 of The Milton Series showing four complete frames. The re-inforcement section is actually on the left hand side of the following page. The pupil works along the top line of the book from page to the end and then returns to the second line. Each of the twelve books in this series contains 96 frames.









Figs 6, 7, 8, and 9, Illustrate four selected stages in the series. Each page shows four frames but because the pupil traverses the book laterally there are 23 frames between each frame on any page.

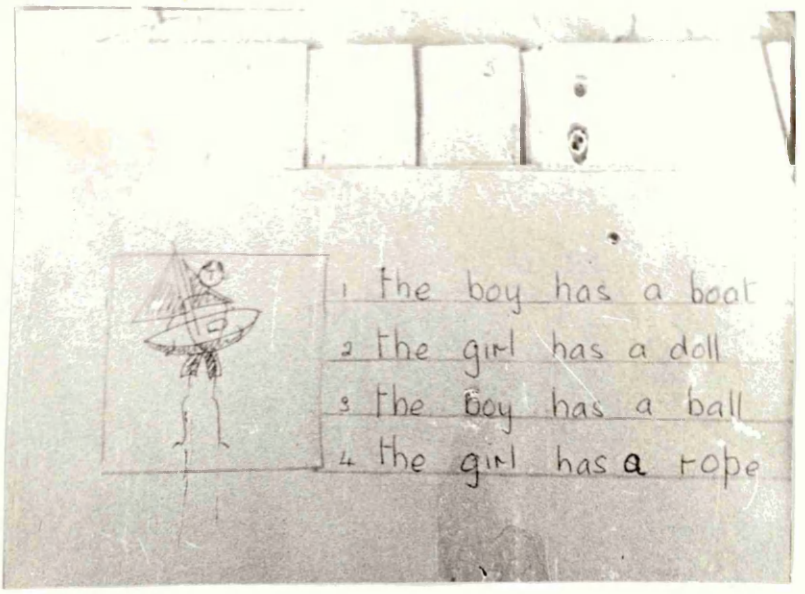
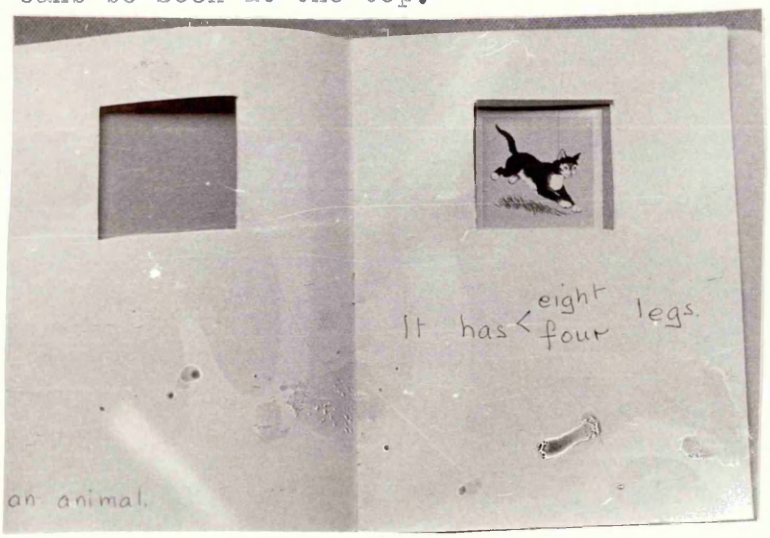
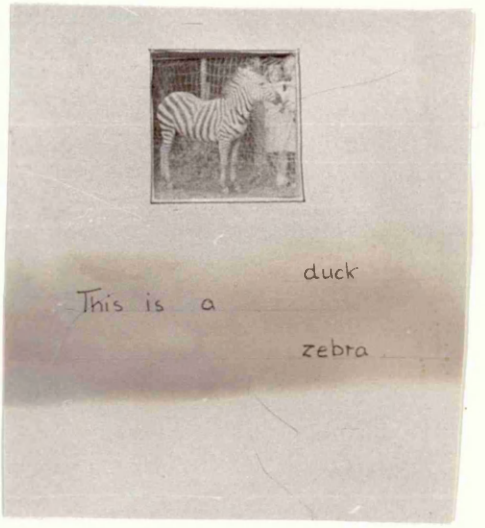


Fig 10. A multi-choice frame from a Oldborough MMachine program using similar material to that in the Milton Linear Program series. The cut-away edges to the pages canb be seen at the top.





Figs 11 and 12. These are book programs which are supplements to the Milton Series. Each book has twelve frames and holes are cut through the pages so that one illustration can serve them all.

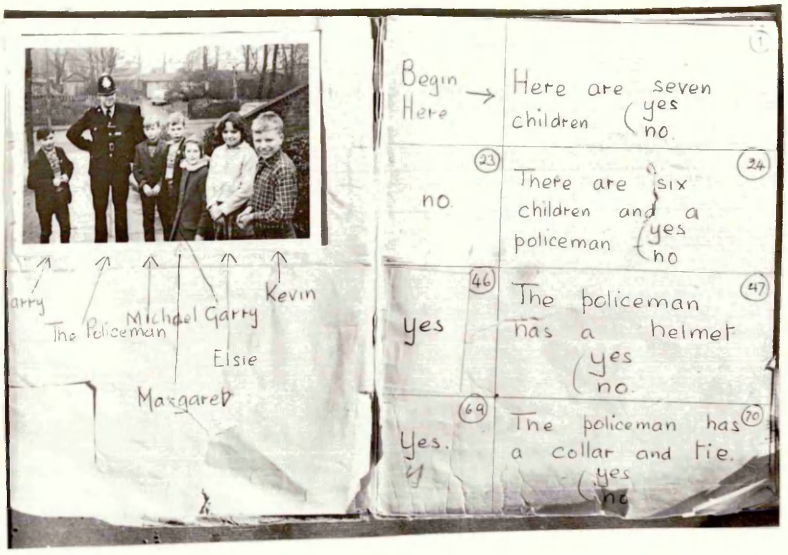


Fig 13. This illustration is from a program based on a local study. The study included visiting such places as the library, the post-office and the railway station. These were all photographed at the time of the visit and the pictures used as panels in a book program.

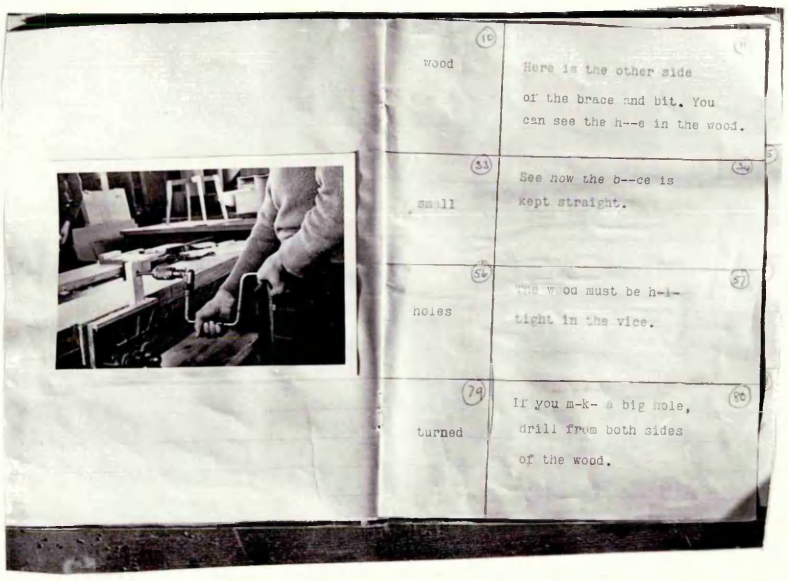


Fig 14.
Here the subject matter is obtained from the wood-work room.

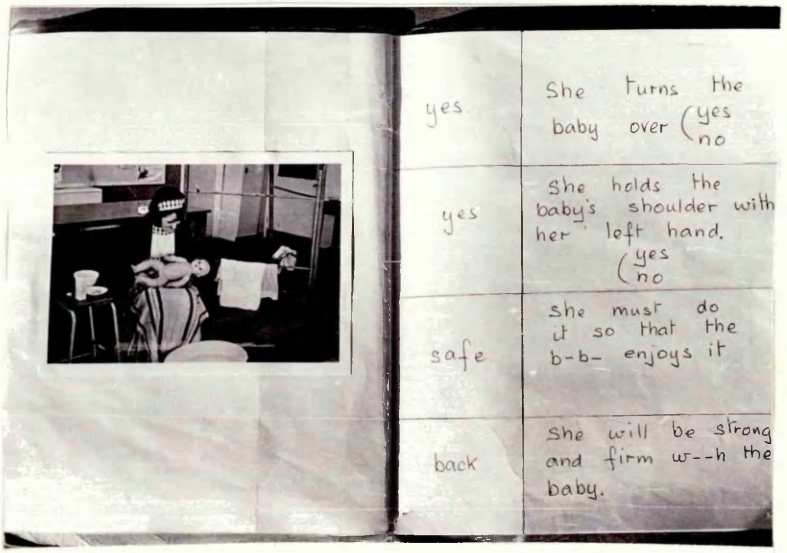
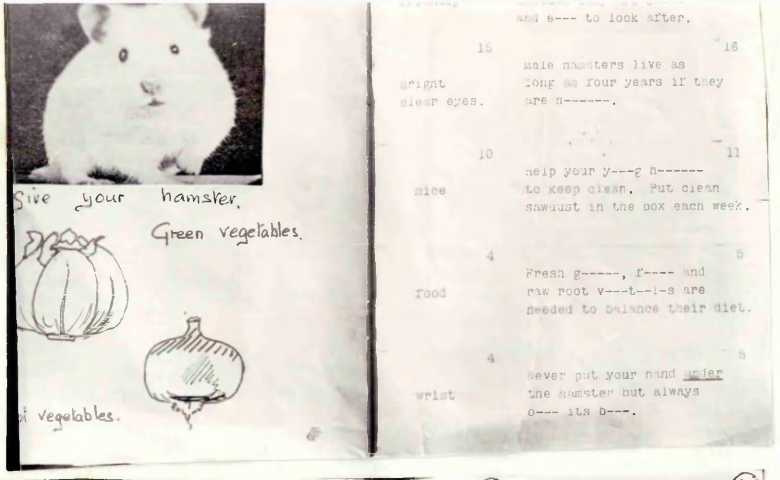


Fig 15. The subject matter for this program is taken from a lesson in mother-craft in the domestic science room. It should be kept in mind that the objective of all these programs is the teaching of reading. The word content is strictly relater to the position of the program in the series.



Figs, 16 and 17.
Two examples of programs which were derived from the children's outside intereste.

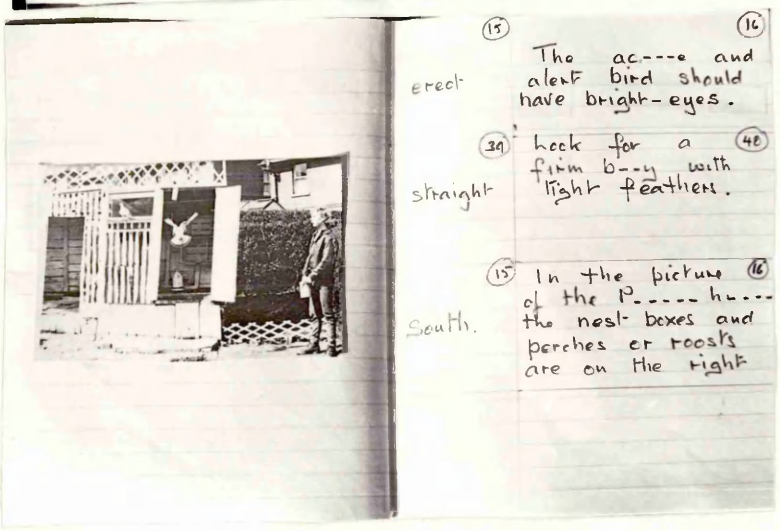
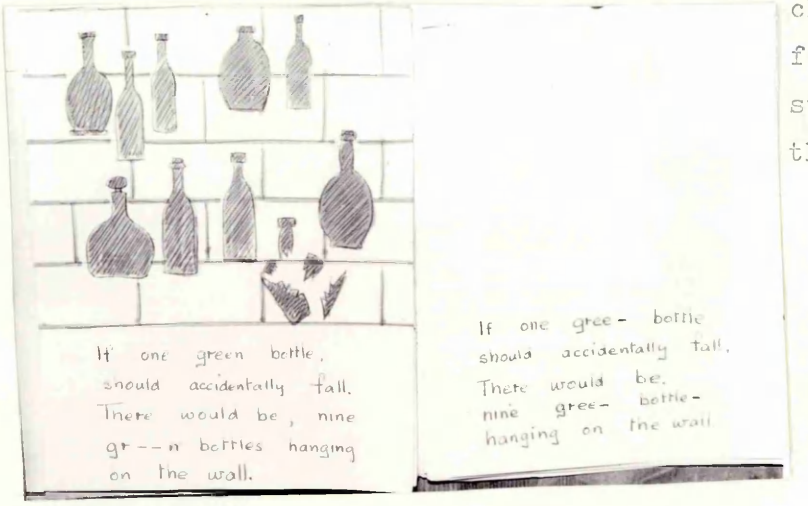
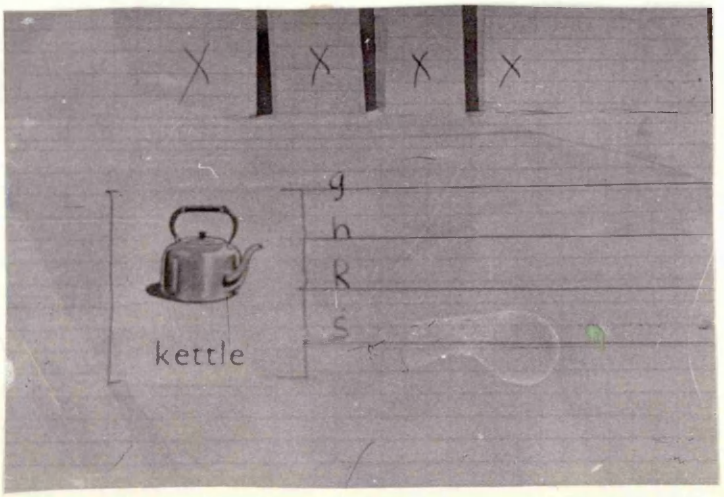


Fig.18.
Folk tales and rhymes provided useful textual matter for programs because the children were either familiar with the stories or had memorised the rhymes.





Fig,19.
An example of a program created to meet a special need of a particular child.
We wished to direct her attention to the initial letters of words.

PART II.

PREPARATORY and BACKGROUND RESEARCH.

INTRODUCTION

RESEARCH IN THE CLASSROOM

The ideal pre-conditions of a researcher in any field, is to put his subject in a situation where all variables are controlled and then, from a position of detachment, apply to the subject or insert into its environment other variables and observe and record the outcome.

When one is concerned with living organisms this is a situation impossible to achieve completely. When researching into the behaviour of human beings the gap between the ideal pre-conditions and the actuality is very wide indeed. The psychologist in his laboratory can, even with human subjects, place them in a carefully planned environment and insert his variables from a point of detachment. But if one wishes to measure the effect of a particular technique in teaching to be applied in classroom conditions, only false or distorted results will be obtained if it is tested in the laboratory.

The ongoing life of the school, or the classroom in the school, can provide, if rightly used, the controlled environment for the educationist to test his methods - indeed, it is the only place where their efficiency can be effectively measured. If these methods are intended for classroom employment then to test them in some artifically contrived situation must produce a contrived result. However, if the experimentor needs to be present during the course of his enquiries he must himself become a normal feature of the environment and not unduly disturb its particular tenor when he joins it. The situation is the opposite of that which occurs when the psychologist places his animal subject into a box and allows it time to accomodate itself to this. Here the experimenter inserts himself into the environment of the

classroom and then allows the subjects to accomodate themselves to him. Generally speaking it requires that the experimentor must become a regular feature of the class over a considerable period of time.

Having established himself as such he can feel that despite the multitude of uncontrolled variables operating in the classroom, nevertheless the day to day situation will be fairly consistent and he will be able to observe and record the effect of the controlled variables he apples to the subjects or inserts into the environment. Any changes that occur in connection with these variables may be reasonably said to derive from them. Further it can be said with some measure of certainty that like effects can be expected when these variables are applied in other similar classroom situations.

This does not mean all classroom situations in all schools, or even all classroom situations in special (ESN) schools such as the one in which these studies are being made, they vary in their individual differences almost as much as the pupils in them. Nevertheless, the liberal approach to learning and teaching which has developed so rapidly in these schools over the last two or three decades, has created many classrooms throughout Britain such as I shall describe later. It is in such classrooms that, if my thesis is correct, that P.L. is a significantly more effective way of teaching reading to the pupils who form these classes, it will be possible for these children to profit from these techniques too.

However, there are a number of factors in the classroom situation which, if they are not given due consideration can negate much of the work done by destroying its statistical

validity. Holland (75) discusses this problem: he is of the opinion that the "dependant variable" of greatest interest is the number of errors on tests, and considers this unsatisfactory. He does not suggest alternative methods and it is difficult to see how use of the pre and post test measuring the outcome of any experiment can be replaced. They can, however, be subject to a more refined examination. In the use of the ordinal scale he complains that some test items may always be missed and some never missed, leaving few items to reveal effects of potent variables. This would seem to indicate poor experimental design, especially if one is concerned with frame, (intra and inter item) variables. He also points out the lack of sensitivity when "ceiling effects" occasionally occur when test performances are near perfect in all conditions. This maybe sometimes difficult to avoid when experimenting with mentally high grade subjects in isolated experiments but it is easily avoided with slow learners if one is continuously involved with them.

He goes on to criticise experimenters for a number of matters such as use of programmed books, mainly because they lend themselves to "cheating" - I have found that in the field of slow learning this does not seem to stop the learning process. In this I can claim support from a variety of sources quoted by Leith (62) who sums up the position as follows:-

" It seems possible to conclude that so called 'cheating' is not a disadvantage and that machines at the present stage of development have no demonstrated advantages over text-book presentation of programmes." However, in the experimental situation, "write in" machines could have some advantages where one is seeking the direction of errors within frames (intra-item sequencing) or

between frames (inter-item sequencing) but for practical purposes, as Leith remarks 'cheating' is not a disadvantage.
The other items to which he raises objections are, poorly controlled data collection, failure to provide experienced supervision in open and over-large classes and students permitted to work at home, none of which are applicable to this study.

All data is collected in the classroom immediately before and after any trial. The experimenter in this case is constantly present, and all tests are carried out by an assistant in an annex to the classroom. Finally all work is done in the classroom.

Spence, (124) in trial-and-error learning and discrimination learning employs a multi-choice maze wherein the rat is rewarded (reinforced) with food if it chooses the right path. The components of his experiment are: (1) a motivated organism, (2) an environmental choice situation, (3) the behaviour possibilities of the organism and (4) the situation or stimulus events consequent to the several responses.

I set up a trial-and-error experiment with slow learning children as follows:-

The child is presented with a multi-choice program through the medium of an Oldborough Teaching Machine (See app. 6) He is to learn when and when not to use the article 'an'. Each frame presents the child with four nouns or noun phrases only one of which requires the article 'an'. To the left of each frame are the article 'an' and the vowels 'a,e,i,o,u.'

Using the vowels as a key, the child makes its selection and presses the related key. If the selection is correct the page falls down and verifies the correctness. If the child is

counter at the side records the total number of choices made during the program of twenty-four frames.

Going back to the components, the child for a variety of reasons is well motivated. Secondly unlike the animal whose environmental choice is increased beyond the maze choices by such possibilities as climbing the side of the cage, the child's motivation follows the teachers direction and only the four alternatives are probables. Thirdly, behaviour possibilities, here the child brings to the situation a large variety of innate and acquired response tendencies which will to some extent control the responses. This is especially so with dull children who, while motivated strongly to essay the response, may tend to guess rather than select the correct key. Nevertheless, each frame is a trial and one correct response must occur in each trial. The consequent stimulus events in the case of the child are that the child will, because it is re-inforced when it makes the correct choice, : tend to use 'an' only before a word whose initial letter is one of the vowels, a,e,i,o,u.

According to Spence, application of the law of effect - re-inforcement - is the primary principle behind the use of programmed learning and teaching machines. He states that the law of effect is"..... one law that seems to me to have held consistently in all of our experimental studies of learning, no matter what the complexity of the situation..... responses accompanied or followed by certain kinds of events (called reinforcers) are more likely to occur on subsequent occasions, whereas responses not followed by this class of events subsequently show a lessened probability of occurence." Thus programmed learning is to be based on the law of effect.

Learning Theories and Programed Learning.

Klaus in trying to define two basic approaches to P.L.(i.e. the connectionist, response centred, or Thorndike Skinner derived theories, as opposed to the configurationist, stimulus centred or Tolman Lewin derived theories) with the purpose of discussing program creating techniques suggests that programmers must be of one school or the other. He says that:-

" The cognitive aspects of the configurationist position are as difficult and foreign to the connectionist as his mechanistic principles are to the configurationist. While the connectionist is attempting to condition responses, the configurationist is endeavouring to generate insights." (109)

In the practical field of writing and applying programs in schools these two aspects are resolved roughly into the Skinner type linear program and the Crowder type intrinsic program. It would seem therefore that these two methods of program writing stem from two very different basic theories of learning. While among educationists there are dichotomies of thought between many learning theories, nevertheless in the classroom practice it would be an unusual teacher who could describe what particular learning theory or theories he was practising at any given moment.

At Milton school we began by employing the connectionist or Skinner type program, first through the medium of the simple 'flap-card' (see app.6.) stimulus - response - confirmation sequence, then we deliberately copied the technique exemplified in Holland & Skinner's book "Analysis of Behaviour" (4) but later, on our practical approaches derived from our eclectic reading, we were in addition soon employing the panel and multi-choice

pattern of the Crowder or configurationist theorists and also, in our own special way, their branching or looping techniques.

In the pragmatic classroom situations of the teacher of slow learners, everything that furthers learning is embraced. However, the branching feature was not employed within but only between programs as I have explained in the Introduction.

The programs I have written for slow learning children are, however, derived mainly from the theories of Skinner. The programs are, strictly speaking, 'linear' in that the pupil has to go from frame to frame even though he may make an error. In the case of a book program he should correct his error by checking it with the re-inforcing item of the frame. On the Oldborough machine he cannot move forward until he makes the correct choice and presses the relevant key. On the Stillitron machine he is unlikely to carry on if the 'feed back' is a 'red light.' On the punchboard he will not move on before he has found the correct hole and broken the paper. But whatever he does there is no change of direction. In the case of the write-in machine, the same pattern follows, when the actuating handle is pulled, the paper moves on just one frame.

However, we have only used the precise Skinner method, which calls for a constructive response (the completion of a word or sentence or the writing of a phrase), in the book programs. In all others the pupil is called on to make a choice - they are in this sense, multi-choice frames. As there is no deviation in the sequence then they are also linear.

Apart from this their fundamental difference with intrinsic programs is that each response is rewarded. To quote M.A. Crowder (110) ;-

"In linear programming the students response is considered an integral part of the learning process; the response is induced in order that it may be rewarded and learning thus occur."

Crowder (28)) and others, supporting Guthrie's contiguity theories of learning (28)) ascribe the re-inforcement in the linear program entirely to the confirmatory item in the frame, whereas it is merely the symbol which triggers off a cluster of re-inforcing stimuli.

To assert that this re-inforcing factor is fundamental to the difference between linear and intrinsic programming is not true, the intrinsic programmer employs the rewarding item 'knowledge' of the results just as the linear programmer does, but he accept a greater error rate and uses the error to lead the student back to the correct path.

I have no objection to the intrinsic program except insofar as slow learners are concerned. There are a number of reasons for this. First, slow learners in the lowest quantile of the educational spectrum suffer excessively from failure - the school can counterbalance this by ensuring a large measure of educational success - the reverse is customary. The Skinner linear type of program devised to ensure 90% success is an excellent technique to effect this. Secondly, the further one descends the spectrum the less logical ability is found. Hence to go to the other extreme and leave it to the learner to direct the sequence of his instruction as advocated by Mager (111) in this field of education would prove self-defeating.

Thirdly, while I have employed branching techniques in that I have prepared parallel program series and in the event of pupil failure switched the pupil to another series at an earlier point. In these circumstances the sense of frustration which so frequently negates learning with these pupils is avoided. Fourthly, while these pupils could probably pursue an intrinsic program on an expensive electronic, visual, press-button machine like the Grundy Tutor, apart from the unlikely possibility of these becoming generally available in British Special schools or classes, there are no suitable programs available, nor are they likely to be written in the number and variety necessary to meet the individual differences found in children in special education.

While the psychologists debate whether the "urge to learn" arises from sex or hunger drives, environmental stimuli, and so on, the teacher has an ongoing problem of teaching willing and unwilling children. Whether it is electricity or gas lighting in her classroom she must use it. If the psychologist has something purposeful and practical to offer, the teacher should take advantage of it. Here Bigge points out what Skinner (122) has offered and demonstrated almost 'ad nauseum' both in the laboratory and in the classroom. Teachers should use it.

The child in its adapted environment, the classroom situation, is for some reason motivated to make an initial effort to solve a problem before him: two words and one picture, to which word does the picture refer? By the nature of the picture and the names and the child's earlier learning it is 90% likely that he will choose rightly. He indicates his choice overtly by writing the name and then turns the page to be re-inforced by knowing that he has chosen

correctly. Whenever he is presented with that problem in the future he will probably make the same choice. Further, he will when he sees the word unsupported by the picture, tend to recall the picture - at least from our personal introspective experience, that is what we assume. This is stimulus discrimination.

'Differentiation of response' is best explained by what Holland &Skinner in "The Analysis of Behaviour" (4) term shaping. This is leading a pupil tc acquire a desired skill by reinforcing a series of successive approximations. The old adage of ' Try, try again'is much more effective if the successive 'tries' are observed by the teacher and only those which show improvement are reinforced. Trying will fail if the successful tries are not reinforced or rewarded in some manner. We know that some skills are achieved without selective reinforcement, where the try is self rewarding or where every attempt is reinforced, but this is a slow, haphazard and wasteful method of teaching, selective reinforcement directly from a teacher or a book or a mechanical teaching device will accelerate learning.

Both of these forms of operant re-inforcement can be embodied in programs whether book or machine presented. Stretch, commenting on Skinner (123) says" He has developed one of the most influential systems for studying learning. He is interested in contingency explanations -what leads to what- and is therefore concerned in the prediction of behaviour rather than the understanding of it; and to this extent his system is not strictly a theory. Skinner has devised potent methods of controlling behaviour, and to some extent he is

concerned with training methods. His ideas are of general interest to educationalists but have also led to specific training methods such as teaching machines and programmed learning. "

The outline of Skinner's work given as an introduction to the above essay summarises my position with regard to Professor Skinner's teaching. I am not competent to say whether his whole system can or cannot be defined as a 'theory' but my experience in applying his techniques in an educational situation have convinced me, as they have many others, that his potent methods of controlling behaviour should be, and I am sure are of considerably more than 'general interest' to educationists.

I include these comments together with the above quotation because in the course of my writing I shall refer again and again to Skinner's work. I have tried to fully grasp his teachings and I have applied his techniques, and as I bring them forward, I will try and link back to the basic teaching of both Skinner and others who are researching in this exciting field of behavioural psychology.

" Although Spence's psychological study is not applied to school situations as such, teachers may assume that his findings in experiments with simple phenomena will apply, perhaps with adaption to complex learning situations." Bigge (122)

Motivation (a)

In over a quarter of a century of work with mentally handicapped pupils I have learned that within all these children, without exception, there is to be found a powerful potential to acquire knowledge. This potential is evidenced in many ways, pathetically so, in some cases, for example where a desire is expressed to learn to do sums like more intelligent brothers and sisters.

I have found this same powerful drive present in adult non-readers who have attended my reading classes. The problem is to tap this stream of energy and avoid frustrating the urge by providing clearly marked channels through which it can flow. Until the advent of P.L. there was practically no material available to teach any subject that was sufficiently well prepared and graduated to enable a student to follow a course of study (no matter what his intelligence level) without frequent recourse to a teacher. The carefully planned program can now supply the need and the need can be satisfied. However, the nature of the slow learner is such that his attention is easily distracted and it is difficult to channel his efforts in one path. Frequent re-inforcement is, therefore, essential. The knowledge that each problem he attempts is either right or wrong, immediately he has tried it, seems to provide this re-inforcement. However, there is a psychological difficulty here in that most of these slow learners have, arising out of their nature and environment, both a history and a current experience of failure; therefore, if the will to learn is to be maintained both in force and direction, this experience of failure must be counterbalanced by success. (Skinner's linear programming method with its small steps, built in low error rate 5%+ to 10%, and its continuous

confirmation would appear to some extent to meet the requirements of the slow learner.)

It is difficult to convey an understanding of this need in slow learning children and how a simple program might meet it but today, during a walk on a warm, sandy Italian beach, I felt that I was experiencing an urge and its satisfaction which might be likened to that experienced by a pupil beginning the pages of a suitably adapted program. First I embarked on the walk because I had a desire to do so. I set out along the sand squelching the warm wetness between the toes of my bare feet. Each step I took gave me affective reward (re-inforcement) but at the same time I was moving forward towards my objective, a castle-like building in the distance. I did not reach my objective but I strode towards it, every step a pleasure. I continued until I was tired.

Concientious teachers of slow learners are daily seeking to channel the efforts of their pupils into substantial periods of purposeful study, sometimes finding success as we did on an occasion at the Milton school when we associated the making of zig-zag books in a craft lesson with the pupils' individual projects. The ongoing strip of pages which could be exhibited on the classroom wall 'in toto' provided additional motivation to the writing up and pasting of pictures which constituted the core of this project.

Thompson (99) has this to say:-

"We do not know very much about motivation. It is a complex condition into which psycho-theraphy has given us some insight but not enough upon which to build a general theory". But goes on immediately, "There is little difficulty in finding adequate motives for any bit of reflection or thought."

In the employment of P.L. in the teaching of readin

we are more concerned with this latter, almost superficial, aspect of 'motivation.' When creating a frame in a sequence or even a whole program we are concerned to motivate the pupil into reflecting and then responding. The subsequent reward of knowing that he is successful is partially responsible for on-going motivation. Nevertheless, with slow learning pupils whose retardation is frequently caused, at least in part, by weak motivation due to a great variety of causes, we must be concerned with the deeper and more fundamental sources of motivation.

I feel that despite the relative scarcity of our knowledge there is a great deal we can employ in furthering our efforts, we can embody that knowledge in creating our programs. We know, forexample, that children are very ego-centred and, therefore, anything which seems to serve that centredness, such as pictures of themselves and their activities and references thereto, or matters with which they can easily identify, will tend to motivate them.

We know that children pass through various stages of development and that during these stages they are strongly motivated towards certain interests. For example, children have very strong emotional feelings about animals. I have a recollection of taking a party of slow learning children, ages 7 to 9, to visit a residential school where there were a number of animals varying from hamsters and rabbits to goats and a donkey. All these were conditioned to the attentions of children and so my party was able to handle, feed, and generally get in close contact with them. None of these children could read or write but the teacher concerned, using the motivation derived from this visit, led the children into first drawing, then painting and finally creating an enormous embroidered mural.

This led me to using animal pictures in my linear programs for more literate hildren, employing photos taken of the animals during visits to the zoo. Green suggests that the sources of motivation available to the teacher are limited (28) or at least in the emotional field, difficult to employ because of the aversive stimuli they are liable to arouse. Even though this is an even stronger factor in dealing with slow-learners, nevertheless there is plenty of scope for experienced and intelligent teachers who need not confine themselves to Skinner's (90) relatively trivial motivations, such as puzzles and scissors etc.

The teacher of slow learning children will have little success unless he is prepared to deal with emotional responses. Some day all schools will, like any special school, dispense with all or nearly all of their authoritarian and aversive controls and all teachers will be enabled to employ the volatile emotions of their slow learners to further their educational objectives. As Skinner (90) asserts:-

"The sheer control of nature is itself re-inforcing. The effect is not evident in the modern school, because it is masked by the emotional responses generated by aversive control." He goes on to say how little re-inforcement is required to control behaviour, he says, " a slight re-inforcement may be tremendously effective in controlling behaviour, if it is wisely used." (90)

This may be so with pupils in the upper intelligence quartiles, but those that we are concerned with here do not respond so easily. The slight re-inforcements of the classroom are so easily overwhelmed by the emotional factors which cannot be overlooked in the total school environment.

In writing a program for a particular 'mental age' group or an individual we can exploit the inherent motivation of these interests. At the Devereau Foundation (100) the primary drives, even those derived from hunger or thirst, are exploited to motivate E.S.N. children. All schools and classes for slow learners, if they are to achieve real success, must pay attention to the great need these pupils have for love and attention. As I have pointed out almost 'ad nauseum' no teacher can give every child sufficient attention so that other aspects of the learning situation must supply this attention. Teachers have, mostly unwittingly, employed generalised re-inforcers in the shape of such things as 'good marks,' 'ticks' or even 'early release from lessons.' The first two of these being marks of the teachers goodwill, even affection, but they have failed with the slow learners because they were so rarely rewarded. Indeed, more usually, they were subjected to the opposite - 'admonition' or 'aversive re-inforcement' which does not in the long run further learning.

The behavioural position in this matter is summarised by Broadbent. (6) "Punishment has then the weakness that when its connective action is not completely clear, it may produce revulsion from right as well as wrong actions. In addition there is some evidence for another weakness: punishment does not simply reverse the action of reward. Therefore when it is used to oppose some pleasant action it does not really root out that action but merely suppresses it. On the views we have been mentioning reward serves to forge a link in the nervous system between stimuli and response to make a given action more probable in a particular situation. But punishment does not weaken a stimulus response link; rather it attaches anxiety to a situation and this in turn causes removal from the situation to be rewarding."

I have already indicated how P.L. can be used to convert what might be just an ephemeral lesson, quickly forgotten, into a much deeper and more rewarding study; there are few activities and studies which with the intelligent use of such relatively simple aids as the camera and tape recorder cannot be so translated. See App. 1.

One example where we employed the deeper emotional drives to motivate the learning of reading through P.L. medium was a series of three short programs based on the senior girls deep and natural interest in babies. The class in mothercraft was conducted by the domestic science teacher assisted by the school nurse. The pupils, as part of the course, were allowed to attend the post-natal clinic and assist in the activities there. The classroom lessons were divided into three groups: (1) Bathing the baby, (2) dressing the baby, (3) feeding the baby. A life-sized doll was used in these classroom exercises. The lessons were photographed at crucial points, providing some thirty or so pictures. The programs were written in such a way that every frame was illustrated, at least in part, by one or more pictures.

The fundamental motives of boys, young adolescents, can be tapped but the connections are not so clearly seen, indeed one cannot be sure what the sources are. With the girls one can clearly see the superficial motivation in the pleasure of bathing, dressing and preparing food for a life-like doll, as can be seen the deeper physical and psychological motivation. In the interest that boys have, from a very early age, in building

and construting one can only suppose that they derive from some deeper wish to build a home or maybe just to create - however, the drive is there and to direct its motivational power into the learning of reading can be done using similar apparatus, the camera etc and then writing programs around the pictures. See App,6 examples.

We deploy an enormous amount of effort into physical culture and games in all schools; this activity is enthusiastically enjoyed by most children, both boys and girls. This enthusiasm and joy can similarly be brought back into the classroom to further reading. Burt (7) has stressed the need for much repetition in the teaching of slow learners - by using these many and varied activities in this way the repetition need not be tedious - indeed, only the program writer need be aware that there is any repetition.

MOTIVATION (b)

Motivation to learn can come from innate drives, it is certainly spurred on by our environment, and the school, providing as it does, at least in time, a substantial part of a child's environment, provides its own motivational urges. They include immediate and long term rewards (e.g. from pleasing the teacher to examination passes) as well as immediate and long term punishments (e.g. from being kept in to failure in future employment.)

The ESN child has little ability to envisage the long term results of his behaviour and is motivated almost entirely by the day to day, hour to hour and minute to minute rewards and punishments. A bad tempered response from a teacher will generally have more devastating re-action on the ESN child than on the normal child, the latter being able to ascribe the response its right measure of importance and even to adjust to a consistently bad-tempered teacher. The nature of the sub-normal child is such that special education tends to keep them under the tuition of one particular teacher for most of their time. If the child re-acts ineffectively to the teacher's efforts there is little opportunity for it to compensate with another teacher, certainly insofar as basic subjects are concerned. P.L. well prepared and graduated can enable such children to achieve rewarded learning in spite of such environmental problems.

Hunt (29) summarising the results of the researches of Millar and Holland, Hall and Sears, says:
"In these theories, motivation derives ultimately from aversive stimulation." (The organism is behaving to evade some unpleasant or painful situation.)
"or homeostatic need" (hunger or thirst) "which are extrinsic to the perceptual and cognitive processing of information, but there has been

a growing appreciation of the fact that motivation may also inhere to the processing of information itself."

This last sentence may help to explain the inherent motivation of the programs themselves, apart from any other motivating factors, a feature which was noted and commented on by my staff and visitors at Milton.

The history of education clearly shows that the 'aversive' stimulus has been basic to its motivational processes. The obvious techniques were the employment of corporal punishment as an alternative to learning. While this is by no means extinct, subtle avoidance contingencies are currently arranged. Even the kindly approach of the modern teacher must hold the threat of withdrawal. Green (28) makes a very pertinent comment on this aspect of motivation. " The use of aversive motivating devices has its disadvantages, as might be anticipated from what we know of the effects of punishment..... one of the effects of aversive stimulation is the elicitation of strong respondent activity. Respondent activity may be so strong that it is prepotent over operant behaviour, The teacher who utilises strong aversive procedures in the classroom may generate in his students emotional predispositions that actively interfere with the emission of the desired operant behaviours. Another by-product of this form of control with which we are all familiar is that the teacher, himself, being identified with his procedures, becomes a conditioned aversive stimulus. As such the teacher loses whatever potential he may have possessed for becoming effective - or for his behaviour becoming effective - as any kind of positive generalised reinforcer. The student spends so much time attempting to reduce the anxieties or tensions produced by the aversive situation and trying to solve the

inter-personal problem in emotional or respondent terms that he is not handicapped in facing and dealing with the substantial tasks in hand."

The problem is what can be done by a teacher to reduce this factor? To eliminate is not possible. The nature of education, whatever theories it presumes to act from, wherever and whenever it is practiced is authoritarian to some degree, it seeks to make changes in behaviour and these, at some point, are invariably resisted, authoritarianism must often arise at this point.

Green talks about the teacher who uses 'strong aversive methods' but the degree of strength arises from the personality of the teacher and as I have pointed out all teachers use it to a degree. There is, however, another side to the equation, the pupils or students whose personalities, individually and collectively, inter-act with that of the teacher. Where the former are inclined to emotional instability, as is found is special schools and classes, even the teacher who positively seeks to avoid aversive re-inforcement can stimulate unwanted respondent behaviour. The typical class of pupils can usually be divided into the 'aggressive' part and the 'withdrawn'part and with almost any teacher they will re-act in varying degrees according to their strongly conditioned personalities. The teachers of these classes spend a considerable part of their preparation and classroom activities in making material and organising the classroom environment to reduce these personality reactions to a point where teaching can take effect.

Consider some of the general approaches: the reduction of standards, the excessive simplification of textual matter, the search for individual interests, and probably, above all, the permitting or even encouraging of their pupils to follow their own courses of 'study' coupled with attempts by the teacher to give purposeful individual attention to them all.

But here again the success or failure depends on the character of the class teacher, or in small schools, to some extent, the head teacher. These techniques or procedures which I have seen employed and, indeed, which I myself have used extensively both at class and school level, while they are notable for their beneficial effect on the school or class environment, do not do much to effectively raise the academic standards of the children, indeed the authoritarians invariably proffer their achievement levels as proof of their superior methods.

In the study at Milton and in my current research at Rossington School and the Mexborough College of Further Education, I have tried to demonstrate that marked academic gain can be inserted into such liberal environment without any increase in unwanted respondent behaviour, by means of programmed and automated self-instruction methods. The nature of the programs and such machines as I have been able to avail myself of, have enabled me to control the variables to a large extent, if not completely and measure the effects of the various methods applied. The motivation inherent in the techniques is such that unwanted respondent behaviour is practically eliminated.

Gagne and Bolles (101) remark that: "From the very great amount of research that has been done on human learning much is known about the conditions that influence learning and many of the variables that govern learning have now been identified. It is somewhat surprising that in spite of this body of information, relatively little of a systematic nature is known about how to promote efficient learning in practical situations."

They offer, as the two basic reasons for this that on

the one hand the researcher is only concerned with how the learning process functions. He is not interested in applying his findings to implement learning. On the other hand, educators who do work in practical learning situations do not carry out the systematic, controlled type of study needed to discount these variables which govern learning. It is the common dichotomy to be found between research and practice everywhere.

Returning to the subject of this chapter, Green (28) says: "With the exception of the discussion of secondary and generalised reinforcers there is little that tells the teacher what he can do to manipulate the variables involved in 'motivation'".

In attempting to remedy the omission he first denigrates a motivational feature which teachers most commonly use. "Goals," and he avoids discussion on "teleology" by saying:- " Let is suffice to say that an account of present adion in terms of future event is not permissible." He does not deny that behaviour has characteristics that are 'purposive' but he rejects the metaphysical interpretation such naming represents.

He next discounts the drive and drive reduction theories, but says that he is concerned with the same phenomena admitting: " We have concerned ourselves with primary reinforcers as controllers of behaviour" adding "We have not become involved in theoretical issues regarding inferred states of the organism relating to such reinforcers and their effects." (28)

He now ties his argument to the Guthrian theory of contiguity of learning; (102) "that a significant change in the environment that reliably follows a member of the desired response class produces those changes which we say represent re-inforcement." He concludes by suggesting that it would be a valuable experiment to

test whether it is;

(a) the pairing with the primary reinforcer that is necessary for the establishing a secondary reinforcer, or

(b) whether it is simply the consistent reliable consequence of action that establishes a neutral event as a secondary reinforcer.

This latter, he says, is in fact what is available to the teacher in most instances as re-inforcement. These conclusions seem to indicate that Skinners 'knowledge of results' are of little importance and that the undefined reinforcers that appear to operate in the experiments by Hively (103) in errorless learning are sufficient.

So far as the subjects I have used in my study are concerned, where book programs are employed, the designed 'low error rate' in them tends to lead the subjects to ignore the confirmatory part of the frame. Even when the 'Stillitron' programs are used, I frequently find the children using the books without the machine.

I propose later to deal with this subject of 'errorless learning' at some length because I am gradually being led toward a conclusion that the most effective programming techniques include this feature and that if combined with others can produce the gentle persistent motivation to learning which slow learners require.

Stimulus Control.

A stimulus control in a learning paradigm may have two forms, firstly and most common is stimulus control through discrimination training, such as the recognition of printed symbols as part of learning to read. The second aspect is the acquisition of motor skills. The two are combined in the teaching of writing.

A special kind of stimulus control is achieved through what is sometimes called 'response differentiation.' For example, a teacher of speech in any language, instructs his student to read or recite at some length. Instead of correcting mistakes the teacher re-inforces the student when he emits responses that approximate to the required standard. On succeeding instances he demands higher and higher standards until the student matches the objective standard. In this way the stimuli which ultimately control his behaviour are those produced by his own behaviour and the effect upon the listeners. We see the effects of the development of such stimulus control in children from homes of poor cultural and speech standards, they acquire two kinds of speech, one for the classroom and one for elsewhere.

The problem in the classroom is to maintain the stimulus learning against other stimuli, often of greater magnitude. In the infant and junior schools noisy activity is accepted on the assumption that the stimulating opportunities will be more powerful than the accompanying noises, or where the purposes are social the noise arising from intercommunication is, maybe, the behaviour to re-inforce.

In the past the belief that productive study could best be achieved in silence and a quiet school was often regarded as

a good school. Lively discussion in the classroom, however superficial the standard of the subject being discussed, is now highly regarded. Where the object is social communication this is probably a good thing - but if individual study at any depth is demanded then silence is a necessity. A very interesting behaviour pattern was developed and maintained at Milton school, the children would enter the classroom devoted to programmed learning in the usual noisy way expected in a permissive school, such as ours was, chattering and clattering. As they received their books or settled down to work at the teaching machines so the noise would decrease until within five minutes of entering the classroom the only sounds were the voice of the teacher occasionally giving direction and the click of the machines being operated. The teachers, by subduing their own voices, tended to subdue the children. It was usually the children who hushed any undue noise. Towards the end of the lesson which was followed by milk and play, the class noise would increase as those with least application were stimulated by their appetites and the prospect of play, and become restless.

This factor of noise is only one of what Green (28) calls the 'intercept' elements. The modern school building designed to be attractive and thus to be an educational re-inforcer (to make learning pleasant) is probably less conducive to the facilitation of learning than the older schools with their high windows and thick walls which limited both unwanted visual and aural intercepted stimuli from outside. In those educational institutions where programmed learning has been seriously pursued and attention has been paid to the physical environment, almost invariably one finds that individual study cubicles have been created so that the

students can work at the machines with the minimum of intercept stimuli affecting their attention. Whether the cost of and effort of these erections can be justified, I do not think has been examined, but on the face of it, they would seem to be an advantage. We found that with some children that they liked to use the cubicles in which to study, or if no cubicles were available they would often esconce themselves in a corner with their back to the class, turning the desk round, if necessary, but such children were few.

Green (28) chooses the position that programmed learning is a form of discrimination learning, that it is an extremely complex process controlled by discriminating stimuli, the responses to which, are re-inforced in many and varied ways. That it consists of S^ds (re-inforced stimuli) S^Δs (un-reinforced stimuli) and that it occurs in an environment of intercept stimuli.

The intercept elements tend to increase the difficulty of discrimination but this does not seem to be altogether a disadvantage in the wider learning situation, as has been found in the studies of programming variables such as prompting vs confirming by Storulow and Lippert (97) where the prompting (easy) response demand produced quicker learning and the confirming (difficult) response demand greater retention. It seems that the most effective learning is obtained by a correct relative weighting of these elements.

However, this does not take into consideration the differing abilities of the students. In theory all students could master all discriminations if they were given sufficient time, according to their speed of learning. In actual fact, slow and retarded students can never be given unlimited time, and even if this were possible, there are a number of other variables which will offset their success. Another variable which is relevant to the

situation is the constancy of the stimuli to which the student must respond. Here again the balance must be maintained to the nature of the stimuli. "If the discrimination is based on a small number of elements then it is most efficient to present these elements with minimal variations."

I would consider a mathematical formula to be a discrimination based on a small number of elements. To memorise its elements that it would be most quickly learned if it is not varied in presentation. However, to ultimately use it most effectively, the more varied the presentation the better. Green also sees advantages on both sides and says: " the gain in generality and resistance to extinction might outweigh the slower rate of training." (28)

A considerable proportion of the money available to a school is spent on books which have very colourful and attractive covers and whose content is largely pictorial. The purpose is to attract the children to pick up these books and attempt to read them. They are attractive stimuli but they are not necessarily attention compelling. More purposeful sets of readers relate the text more closely to the pictures and seek to guide the child from a presumed understanding of the picture to an understanding of the adjoining text. Here we have two parts of a learning paradigm. The picture which is the 'prompt'' and the text which is the 'stimulus' to which the pupil is expected to respond. If the response is elicited, unless the teacher is at hand to confirm the response, it is unlikely that learning will be effected. However, it is possible that the pupils response may be re-inforced from another source and the response, right or wrong, be learned.

The stimulating display of colourful books may induce children of average and above average intelligence to respond to the

social and school pressures to read. But they can also be an aversive stimulus to a dull or retarded child who has experienced continuous failure in its attempt to read.

Re-inforcement.

" In education the instructional program of re-inforcement is the raison d'etre of teaching machines the future of which is much brighter than current activities suggest..... Those who are sensitive to this fact (of re-inforcement) are sometimes embarrassed by the frequency with which they see reinforcement everywhere as Marxists see the class struggle or Freudians the Oedipus relation. Yet the fact is that re-inforcement is extraordinarily important." (87)

If re-inforcement is important then one should be clear in ones mind, when constructing program frames, what it is, for it is far from being a simple concept, this apart from confusion arising through degradation of the word itself in the language of P.L. Gagne (83) in defining this factor in P.L. states:-

" Most investigators of learning are agreed that some set of conditions which either follow or are coincident with the newly acquired behavioural act serves the function of raising the probability that this act will occur again when the situation calls for it. This set of conditions is called re-inforcement, and there is no generally accepted definition of exactly what it is in a fundamental sense. Nevertheless as used in connection with programmed instruction the procedure of bringing this important set of conditions to bear upon learning is fairly standard. The learner is required to supply a missing word, character or phrase which will serve to complete a statement containing a blank. Having done this, he is asked to look at a printed representation of this response, in order to see that he has responded correctly. (he checks the 'correctness' of his responses) Evidently, what re-inforcement means in the programmed

instruction is that the learner matches a response production of his own to the one he is told (or already knows) is correct."

If the writer of programs were to confine himself to this somewhat limited range of re-inforcement then he would be depriving himself of considerable resources for re-inforcing his subjects; this definition hardly covers the Skinner linear theory and practice of program writing.

Green (28) gives re-inforcement, in relation to programmed instruction, a much broader relevance :-

" It is the very nature of learning that the behaviour of an individual must be changed. Whether the change involves the acquisition of new response modes or the strengthening of behaviours preexisting in the individual's repertory,some behaviour must be strengthened. Behaviour is reinforced by strengthening contingencies. It is tempting to equate reinforcement with 'reward,' 'pleasure' and other hedonistic concepts. Quite often operations that reinforce behaviour fit such labels, but identification of the reinforcing process with reward is dangerous."

As he asserts, there is no evidence for this and he adds the circular statement "A reinforcer then, is just that which reinforces," but he goes on to explain how to narrow the definition by experiment in specific instances.

Hull (88) defines learning and the strengthening of the associative connections as something quite different:-

" The essential nature of the learning process may, however, be stated quite simply. Just as the inherited equipment of reaction tendencies consists of receptor-effector connections so the procession of learning consists in the strengthening of certain of these connections as contrasted with others, or in the setting up of

quite new connections."

His reinforcement theory is roughly that the stimulus precedes the response. Learning is stamped in by repeated drive reductions. The drive reductions are the strengthening factors. Green (28), however, discounts Hull's reduction theory completely when he asserts:-

"To say that a pupil performs at a high level because he has a drive to succeed or an instinct to excel is to say no more than that a chicken crosses the road to get to the pther side."

My experience leads me to disagree to some extent with Green.

The re-inforcing stimuli available to teachers in the classroom situation vary from direct and immediate commendation to such secondary re-inforcers as ticks, stars, which in turn derive their effect from the teacher, and the eventual examination successes. The efficiency of these and others vary not only between reinforcers but also in relation to the individual differences of the students. But whatever reinforcers are exploited by the teacher the role of Thorndikes law of effect (89) appears to be involved in the learning. Mowrer (94) is of the opinion that the ultimate basic laws of learning may eventually prove to be this. It is doubtful that the 'drive reduction' is to-day employed intentionally in learning establishments, though there are pressures on students which are relieved in part by studies completed and desired standards achieved. Teachers still show their displeasure at those who consistently fail to succeed in their learning tasks. Such pressures can be described as a 'drive stimulus' whenever the student is re-inforced when it is reduced or withdrawn and, of course, the strong desire to pass examinations can be considered as a drive which is reduced by success. But as Miller (95) says:

"The drive reduction could produce the re-inforcement or the re-inforcement produce the drive reduction."

So far as children in special education are concerned, I have found that they have an urge to succeed and hence to learn (in school) where (school) learning is shown to be the criteria of success. In the past - and probably it still is to-day - teachers exploited a comparable drive in all children, by giving them the task of completing long lists of problems, usually arithmetic problems, because they were most easily prepared or because school publishers provided them. The rewards were the teachers' commendation exemplified in a series of ticks to indicate the correctness of the answers.

The teachers' purpose behind this kind of classroom work was that "practice makes perfect" and furthermore it kept their large classes of pupils in what appear to be a condition of intensive study, Furthermore, those teachers who were aware of it could quote Thorndike's law of practice, now generally thought to be of doubtful validity.

At other times teachers sought to encourage children to correct their own work, again particularly in the field of arithmetic. Had the average textbooks been prepared suitably they could have provided good self learning material but compression of thought and lack of sequencing presented all but a very few exceptional children from using their textbooks in this manner. It is probable that most children have this drive to learn which I have found in slow learners and it would seem from experience that it can be tapped if the material to be taught can be put into correctly stepped and sequenced programs. The nature of the sequencing of theprogram and

the manner into which it is sub-divided are important factors, as are the step sizes between the frames.

The matter in question, if we are prepared to accept the Hullian theory is, whether this drive reduction and the satisfaction it gives, is the strengthening factor in establishing the behavioural act. Perhaps Thorndikes "Law of Effect," (89) covers the situation better:-

"Of several responses made in the same situation, those which are accompanied or closely followed by satisfacion to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur. Those which are accompanied or closely followed by discomfort to the animal, other things being equal, have their connections with that situation weakened so that when it recurs they will be less likely to occur. The greater the satisfaction or discomfort the greater the strengthening or weakening of the bond."

This, however, introduces the factors of 'negative re-inforcement' and 'aversive re-inforcement' . That teachers would admit to purposefully employing these is unlikely, nevertheless, there is no doubt that they are an aspect of the reinforcement matrix which is part of any school environment. Pressures of all kinds are on the pupils and the reduction of any of these must lead to strengthening the acts of behaviour which lead to this reduction.

To a slow learner, very sensitive to every nuance of any adult indicating failure, even a teacher's grimace can be an aversive act. Teachers consciously and unconsciously employ

many pressures to maintain motivation toward their educational objectives. The teacher of the slow learner must step warily in the 'mine field' of re-inforcements, as it contains too many S^ds (discriminative stimuli) for unwanted behaviour, both aggressive and recessive.

Skinner (90) asks:-

" In the first place, what reinforcements are available? What does the school have in its possession that will re-inforce a child? We may look first to the material to be learned because it is possible that this will provide considerable automatic re-inforcement. Children play for hours with mechanical toys, paper, scissors, noise makers, puzzles, in short anything which feeds back significant changes in the environment and is reasonably free from aversive properties."

I have referred to the 'minefield' in the environmental field of reinforcements, and Skinner talks of 'aversive properties' . Two of these which the teacher of slow learning children must handle with care are (a) the teacher himself and (b) the books which are his basic learning medium. Earlier experience will often have made these S^ds for unwanted behaviour. The program, particularly one presented on a machine avoids the latter and incidentally allows the teacher to withdraw into the background. On this subject of re-inforcement, Borger and Seabourne (31) make two observations which are particularly relevant to this study - first :-

"To be motivated is simply to want something and re-inforcement consists in getting it." There is no question in my mind that those who have failed to acquire reading skills, despite their

behaviour which seems to indicate the reverse, still want to read. To present them with an 'easy' way to achieve these skills like a carefully programmed book, or machine presented program is to provide the re-inforcement necessary to establish and strengthen the skills.

And second:-

"When we make a statement about learning as a function of re-inforcement, we are stating a relationship between variables that may be independently observed and measured."

This study is founded on the independent observation and measuring of the relationship between learning variables. Holland (75) quotes six experiments as having failed to show any significant differences between confirmed and unconfirmed sequences but he then points out that Meyer(93) found a clear advantage for confirmation. She used a constructed response program in one which taught vocabulary by adding prefixes and suffixes. Holland (75) also refers to five further experiments where confirmation to be sometimes significantly better non-conformatory sequences and concludes:-

"The findings of these studies are quite consistent with others comparing confirmation and non-confirmation; there is enough suggestion of small differences so that the importance of confirmation cannot be discounted. The effect, however, is not pronounced."

A feature about all the experiments quoted is that they employed program confirmed Vs program unconfirmed. I consider that it is difficult to avoid including in an efficient program, if not confirmation, at least some kind of re-inforcement

however unintentionally. For example if the step-size and sequence of a program is good, then the steady completion of the program by the student, believing himself to be correct at each step, even though it is unconfirmed, is a re-inforcing factor; or where multi-choice material is used and the text guides the student to the correct choice, then he will be certain every so often that he is correct and he will be re-inforced; thirdly where machines are employed the machines themselves often carry built-in re-inforcing factors which cannot be eliminated.

The falling page of such a machine as the 'Oldborough' see (App,6.) cannot be eliminated so the confirmation cannot be divorced from its operation. But a sophisticated machine like the Grundy Tutor could, probably, be programmed to leave out knowledge of results as could some of the 'write-in' machines, but sound and feeling of the moving mechanism following on the acts of discrimination, even though it did not include any 'confirmation' would provide some re-inforcement. Or consider a 'one page, one frame book', unre-inforced; if it was well sequenced to provide an almost certain correct response, the student would feel sure that he was correct and the completion and turning of the page itself would re-inforce.

This re-inforcement by completion of a frame, page, or complete text has been very evident in the course of this study, the students of the class, with only one or two exceptions, have clearly demonstrated that they prefer short programs. The most popular series have been the ones used in the 'prompting' and 'confirming' experiment, short 12 frame booklets. A similar preference has been shown for a series of about 100

hand written and drawn short (12-24 frame) books see (App,6. Fig, 10) which aim to teach from one to six new words. In both these series, apart from the programmed confirmation, the relatively quick completion itself serves as a re-inforcing factor.

Schedules of re-inforcement.

It is of some importance that the temporal aspects of re-inforcement be considered when one is preparing a course of programmed learning if the greatest advantage for the pupils concerned is to be gained. The timing factors in the overall picture must be considered in their various aspects, how they can best generate learning situations and on-going motivation. The classroom situation with variable interval re-inforcement from the teacher provides the possibility of both rapid learning and resistance to extinction; nevertheless, if we are to profit from, say, Skinner's (4) research into schedules of re-inforcement it will be necessary to go deeper. Green (28) discusses the matter at some length and, indeed, he suggests combining the above two kinds of schedule to achieve a similar learning pattern, though his suggestion takes a different path to achieve this end.

"That the distribution of frames in subsections of programmes be organised to take advantage of the two processes that compete in their immediate effects, both of which are necessary for the establishment of an effective behavioural repertory."

He goes on to describe variations of subject matter within frame sequences pointing out that the demand on the student to make the correct response and thus be re-inforced, can be controlled by varying the number of frames between the presentation of a particular item to be learned. But this becomes excessively involved even in the most elementary programs.

Green (28) says later " We cannot schedule re-inforcement in the early stages of learning because the effective acquisition of

a response repertory during the differentiation phase is accomplished with continuous re-inforcement."

This may be so in a laboratory situation where one is conditioning a pigeon to peck a key. In the classroom situation in which the slow learning child is likely to be studying, whatever schedule of re-inforcement is built into the program other re-inforcements both rewarding and aversive will arise, but in a good class environment those of the program superposed by those of the teacher should be predominant.

As students become more advanced, able to read, abstract and comprehend longer pieces of textual matter, then one can possibly use variable ratio schedules within the program, but when this situation is reached one hopes that the behaviour of reading will have become self-rewarding; indeed it is the purpose of the teacher to continually introduce to the pupil suitable literature with that purpose in view.

In the great variety of programs we introduced into the Milton school between 1961 and 1966 we made considerable use of the fading technique in programs. As a technique it is common to infant teachers and frequently adopted by teachers of slow-learners. We found it very effective in programs varying from ten to one hundred frames in length. As an example of its use in a short program I outline an individual program created to teach a twelve-year old girl, I.Q. 65, to spell correctly, her own name - Elizabeth. I embedded the name in the textual matter which she could read with a little effort, and faded one letter approximately each two frames until she had to write the whole unsupported as a response to the last frame. It was eminently successful.

The "Ten Green Bottles" program (see App.1) is a longer example of the technique. Here I faded the whole in eighty frames. Exactly what schedule of re-inforcement the technique employs is hard to define. Within the program it is, I suppose, an example of continuous re-inforcement but as the cues and prompts are withdrawn the response demands become more difficult, take longer and, therefore, theoretically at least, the time between each re-inforcement becomes longer and longer, and if one considers the 'Elizabeth' program, one can say that the responses increase in number in each frame, but now we are getting away from the simple assumption that each frame is composed of one stimulus followed by a response and a re-inforcement, and I feel that at this point it would be unwise to do so. Nevertheless, if the maximum advantage of P.L. is to be gained for education, at some stage the total 'Stimulus - Response' content within any one frame must be studied. No matter how simple a frame may be constructed the reaction of the pupil will be multi-faceted.

Response Modes.

This study is founded on the assertion that in a large measure of living organisms learning is achieved through the process of : stimulus - response and almost instant reward. Skinner's linear programs follow this pattern and my experiments have been derived to a considerable extent from Skinner's theories.

In the course of this study I very often refer to these three aspects of behaviour in human beings, therefore, whilst I will not attempt to define them, that would be too difficult and lengthy a task, nevertheless, it is necessary to make some attempt to explain what is meant when these terms are used.

Our behaviour may be said to be made up from a chain of responses. "Any definition of a response is artificial. It is imposed by the observer upon behaviour. The sharply defined response does not per se emerge as an aspect of behaviour."(F.L. Green)(28

However, when we create the frame of a program, we construct it in such a way that we call for a response. In the case of a Skinner type of a linear frame we do this in such a way that we aim to get a very specific and correct response in 95% of cases. But this response can only be one aspect of a very complex chain of behaviour. It is not even an end product because the behaviour of an organism is an ongoing series of continually changing actions and one 'response' is only a brief aspect of these. Nevertheless one can define it and in this instance can say that it arises as a result of stimulus presented to the student in the first part of the frame.

This response is only one of a group of responses all

of which are the functions of the stimulus we presented. In presenting it to the student we are initiating a change in the ongoing chains of stimuli and responses which make up the students complex pattern of behaviour. "Consider a pattern of stimulation affecting the sense receptors, such as the presentation of a geometrical shape producing both a temporal and spatial pattern. Its impact on the organism will be a function, not only of this pattern but also of the activity that happens to be going on at the time within the organism's nervous system." (31)

Our stimulus is so arranged that the student will consciously see the connection and produce the response - and a further feature in Skinner's technique which I also employ is to insist that the pupil writes the response, i.e.:

Stimulus; London is the capital city of B------.

Response; (mental) Britain, followed by writing 'Britain'.

One might liken the behavioural stream of the human organism to the weft and warp of a complicated cloth pattern Into this pattern the programmer inserts his stimulus which triggers a response which is a high-light in the pattern. Linear programming employs both the Pavlovian or classical learning technique defined by J.McV Hunt (29) as "Modification in the mediation process elicited by particular stimulus pattern."

and

Operant Conditioning which he defines as "Modification in the instrumental sequence elicited by the particular mediator."

The former technique is employed in a paired association frame in which the known is paired to that which is to be taught- e.g. If we present the picture of a key

together with the word 'key' and direct the child to write 'key.'

The latter technique is exemplified in the example " London is the capital of B-------." Here the student will be re-inforced if he completes the missing word and thus indicates the relationship of the two names.

E.L. Green (28) includes in the second process (Operant conditioning) a whole body of learning processes: trial and error learning, instrumental conditioning, verbal conditioning, motor learning, problem solving, concept formation and insightful solutions. Each of these can be a separate contention and I do not propose to discuss them at this point, but I do find them a convenient package subject to Hilgard's comment on learning (32):—

"Both theory and practice need emphatic and frequent reminders that man's learning is fundamentally the action of the laws of readiness, exercise and effect. He is first of all - an associative mechanism working to avoid what disturbs the life-processes of the neurones. If we begin fabricating imaginative powers and faculties, or if we avoid thought by loose and empty terms, of if we stay lost in wondcr at the extraordinary versatility and inventiveness of the higher forms of learning, we shall never understand mans progress or control his education."

I have already referred to B.F. Skinner's method and I think that here a brief definition is called for:-

" 1. Material is divided into a series of small related steps (named frames.)

2. Each frame would give information to a student and require him to make an overt response.

3. The steps are sufficiently small for nearly all students to respond correctly.

4. As soon as the student has responded he is given the correct answer." (30)

The response aspect of programs is of great importance when dealing with slow learning students. Skinner demands that it must be an overt response - a button pressed, and for slow learners, the answer recorded, a word or a sentence written down. To make the child record the response is to repeat the learned matter. Burt stresses the importance of this when he says:-

"This means, broadly speaking, that the backward child will require to hear a thing twice as often as a normal child, to have twice as many exercises on each problem, and to go by steps that are twice as easily graded." (67)

This method of increasing the response demand had secondary results as we came to learn in our experiments at the Milton School. The recorded results provided a detailed record of the infinitely slow advance of the pupils, they showed up errors and blocks in the process which proved of great value to the teacher, and a quite unexpected bonus was the unusual neatness of all the childrens' work, far above anything they normally produced. This of itself proved to be a re-inforcer, not only to the children but also to the staff. Despite the current strongly voiced opinions that good legible writing and correct spelling

[illegible] most teachers

are rewarded when their pupils present neatly written and correctly spelt work. While P.L. cannot, certainly at the level at which we employed it, be described in any way as creative, nevertheless a notebook filled with neatly written and mostly correct answers is a satisfactory effort for a slow learning child - especially for one who has previously suffered almost continuous admonition for presenting illegible and untidy work. Having stressed the importance we gave to Skinners theories, I should point out that we also made considerable use of the multi-choice form of response which he decries.

S.J. Pressey created a simple multi-choice machine in the course of his research into multi-choice examination questions. In doing so he became aware that the questions, furthered learning. Many programs available to-day are constructed in this form, but Skinner asserts several advantages of programmed learning are lost when such material is used in straightforward instruction. The student should construct rather than select a response since this is the behaviour he will later find useful. Secondly he should advance to the level of being able to emit a response rather than recognise a given response as correct. Thirdly, and more important, multiple choice material violates a basic pronciple of good programming by inducing the student to engage in erroneous behaviour.

D. Rowntree, the author of "Basically Branching" (35) which book, as its title suggests is devoted mainly to the branching method of P.L., points out the many disadvantages of multiple choice response demands but has to justify their use because they are used to such a large extent in branching programs. He says:- "Use multiple choice questions only when the wrong answer choices

represent plausible misunderstandings that the student can be reasoned out of on the remedial pages." (36)

Writing on programmed variables Holland (75) devotes two pages to this aspect of program responses, he quotes eleven studies most of which because of the nature of the study were unlikely to produce conclusive evidence either way. Of studies which deserve greater credence, he says of Williams (76) " slight, although not significant, difference favoured the constructed response condition", and of Coulson and Silberman's research, "he also found no overall post-difference, but he did find that in the constructed response part of the test, the constructed response program provided a better performance." Holland,(75) then concluded that " the sketchy pattern which emerges is that the nature of the learning task determines the preferred response form."

At Milton School we made great use of the multi-choice response demand and found it effective. The possibility of teaching erroneous material, with slow learning children, beginning to read, is strongly offset. There is a great need to familiarise them with the visual script, images or graphemes of a basic vocabulary.By using the multi-choice method, we presented them with four words in every frame - four words with which they needed to become familiar. To ensure that in 90% of responses they were correct, we arranged the total response demand, or stimulus part of the frame, so that the student was unlikely to fail, i.e. by using ridiculous alternatives in the three wrong choices or using words which the student would recognise. It should be kept in mind that a fundamental feature of our teaching philosophy was that "the student must have almost continuous success."

Another feature in favour of the multi-choice response

demand is that it can be adapted to simple teaching machines. "Plausible misunderstanding that the student can be reasoned out of " (36) did not feature in our programming.

A feature of the response factor in programming to which a lot of attention has been given with little definitive result is the covert-overt controversy.

Widlake says:- (73) "As regards practical application of these findings one can recommend that teachers and programmers need not be over-anxious about so called 'cheating' in linear programs. In a well cued frame the response comes almost automatically so that reinforcement is supplied whether or not overt confirmation is given, the best pupils hardly bother to check."

This supports my experience both at Milton, where the pupils often preferred to study machine book programs apart from the machine and without its mechanical reinforcement and also with adult illiterates who ask to be permitted to take the Stillitron (16) book programs for homework for use without the confirming machines.

Widlake (73) continues:-

"The written response has the advantage that it enables one to say with certainty that the work has in fact been done. This is an asset not likely to be discarded by those in charge of the less able."

Cumming and Goldstein (74) summarising the results of a study in overt and covert responding attach great importance to the consequent confirmation: " These and other researches have demonstrated that the essential factor in learning materials of this sort was knowledge of results, subjects were able to improve their performance, i.e., to learn the response required in proportion to the knowledge of results they received."

Density of Responses (Inter item.)

"One cannot measure the difficulty of an item without recourse to measurement of the behaviour that the item calls forth. The behaviour is subject to the contamination by the variables not under the control of the programmer." (Green, 28)

Green continues by describing a system for measuring 'density of responses.' This is a laboratory technique which I fear could not be satisfactorily appled in the classroom - nevertheless one might, when studying the effectiveness of a program, employ a simple way of measuring those responses made correctly, those incorrectly and those missed, as against the total response demand, assuming the latter to be one per observable response frame. Or one could compare the pupil's responses with the estimated 90% or 95% correct responses which the programmer prepared the program to produce.

When one considers the wealth of information about a pupil's work that is produced by a pupil responding to a program, one is surprised that teachers have not been more enthusiastic about their employment. I have considered measuring responses correctly made in relation to the total possible and the built-in or intended number. If the average over a fair sample of pupils is near the intended figure, and the dispersion not too wide, then we can say that the program, from that point of view, is satisfactory. However, the next real test is 'did it have the effect on the pupil's behaviour that was intended?' 'How did the pupil fare in the criterion test?' I have used a 60% pass standard in my experiments and in teaching and have set the pupils to some remedial or parallel program when they have failed to reach this required

standard - my method of doing this I have already explained.

When we have decided on the program objective, measured the pupil's knowledge before and after completing the program, we have applied the program to a number of pupils and measured the response rates and the criterion. Using the combination of two re-inforcement schedules, the continuous re-inforcement of the program for maximum rate of learning and the intermittent or variable ratio supplied by the teacher which favours retention, then we should be approaching a well balanced teaching tool applicable to the pupils under consideration.

What Green (28) calls the 'independent density rate' could be a useful factor in preparing programs - it is a measure of the number of different responses called for divided by the total responses. If every response is different it produces a density figure of 1.00 - this figure decreasing as the repetition increases. Without using such a process, in our early programs we introduced six items in a twenty-four frame program and thus in Green's terms produced a density of 0.25. According to my recollection, at Milton only about a quarter of the pupils found this sufficient to achieve the criterion and the other needed further programming. To have increased the density would have induced boredom, lengthening the program we had learned produced resistance, so we achieved our end by repeat programs using different programming techniques. Program '1' demanded a copy response, '2' an alternative title selection, '3' a 'Yes - No' choice and '4' a fading technique with a 'constructive response.'

If one could establish a density rate best suited

to the pupils for which the program is intended, it would simplify their preparation whilst their content is fairly simple and limited. But in complex programs where it is necessary to consider the arrangement in some detail, of presentation of material and the advantages and disadvantages of varying densities it is probably advisable to adopt such techniques as 'ruleg' and 'flow chart' (62) as well as density figures.

I think that if the use of programs by teachers of slow learners is to be encouraged, the short (20 - 40) frame program written around the teachers' own lesson or subject concept, using either Skinner's short linear frame with a constructed response or a short frame with a multi-choice response, is the best approach.

As it is my purpose here to try and prove the effectiveness of P.L. with slow learners and, if successful, encourage other teachers to employ these techniques - I shall in the main employ only such programs as these in my future research. It is not my purpose to suggest that teachers change their often painfully acquired teaching skills but rather to enable them by applying simple programming techniques to increase their teaching efficiency and thus speed and improve their pupils' learning.

Overt Vs Covert Responding.

I have already made the point that in our use of P.L. at Milton School (1) we invariably insisted on the pupils' responding overtly. The responding varied, sometimes writing the text of the frame in full, sometimes writing a missing word or phrase, or completing a half-spelled word, or at its minimum pressing the key of the teaching machine. Even in the last case, so sure were we that overt responding was more effective with slow learners, we usually insisted that they wrote the confirmatory stimulus after pressing the correct key.

The reasons were that we valued the record made and were able to assess the pupils' progress more closely and also, as traditional teachers, we liked to see evidence of the work done and further still believed, despite evidence to the contrary, in the 'law of exercise.' There was also an additional and very important factor, this was the pleasure that these children received when they presented a completed exercise or program to the teacher. The value of this as an additional reinforcer could not be discounted.

In researching P.L. with these children, this last is a variable that it would be difficult to eliminate so one must accept it as part of the environment in which one is working, part of the background against which measurements must be made.

In linear programs Skinner insists that the student should 'compose' his response, but other forms of programming demand different kinds of 'overt responding', such as discriminating in multiple choice questions, pressing a button, inserting a stylus, following an expository panel such as Crowder advocates. Overt responses have been defined generally as the writing of

constructed responses to variously cued open-ended blanks in program frames or pressing a button in responses to a multiple choice alternative or in some cases - usually experimental situations - speaking aloud. Covert responding is defined as 'thinking' the missing word or phrase or multiple choice selection.

It is not sufficient to 'feel' that 'overt' responding is a more efficient learning factor in P.L. for slow learners; if one is seeking to widen and deepen as well as to speed their learning, one must seek, if possible, to know that it is more efficient. If nothing is gained by lengthy writing of 'answers' or by even writing them at all, then the sooner one is aware of it the better. It maybe that there is a curve of efficiency in the physical length of the response demand and that a peak of efficiency lies somewhere between a ticked letter and a lengthy written response. It is my experience that with most slow learning children too long a response demand in each frame tends to build up a resistance and too brief a demand leads to skipping and loss of attention. The former is regarded eventually as a bore and the latter too trivial to be important. This response mode is too vital a factor to be left unresearched.

It would be well to consider the probability that every 'overt' response is preceded or accompanied by a 'covert' response so that in an investigation of the matter it is not 'overt vs covert' but 'covert and overt vs covert.' We are really trying to establish whether any useful purpose is effected by the overt part.

The two factors of overt responding are (a) the motor act of writing and (b) the record. If the former

were part of the terminal behaviour desired, its inclusion would be essential but as we are concerned with the skills of reading, this motor act is not a terminal objective.

The usefulness of the record and the beneficial effect of the 'exercise' completion are such that I should not like, in the practical field of teaching, to dispense with them. Going back to the consideration of (a) it maybe that there are concealed variables in the motor act of writing the word, phrase or sentence that have important contributions in the total learning situation and that while the dropping of the 'overt' response may speed the rate of program completion and even the apparent speed of learning, the loss of these unseen factors (and who can tell at this time what psychological and physiological changes are effected by such a motor act as writing) may actually result in as slowing down of the total process of acquiring desired skill.

The primary re-inforcing factor of a program is 'knowledge of results'. There are often aspects of 'feed-back' which are said to re-inforce, such as lights and falling pages, but they merely serve to indicate that the response is correct or otherwise. In a paired-associate learning sequence where a picture elicits a word known verbally and a discrimination has to be made, the writing down of the discriminated word leads to the giving of closer and longer attention by the pupil, covert discrimination may be too brief to establish the physical concept of the whole word - it is known that the discrimination of a word symbol may be established by just one small feature, the first or last letter or just a part of a letter like a loop. If the word is to be learned its complete configuration must be firmly paired with the pictured object. When the pupil writes

the word he can compare his own construct with the confirmatory part of the frame. In this situation, only by so doing is he likely to achieve a knowledge of the result.

It might be said that the brief response whereby the pupil discriminates the word, possibly from the initial letter, can be supported by a similar brief and partial recognition of the confirmatory stimulus. This is, however, a low level knowledge of results following a limited sequence of learning. The pupil has presumably learned not the word but the initial letter. He has learned "A is for  " not that "apple means  "

In an experiment in a women's college in New York, Cummings and Goldstein (74) investigated the hypothesis that 'overt' responders would score significantly better than covert responders and that 'overt' responders would be superior on both post-tests and delayed post-tests.

Their results established, so far as their subjects, material used and general situation was concerned, that 'overt' responders were significantly superior in all respects. They concluded that it appeared that for certain kinds of verbal responses which contain a large amount of material, merely 'thinking' about the answer does not provide the learner with a clear and complete record of his own response. In the absence of such a record he cannot compare his response with the correct one given in the program. The study also found that 'overt' responders required twice as much time to complete the program as did the 'covert' responders.

Whether one can generalise these findings to other populations of students is doubtful, it certainly would be

be a doubtful proposition to extend the findings to slow learners (the subjects of Cummings and Goldstein were women undergraduates) nevertheless it is one clear indication that 'overt' responding has advantages over 'covert' responding.

PART III

ORIGINAL STUDY

Introduction

The basic feature of these studies is not the relative levels of attainment but the relative rates of learning. Very little research seems to have been done in this field of learning, certainly in respect of slow learners. Storulow (49) commenting on Woodrow's research says:-

" If the learner had the minimum level of ability required by the task, the rate at which he learned would be a function of factors other than his ability. This would mean that minimum mental age levels should be identified for school tasks. Second, it suggests that the learning research should be directed at variables which determine rate of learning rather than at comparative studies of normal and retarded children. Research in special education would be concerned with the way information and skills should be taught rather than what should be taught."

An early study, as far back as 1915, was made by Ordahl and Ordahl, (50). Using a teaching machine, they studied the learning rates of subjects whose C.A. was 15 - 35 and whose M.A. was 6, 8, and 10. Those with a M.A. of 6 years required most instruction, started at the lowest level of efficiency and increased at the lowest rate. Those whose mental age was 10 years started at the highest level and progressed fastest. Those with a mental age of 8 years obtained, as one might expect, an intermediate position.

This early study would seem to confirm the general expectation that there is a positive correlation between M.A. and rate of learning. Storulow (49) however, observes that the positive correlation is not supported by subsequent studies, he says:-

" there are studies showing that with efficient programming of learning materials the correlation between a measure of intellectual ability,

or of aptitude, and learning scores tends to be reduced to zero (e.g. Detamble and Storulow 1956, (51)). Thus it would appear that, with efficient methods of learning, the poorer student is assisted sufficiently so that he becomes in terms of criterion performance, indistinguishable from the more able students."

Bradley, (57) on this matter of mental age and learning, takes an intermediate stand. She quotes the Ordahls' research results and also the contrary evidence of Porter (55) who found correlates only when not using teaching machines and programs. She then says:-
" In our study using arithmetic and time telling programs there appeared to be a relationship between achievement level and performance on the arithmetic program but no relationship between achievement and performance on the time telling level." One presumes that she means mental age when she talks of 'achievement level' and 'achievement.'
She continues:-
"Although the sample was limited one could suggest that the achievement level as a predictor of success on a program may be dependent on the material within each individual program."

The study referred to by Storulow (49), that of Detamble and Storulow (51) is a very carefully controlled experiment in concept learning in which the subjects were university students, whereas Bradley's researches were with under-priviledged pupils.

Woodrow (59) again quoted by Storulow (49):-
"Woodrow argues that mental deficiency is an inability to grow rather than to learn from practice. He feels that ability tests such as the I.Q. predict the initial level of performance but not the gain scores."

I have remarked on the sparsity of P.L. research in the field of slow learners in Britain, however, some attention has been given to the matter and Kenneth Richmond (61) commenting on the effect

of P.L. in the normal school asserts:-

"On the score of intelligence it goes without saying that bright pupils learn more than dull ones from the same program. The only surprising feature about the results obtained from using linear programs is their comparative uniformity. Almost invariably the range of test scores is narrower than it is in an examination based on normal class teaching; the not-so-clever do very nearly as well as the clever ones. The indications are that the small step arrangements in linear sequence helps to obviate the fear of failure and encourages the broad mass of pupils to maintain interest and attention. The arrangement is ideal for the butterfly mentalities who are easily distracted and for the plodders who tend to fall so far behind with their work that they eventually drop out altogether.
There is a significant correlation between I.Qs. and test scores where the children are taught by traditional methods but this is not always the case when they learn from a program."

This, too, is the comment of G.O.M. Leith (62):-

"The argument put forward was that, if learning is facilitated by small steps careful sequencing, cueing, immediate confirmation, low error rate and so on, the slower pupil can learn as effectively as the brighter."

Roncek, (63) referring to the Roanoke Experiment (64) stated that:-

Some of the students completed the equivalent of a years instruction in algebra in three months time " using P.L.

Another example of P.L. accelerating the rate of learning, though again with high grade students, is given by E.E. Platton (71):-

"The economy of P.L. has been described by Ferster and Sapon (72)

who indicated that subjects who completed a programmed course in German learned in 47.5 hours an amount of German comparable to that presented in 145 hours of combined classroom and outside preparation."

These two last research studies, it must be admitted, are concerned with students who would be found in the upper quartile of the intelligence spectrum, but my experience both with slow learners in further education and special education indicates that P.L. has even more to offer to those who are educable in the lower quartile.

MAIN STUDY

Third Evaluation or Comparative Study.

This study was carried out in the Rossington Special (ESM) School in the Doncaster Education Authority. The school is situated on the old A1 road between Doncaster and Bawtry and serves a very mixed community, mining, industrial and rural. The Doncaster County Borough is mainly industrial, the mining centres and rural areas being mainly in the West Riding of Yorkshire.

The building, a Victorian country house, was purchased for its present purpose by the Borough in 1953. It is a large, rambling, red brick building standing in its own grounds and lying back a quarter of a mile from the main road. It has undergone considerable modification and extention including some new classrooms and a hall and gymnasium.

The school is part residential and part day school. There are 110 boys of whom 60 are residents and 30 girls all of whom are day pupils. In addition there is a diagnostic nursery class housed in a separate new building. The teaching staff consists of the head-teacher, nine permanent members and two part-time members.

The study was carried out entirely with the girls, partly for the convenience of the school but specially to meet my requirements in that it provided a group in the age-range 10+ to 15 and which was brought together for language study twice weekly.

To have included boys of the required age range in the study would have entailed drawing pupils from at least three other classes with all the consequent problems of arranging study times for both individuals and groups, supervising them and marking

and checking their work immediately it was completed. I just could not have done this entirely myself. By accepting the head-teacher's suggestion I had an unchanging group almost covering the complete desired age range for two weekly periods, always in the same room in which my programs and machines were stored.

Hypothesis.

The null hypothesis of the following experiment was:- That following the introduction of regular periods of study of suitably graded programmed reading material into the curriculum of the subjects they would not increase their rate of learning to read as compared with their rate of learning to read prior to the commencement of the experiment, as measured by the Schonell Graded Vocabulary Test.

Subjects.

The subjects were seventeen, ascertained educationally sub-normal girls, in the age range 10+ to 15+. The details of their age, IQ and tested Reading Age on the 29th July 1971 is shown in the following table.

No.	CA	IQ*	RA*
1	12.1	59	6.4
2	14	59	6.2
3	10.11	54	5.8
4	13.6	71	7.9
5	14.7	72	7.5
6	10.10	80	6.8
7	10.8	64	7.5
8	11.3	62	7.5
9	11.2	66	6.4

* IQ Terman & Merrill

* Reading Age Schonell Graded Vocabulary Test

No.	CA	IQ	RA
10	10.9	44	6.3
11	12.11	66	6.5
12	12.3	59	7.7
13	10.8	59	6.8
14	14.11	64	6.9
15	11.1	70	7.8
16	12.8	81	7.6
17	11.10	60	7.4

Further details of their individual differences are included in the appendix. (9)

Method.

All study of the programs by the subjects took place in one classroom and only during the two set periods each of one hour each week, i.e. Mondays at 1p.m. and Wednesdays at 9.40a.m. At no other time were the subjects permitted to study the programs. The total period covered by the study was 29 weeks but this included six weeks of closure so the effective period was 23 weeks or 46 study hours. However, the whole 29 weeks, closure included, are considered as the basic time for the study because (a) the expected learning rate based on mental growth and (b) the expected learning rate based on previous rate of learning, are standards against which programmed rate of learning are measured. To exclude school closures or even school absences would distort the measures in favour of the programmed period. Nevertheless, individual absences will be looked at to ascertain what effect they may have had on individual performances.

I was present in the classroom throughout the whole of

the 46 study hours. The class teacher was also present but I was the effective teacher during these periods.

Teaching Material Employed.

This consisted of :-

(1) 8 Stillitron machines

(2) 8 Sets of "Word Control Readers". A programmed series of 6 books, each of 7 sets, and a post-test. A total of 1088 frames starting with matched words and leading to the reading of 10word sentences. The series was created by the experimenter and its preparation is described elsewhere in this study. A sample 'set' is shown in the appendix.

(3) "Action Readers" 4 books, short stories with question pages adapted to the Stillitron Machine. (Stillit Books, 1970)

(4) Elementary Language Exercises. L. Hill. Stillit Books 1967

(5) Vocabulary Practice Tests. L.A. Hill and R.S.D. Fielder, Stillit Books, 1967.

(6) Basic Comprehension Tests L.A. Hill, Stillit Books, 1967

All the above are Stillitron Responding Books but 4, 5 and 6 were hardly used in the study and No.3 also had a very limited employment.

(7) 120 graduated, short (12 - 24 frame) programs, each teaching one to six words. These were all manuscript programs.

(8) The Oldborough Teaching Machine and some 40 spelling programs. (See appendix.)

(9) The Milton Readers - a set of 12 books each of 96 frames covering approximately the same area as Books 1 - 4 of the "Word Control Readers". These are described and illustrated in detail elsewhere in the study.

(10) 20 Supplementary Readers to the Milton Readers. Like No.7, the graduated programs, these were short (8 - 12 frame) supplementaries related to particular books.

(11) A few linear book programs of traditional stories, and one or two programs such as "A Mothercraft Program" and a program on hamsters, all in manuscript.

The basic programs to the study were the "Word Control Readers" and "The Milton Readers" both of which have a controlled vocabulary. The difference in their structures, apart from the fact that the former were machine presented, was that the "Milton Readers" employed "constructed response frames" and "fading" as well as multi-choice frames.

Because of the criterion tests with these programs it was possible to establish the most suitable point of entry for each subject. Once a study suitable to each child was established, it was not difficult to provide a continuous and progressive course.

I had hoped that a second and continuing series of 6 Word Control Readers which are in course of publication would become available but for technical reasons this was not so. The pattern for most pupils, after completing the first six books, was to continue with the short graded programs and the story programs. However, the pattern varied considerably as can be seen in the individual records. It was intended that the experiment should continue until the Easter closure but owing to the occurrence of the coal-miner's strike and the possibility of the school closing, which would have led to the break-up of the group due to class promotion and Easter leavers, I decided to test the group on Feb 15th '72 and close the experiment.

Results.

The intention in this study was to compare the rate of learning, in reading, prior to the introduction of programmed learning, with the rate of learning during a period when programmed learning in reading was a regular feature of the pupils' study.

The scores are shown in two ways in the appendix, as comparative figures (gains and losses) and as irdividual graphs. The Wilcoxon Signed Ranks Test was applied to the former and it was found that P .02% and is significant. (App, 7.)

The graphs clearly indicate the accelerated rate of learning; in fifteen cases out of seventeen, these all exceeded a 100% improvement. This marked improvement is over both the expected rate of learning based on previous learning rates and that based on the expected growth of MA. With regard to the latter, it has been assumed that MA will accelerate on a straight line, whereas Phillips (113) with ESN children, found it tends to decelerate before eleven years of age and that, on the whole, with girls after age 13, the deterioration of IQ and hence MA was greater.

Discussion.

In discussing the effects of this study and its outcome one should first consider the nature of the children involved. These children fall in the mental age range of 5 - 11 and, therefore if we consider them in the light of Piaget's theories they will fall generally into his development period of (Intuitive Thought 4 - 7 years) and (Concrete Operations 8 - 11.)

Thompson (99) summarises these important developmental stages of thought as follows:-

" (1) The intuitive stage is the one in which the child begins to represent absent objects through the use of signs. Not only are things and happenings which are not perceptually here and now envisaged, but the child can understand means-end relationships and work out what it has to do to realise its wants and needs (e.g. to get sweets from a cupboard). The child has a sort of map of reality, but it has many blank spaces, and he has not mastered sufficient co-ordination to deal with more than a few limited situations. He has not yet formed the concepts of class or relationships because actual conceptual configurations in imagination are his only data "

In extending Piaget's theories into the field of the educationally sub-normal children I have found . 12- . 16 year old girls in the IQ range of 60 - 80, in the Milton School who could competently weigh and measure food into half and quarter pounds but could not comprehend simple pictorial diagrams of this process. It would seem that as far as this simple process is concerned, they do fall to some extent as I have suggested, at some points into this intuitive stage. Thompson compresses the concrete operation period into:-

" (2) Between 7 and 8 years clear cut operations are formed: concepts of classes, relations and numbers, and ideas of space, time, and a material world in which everything has its place in relation to everything else, emerge for the first time. But there are limits on the extent to which the environment can be understood."

My observations of ESN children would lead me to accept that as tests such as the Terman and Merrill (114) Intelligence Test and Schonell (8) Attainment Tests indicate that the children in the age range with which I am concerned do largely compare with normal children (on whom Piaget's researches are founded) in the age ranges 4 - 7 and 8 - 11.

Changes are now taking place in the ESN Special schools following the recent legislation, but these girls are typical of pupils found in similar schools prior to the changes. I have further underlined their typicality by adding some background information to their individual score sheets (See appendix. 8)

A striking feature of this study is that marked acceleration of learning occurred in no less than fifteen of the seventeen subjects. A second interesting one is that prior to the experiment the rate of learning in every case closely followed the rate of mental growth.

It seems from this, that despite Vernon's finding (115) rate of learning does not necessarily correlate with IQ when P.L. is used. Sorenson(125) noted a consistency of reliability in a machine provoked learning and he advocated the substitution of the IQ concept with machine measured learning rates, DeCecco in the "Educational Technology" (116) writes:-

"The effectiveness of intelligence and battery scores as predictors of achievement was studied for linear, spiral and traditional instruction methods.

"The data suggests that intelligence and overall achievement measures may not be as predictive of the amount of achievement that results from linear programmed instruction as

they are of achievement resulting from other methods."

Storulow (49) on the subject of research into the correlation of MA with learning ability remarks:-

" Thus it would appear that, with efficient methods of learning, the poorer student is assisted sufficiently so that he becomes, in terms of criterion performance, indistinguishable from the more able students."

Later in this article he refers to Woodrow (59) "Woodrow argues that mental deficiency is an inability to learn from practice. He feels that ability tests such as IQ predict the initial level of performance but not the gain scores."

Whatever the relation between learning ability and MA there maybe, the outcomethat can only really be of value (when one is concerned with the educationally sub-normal) is their ability to adapt to those people in the environment where they live, and to become indistinguishable therein. To read with some facility is of paramount importance. I was reminded of this factor recently when I complimented a middle-aged man whom I had assisted to learn to read up to a RA of around 7 years. His response was:-

"Yes, and I can read the television programmes."

Television programmes are a staple of conversation in these childrens' homes. The problem of teaching ESN children is different to that of teaching the low stream in the normal school. Each child has been selected, amongst other things, because of etiological and sensory differences and the individual differences generally are much wider within a class of the former.

My failure to accelerate the rate of learning in numbers 5 and 17 may have been and probably was due to not

matching the programmed procedure and material closely enough to the needs of these two pupils.

No.5 was an extremely anxious child and I think, on reflection, that she fails primarily because of this intense anxiety. Instead of setting her to work at material at the limit of her ability she should have spent a long time working within it and enjoying a great deal of success.

No 17 was completely opposite in temperament and though she did, as most of these children do, suffer from anxiety, she did not show it. She was very placid and stolid, working away at her programs, usually on a Stillitron machine, she tended to get overlooked. Here again I should have adopted different procedure and material. However, she applied herself to her work so assiduously that as was my policy, I did not interfere any more with her than appeared necessary. As far as possible, I left the pupils and the programs to work together uninterruptedly.

Finally, I would say that my findings and experience in the study do parallel those of others who have experimented with the use of this method of teaching reading to slow learners. For example Hines (119) reported on the culturally deprived child:-

" He does not respond well to over verbalised situations and finds it difficult to concentrate in strictly verbal terms. The machine, however, accents the learners participation and is able to rectify part of this deficiency in concentration by appealing to the activity of the deprived child. Interest is retained and regenerated..... The machine can be an effective prime mover in aiding the child to overcome the difficulties of his verbal, visual and auditory deficiencies."

Or the conclusion of Malpass et al, following a two year

study:- (120)

" First, automated instructional procedures like those used in this study are effective for helping retarded children to learn word recognition, spelling and reading skills."

Third Evaluation Study.

Rossington (E.S.N.) Special School.

N	Age	I.Q.	Reading Ages. Gains shown in 10ths of a year			Wilcoxon Signed Rank Test				
			Expected Rate (1)	Actual Rate (2)	Difference	Difference Values	Tally	Rank Values	+Rank	-Rank
1	12.1	49	4.9	17	12.1	.5	+	= 1	1	
2	14.0	59	2.6	6	3.4	- .9	-	= 2		2
3	9.11	54	3.0	7	4.0	2.3	+	= 3	3	
4	13.5	71	3.2	7	3.8	3.1	+	= 4	3	
5	14.7	72	3.5	4	.5	3.4	+	= 5	3	
6	10.1	80	3.3	9	5.7	3.8	+	= 6	3	
7	11.8	64	3.7	6	2.3	4.0	++	7&8 = $7\frac{1}{2}$	15	
8	12.3	62	3.4	11	7.6	4.1	+	= 9	9	
9	11.2	66	2.9	6	3.1	4.4	+	= 10	10	
10	10.9	44	2.5	8	5.5	5.4	+	= 11	11	
11	12.11	66	2.9	7	4.1	5.5	+	= 12	12	
12	12.3	59	3.5	14	11.5	5.7	++	13&14=$13\frac{1}{2}$	27	
13	10.8	59	3.6	8	4.4	7.6	+	= 15	15	
14	14.11	64	2.6	8	5.4	11.5	+	= 16	16	
15	11.1	70	4.0	8	4.0	12.1	+	= 17	17	
16	12.9	58	3.3	9	5.7					
17	11.10	60	2.9	2	- .9					
								TOTALS	151	2

Smaller Rank Total (-) 2

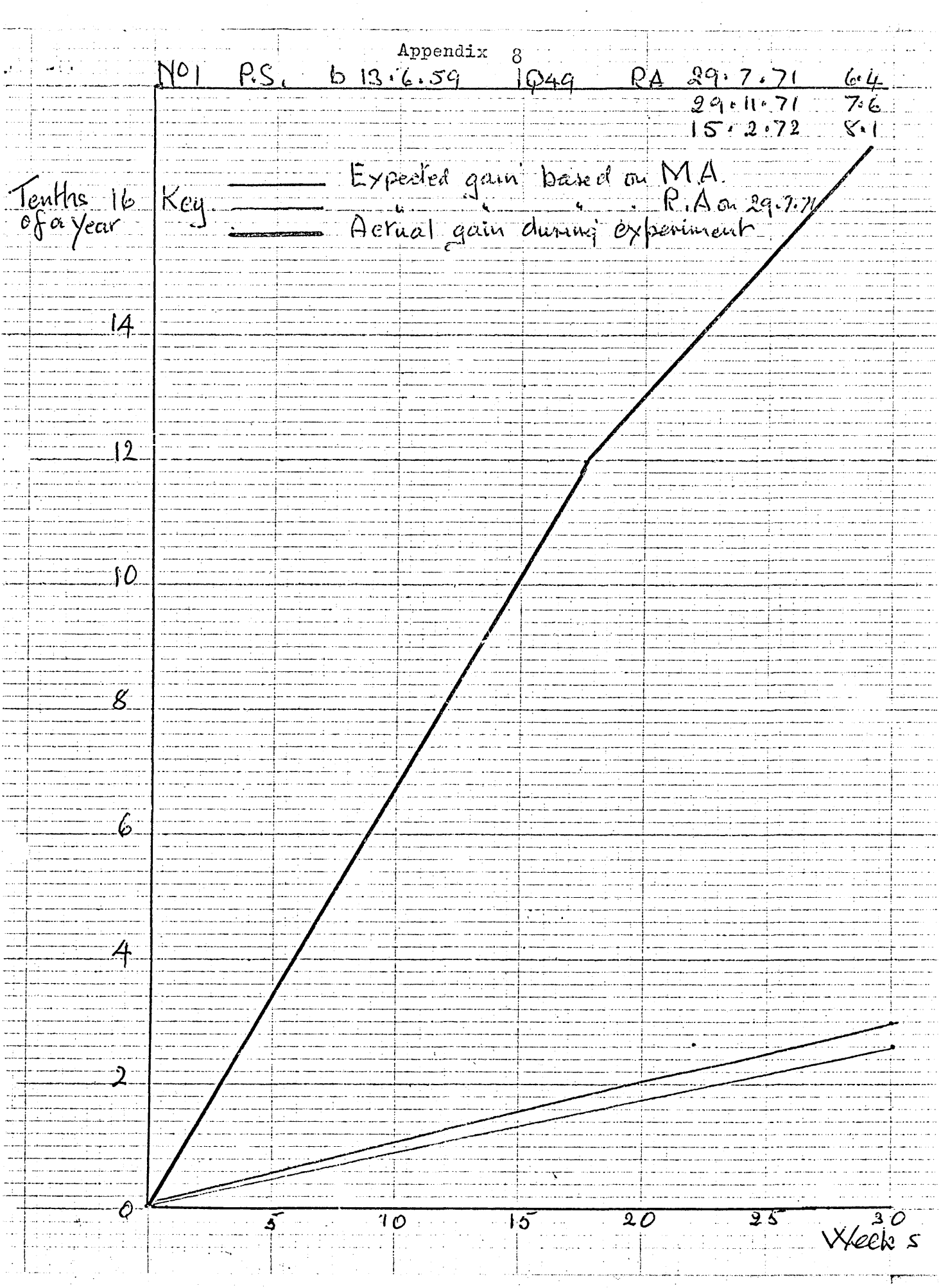
N = 17

From the 'R' Table,
Wilcoxon's Signed Rank Test (69)
When N = 17 and R = 2 (Or less than $14\frac{1}{2}$)
P = less than 0.2%

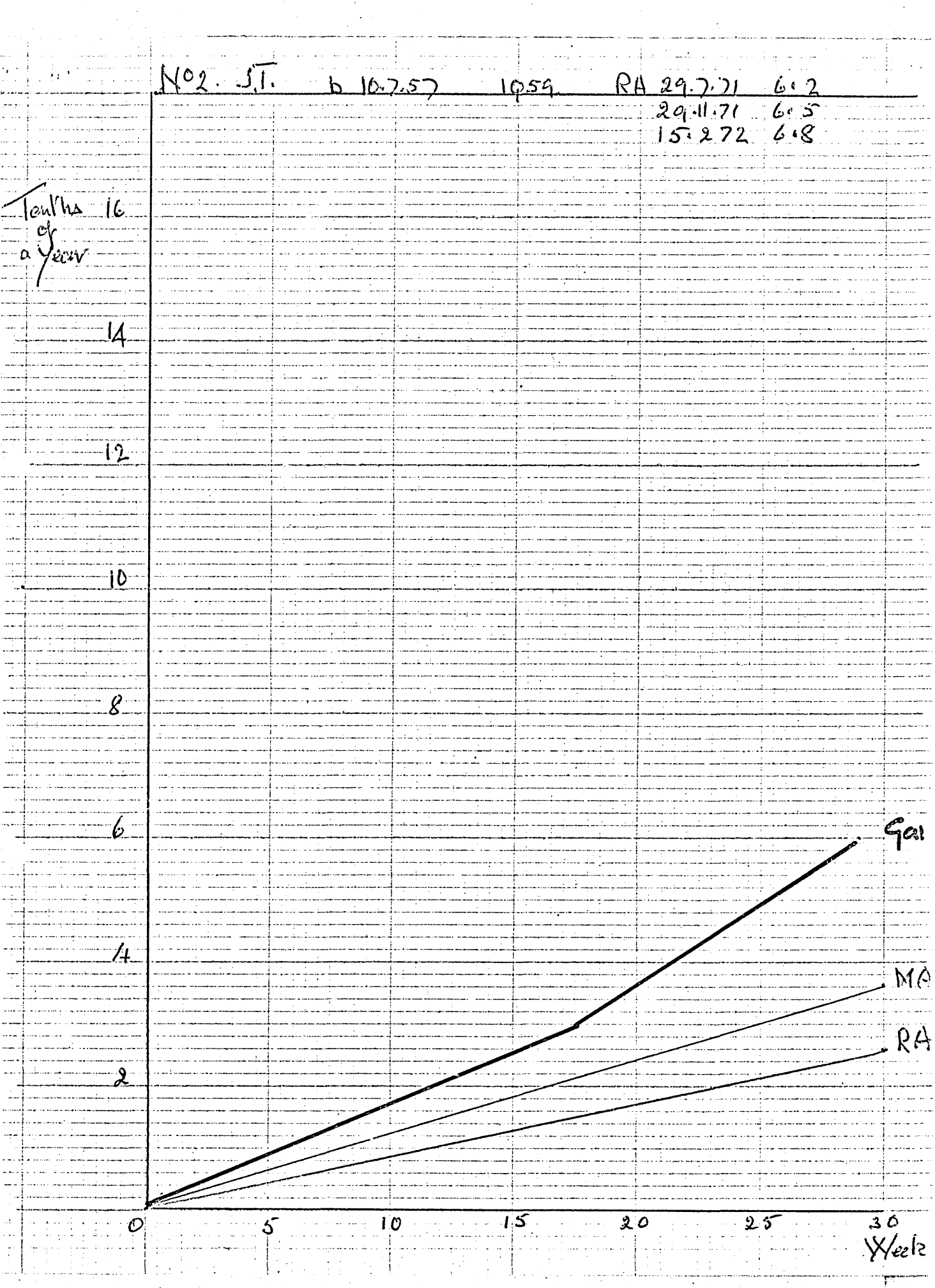
(1) Expected rate of learning during the period of the trial, base on the reading age at the commencement.

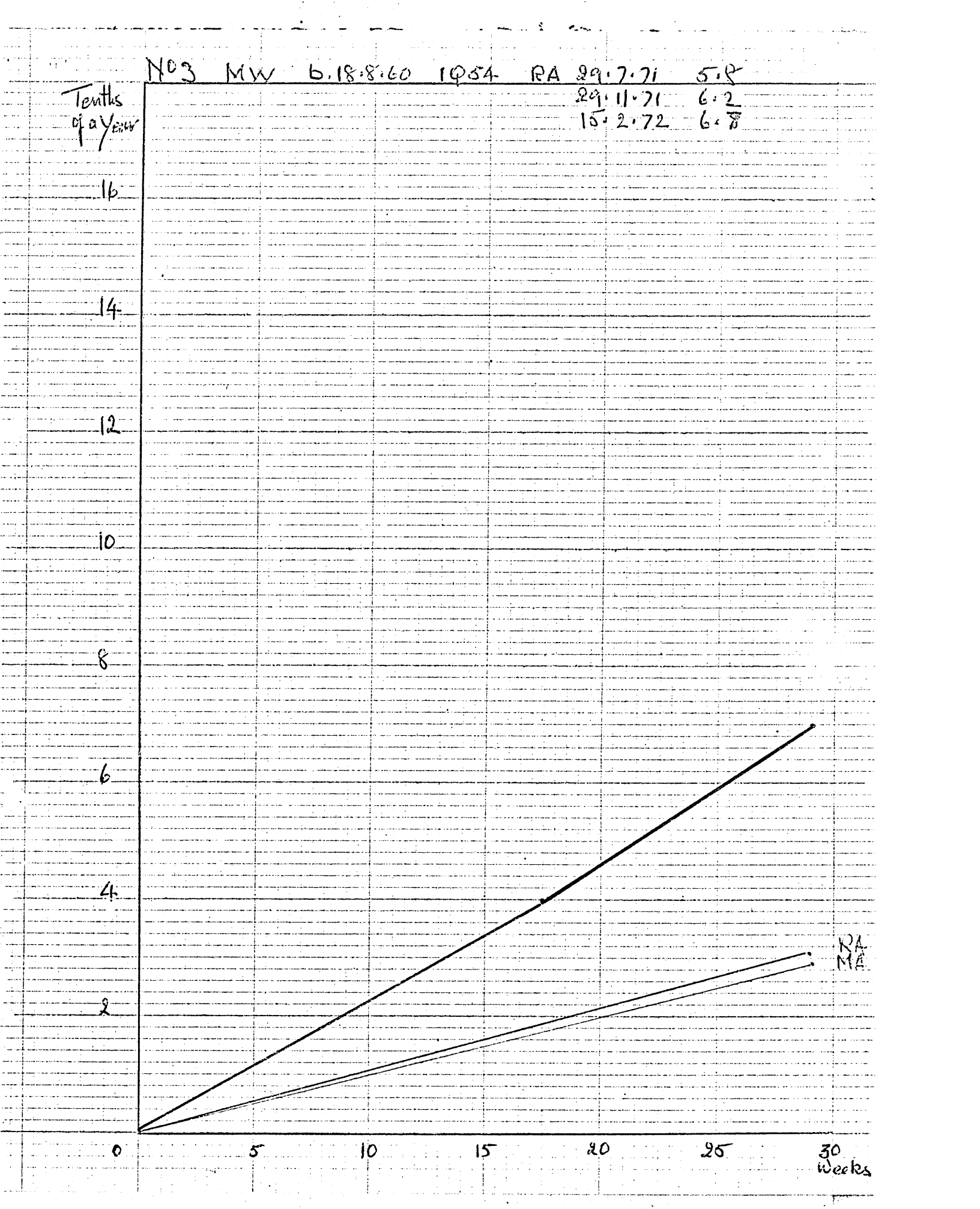
(2) Actual rate of learning during the trial when P.L. was used.

No1 P.S. b 13.6.59 1949 RA 29.7.71 6.4
29.11.71 7.6
15.2.72 8.1

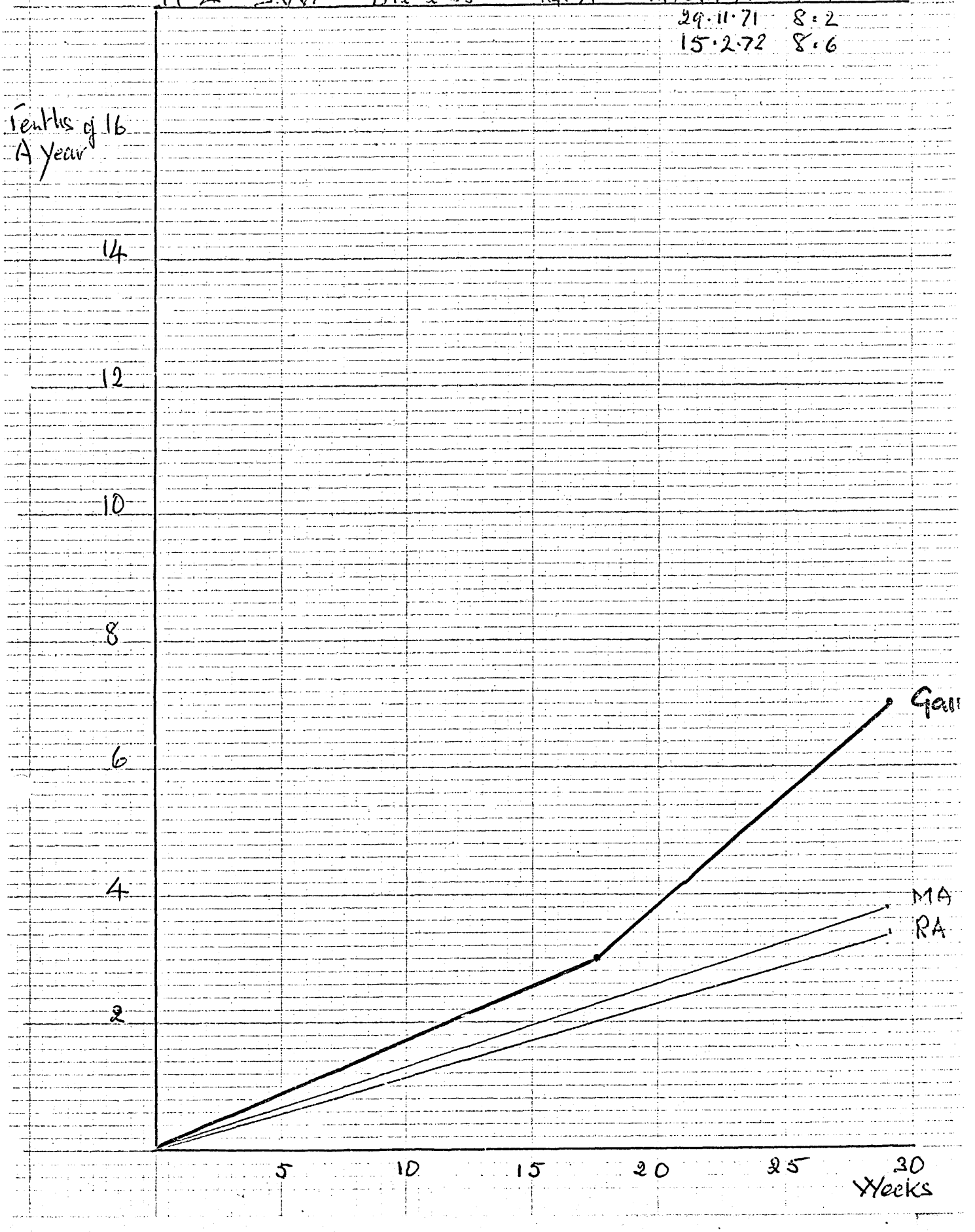


No2. S.T. b 10.7.57 10.59 RA 29.7.71 6.2
29.11.71 6.5
15.2.72 6.8

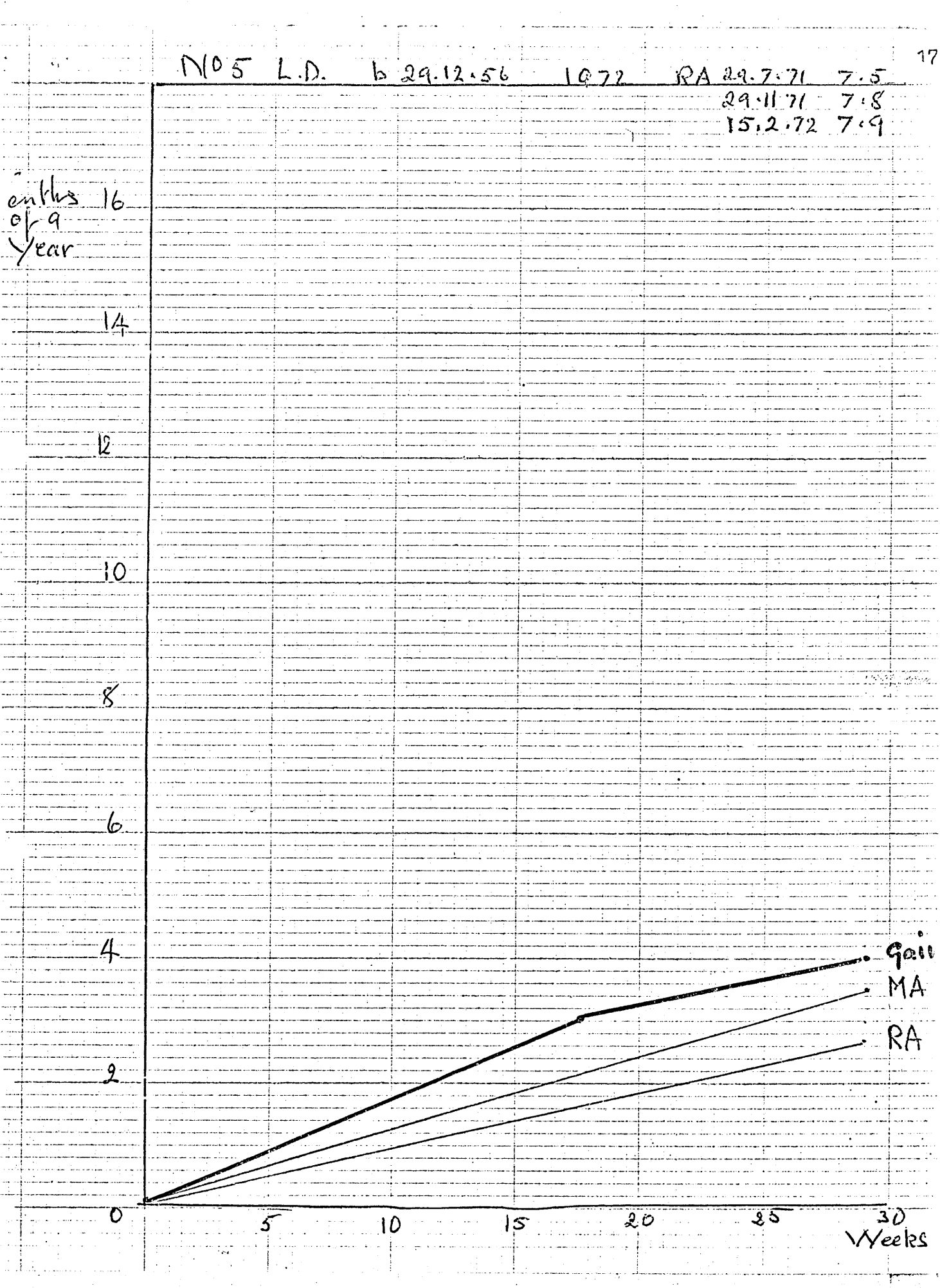


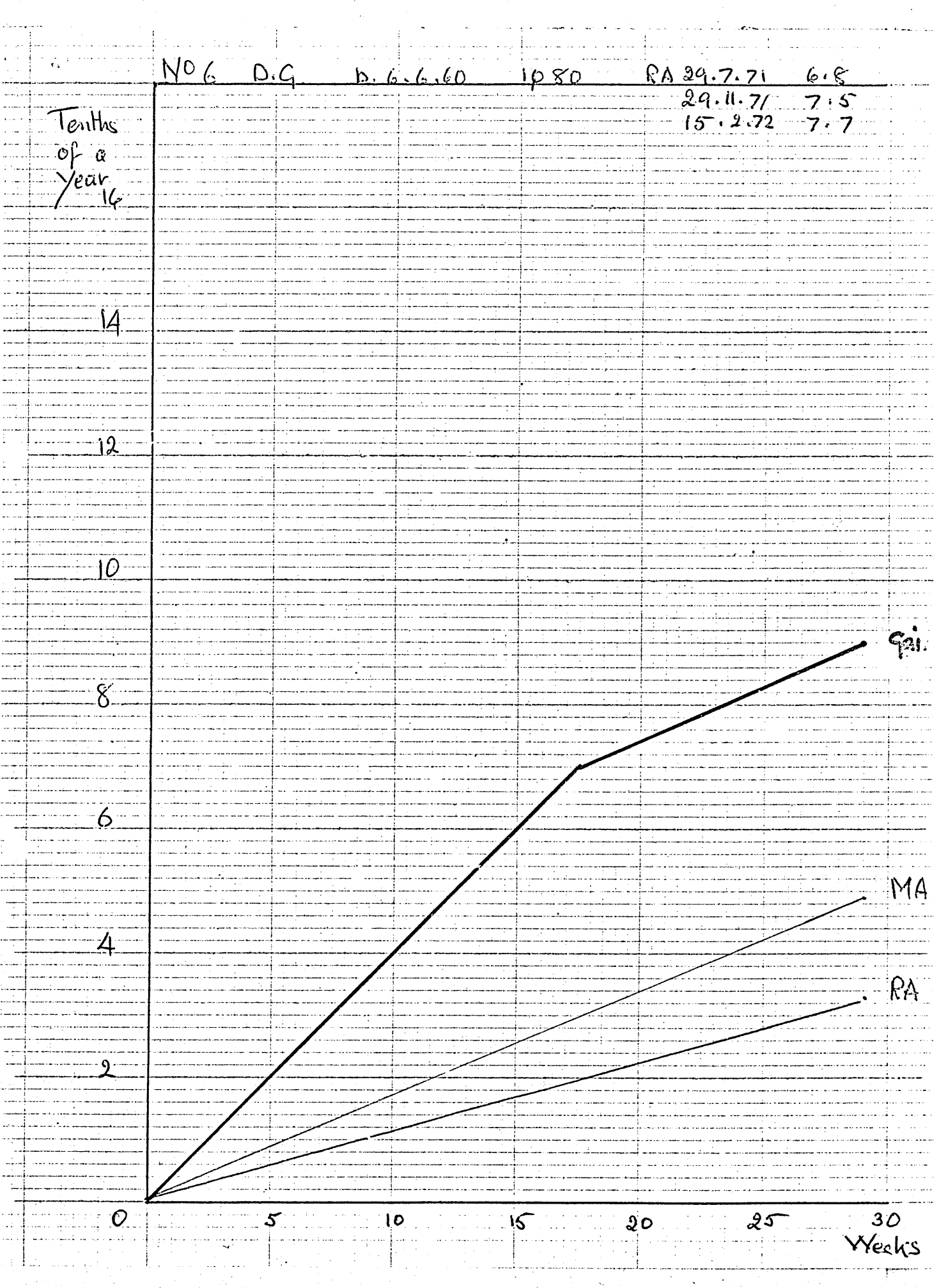

No3 MW 6.18.8.60 1954 RA 29.7.71 5.8
29.11.71 6.2
15.2.72 6.8
Tenths of a Year
16
14
12
10
8
6
4
2
0
5
10
15
20
25
30
Weeks
RA
MA

No 4 S.W. b 12.2.58 IQ 71 RA 29.7.71 7.9
29.11.71 8:2
15.2.72 8.6

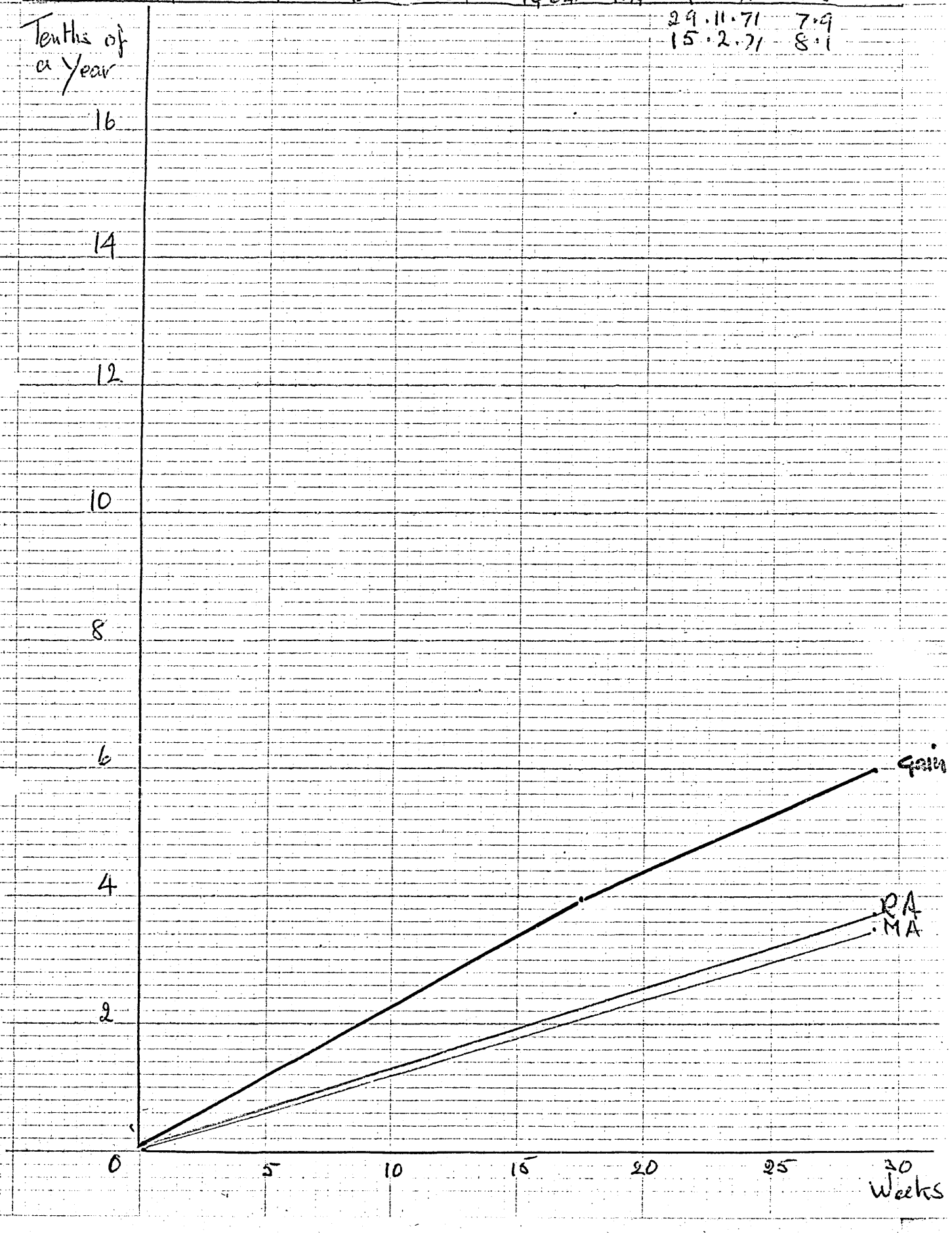


N05 L.D. b 29.12.56 1972 RA 29.7.71 7.5
29.11.71 7.8
15.2.72 7.9

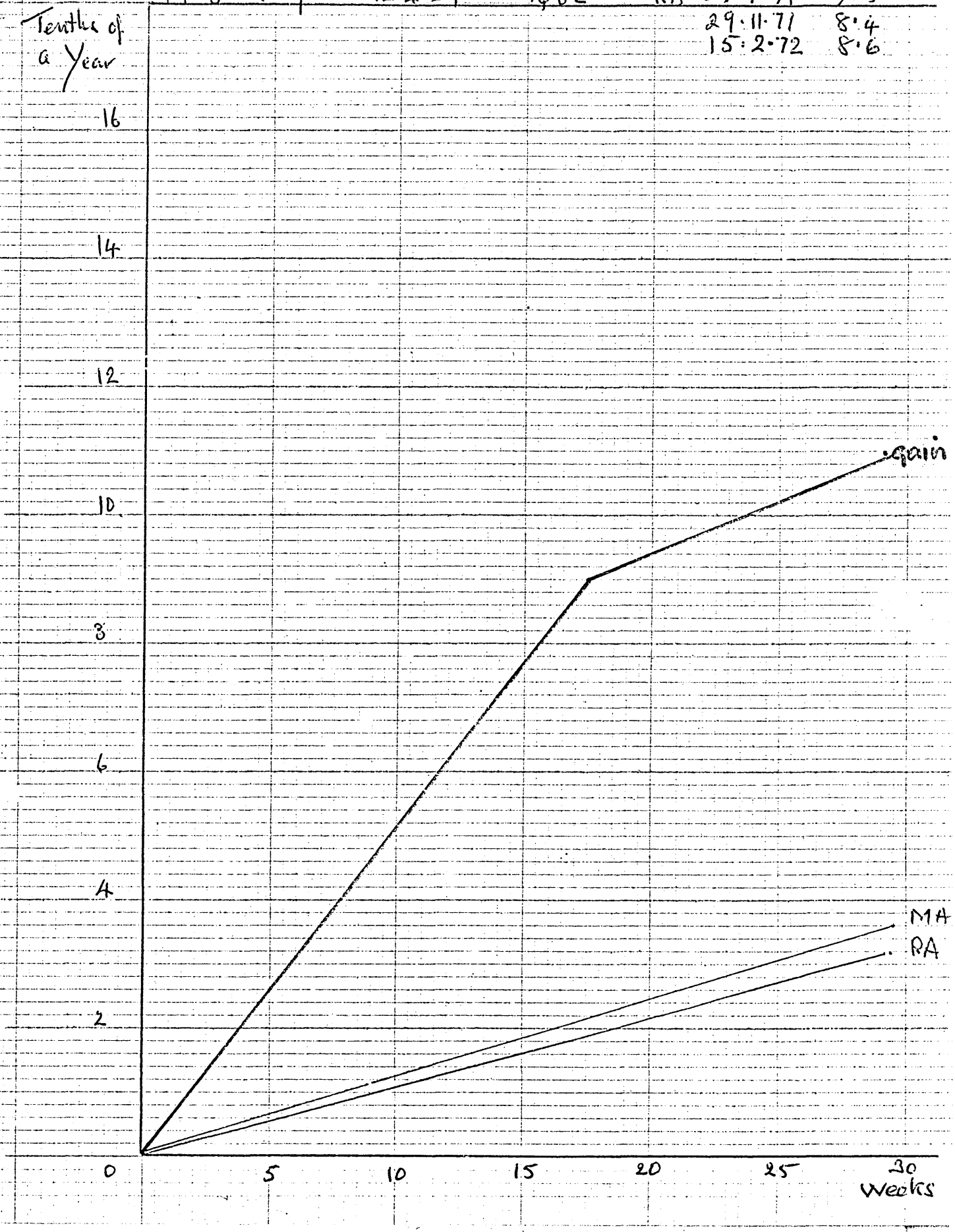



No 6 D.G D. 6.6.60 1080 RA 29.7.71 6.8
29.11.71 7.5
15.2.72 7.7
Tenths of a Year
16
14
12
10
8
6
4
2
0
5
10
15
20
25
30
Weeks
Qai.
MA
RA

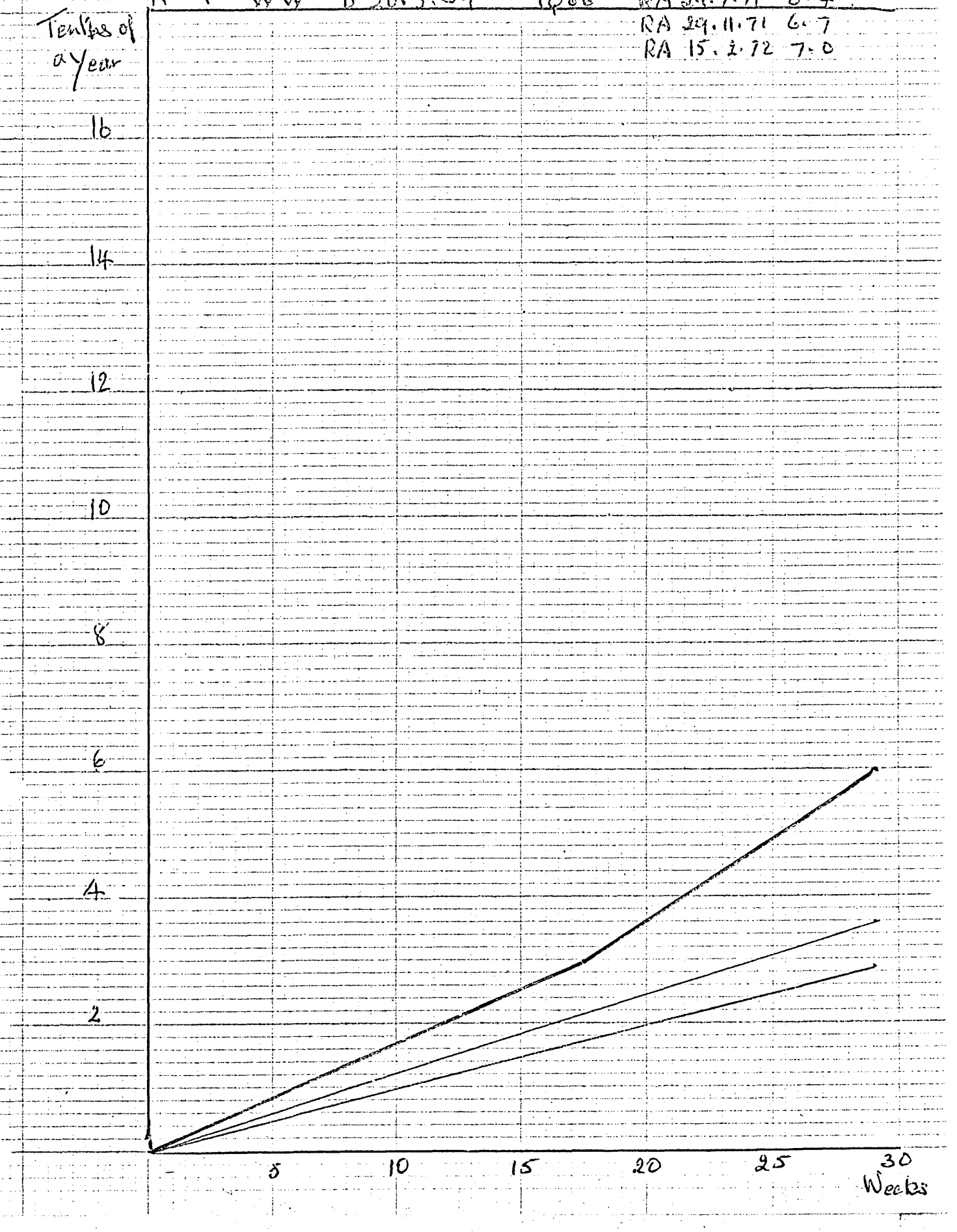
No 7 T.M. b 10.11.59 1964. RA 29.7.71 7.5
29.11.71 7.9
15.2.71 8.1



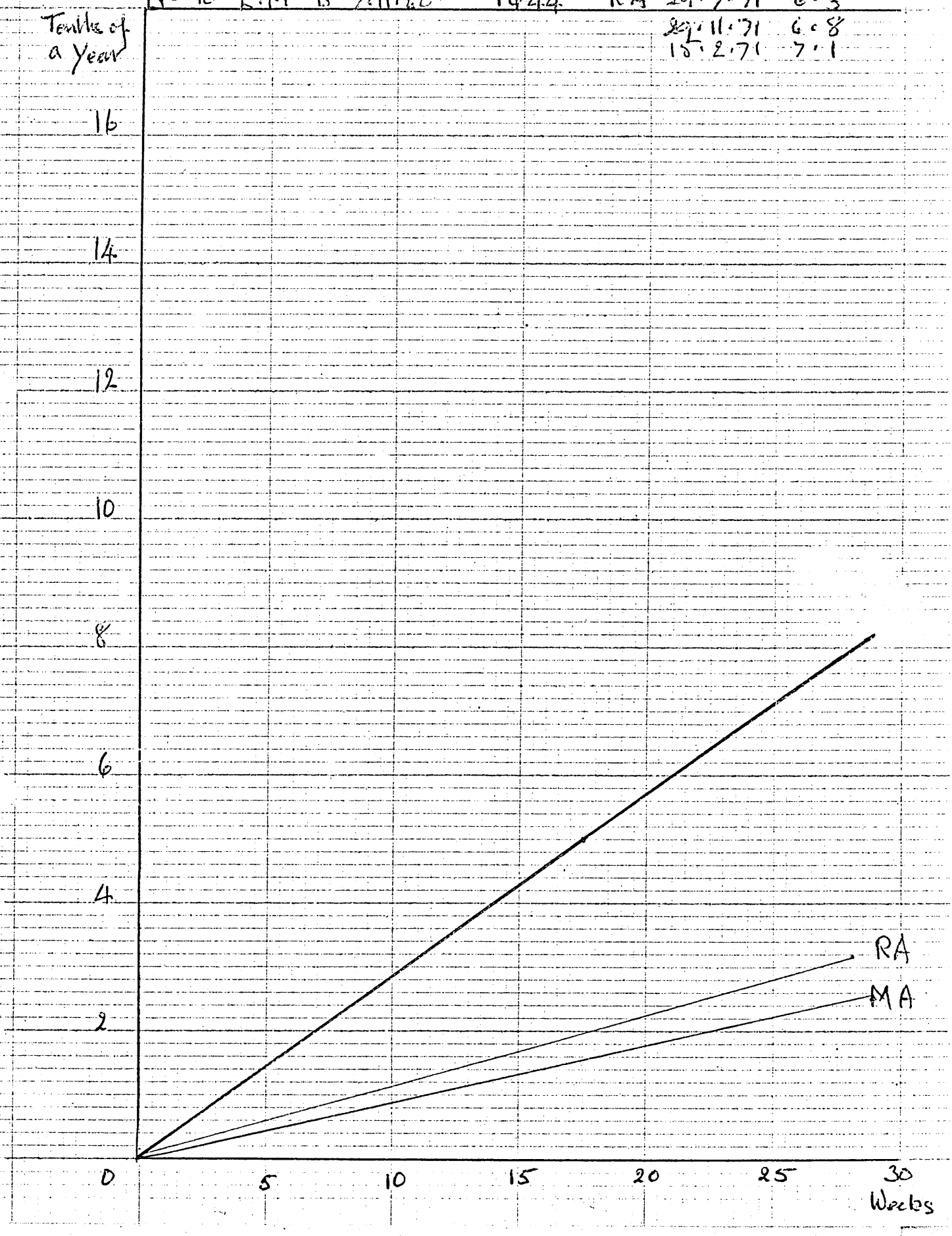
N°8 SG b 12.4.59 1962 RA 29.7.71 7.5
29.11.71 8.4
15.2.72 8.6



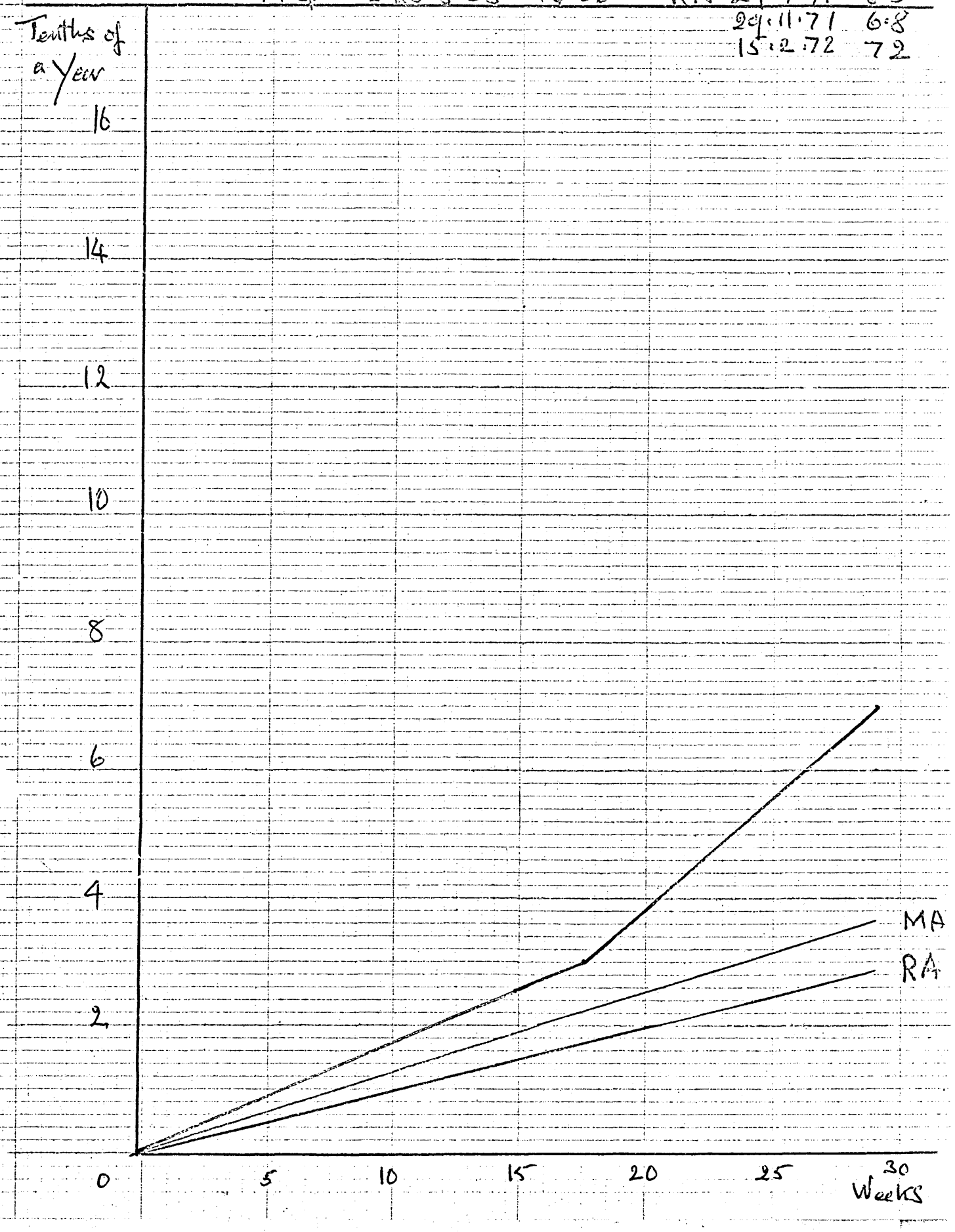
No 9 WW b 20.5.59 1966 RA 29.7.71 6.4
RA 29.11.71 6.7
RA 15.2.72 7.0

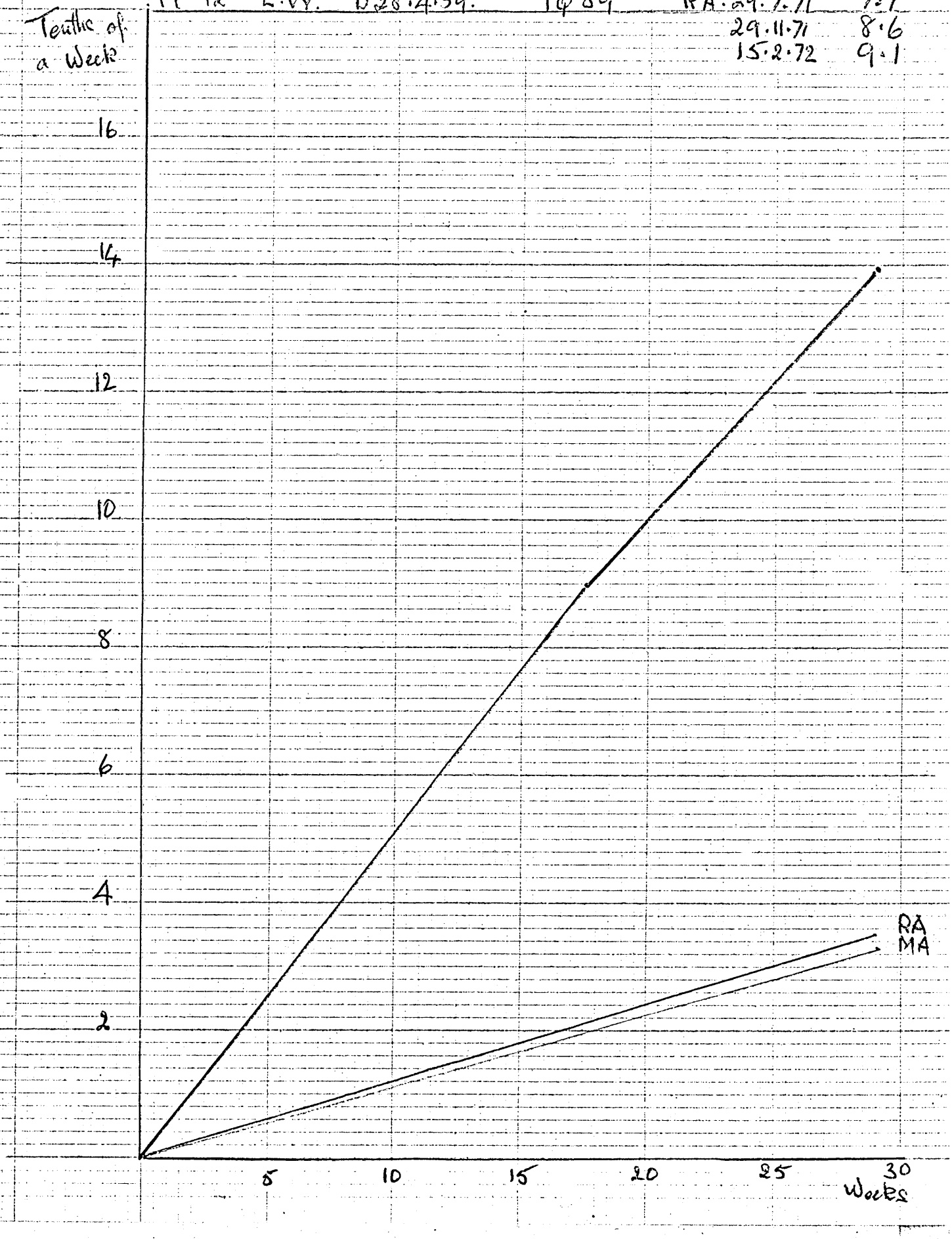


NO 10 L.M b 7.11.60 1944 RA 29.7.71 6:3
29.11.71 6:8
15.2.71 7:1

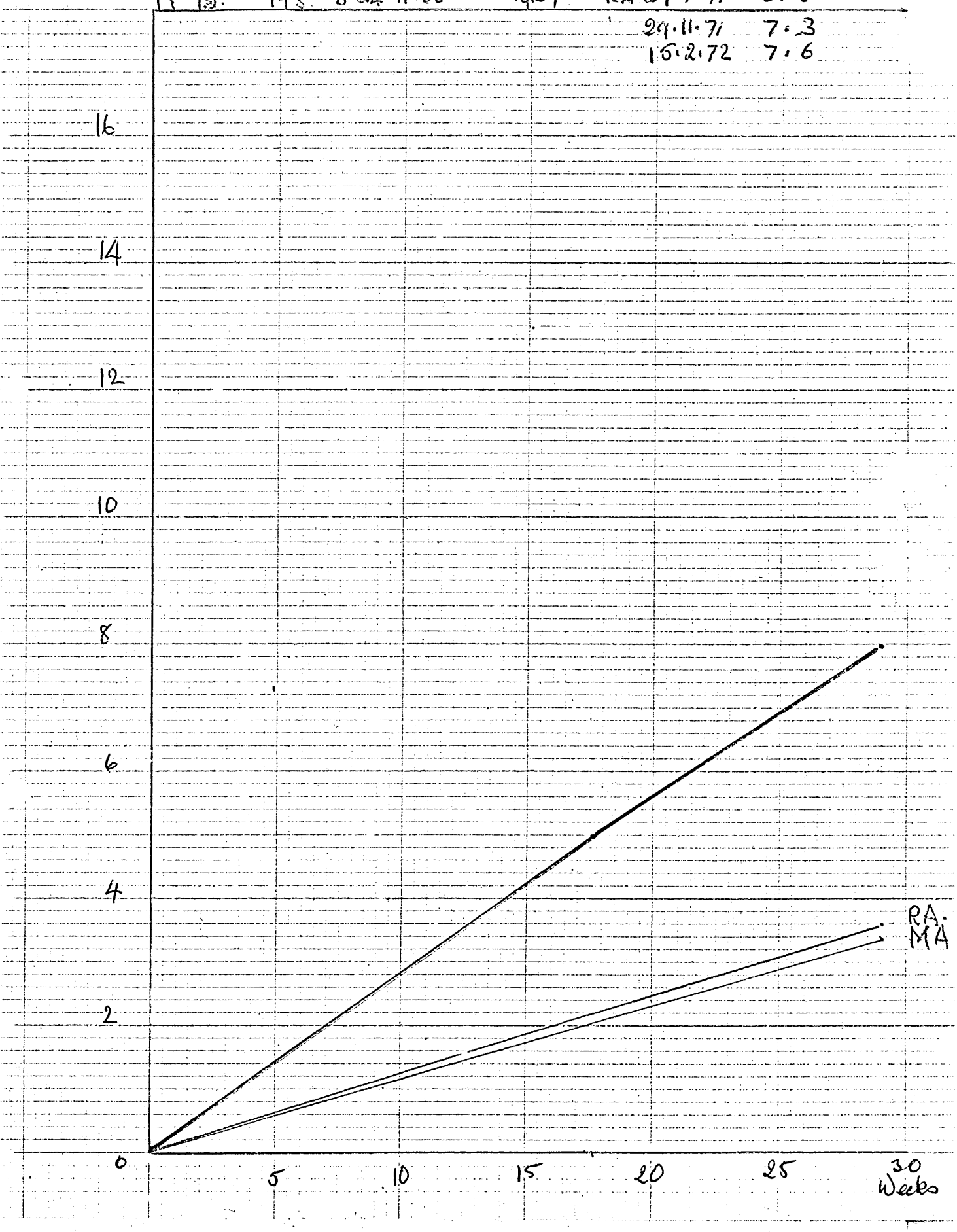


N° 11. MS b 25.8.58 1066 RA 29.7.71 6.5
29.11.71 6.8
15.2.72 7.2

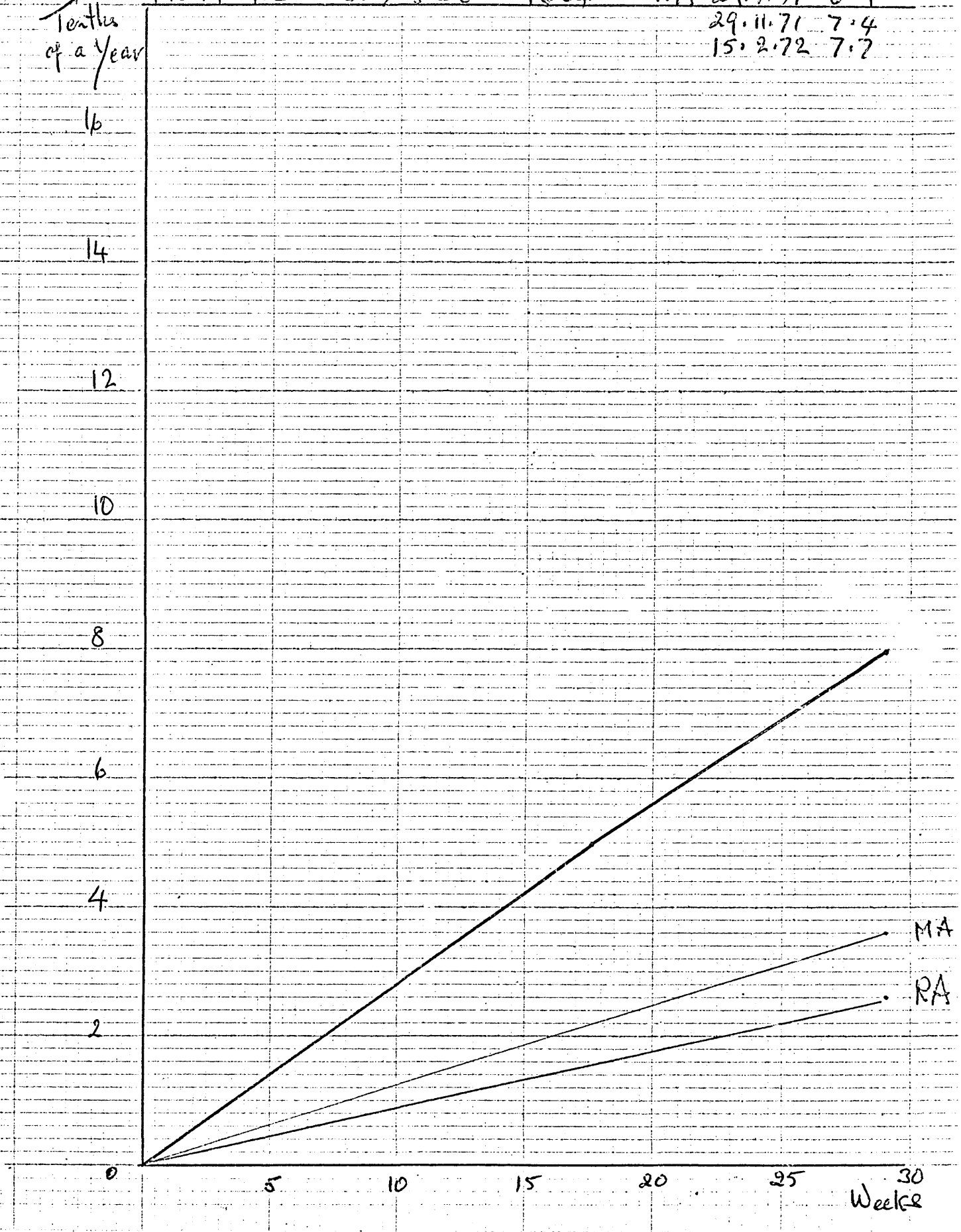


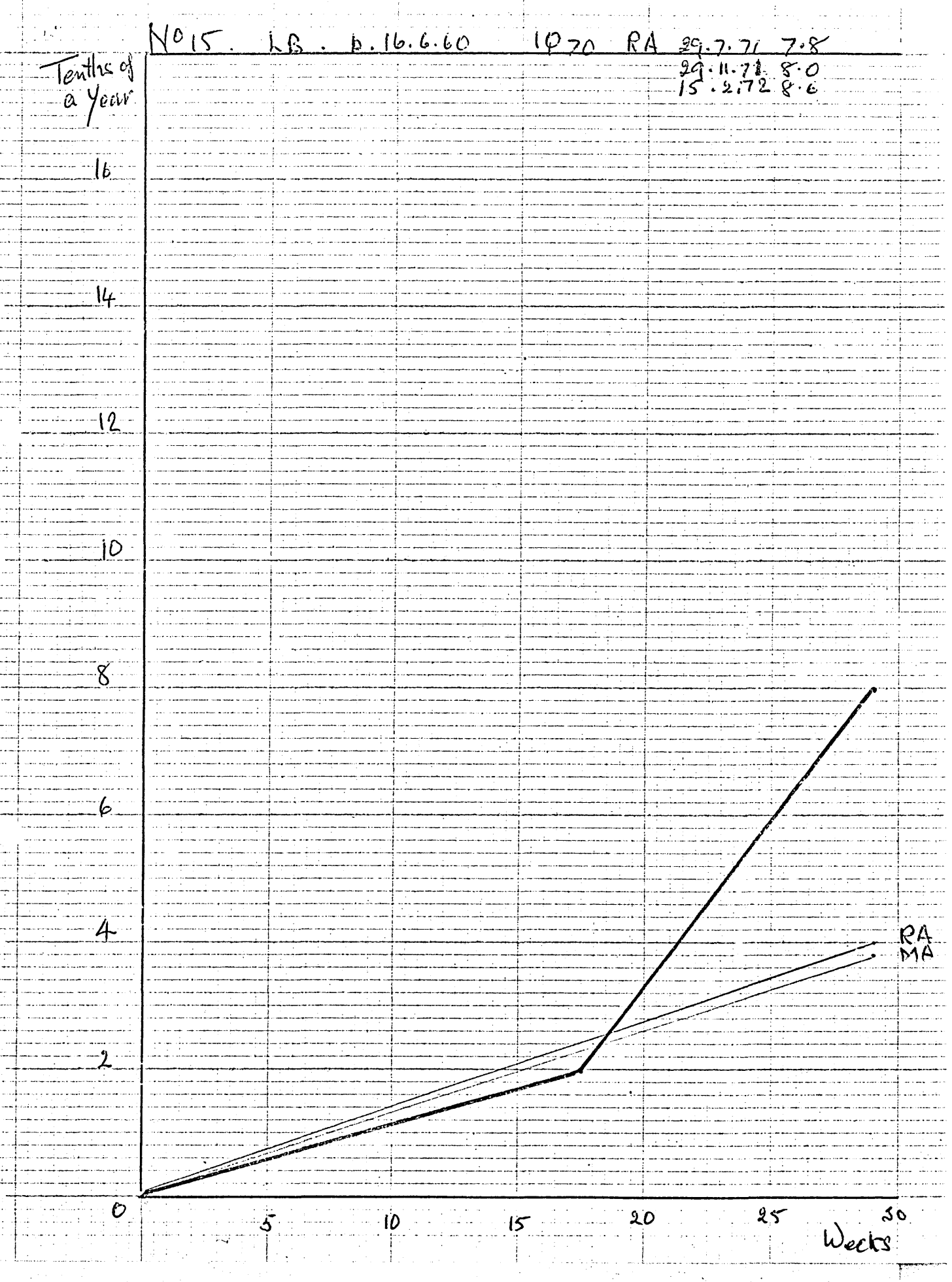

No 12 L.W. b 28.4.59. 1959 RA. 29.7.71 7.7
29.11.71 8.6
15.2.72 9.1
Tenths of a Week
16
14
12
10
8
6
4
2
RA
MA
5
10
15
20
25
30
Weeks

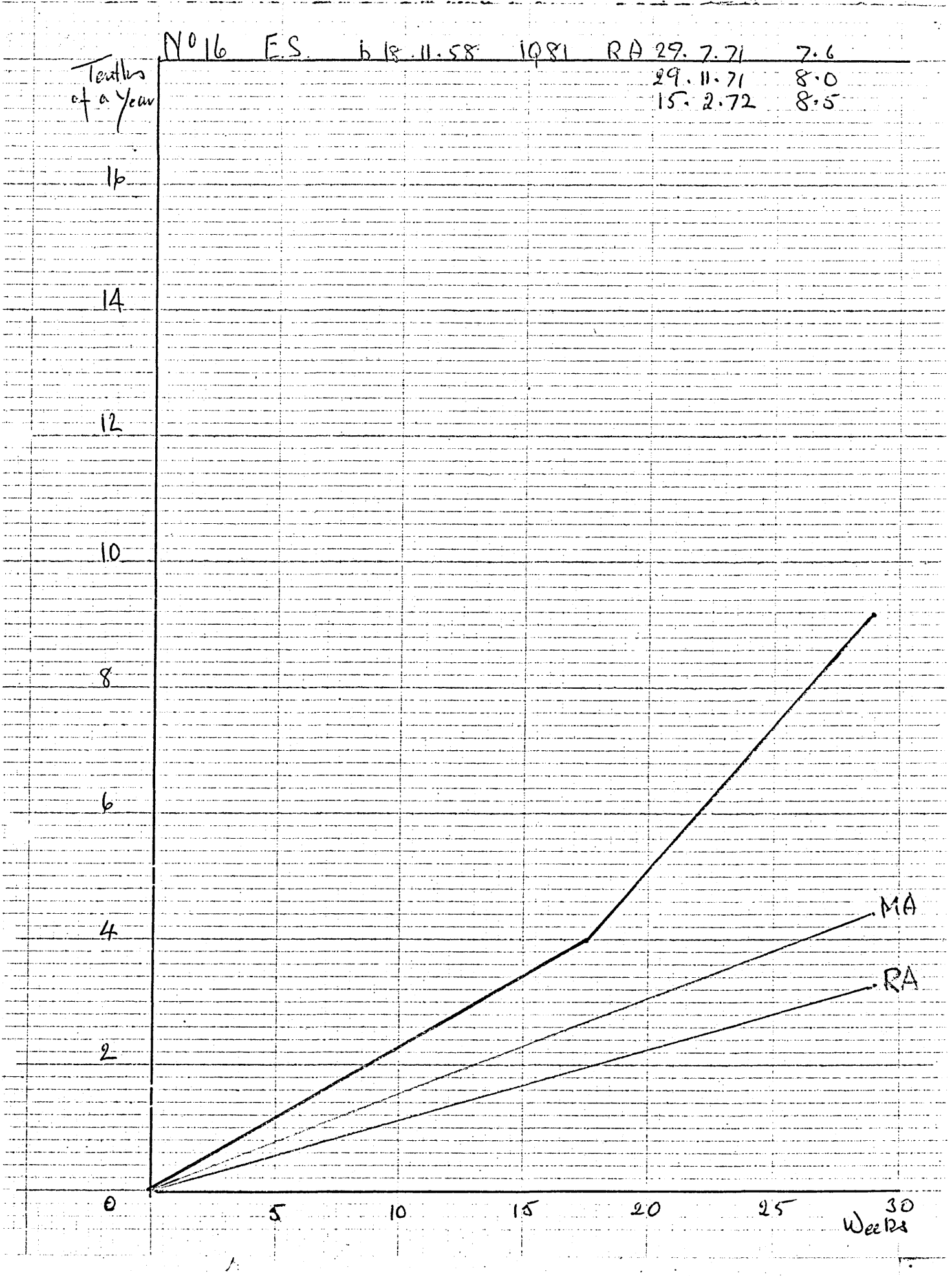
No 13. MS b 24.11.60 IQ59 RA 29.7.71 6.8
29.11.71 7.3
16.2.72 7.6



No 14 HC b. 7.8.56 1064 RA 29.7.71 6.9
29.11.71 7.4
15.2.72 7.7

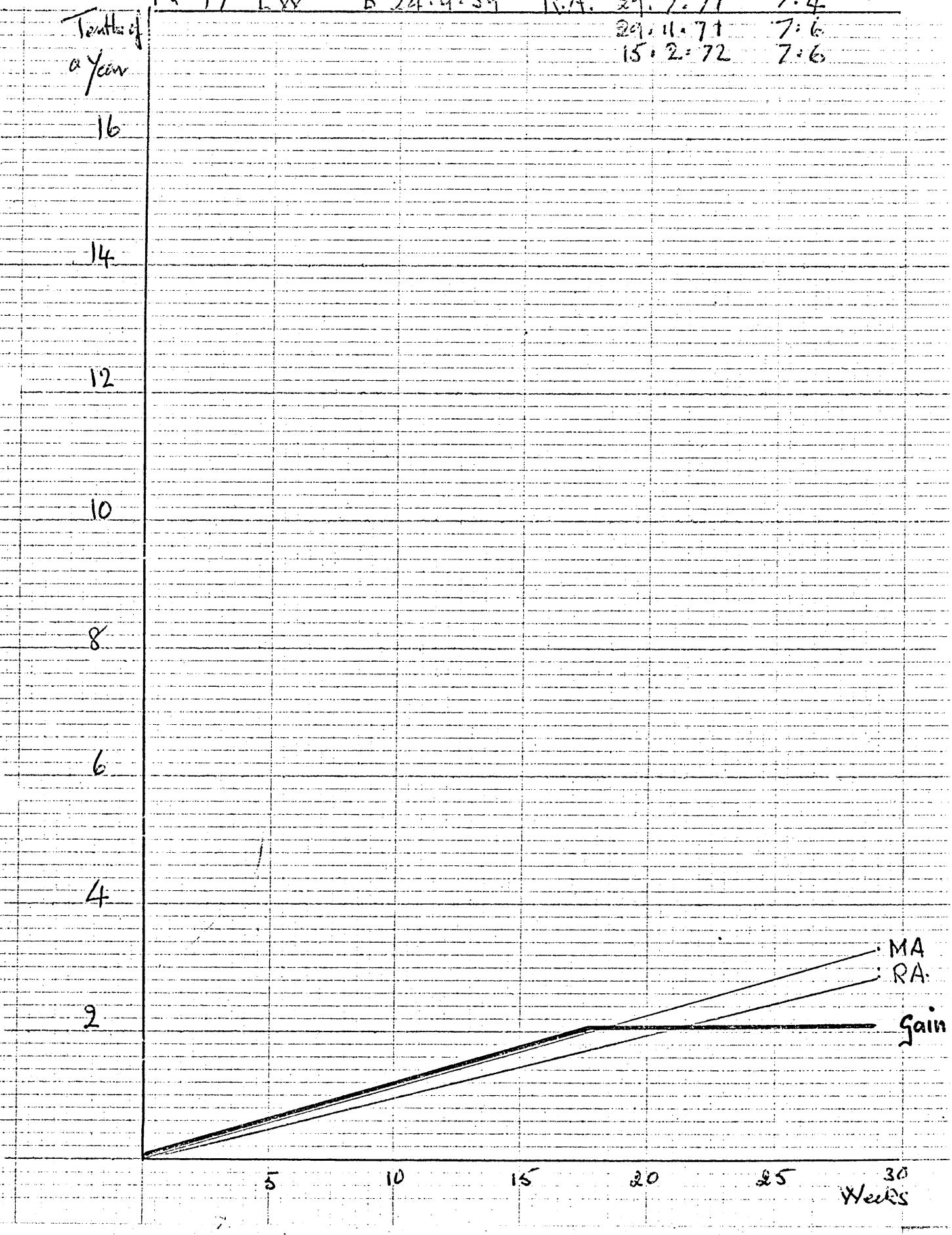



No 15. LB. b. 16.6.60 1970 RA 29.7.71 7.8
29.11.71 8.0
15.2.72 8.6
Tenths of a year
16
14
12
10
8
6
4
2
0
5
10
15
20
25
30
Weeks
RA
MA


N°16 E.S. b 18.11.58 IQ 81 RA 29.7.71 7.6
29.11.71 8.0
15.2.72 8.5
Teeth of a Year
16
14
12
10
8
6
4
2
0
5
10
15
20
25
30
Weeks
MA
RA

IQ. 60.

No 17 EW b 24.9.59 R.A. 29.7.71 7.4
29.11.71 7.6
15.2.72 7.6



No. 1

Patricia Sanderson.
b. 13/6/59
Admit. Ross. 28/11/66
IQ 49.

2 sisters. Youngest child
Creates fantasies
Parents low intelligence
but care for Patricia

Reading Age Schonell Test

28/7/71	6.4
29/11/71	7.6
15/2/72	8.1

Expected Gain based on MA 5.6
" " " " RA 4.9
Actual Gain in 29 wks. 17

Comprehension (Schonell)
28/7/71 Below 6
15/2/72 N Score

No. of attendances 44/46

Diagnostic Tests (Schonell)
R 5 A. Letters & Sound

Errors
Capitals 2. L case 3 Sounds 3

Experiment Scores.

	Word Gains	
Gp. Pgm Vs Flash Cards	P.1	F.C.4
M. Choice Vs Constr. Resp.	C.R.4	M.C.2
Prompting Vs Confirmation	P .2	C 11

Programs Completed
Book 6. 8B Mil 10. 19. M 37. M43. M44 M48 M49 M 60. DS 1. DS 2
M 44A 44B 44C 46A 53 M58 M60 M80 M88

No.2

Julie Toseland.
b. 10/7/57
Admit. Ross. 26/7/67
IQ 59

Separated from parents and family after eviction from home. Father unemployed, various illnesses, mother heart condition, overweight. 3 siblin[g]s history of convulsions, called Stinker at school. History of fits in family.

Reading Age	(Schonell)
28/7/71	6.2
29/11/71	6.5
15/2/72	6.8

Expected Gain based on MA	3.2
" " " " RA	2.6
Actual Gain in 29 wks.	6.0

No. of attendances 26/46

Comprehension (Schonell)

28/7/71	Under 6
15/2/72	Not tested

Diagnostic Tests (Schonell)

R 5A Letters & Sounds

Errors.

L.cases 12 Cap. 10 Sounds 8

Failed to sound c d f j l o p q r t w

Experimental Scores.

Gp. prog. Vs Flash Cards not tested

M. Choice Vs Constr. Resp.

Prompting Vs Confirming P6 C not tested.

Programs Completed.

Book 2. 6. WC.R. 1.2.3.4.5.6.

No. 3.

Mary Whittle.
b. 18/8/60
Admit. Ross. 2/8/66
IQ 54

Is a twin. 2 siblings at Rossinton. Speech poor. Refers to brother as David Whittle.

Reading Age (Schonell.)

28/7/71	5.8
29/11/71	6.2
15/2/72	6.6

Expected Gain based on MA	2.9
" " " " RA	3.0
Actual Gain in 29 weeks	7.0
No. of attendances	37/46

Comprehension (Schonell)

28/7/71	Under 6
15/2/72	Not tested. Absent.

Diagnostic Tests (Schonell)

R 5 A

Errors.

L.cases 20. Caps. 16
Sounds 19 failed

Experimental Scores.

Gp. prog. Vs Flash cards
Prompt Vs Confirming

Word Gains

Gp. 2 F.C. 1
P6 C5

Programs Completed.

Mil. 1. WC.R. 1. Mil. 2. Mil. Supp. 1/5 2/5. WC.R. 1/2
Mil. 4 WC.R. 3, 4.

No. 4.

Sandra Wilson.
b. 12/2/58
Admit. Ross. 6/4/66
IQ 71

Mother retarded. Adopted.
Had a fall at 14months, suffered convulsions. Attends chest clinic.

Reading Age (Schonell.)

28/7/71	7.9
29/11/71	8.2
15/2/72	8.6

Expected Gain based on MA 3.8
" " " " RA 3.2
Actual Gain in 29 weeks 7
No. of attendances 44/46

Comprehension (Schonell)
28/7/71 R 2 6.5
15/2/72 Comp. 7

Diagnostic Tests (Schonell)
R 5 A

Errors
L. cases 2. Caps. 2
Sounds 0

Experimental Scores.

Gp. Prog. Vs Flash Cards	Not tested
Prompt Vs Confirming	Scores 11 & 12 on Pre-test

Programs Completed.
B.C.T. 1 B.C.T. 2. M.67, 68. M/Craft 1. M.92, 93, M
M.104, 109.

No. 5.

Lorraine Dilworth.
B. 29/12/56
Admit. Ross. 30/7/64
IQ 72

Rather immature. Mother dead, v.g. stepmother. 2 half-brothers and 2 half-sisters - younger.

Reading Age (Schonell)

28/7/71	7.5
29/11/71	7.8
15/2/72	7.9

Expected Gain based on MA	3.5
" " " " RA	2.7
Actual Gain in 29 weeks	4.

No. of attendancies 43/46

Comprehension (Schonell)

28/7/71	Under 6
15/2/72	No score

Diagnostic Tests Schonell.
R 5 A.

Error
L. cases 1. Caps. 2
Sounds 0

Experimental Scores.
Gp. Prog. Vs Flash Card
Prompt Vs Confirming

Word Gains
Gp. 7 F/c 5
Prompt 6. Conf. 5

Programs Completed.
Mil. 9, 11, 12. BC 1. AS 2. AS 1. AS 3 AS4 EE 1.

No. 6.

Denise Griffiths.
b. 6/6/60.
Admit. Ross. 15/7/68
IQ 80

Mother has lived with a series of 'Uncles'. 13 children, all in care. Parents address unknown. 3 siblings ascertained ESN - two suspected to be.

Reading Age	(Schonell)
28/7/71	6.8
29/11/71	7.5
15/2/72	7.7

Expected Gain based on MA 4.9
" " " " RA 3.3
Actual Gain in 29 weeks 9
No. of attendancies 44/46

Comprehension	(Schonell)
28/7/71	Under 6
15/2/72	" 7

Diagnostic Tests (Schonell)
R 5 A

L. Cases 0 Caps 1
Sounds 0 (failures)

Experimental Scores.
Gp. Prog. Vs Flash Card
M.Choice Vs C.R. (Book)
Prompts V Confirming

Word Gains.
Gp. 11. F/C 8
M/C 7 C/R 7
Prompt 6 Conf. 11

Programs Completed.
Mil.1. WC.R. 2. Mil.1,2,7A,6,10,13,14,15,16,16A,17,18
BCS 1.(Too difficult) M61

No.7

Terry Marshall.
B. 10/11/59
Admit. Ross. 16/12/64
IQ 64

Was incontinent and resented by other children. Elder sister at Rossington. Mother illiterate - Father intelligent.

Reading Age (Schonell)

29/7/71	7.5
29/11/71	7.9
15/2/72	8.1

Expected Gain based on MA 3.5
" " " " RA 3.7
Actual Gain in 29 weeks 6
No. of attendances 39/46

Comprehension (Schonell)

29/7/71	Under 6
15/2/72	No score

Diagnostic Tests (Schonell)

R 5 A

L. Cases 1 Caps. 0 Failures
Sounds 0

Experimental Scores.

	Word Gains
Gp. Prog. Vs Flash Card	G.P. 10 F/C 9
Constr. R. Vs M.Choice (Book)	M/c 7 C/R 4
Prompt Vs Confirmatory	P.4 C.9

Programs Completed.

Mil.5 WC.R. 2,5,6,7/1,7/2,7/3,7/4, M.1,2,4,5,9,11,20,21,22,23,25.

No. 8

Susan Griffiths
b. 12/4/59
Admit. Ross. 10/11/69
IQ 62.

See No. 6 (Sister)
A somewhat aggresive child.

Reading Age (Schonell)

28/7/71	7.5
29/11/71	8.4
15/2/72	8.6

Expected Gains based on MA 3.6
" " " " RA 3.4
Actual Gain in 29 weeks 11.
No. of attendances 44/46

Comprehension (Schonell)

28/7/71	Under 6
15/2/72	9

Diagnostic Tests (Schonell)
R 4 A

L. Cases 0. Cap.0
Sounds 0
Failed

Experimental Scores.
Gp. Prog. Vs Flash Cards
Constr. Rep. Vs M/Choice (Book)
Prompt Vs Confirmatory

Word Gain.
GP 8 F/C 5
All read Pre.test
P. C. Read Pre.test

Programs Completed.
WC.R. 22. Spell 46B. Mil. 94, 16A, 35, 93 (The Lords Prayer)
M 70, 92, 110, 89, WC.R 7/1, 7/2. Mil. 16A, 17, 18, 20, 31, 34, 35, 36, 62.

No. 9.

Wendy Winter
B. 20/5/59
Admit. Ross. Jan. 1970
IQ 66

Only child. R.Hemiplegia
Speech poor. Parents intelligent and co-operative.

Reading Age. (Schonell)

28/7/71	6.4
29/11/71	6.7
15/2/72	7

Expected Gain based on MA 3.6
" " " " RA 2.9
Actual Gain in 29 weeks 6
No. of attendances 41/46

Comprehension (Schonell)
28/7/71 Under 6
15/2/72 No Score

Diagnostic Tests (Schonell)
R 5 A

L.cases 2. Cap. 4 Failed
Sounds 1

Experimental Scores
Gp. Prog. Vs Flash Cards

Word Gains
G.P. 2 F/C 4

Programs Completed.
Mil. 3,5,6,7,8,9,10,11,12
Mil. 1,2,3,4,5,6,7,7A,8

No. 10

Lesley Marshall.
b. 7/11/60
Admit Ross. 9/5/66
IQ 44

See T. Marshall, No.7 (Sister)
Occasionally incontinent
3rd in family.

Reading Age (Schonell)

28/7/71	6.3
29/11/71	6.8
15/2/72	7.1

Expected Gain based on MA 2.5
" " " " RA 3.1
Actual Gain after 29 weeks 8
No of attendances 39/46

Comprehension (Schonell)

28/7/71	Under 6
15/2/72	Absent

Diagnostic Tests (Schonell)
R 5 A

L. Cases 1 Cap.2 Failed
Sounds 1

Experimental Scores.
Grp. Prog. Vs Flash Cards
M.Choice Vs Constr. Resp. book
Prompt Vs Confirmatory

Word Gains
G.P. 6 F/C 2
M/C 5 C/R 11.
P. 7 C.8

Programs Completed.

Mil. 1,2,3. WC.R. 1,2,3,4,5,6,7/1

No. 11

Myra Spreadborough
b. 25/8/58
Admit. Ross. Jan. 1970
IQ 66

Mother low intelligence, no formal education. 6 weeks in hosp. vague history of convulsions. Withdrawn.

Reading Age. (Schnoell)

28/7/71	6.5
29/11/71	6.8
15/2/72	7.2

Expected Gain based on MA	3.6
" " " " RA	2.9
Actual Gain in 29 weeks	7.0
No. of attendances	39/46

Comprehension (Schonell)

28/7/71	Under 6
15/2/72	No score

Diagnostic Tests (Schonell)

R 5 A

L.Cases 1 Cap.0 Failed
Sounds 0

Experimental Scores	Word Gains
Grp. Prog. Vs Flash Cards	G.P. 4 F/C 3
M. Choice Vs Constr. Resp. book	M/C 0 C.R. 5
Prompt Vs Confirmatory	P.6 C.5

Programs Completed.

Mil. 5, 8. WC.R. 2,3,4,5

No. 12

Lynn Ward.
b. 28/4/59
Admit. Ross. Jan. '68
IQ 59.

Mother attended ESN school.
Very poor eyesight, had nervous breakdown. Rejected by father over-protected by mother.

Reading Age (Schonell)

28/7/71	7.7
29/11/71	8.6
15/2/72	9.1

Expected Gain based on MA 3.3
" " " " RA 3.5
Actual Gain in 29 weeks 14
No. of attendances 45/46

Comprehension (Schonell.)

31/8/71	6.5
15/2/72	7.

Diagnostic Tests (Schonell)
R 5 A

L.Cases 1 Cap.1 Failed
Sounds 1

Experimental Scores

Grp. Prog. Vs Flash Cards
Prompt Vs Confirmatory

Word Gains
G.p. 11 F/c 12
P.5 Conf. 6

Programs Completed.
BCT 1 AS 2, AS 1 M.93,94,91

No. 13.

Mary Smith.
b. 24/11/60
Admit. Ross. 17/9/69
IQ 59

7 in family. 3rd child.
Deaf in 1 ear.
Pleasant mother.

Reading Age (Schonell)

28/7/71	6.8
29/11/71	7.3
15/2/72	7.6

Expected Gain based on MA	3.4
" " " " RA	3.6
Actual Gain in 29 weeks	8
No. of attendances	45/46

Comprehension (Schonell)

11/8/71	Under 6
15/2/72	No score.

Diagnostic Tests (Schonell)

R 5 A

L. Cases 0 Cap. 3
Sounds 0
Failed

Experimental Scores.

Grp. Prog. Vs Flash Cards	G.P. 8 F/C 9
M. Choice Vs. Constr.Resp.	M/C 0 C/R 4.
Prompt Vs Confirmatory	P.8 C.6

Programs Completed.

Mil. 4, 7,8,6,5. WC.R. 7/2,7/3, M.12,15,17,18,44A,46,44c,44b,47,48
50a,56.

No. 14.

Helen Clark.
b. 7/8/56
Admit.Ross. 15/9/66
IQ 64

2 brothers, 2 sisters.
3rd child. Father semi-invalid, off work. Mother illiterate

Reading Age. (Achonell)

28/7/71	6.9
29/11/71	7.4
15/2/72	7.7

Expected Gain Based on MA	3.6
" " " " RA	2.6
Actual Gain in 29 weeks	8.
No. of attendances	37/46

Comprehension (Schonell)

31/9/71	Under 6
15/2/72	No score

Diagnostic Tests (Schonell)

R 5 A

L. Cases 0 Cap.0 Failed.
Sounds 0

Experimental Scores

M.Choice Vs Constr.Resp. book
Prompt Vs Confirmatory

Word Gain

M.C. 7 C.R.7
P.6 C.11.

Programs Completed.

Mil.3 WC.R.1 M.94,109A,112A

No. 15

Lorraine Brogan
b. 16/6/60
Admit. Ross. July '70
IQ 70

Trans. from Scottish S.School.
Parents separated. 6 children
Was in care. Insecure

Reading Age (Schonell)
28/7/71 7.8
29/11/71 8
15/2/72 8.6

Expected Gain based on MA 3.9
" " " " RA 4
Actual Gain in 29 weeks 8
No. of attendances 34/46

Comprehension (Schonell)
28/11/71 7.4
15/2/72 9

Diagnostic Tests (Schonell)
R ~~85~~A

L.Cases 0 Cap. C Failed
Sounds 0

Experimental Scores

Grp. Prog. Vs Flash Cards
M.Choice Vs. Constr. Resp.
Prompt Vs. Confirmatory

Word Gains
P.10 F.C. 10
M.C. 5 C.R.5
P.9 C.8

Programs Completed.
M.5B, WC.R. 6. M.91,93,
Oldborough Matching Programs. M.112A. M/Craft 1,2,3.
M.17,33,35,54, WC.R. 7/3 DD 1,2,46a,44a,44c,53,81,82.

No. 16

Elizabeth Slatter
b. 18/11/58
Admit. Ross 28/10/65
1Q 81

half-caste - five siblings.
Mother unmarried,
Living with Jamaican, (not father)
Had meningitis at 9 months. Has twin brother.

Reading Age (Schonell.)

28/7/71	7.6
29/11/71	8
15/2/72	8.5

Expected Gain based on MA	4.4
" " " " RA	3.3
Actual Gain in 29 weeks	9.

No. of attendances 41/46

Comprehension (Schonell)

28/7/71	6.6
15/2/72	8.0

Diagnostic Tests (Schonell)

R 5A

L.Cases 0 Cap.2 Failed
Sounds

Experimental Scores.

Grp. Program Vs. Versus Flash	P.12 F.C.12
M.Choice Vs C.R. (book)	M/C 1. C.R.0
Prompt Vs Confirmatory	P. 12 C.9

Programs Completed. Mil.7, WC.R. 6, M112A, M.91,92
M/C. 1,2,3, M31A, M35,40,48, 41,43,54,76A, BC 1, Dom.Scl DS.2

No. 17

Enid Winter.
b. 24/9/59
Admit Ross. 5/4/67
IQ 60

-

Fourth of five children.
Father illiterate

Reading Age (Schonell)

28/7/71	7.4
29/11/71	7.6
15/2/72	7.6

Expected Gain Based on MA	3.3
" " " " RA	2.9
Actual Gain in 29 weeks	2.0
No. of attendances	45/46

Comprehension (Schonell)

28/7/71	Under 6
15/2/72	7

Diagnostic Tests (Schonell)

R5A

L.Cases 1 Caps. 3
Sounds 1
Failed

Experimental Scores.

Grp. Prog. Vs Flash Card	P.5	F/C4
M.Choice Vs Constr. Resp. (book)	M.C. 2	C.R. 10
Prompt Vs Confirmatpry	P.12	C. 9

Programs Completed.

Mil. 8,10,11,12. E.E.1, V.C.1, M.112A,111A, B.C.1 A.S.4

[redacted]

	here is a it is a	● bike ● gun
	it is a here is a	● rope ● gun
	it is a here is a	● book ● ball
	here is a it is a	● barrow ● ball
	here is a it is a	● boat ● ball
	it is a here is a	● barrow ● knife

1/2

	here i it is a
	it is a here is
	here is it is a
	here is it is a
	it is a here is
	here is it is a

1/2

[redacted]

WORD CONTROL PROGRAM. STILLITRON.

Set 2. Book.1.

SET 2

NEW WORD
here

	here is a	● boy ● girl
	here is a	● bat ● girl
	here is a it is a	● ruler ● bat
	here is a it is a	● gun ● boy
	here is a it is a	● rope ● book
	it is a here is a	● bike ● book

1/2

A STUDY INTO THE RELATIVE EFFECTIVENESS OF PROMPTING AND CONFIRMING FRAME SEQUENCES.

Much experimenting has been done in endeavouring to establish the most effective methods of preparing learning programs. Apart from what is now considered the classical differences between Skinner's 'linear' programming method and Crowder's branching technique, there has been a great deal of study into the most efficient ways of sequencing the subject matter of programs and these have produced various methods of trying to ensure that the most effective structures and sequences are employed.

There is still a great deal to be learned about this matter, of what Storulow and others call inter-item sequencing, but in the use of learning programs with slow learners, it it probably more important to ensure the most effective frame construction, or the best intra-item sequence.

Little has been done in this field in Britain and even in America, where P.L. is used much more widely most intra-item study has been concerned with the nature of the 'prompts'.

Much teaching of slow learners is effected by paired-associate learning and it is, therefore, of prime importance that when this is employed in P.L. with such students, the most efficient sequencing within the frames be employed, subject to the nature of the learning intended. For example, a number of investigations quoted by Storulow and Lippert (97) found that what he described as a 'prompting' sequence taught more quickly than a 'confirmation' sequence but that the latter provided better retention. The subjects of his studies were mentally retarded pupils and were concerned with two methods of arranging the three factors in a paired-associate learning sequence - i.e., (a) The cue stimulus, (b) the eliciting stimulus and (c) the overt response.

In the teaching of reading, the cue stimulus is the new word to be learned; the eliciting stimulus is the picture, object or other factor which elicits the new word. The 'overt' response is the speaking, writing down, or act of discriminating the new word.

In their experiment, Storulow and Lippert (97) delineated

the sequences of their different presentations of 'prompting and confirming' see(Appendix 11) In the research study they used forty mentally retarded children, defined as EMH. The scores were recorded: 'learning' (errors and trials to criterion) and 'retention' (recall and recognition.)

They found that the Prompting S-R sequence produced significantly different means from the confirmative sequence. The conclusions drawn from the experiment were finally summarised: "This study showed that one technique - the Prompting S-R sequence - was better for learning than another technique - the Confirmation S-R sequence. However, it showed that with high levels of overlearning retention was better following the second technique - Confirmation S-R sequence.

It would seem to be purposeless to present the cue stimulus, unsupported by any prompt, as Storulow and Lippert do, (97) until the pupil can associate it with something known, until then it is meaningless. In this I am supported by Gagne and Rohwer (98) who, commenting on studies in stimuli presentation, had this to say:- " The results showed that, in the stimulus position, pictorial materials produced more efficient learning than word materials."

In writing frames such as these, we at Milton, like most writers of such programs, usually commenced a sequence with the cue stimulus and the eliciting stimulus together. Sometimes we faded one and sometimes the other. Storulow appears to vanish or fade neither. Instead he presents a discriminatory task by introducing a new and presumably unknown factor. However, the important aspect is that in one instance 'prompting' he presents the associated picture and word before the discriminatory part of the sequence and in confirmation he reverses this. In the former he helps the pupil to discriminate the correct response, in the latter he puts the pupil in a limited trial and error situation. Here we have this classroom dilemma reduced to its elements.

As with slow learners the problem of repetition of trials produces irrational resistance difficult to overcome, in this study the repetitionis limited to two trials. A basic feature of all the studies in this thesis, with the exception of the long term study at Milton, in the introduction, is the measuring of the child against itself. In preparing a study such as this there are two possible methods. One is to match the subjects, a group using prompting programs and another confirmation programs - here one is faced with variables arising between the two groups of subjects. The second method is to make all the available subjects work both types of program. Here the variables may arise between the subject matter of the two programs, in this case one set of words may be easier to learn than the other.

I consider the advantages of the second method outweigh the first because (a) they measure the child against itself and thus avoid the quagmire of individual differences and secondly the sample size of the study is doubled if the subjects are not divided into two groups.

The subjects of this study were fourteen girls between the ages of 10 and 15, in the I.Q. range of 44 to 80. All were ascertained as educationally sub-normal and were attending a day special school.

The material used was four, twelve framed programs the objective of which was to teach 48 nouns. Two programs were arranged with 'prompting ' frame sequences and two with 'confirming'frame sequences. (See App ,11.)

The method employed was for each subject, after pre-testing, to complete all four programs. Two trials at each program were permitted if the score was less than 12 at the first one.

The results which were not significant can be seen on (App,10.)

I have given one reason why Storulow and Lippert's method of examining, not only the differences in sequences but also the effects of overlearning, was not followed here. It was the difficulties one faces with slow learners of inducing them to repeat work done once unless it is presented in a different form, a process that would invalidate this study. A second, and possibly equally important reason is that the purpose of this study as part of the overall research, is to establish the effectiveness of P.L. with slow learners. The subject matter taught should of necessity be that which they will use daily once they have learned it. In the matter of reading a word taught must be one which they need in their daily reading and writing and, therefore, once acquired, overlearning will occur as a matter of course. Storulow and Lippert were concerned with the basic techniques of P.L. in general I am concerned with P.L. in the narrower relation to slow-learners.

As can be seen from the scores in Appendix 11 the test produced no significant difference though eight of the 13 who completed the test produced higher scores on the prompting sequences and thus tended to confirm Storulow and Lippert's findings. (97)

One feature concerning the experiment which I cannot forbear to point out is, that the thirteen children who completed these two simple programmed reading exercises, over which they took on average about a half an hour, added an average of 15.2 words to their vocabularies and none of them gained less than 11 words.

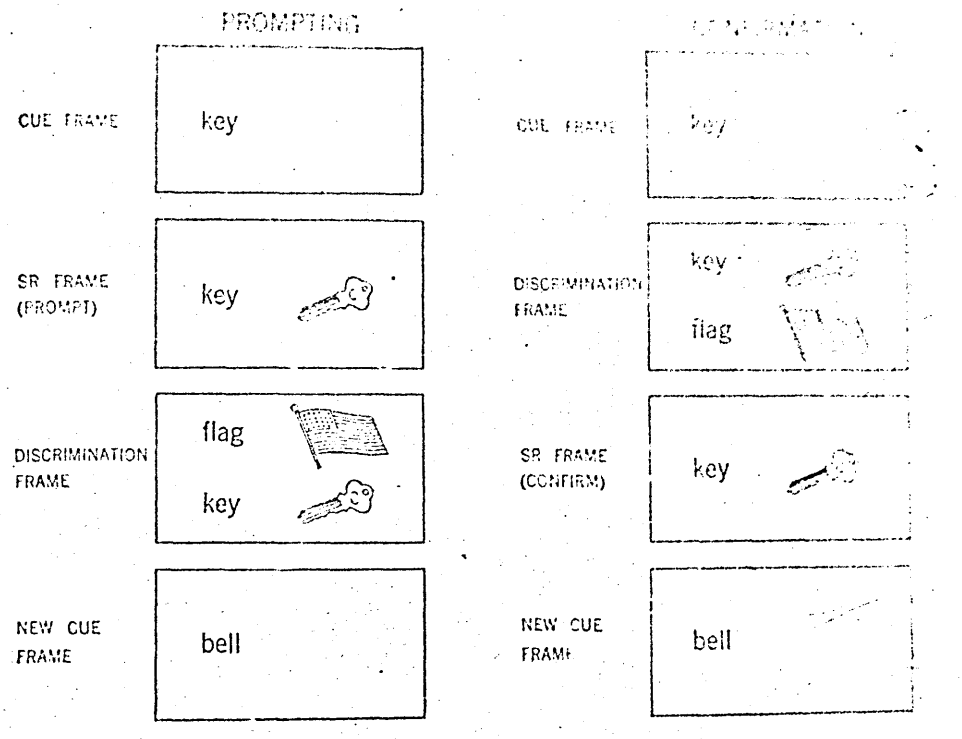
Prompting v.s Confirming Rank Sequences.

No.	No.	Prompting Test		Confirming Test.		Gains.		Wilcoxons Signed Ranks Test.					
						Prompt	Conf.	Differences	Diff, Values	Tally	Rank Values	+ Ranks	- Rank
		Pre	Post	Pre	Post	+	-						
P.S	1	3	12	2	11	9	9						
J.T	2	0	6										
M.W	3	0	8	0	5	8	5	+3					
L.D	4	5	11	2	7	6	5	+1	1	++++-	1-5=3	12	3
D.G	5	4	10	1	12	6	11	-5	2	++	6-7=6½	13	
T.M	6	7	11	3	12	4	9	-5	3	++	89=8½	17	
W.W	7	0	10	0	8	10	8	+2	5	---	10-12=10		33
L.M.	8	0	9	1	9	9	8	+1					
M.Sp	9	1	7	2	7	6	5	+1				42	36
M.S	10	3	11	3	9	8	6	+2					
H.C	11	3	9	0	11	6	11	-5					
L.B	12	3	12	3	11	9	8	+1					
E.W	13	0	12	3	12	12	9	+3					
L.W	14	7	12	5	11	5	6	-1					

Smaller Rank Total (-) 36

Omitting (1) because the scores are equal and (2) because the Confirming Test was uncompleted, then 'n' =12. The smaller Rank total is (-) 36.

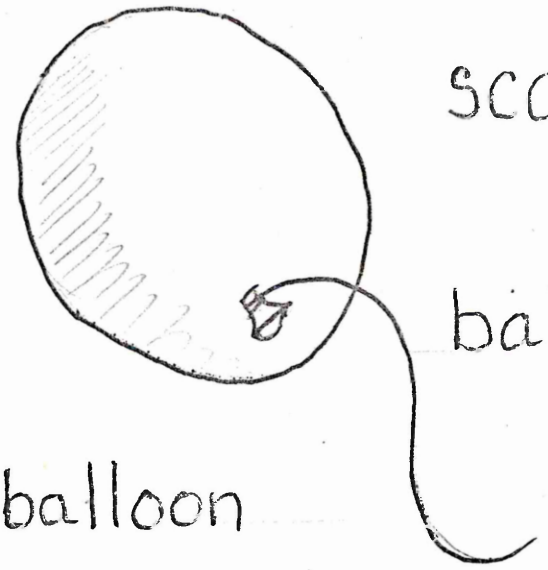
Therefore when 'n' =12 and R =36, applied to the R Table (69) P > 10% and the results are not significant.



Teaching sequences. The word "bell" (frame 4) starts a new series identical to the one begun with "key." The up-down relationship of the taught word (key) with the foil word (flag) was randomized to eliminate the use of position cues.

Extract from Storulow and Lippert (97)

PROMPTING FRAME



scarf

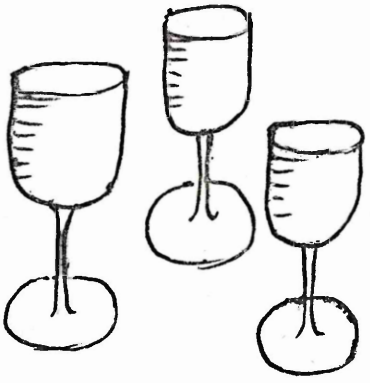
balloon

balloon

balloon

*

CONFIRMATION FRAME



glasses

sponge

glasses

*

* In each case the confirmation is on the following page.

THE GROUP PROGRAM.

One way of overcoming the teacher resistance to P.L. is possibly the employment of group programs. It is I suppose, a compromise between P.L. and class teaching and might meet the need of some teachers who feel that they have to do at least a proportion of class teaching in every lesson. It might satisfy those who feel that they are not doing their duty unless they themselves are the lesson medium.

However, the group programs, like any other compromise, lose something because they are a compromise. The biggest loss is that of self-pacing, though some advocates say that group pacing has advantages. For slow-learning pupils in classes, the probablity is that individual learning differences are generally too wide for them to benefit a great deal by this group pacing.

There are various techniques for imparting group programs, but like all programmed learning, they are basically the same in that they are founded on the stimulus-response-confirmation pattern. The presentation can vary between the blackboard or chart and the most sophisticated audio or visual aids. The response mode and confirmatory methods can likewise be simple or complicated.

Doctors Stenhouse and Womersley (84) installed an electrical system with 128 student stations linked to a lecturer's console. Each student had a box with four switches and a green and red light. The student responded to the multi-choice question by pressing one of the concealed switches and at once knew if his answer was correct or not according to whether the light was green or red. To what extent the lectures were otherwise programmed was not mentioned.

In the Stocksbridge College of Further Education, Sheffield, a fairly sophisticated classroom group programming set-up was created. Like the above system it included a number of student stations with switches and lights and a lecturer's console. In addition there was an ingenious perforated belt mechanism which co-ordinated the taped program with either a cinematograph or strip-film projector. The console not only showed the lecturer or operator the student responses as they made them but recorded them as well. When the lecturer wished to use film which was not designed as part of a program he could insert multi-choice questions by means of an overhead projector. This, however, usually

needed an assistant to operate the overhead projector.

The whole thing was cumbersome and subject to frequent breakdown due to the classroom having to be used for other purposes and the consequent damage to the electrical wiring. The labour of preparing a program and setting it up was such that the system was seldom used except to demonstrate its ingenuity to visitors. However, there are simple ways to employ common audio visual aids such as the cine-projector, tape recorder and strip and slide projectors.

Kersh (84) describes some direct application of a group-paced classroom instruction. He says: "The result may be very similar in appearance to classroom procedures which are presently employed by teachers, but the resemblance may end there. There will be no greater similarity between conventional classroom techniques than there exists between conventional self-study materials and programmed self-instructional materials."

The ultimate in automated classroom is probably "Class." This system is capable of imparting both individual programmed lessons or group-paced lessons. Kersh says: "Briefly, Class is an automated classroom using a Philco S-2000 computer as a central control mechanism. Class permits instruction through a variety of different media, including motion pictures and television. Each student receives an individualised sequence of instructional materials through a manually operated film viewer containing 2000 frames of instructional material. A response device linked to the computer, tells the student which frame to turn to, enables the student to respond to questions and presents knowledge of results. The computer keeps track of all students and makes the records available to the teacher."

Kersh also describes some commercially available (in America,) automated classrooms similar in construction, if more refined; to that which was erected at Stocksbridge.

The following experiment was carried out with a group of teachers studying P.L. at the Educational Development Summer School in London, 1970. The subjects were eight teachers with widely

different backgrounds. The program was titled "Five Oak Trees Defined by Leaf and Fruit." It consisted of 15 multichoice frames. Each frame consisted of a tape recording supported by a picture projected by a slide-projector and followed by a taped response demand. (See App. 13) The student responded by turning a cube toward the lecturer on which a bold letter A,B,C or D, was printed. With this limited subject and these very favourable conditions the technique was very effective.

A form of combined classroom lesson and program which ensured an attentive class was used in the Milton School to supplement nature studies. Short 12 - 20 frame linear programs were created and duplicated. The teacher first gave a very short lesson which confirmed as closely as possible to the program and in the course of which illustrations similar to those used in the program were used. The teacher then presented the children with the programs to work at individually. This is undoubtedly a simple and effective teaching technique which has many possibilities. (see App. 13)

The following study was aimed to compare a common teaching technique - the use of flash cards to teach word recognition - and a group program presented in a similar manner. The Null hypothesis being that there would be no significant difference (5% or below) in the two results.

Two groups, each of twelve words were selected from the 'Language Master List of Common Words'(79). Twenty-four of the most difficult and those most unlikely to be already known to the subjects were chosen. 'A' group (presented on flash cards)
perhaps, perfect, person, perfume
programme, protect, propellor, protest,
discover, disturb, disappear, disgust.
'B' group (presented in the form of a group program)
because, before, begin, behind,
remember, return, refuse, reply,
impatient, impossible, improve, important.

Four trials were given with each word group, eight trials in all. The first three were given during two successive

weeks but the fourth after a lapse of twenty-eight days during which time the school was closed. The subjects were then tested individually. The pre-trial scores were for practical purposes negative in both groups.

The subjects were fourteen children who were all present at the first trial - details of their age, IQ, RA and post-test scores are shown in App. 12

The flash-card trials followed the pattern as follows:-

(1) The card was shown to the group who were invited to read or guess the word.

(2) They were told the word.

(3) The word was explained and put in a context, verbally.

(4) The children were again asked to read it aloud.

No.(3) was sometimes extended by a short verbal dramatisation of the word by the teacher; i.e. with words such as 'disgust' or 'protest' or made personal to the children with words like 'perfume.' A trial would last about fifteen minutes.

The Group Program trials took approximately the same time and the process was as follows:-

The children, sitting in a semi-circle, were each provided with an adaption of the 'Cosford Cube' (80). This is a small cube of wood, each side painted a different colour. The student holds it in his cupped hands concealing the side he exposes to the teacher. Multi-choice question are keyed to the colours. Our cubes were not coloured but numbered, on four sides only, 1, 2, 3, 4 (see app. 13

The program had each frame printed on a separate sheet in a script similar to that of the flash cards; it was presented one frame at a time. The cue stimulus was a sentence with a blank space into which the children had to visually place one of the four words which were placed immediately underneath and itemised 1 2 3 or 4. The teacher then recited the text pointedly omitting the required response word. Without calling out the subjects had to turn the correct side of their cube toward the teacher. The teacher was at once able to see what item each pupil had chosen. If there were more than two or three errors, the teacher would say something like "Look more closely," then he would confirm the correct response and make the pupils repeat it before turning to the next frame.

The text into which the new word had to be fitted

was such that it could easily be read by all the subjects and so constructed, within these limitations, that only the correct word made sense. As only the words in the group were used as choice alternatives, each frame reduced the number of possible answers though I doubt if any children consciously exploited this.

The study, as I expected, did not produce a result significant enough to upset the null hypothesis, though the programming procedure seemed to be somewhat more effective than the flash cards. The comparative mean gains being 8.1 words for the program group of words and 6.7 for the flash card presented group.

An interesting feature of this study was that it is possible in teaching periods totalling two hours in all, to add to the reading knowledge of these slow learning children, an average of 14 new and difficult words. The study was designed to compare the effectiveness of two teaching techniques, one called programmed learning because it was based on behavioural theories and a commonly used technique of the flash card.

Considering the matter in retrospect, it could be said that both tests were based on behavioural theories and the study might be considered a comparison of response modes. Using the terminology of Storulow (85) the programmed test employed a 'prompting' sequence and the method of presenting the flash cards, a 'confirmation sequence.

The study to follow this will consider response modes more closely.

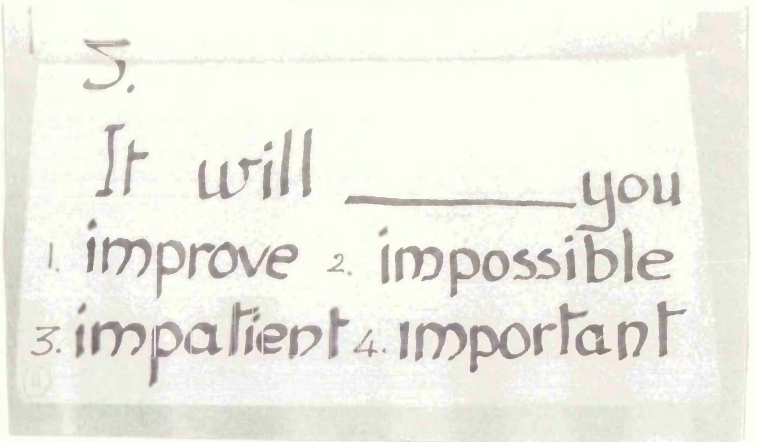
GROUP PROGRAM STUDY

No	Age	I.Q.	R.A.	Scores P	Scores F.C.	Wilcoxon Test Diff
1	11	44	6.3	7	2	+5
2	12.6	59	7.7	11	12	-1
3	12.6	66	6.4	2	4	-2
4	12.3	49	6.4	1	4	-3
5	11.2	54	5.8	2	0	+2
6	12.5	62	7.5	12	12	0
7	11.11	64	7.5	10	9	+1
8	11.2	80	7.8	11	8	+3
9	10.11	59	6.8	8	9	-1
10	13.1	66	6.5	4	3	+1
11	11.4	70	7.8	10	10	0
12	12.0	60	7.4	6	4	+2
13	12.11	81	7.6	12	12	0
14	14.9	72	7.5	8	5	+3

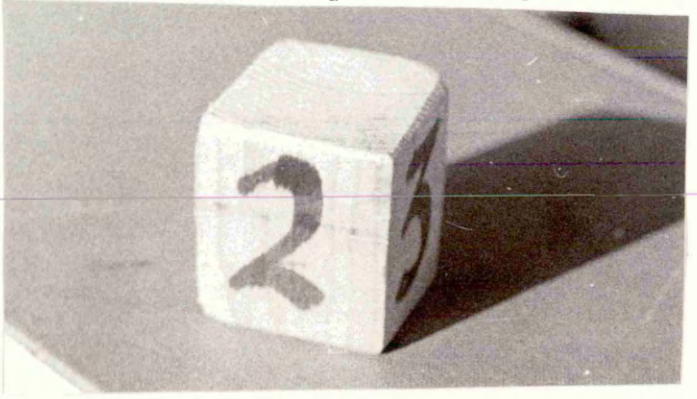
Diff Val	Tally	Rank Val	+Rank	-Rank
1	++--	$2\frac{1}{2}$	5	5
2	++-	6	12	5
3	++-	9	18	9
5	+	11	11	0

Smaller Rank Total (-) 19
Eliminating 6,10 and 13
N = 11.
From the 'R' Table for
Wilcoxon's Signed Rank
Test (69)
When N = 11 and R = 19
P is less than 10%
Therefore the Difference
is not significant.

APPENDIX 13.



A frame from the Group Word Recognition Program.



The adaptation of the Cosford cube.

PICTURE 6. Turkey Oak.

The Turkey Oak, so called because it was introduced into Britain from Turkey about the year 1600, has a long, narrow, leaf with pointed lobes. The lobes are more clearly stepped than those of the Common Oak.

You can say that this foreign oak differs from the Common Oak in its leaf .....

(a) colour (b) stalk

(c) shape) (d)thickness

The above text is recited by the tape recorder at the same time as the illustration is projected on the screen.

After a pause the correct response is announced.

BACKWARD MINING ENTRANTS.

RATE of LEARNING.

This study is based on remedial teaching in reading given to youths accepted by the National Coal Board as trainees. The classes were held in the Mexborough College of Further Education, Mexborough, Yorks.

The pupils were mainly school leavers of fifteen years of age, but a few were older. The total intake each term was approximately 30. Those in need of remedial teaching were selected by means of the Schonell Graded Vocabulary Test, (66) applied by a member of the permanent staff. Later, when I took over the selection myself, I also applied the Schonell Silent Reading Test. (66)

Any pupil with a reading age below 11 (i.e. 4 years backward) was selected for the group. The numbers varied between 6 and 10. Many of these youths, despite their backwardness in this basic subject, would not have been considered in need of special education in the schools they had just left, although C. Burt (67) emphasises that " a child two years retarded in relation to its mental age is backward."

For the purpose of this study, I have selected all those whose reading scores were 10 or lower on the Schonell Tests and who were, so far as reading is concerned, at least five years backward in relation to their chronological age. However, to fall within the limits of this study they must be generally dull, that is to have an I.Q. not higher than 80. All these pupils were submitted to the Group Intelligence Test AH4 by A.W. Heim (68). As will be seen by their recorded scores see(App. 14) , all those included here fall in bottom of Grade C or below and can be said to be 'dull.' Lastly, only those under the age of 16 at the time of selection are included.

All these pupils received ten hours remedial teaching in the course of one term, usually of ten weeks. Two-thirds of this teaching was devoted to programmed learning and examples of this are shown in App. 15. There are two factors that must be considered - firstly, these pupils are just those who the teachers in secondary schools find the most difficult to control and hence teach and those whose records I quote here are the least teachable of this group. Secondly, I knew that if I adopted any of the usual remedial teaching techniques or indeed any methods which suggested that they were inferior to their workmates, I should make little headway and fail completely with some.

With few exceptions their backwardness in reading ability as opposed to their innate dullness was due to the fact that they had done far too little reading, either for pleasure or educationally. I decided, therefor that I must make them read and read purposefully, I had to lift them, if possible, out of what has been described as the 8 - 10 reading plateau.

From the beginning I chose to use P.L. as a remedial measure; presented in various ways, but in the main through book programs. At different times I have used the Oldborough Teaching Machine and the Pressey type of punchboard (see app. 6.) More recently I have used the Stillitron Teaching Machine with commercial multi-choice programs. (see app. 15)

From the beginning I realised that I should have to write special programs. Programs, the content of which would interest them and which would have a vocabulary that would just stretch, but not over-stretch their reading ability. The content of my first program was based on a simple pamphlet supposed to be issued to each mining entrant but which, from the nature of its presentation, I was certain that even if they had received a copy they would have been unlikely to have read it. The pamphlet gave a brief history of the mining area in which they were to be employed and described its organisation. This program was worked through concientiously by at least two groups and I followed it with a short linear program on a mining tool, the 'Single Acting Lifting Jack.' (see app. 15 .)

The problem in writing these programs and others which followed, was first finding words to replace the technical language in which the original matter was written and then, having used in the early frames a word they could read, later changing it back into the technical expression. However, linear programming is an excellent medium for effecting such changes in verbal concepts. For example, in a program on the motor-cycle one can talk about squeezing the petrol mixture in the cylinder head in the early frames and then later alter it to 'compressing' by associative changes.

All these programs were short (20 - 30 frames) and were intended to be completed in 30 - 45 minutes, but I found that with these slow learners, as I had earlier found with ESN children at Milton (1) , that the best results were obtained if the pupil wrote the full text of each frame adding the constructive response demand, or multichoice selection. One has to lead these pupils into learning situations, they will not seek them themselves.

To get the maximum learning effort out of these pupils in ten hours of study necessitated considerable variation of pace and content in the ten sessions. They consisted of five half-hour sessions and five one and a half hour, ten in all. The half-hour sessions I confined to straigh programmed learning. I employed the Stillitron machine in these sessions with various commercial programs. The longer session is too long for continued programming so I usually divided it into three parts: forty-fiv minutes alloted to working at linear programs on such subjects as motor-cycle and car mechanism, motor-cycle maintenance, car driving, road signs and traffic acts etc., (see app. 15) This was followed with a taped recording of a novel such as "Treasure Island," (abridged and simplified,) the pupils following the text and having to respond to spelling questions in writing - a kind of group-paced program. The final half-hour was devoted to play reading in which I ensured by choice of play and direction of the reading, that each pupil read a suitable part. This was the only unprogrammed work.

In selecting the subjects for this study I have chosen from the 150 or so who have been subjected to this programmed remedial system over the period from January 1967 - December 1970, only those whose AH4 test (68) clearly indicated that they fell within my terms of reference; i.e. their scores fell at the bottom of the middle 40% or lower, indicating that their I.Qs were below 80. The chronological ages were all between 15 and 16. There were a further 20 who might well have been included on the grounds that being at least five years backward in reading ability they were probably in the I.Q. range of my study but in these cases no intelligence scores were available and for this reason they were omitted.

The Null hypothesis for this study is that the rate of increase in reading ability during the period they received programmed instruction will not exceed the expected rate of increase derived from their average rate of increase prior to the application of programmed instruction.

The Wilcoxon Signed Ranks Test (1945) is here applied to the resulting figures. This test is used because, to quote Russell Langley: " The test depends on the fact that there is no significant differences between two sets of period measurements, any chance differences which are present ought to consist of about equal numbers of plus and minus differences. But this takes into account not only the direction of the differences but also the size of differences between matched pairs and this feature increases the sensitivity of the test to a point where it compares very favourably indeed with the more complicated 't' test."

The test is applied to two aspects of the study; gain as measured on the Schonell Graded Vocabulary Test and on the Schonell

The smaller Rank total 'R' in both the Graded Word Reading and the comprehension test is (-) 3: therefore we find from the 'R' table (69) that when N = 18, a value of R = 3 the probability of these results occuring by chance is less than 2 in 1000 or P is less than 0.2% and therefore a 'null' hypothesis is not sustained.

It could be said that a similar result might have been achieved through the medium of normal remedial teaching, and it must be accepted that this is possible but, whereas remedial teaching requires a special class arrangement and considerable teacher time per pupil, P.L. can be applied to individuals in a normal class situation or to whole classes without special class arrangements.

The significant feature of this study is that in a few hours of study spread sparsely over ten weeks, youths who had no "apparent" desire to improve their reading and, indeed, often appeared to resist any learning, could make such rapid improvement. It confirms the more refined research of Storulow(49) and others that with a proper approach to teaching method the gap of attainment between slow learners and high grade students can be significantly narrowed.

RATE OF LEARNING

READING STUDY WITH MINING ENTRANTS 1967 - 1970

No	AH4 Score	Schonell Graded Word Reading Test Scores & Gains: Before Instruction	After Instruction	Gain in 3 months	Expected gain in 3 months.
1	34	8.2	9.4	+12	1.4
2	28.	8.7	8.4	- 3	1.5
3	27	9.7	10.3	+ 6	1.6
4	25	9.8	10.3	+ 5	1.6
5	16	9.3	10.4	+ 5	1.6
6	29	7.2	9.1	+19	1.2
7	37	8.0	8.5	+ 5	1.4
8	36	9.0	10.1	+11	1.5
9	25	7.8	10.1	+23	1.3
10	32	9.7	10.4	+ 7	1.6
11	26	9.7	9.9	+ 2	1.6
12	30	9.8	10.1	+ 3	1.6
13	32	8.0	9.2	+12	1.4
14	30	8.4	9.6	+12	1.4
15	20	9.6	10.4	+ 8	1.6
16	28	10.	11.7	+17	1.7
17	43	8.7	9.6	+ 9	1.5
18	42	9.1	9.6	+ 5	1.4

Wilcoxon's Signed Rank Test for Significance.

Differences	Difference Values	Tally	Rank Values	+ Rank	- Rank
12.6	.4	+	1	1	
-1.5	1.4	+	2	2	
4.4	1.5	-	3		3
3.4	3.4	+	4	4	
9.5	3.6	++	5½	11	
17.8	4.4	+	7	7	
3.6	5.4	+	8	8	
9.5	6.4	+	9	9	
21.7	7.5	+	10	10	
5.4	9.5	++	11½	21	
.4	10.6	++	13½	27	
1.4	12.6	+	15	15	
10.6	15.3	+	16	16	
10.6	17.8	+	17	17	
6.4	21.7	+	18	18	
15.3					
7.5			Total	167	3
3.6					

The smaller rank total is (-) 3.

From the 'R' table of the test (69):

When N=18 and R=3 P is less than .02%

(1) The Norm for the AH4 Test is 47.17 and the S.D. is 19.37

(2) The Reading age is shown in years and tenths of a year.

(3) Actual gains in three months is shown in tenths of a year.

(4) The expected gain in three months, based on previous rate of learning gain, is shown in tenths of a year to one decimal point.

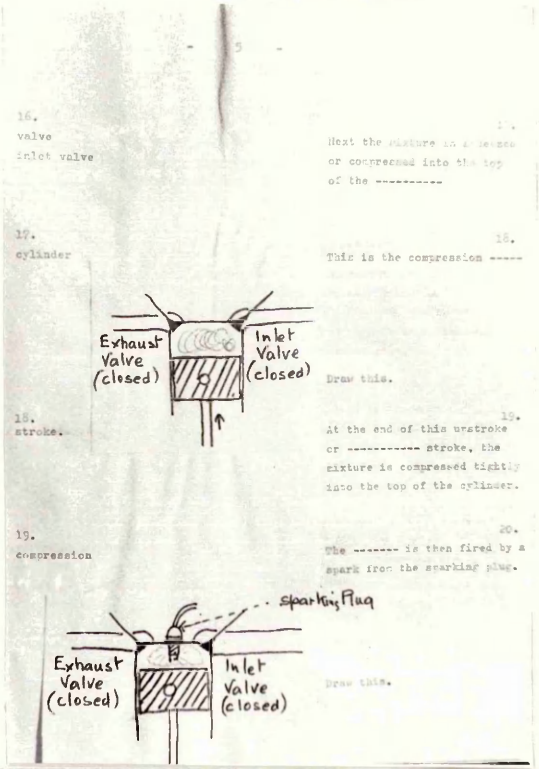
RATE OF LEARNING.

READING STUDY WITH MINING ENTRANTS 1967 - 1970

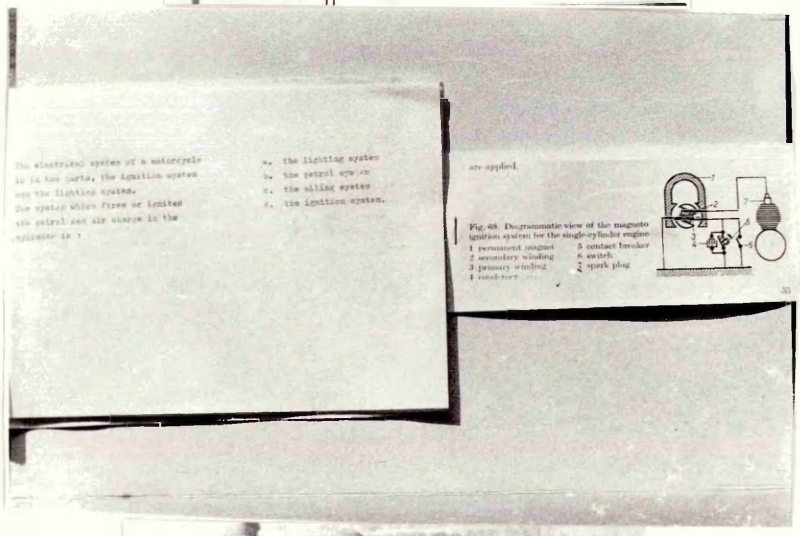
No	Score on A.H.4. Test	Schonell Silent Reading Test 'B' R.A. Before P Instruction	R.A. After P Instruction	Gains in 3 months.	Expected gains in 3 months	Wilcoxon's Signed Rank Test for significence: Differences	Difference Values	Tally	Rank Values	+ Rank	- Rank
1	34	8.0	8.9	+ 9	1.4	+ 7.6	.4	+	1	1	
2	28	8.3	8.5	+ 2	1.5	+ .5	.5	+	2	2	
3	27	7.11	9.4	+17	1.6	+15.4	3.4	-	3		3
4	25	8.11	10.8	+21	1.6	+19.4	4.4	+	4	4	
5	16	8.5	10.6	+25	1.5	+23.5	4.7	+	5	5	
6	29	8.2	9.10	+20	1.2	+18.8	5.4	+	6	6	
7	37	7.7	8.9	+14	1.4	+12.6	6.6	+	7	7	
8	36	8.4	9.4	+12	1.5	+10.5	7.6	+	8	8	
9	25	7.10	8.4	+ 6	1.3	+ 4.7	8.6	+	9	9	
10	32	7.10	9.4	+ 6	1.6	+ 4	9.6	++	10½	21	
11	26	8.2	7.9	- 5	1.6	- 3.4	10.5	+	12	12	
12	26	10.10	11.0	+ 2	1.6	+ .4	12.3	+	13	13	
13	32	8.5	9.3	+10	1.4	+ 8.6	12.6	+	14	14	
14	30	7.10	8.9	+11	1.4	+ 9.6	15.4	+	15	15	
15	20	8.7	9.2	+ 7	1.6	+ 5.4	18.8	+	16	16	
16	28	8.11	10.1	+14	1.7	+12.3	19.4	+	17	17	
17	43	9.1	10.0	+11	1.4	+ 9.6	23.5	+	18	18	
18	42	9.10	10.6	+ 8	1.4	+ 6.6					
							Totals			168	3

The smaller rank total is (-) 3
From the 'R' table of the test (69)
When 'N' = 18 and R = 3 then
P is less than .02%

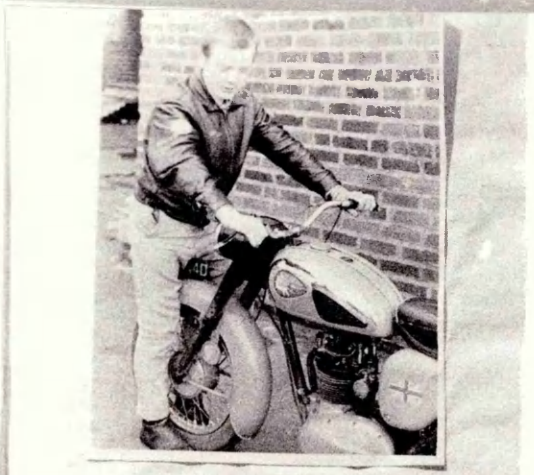
APPENDIX 15.



Four frames from the (four stroke) Motor Cycle Program.
The confirmation is below the stimulus and on the left.



The Motor Cycle Ignition (dynamo) Program.
The Diagram is on a fold out and is visible all the time.



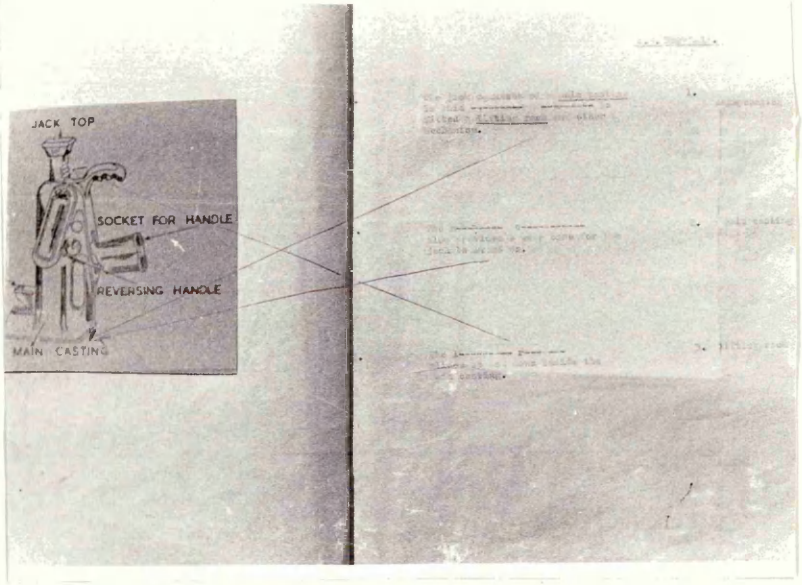
The Check your Motor Cycle Program. The confirmation is on the reverse of the page.

a Examining the brake or clutch cable for wear and fraying.

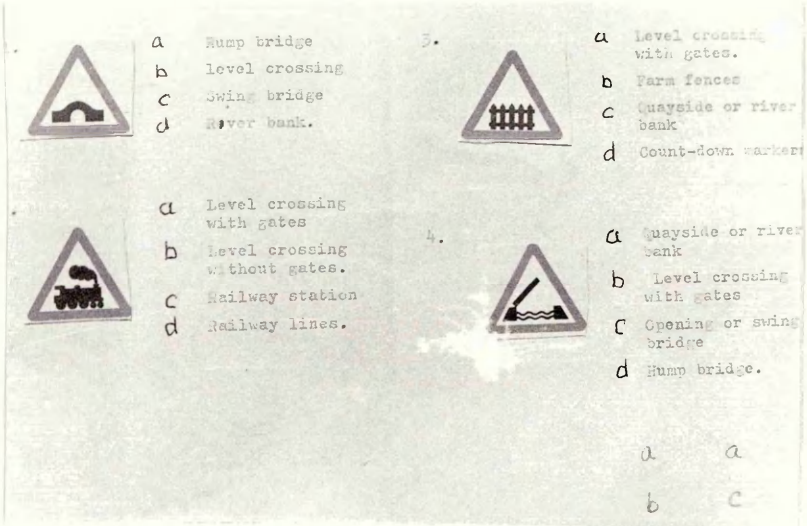
b Squeezing the wheel spokes to make sure that they have not become loose.

c Checking that the headlamp is not loose in its mounting.

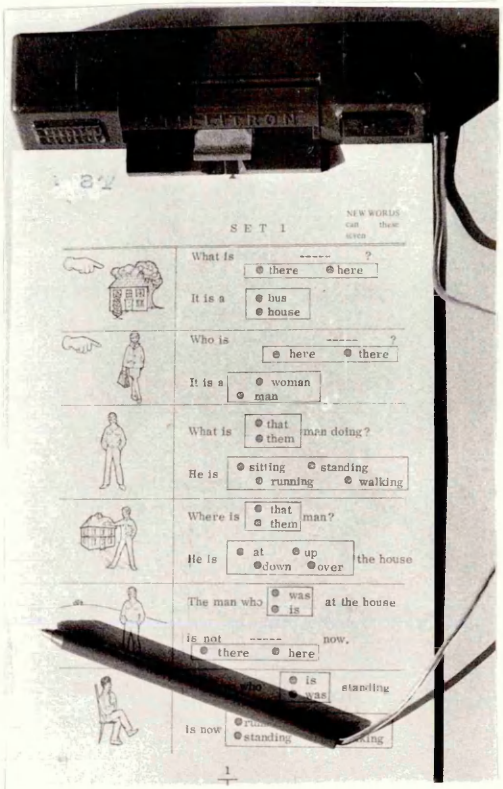
d Holding the wheel straight with the knees and feeling for looseness in the steering.



The Single Acting Lifting Jack Program



The Multi-choice Road Sign Program.
This is only a program in the sense that it employs the behav oural S R-R sequence in each frame.



The Stillitron Machine.
The studentent places the stylus on the selected response spot. He gets a green light if he is correct and a red one if he is wrong.
The Program is an elementary reading program.

A SPELLING EXPERIMENT.

(Multi-choice material Vs a common teaching technique.)

The following experiment was an attempt to find out if simple multi-choice teaching programs were more effective than a normal teaching techniq that of telling a pupil to study a word list with a view to improving his spelling of the words.

The multi-choice programs used were of a type that a teacher could easily prepare and which were in use daily, both in book form and machine presented, at Milton school. The students employed as subjects in the experiment were, as part of their remedial studies, using an abridged and simplified version of R.L. Stevenson's "Treasure Island." The words used in the test were taken from the book..

Procedure: The subjects were three groups each of five dull and backward mining entrants, i.e. they all returned scores in the lower end of the third quartile or the fourth quartile of the AH4 Intelligence Test (68) and all produced reading scores on the Schonell Graded Vocabulary Test and the Silent B Test (66) at least five years below their chronological age.

The material employed was two lists, each of thirty-three words, selected from an abridged and simplified version of "Treasure Island." They are referred to as 'A' and 'B' lists. Each group was given a spelling test and the scores recorded under A and B.

The teaching material was prepared as follows:-
The two sets of words on cards 5" X 8", and the two sets of programs, four line choice with a puzzle stimulus (see app. 17) and confirmation on the reverse of the page.

The subjects were divided into 'A' group, nine subjects and 'B' group 8 subjects. However, as only 12 completed all the trials and were present at the final test, only these are considered. There were 8 from the 'A' group and 4 from the 'B' group. This number is further reduced by one from the 'A' group whose scores both pre and post-test were equal and therefore cancelled each other out for the purposes of the Wilcoxon Signed Ranks Test.

The subjects completed six trials, (each lasting 15 minutes) during three sessions each of 30 minutes. At each session the 'A' group spent

15 minutes working with the 'A' Multi-choice word series and 15 minutes with the 'B' list on cards. The 'B' group using the 'B' Multichoice word series and the 'A' list on cards.

When using the Multi-choice series they wrote the selected word and checked its correctness. When using a card list they either copied the words, at the first trial, copied or put the word into phrases or sentences in the second trial, and in the third trial, after looking at the words, turned the card over and attempted to write them. In all trials they were permitted to just copy out the word list on the cards if they so preferred. In other words, when studying the card lists they employed the sort of methods that one might expect a student to use, working on his own, in the course of such study.

Discussion. As can be seen the test was inconclusive. Although the total words gained in the confirmed series were nearly double those in the unconfirmed series, nevertheless when statistically examined ('p') is greater than 10% and, therefore, the null hypothesis cannot be rejected.

This inconclusive result can have arisen from a variety of causes, probably the sample was too small, especially as it was reduced by three due to absence and a fourth was eliminated because of equal scores. Further, the number of trials may have been insufficient, but this in turn was due to some extent to the nature of the material. The multi-choice material had sufficient inbuilt motivation for the subjects to have repeated the trials several times more, but their application to the cards was falling off visibly at the third trial.

The built-in motivation is a very marked factor and is found in most programs designed for, and used with slow learners. for the sake of the experiment it might have been worth while to continue until the subjects achieved much higher scores, but this would have nullified the equal time factor between the programs and the cards. Furthermore, in a practical teaching situation the student must be constantly considered and further time allotted to the study of the cards would not only have been ineffective but, so far as the students were concerned, wasted.

This is only one of the problems of experimenting in the classroom and I hope to discuss at some length later.

S P E L L I N G E X P E R I M E N T.

		Pre-Test Scores. A list	Pre-Test Scores. B list	Post Test Scores A list	Post Test Scores B list	Gains M/C A	Gains M/C B	Gains Cards A	Gains Cards B	Combined Gains M/c	Combined Gains Cards	Difference
A	1	10	10	11	11							
B	2	2	4	6	9		5	4		5	4	1
A	3	4	8	11	6	7			-2	7	-2	9
A	4	0	1	1	0		1	0		1	0	1
B	5	0	0	3	4	3			4	3	4	-1
A	6	16	14	20	23		9	4		9	4	5
B	7	3	1	8	7	5			6	5	6	-1
A	8	4	8	26	11	22			3	22	3	19
A	9	6	11	17	14	11			3	11	3	8
A	10	8	10	21	17		7	13		7	13	-6
B	11	0	0	0	6	0			6	0	6	-6
A	12	1	0	6	4	5			4	5	4	1

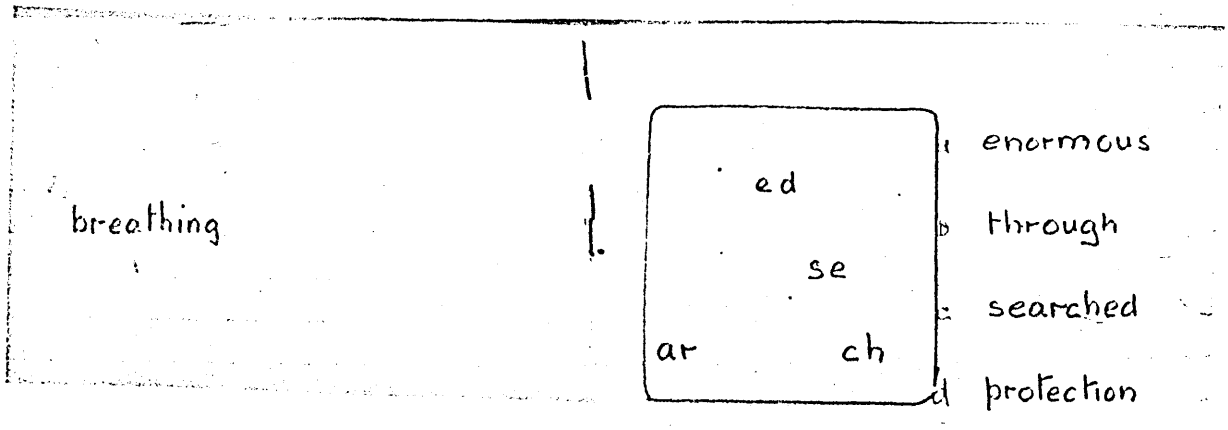
WILCOXON'S SIGNED RANKS TEST.

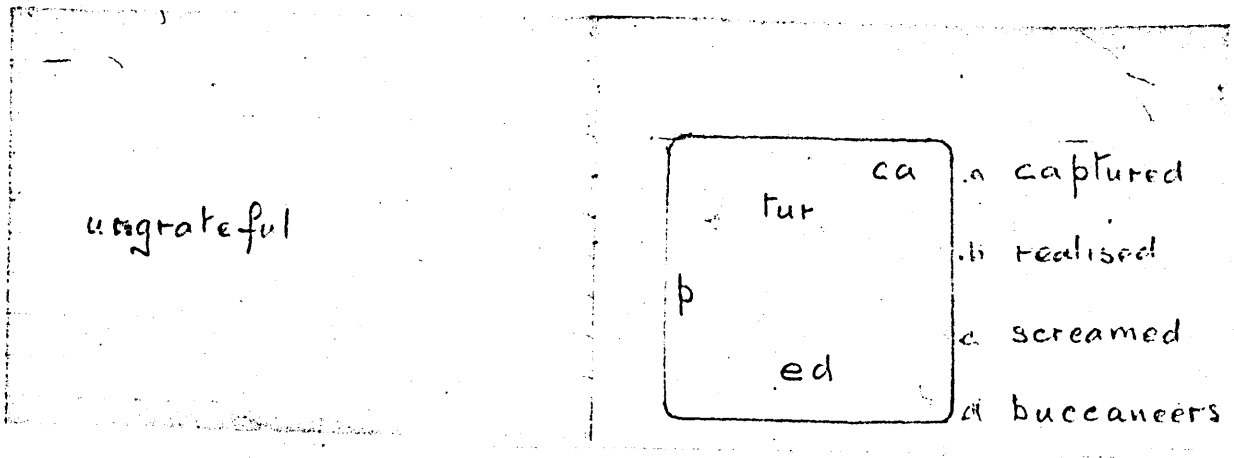
Diff. values	Tally	Rank values	+R	-R
1	+++--	1 to 5=3	9	6
5	+	6	6	
6	--	7 8=$7\frac{1}{2}$		15
8	+	9	9	
9	+	10	10	
19	+	11	11	

Smaller rank total = 21
N = 11 and R = 21
From the R. Table 'P' is greater than 10%

APPENDIX 17.

Spelling Experiment.





Spelling Program Pages.

(The confirming part on the left-hand page refers to the previous page or frame.)

Response Modes. (Study with retarded Mining Entrants)

I have already discussed at some length the problem of overt vs covert responding, or more accurately stated covert and overt vs covert responding. There is, however, another aspect of the matter which has concerned me in my work of endeavouring to raise the literacy of retarded mining entrants. Over a number of years I have employed programmed material to remedy a common cause of this retardation in practically all of these students; the fact that in the course of their secondary education they have just not done sufficient reading, they have not been led, encouraged, or just made to do enough regular reading to become literate even when their basic reading skill was little below average. The inbuilt motivation of suitable programs, I have found, is particularly effective in leading them into attentive states of reading for substantial periods.

A particular program which I introduced first in 1969 was a short 31frame linear type program with a 10 question criterion test on the Otto-cycle, exemplified in a single cylinder motor-cycle engine (see app. 15) Because my primary purpose was to raise their basic standards of literacy rather than teach them the fundamentals of the Otto-cycle, I insisted that each frame was written in full.

In considering whether this extended overt response was more effective than a relatively cursory response of just filling in the blanks, in the Skinner fashion, I realised that my past records would provide a base to examine this feature, though only insofar as the criterion objective was concerned.

Therefore, when setting my most recent group of 15 students to work on the program, I instructed them to respond

by only completing the blanks in the program.

The null hypothesis of this test was that I should find no significant difference in the criterion scores made by those completing the frames in full and those who only completed the blanks.

The method.

All students on completing the program were subjected to the criterion test. Each student had unlimited time to complete the test and program. The six hours available were more than sufficient to enable the slowest to complete the program. The parent group who wrote the text in full, usually took from two to four hours, the sample group seldom took more than two hours and sometimes as little as one hour.

The subjects were:-

the parent group, 26 retarded mining entrant who attended my remedial class during the period April 1969 to Sept. 1970 and who completed the program and tests.

The sample group were 14 retarded mining entrants who attended my remedial classes between October 1971 and February 1972 and who completed the program and tests.

The material: an unpublished 31 frame linear book program titled "The Four-stroke Motor-cycle Engine."

Results.

The mean score of the parent group was 6.3 with a standard deviation of 11.25.

The mean score of the sample group was 5.5 with a standard deviation of 15.33.

On the face of it the method of writing the text in full seems somewhat more effective than that of filling in the blanks. However, submitting the results to the 't' test, where N =14 and T = 19, 'p' is 10% and the result is not significant, therefore null hypothesis is not disproved.

Discussion.

Though the slight advantage gained by writing the text of the constructive responses in full, is not significant; nevertheless, this repeated exercise by the students, of writing the responses, must prove a valuable experience to them when they are called upon to create and write their own responses to questions in the written examinations, to which they have to submit themselves during their short course of studies.

I have frequently noticed, as have other teachers at Mexborough College of Further Education, that students who are accustomed to using programs, subsequently show marked improvement in their ability to write readable and reasonably grammatical answers to papers on technical subjects.

CONCLUDING DISSERTATION

On the application of the findings of behavioural science research to educational practice, Skinner in 1954 said, "From this exciting prospect of an advancing science of learning, it is a great shock to turn to that branch of technology which is most concerned with the learning process - education." He went on to consider the inefficiency of teaching elementary mathematics in schools. His words are as pertinent today as they were nearly two decades ago.

Here I have been concerned only with a limited section of education, the teaching of reading to slow-learning children but here, as in the teaching of mathematics to all children in all schools, the inefficiency is clearly demonstrated and it is my opinion that automated teaching can go a significant way towards remedying this inefficiency.

Among the wide range of objectives which are put forward from time to time as the intended outcome of our educational system, the ability to read and write ones own language is fundamental, indeed it is the foundation of most of the others and, if our system fails an educable child in this, for that child the whole system falls to the ground. That it does fail for the purposes of further education for something like one child in ten, there is no doubt.

The task of the school in the teaching of reading is the imparting of verbal responses. To achieve a minimum standard of literacy a child must acquire a vast number of these responses. They begin with relatively simple responses to objects

but later to pictures and then to printed and written words. By the time that the average child begins formal school he is already responding with varying degrees of accuracy to a considerable volume of educational stimuli. At this point the teacher takes over and using various 'contingencies of re-inforcement' starts the child's climb to literacy. If the child is to reach a satisfactory standard it must learn daily, a considerable number of these increasingly intricate responses. According to Skinner (34) for a child to achieve a modest mathematical standard in the first four years of school, the teacher must arrange at least 25,000 contingencies of re-inforcement. To reach a reading age of nine years I would estimate that an even greater number of such contingencies must be provided. Divide this by the number of hours the child is expected to spend on the subject and multiply it by the number of children in the class and the resulting task of preparing the contingencies is an impossible one for the teacher. In consequence of this most teaching is done collectively and most learning is done with little individual help from the teacher, although individual help is essential.

I have described some of the many basic teaching methods and also some remedial techniques but of themselves they do not solve the problem of the failure to learn to read by children in the infant school or remedy it later. These methods can only be fully successful if they are applied daily, for substantial periods of time on something approaching a one teacher to one child basis. Until a drastic change is made, the bright children will continue to learn with ease, those in the middle quantiles will learn with considerable effort and the dull ones will go on failing. It is clear

that we shall not substantially reduce these failures until something near to an individual teaching system is provided and this I feel can only be done by employing automated teaching techniques.

All parents use direct re-inforcement to establish required behaviour in their children, reinforcements such as money and sweets. Teachers occasionally use such reinforcements with young children but mainly rely on secondary reinforcers available within the educational system - but these reinforcers are used haphazardly to such an extent that they are, for the majority, too few and too widely separated in time to be effective.

Direct re-inforcement to teach the skills of reading were experimentally studied by Staats and Butterfield (107) "with a 14-year old Mexican American delinquent boy who had a long history of school failure and misbehaviour. He had a 2.0 grade reading achievement level. He was given 40 hours of reading training which extended over a four and a half month period. Science Research Association reading materials were adapted for use with a token re-inforcement system. The boy exchanged tokens for such things as 'beatle shoes' and ice-cream. The total amount he received was 20 dollars 31 for which he made 64,307 responses.....he learned and retained 230 words, his reading achievement was raised to the 4.3 grade level. His school misbehaviour was eliminated."

The Devereux Schools (108) in the suburbs of Philadelphia used a similar re-inforcing technique but on a much larger scale: " a double reward system has been worked out. If the student does well in the classroom, he is given a monetary allowance, which is controlled by the teachers ratings. In addition the home staff give citizenship grades based on the students behaviour during meals..... If a student gets an 'A' in this area for a week he is allowed to go off the campus to a small town within walking distance. Alternatively if he fails he can lose either or both of his privileges ."

Smith (108) claims that " an involved re-inforcement schedule is in operation resembling the features of Ferster and Skinners term 'concurrent schedules.' This claim seems to me like that of teachers who, when first introduced to 'programmed instruction' say, "We have been employing these methods for years."

While the Devereux Schools do make considerable use of teaching machines and programmed material, to claim that the re-inforcement techniques described above are controlled reinforcement schedules as advocated by Skinner, is ridiculous. They merely strengthen the normal reinforcements available to teachers and only by some token system directly related to specific learning responses could the method be described as a 'reinforcement schedule.'

This practice at the Devereux Schools highlights the negative and avoidance aspects of reinforcing. In the Milton school we tried to stress the rewarding, pleasant aspects of reinforcement and to play down the avoidance which is a necessary part of any schedule. Sc far as we were able, we physically segregated the programmed instruction from the remainder of the school activities. It took place at fixed unalterable times, in one specific school area (a wing of the school hall) and it was strictly limited in time. All the programs were prepared in the school and in such a way that failure was minimised. We aimed to create a time and place of quiet, continually rewarded study with no aversive aspects or need for avoidance behaviour. We succeeded to a large extent, I believe, because of the inbuilt motivation of the programs. Providing the rules which I outlined in the introduction were obeyed, and this was generally so over about five years in which the scheme was in operation, our aim was achieved to a quite remarkable extent.

This study covers a period of ten years of teaching, experimenting and researching. It reaches back nearly thirty years to my first tentative experience of testing and teaching ESN children.

Its culmination leads me to assert that automated self-instruction, more commonly called programmed instruction, is the best technique yet devised to teach these children to read.

I have, at considerable length and in some detail, explained the 'how' of this effective method, extracting much evidence from reported research and my own extended experiments, if I have omitted much of the 'why' it is because much further research is needed, particularly in the field of program variables.

In the classroom where programmed learning is put into practice, the slow learning child is released from the confinement of the usual class lesson. This has two significant features, firstly the teacher is in a position to give attention to the individual problem of any one child without holding up the learning processes of the remainder of the class. He is enabled to make those intellectual and emotional contacts with his pupils, contacts discussed at great length by lecturers and in educational seminars but which, because of the constricting nature of class-lessons, are seldom effectively made. Secondly, it is possible for all the pupils in the class, without exception, to maintain steady learning progress at their own speeds, irrespective of the others or the teacher. This learning process is maintained because the technique ensures success, and repeatedly indicates this to the pupil who, usually where P.L. is not used, is only aware of failure. The technique enables the teacher to doubly re-inforce this achievement by adding his praise to individuals. Instead of standing before

the class, striving to hold the attention of them all by eloquence, demonstration or use of audio-visual teaching aids applied collectively, the teacher can relax and move from pupil to pupil while the most intensive form of study goes on effectively around him. The interaction between the program, book or machine presented, and the pupil keeps the latter actively engaged.

Automated self teaching is not a form of rote learning, though it does employ repetition. McV. Hunt (29) evidencing Kaufman and Peterson asserts that retarded children (I.Q. 50 - 75) require more blocks of problems to reach a criterion of perfection in learning sets than do normal children. In a well prepared program concepts can be presented with the necessary frequency without provoking boredom. Indeed, the intelligent programmer of material for slow learners can prepare repetitive drills in such a manner as to evoke enthusiastic application by the employment of re-inforcing contingencies.

The scope of possibilities for the use of P.L. in remedial teaching is unlimited. It maximises every pupils' exposure to the remedial subject matter without physically and psychologically exhausting the teacher. The teacher, instead of becoming tired and tense is able to be encouraging and optimistic. The pupils' reaction to this is raised confidence and his more amenable re-action toward school and learning generally.

A great deal of public educational discussion is currently being given to school discipline. A good program creates a discipline of its own - it leads to disciplined study. This can prove a pleasant and enjoyable experience for slow learning children who are prone to resist study as a painful experience. They often express this resistance by unacceptable behaviour. P.L. of a

suitable nature, correctly applied, does reverse the chain of behaviour, it establishes discipline in the class-room which is reflected in general behaviour.

The project approach to the education of the below average and the slow learner, so often advocated to-day, is an unorganised process of learning, it presents too many problems at once for a group of these children to resolve; social problems of who shall lead, management problems of what comes first, administrative problems of who does what, and with what and so on. I have often been critical of teachers who demand creative work without ensuring that the pupils have the necessary materials with which to create, but I think the usual approach to project work with slow learners is even more deserving of criticism. However, suitable programs can provide guides to the organisational procedures so necessary in project work. The step by step method of the linear program can prepare the pupil to resolve the project problems at a later stage.

An excellent quality inherent in a program, suitable for a particular pupil, is its ability to re-activate that pupil daily into an attentive learning mode. This is to a considerable extent dependent upon the correct employment of the program by strictly limiting the length of time the pupil is allowed to work at it. For the type of verbal study which the learning of reading entails, I suggest thirty-five minutes as a maximum. This ensure two things; the pupil leaves the study whilst still enjoying it and thus retains a pleasant recollection, and he leaves off before the build-up of resistance to learning reverses the effects of the study.

What are the arguments against programmed learning?

I do not propose to deal with naive criticisims such as that it will replace teachers, but Norberd (126) in an essay on programmed teaching itemises six disadvantages most of which have little bearing on its employment in teaching slow learners the elementary aspects of reading. However, the sixth disadvantage he puts forward is that the metaphysical presence of the teacher is lost. I presume by metaphysical presence he means all that transpires in the interaction between pupil and teacher, if so then surely the individual relationships that the teacher can develop with pupils during self-instruction periods will be stronger and more lasting than the remote contacts he may or may not make during class-teaching sessions?

I have said that my position with regard to programming method is eclectic, but on the matter of creating programs I would support Deterline (129) who said:

"Programming is largely a 'trial and error' process (though it sounds much more impressive to call it an 'empirical' process) and even the most technological programming process requires so much programmer judgement, intuitive design, creative writing ability and flexibility, (all of which can be described in behavioural terms) that one should wince whenever programming is described as having already established scientific procedures."

The employment of the matrix and flow chart do lend a superficial scientific aspect to program creating but when one gets down to the hard grind of writing the most simple programs, such techniques do no more than provide frames and props to support judgement, design and creative ability.

The scientific foundation, such as it is, must

be provided by the research activities of educational psychologists in their laboratories. The teacher, experimenting in the classroom, must be aware of these theories and employ them as best he may in the medium of his own teaching techniques. He need not fear, however, that he will have to discard the pedagogical theories and expertise he has acquired. Consider Herbart's theory of apperception as outlined by Bigge: (122)

"right thinking will produce right action; volition or willing has its roots in thought. If a teacher builds up the right sequence of ideas, the right conduct follows."

How better can a teacher ensure the right sequence of ideas than through a program, it will not be subject to the hazards of the classroom as class presentation would be.

Or consider the five steps of Herbartian learning: preparation; presentation; comparison; association and abstraction; generalisation; and application. These could provide as efficient a frame or prop for program writing as the matrix and flow chart, or better still in conjunction with them.

Kenneth Richmond (61) in an attitude of 'faint praise' says:

"When all is said and done the way a pupil feels is a vital factor in the learning process. If he senses he is being fobbed off with a second best instrument, a makeshift (and let us face it, the best of programmed texts is a poor substitute for the personal influence of a teacher) his response is certain to be half-hearted."

Such a statement shows, to my mind, a failure to grasp just what a program is. It is not a substitute for a teacher anymore than a textbook is such a substitute. One does not suggest

that telling a pupil to read certain pages of a book is giving him a second-best instrument or fobbing him off with a makeshift.

The program, at its best, (one prepared by the teacher himself) is the most individual form of teaching over an extended period, any pupil is likely to get. The commercial program, while not conveying that personal interaction that the teacher's program can provide, nevertheless still gives individual tuition and a better possibility of personal attention from the teacher than any class lesson can offer.

This study has three aspects: firstly, to demonstrate that for slow learners P.L. is an effective way to teach them to read, particularly the beginnings of reading. This I feel that I have done through the results of my own research and by presenting considerable supporting evidence from other sources.

Secondly, to define the programs, programming techniques and material I have employed to effect my results. Thirdly, to make some effort to ascertain the most effective forms of program, both in general sense; such as whether they should be linear or intrinsic; their presentation, should it be book or machine; and, in the particular whether they should employ multi-choice or constructed responses and the intra-frame construction generally.

This is a considerable subject and little research has been done concerning it. It is, however, only secondary or incidental to the main purpose of this study and I have only dealt with it tentatively. This, together with experience gained in the general study has led to some indications regarding the best form of programming for teaching reading to slow learners.

On the nature of the program, these are that they should be short in length i.e. (completion of a set should not exceed thirty-five minutes in time). The frames themselves should be compact and short, and the response demand probably multi-choice. In the early stages every frame should be individually illustrated. Where illustration is difficult or impossible then arrangements must be made for resorting to the teacher - this must be built into the program, not left to a casual instruction such as " ask me if you do not understand anything." In the early programs it is best that they should have one frame to a page with the confirmation on the reverse. So far as prompting Vs confirming intra-item sequencing is concerned, for slow learning pupils, prompting is an essential factor. The prompting should increase inversely in relation to the pupils educational limitations and the gradation of the steps slowed down accordingly. The limit of this is exemplified by Sidman & Stoddard (127) . In their successful programming experiment with a micro-cephalic idiot they created a form of almost 'errorless learning'. This and the work of Hively (103) suggest the most promising directions for further practical research into this field that of the teaching of reading to slow learning children.

Finally, my purpose in researching and writing this thesis was to attempt to establish authoritatively that P.L. or what Lumsdaine and Klaus (128) titled "Auto-instructional Methods" and defined as:"instruction characterised by the controlled presentation of material, the elicitation of appropriate response, guidance with respect to the subject matter and control of the way in which the learning proceeds:" could more effectively teach

reading to slow learning pupils than those techniques currently practiced by the majority of teachers working in this field of education.

The thesis consists of five comparative studies and three studies of programming variables. Of the five comparative studies, three, the original study at Milton and the Mining Trainees study and the final study at Rossington are all concerned with speed of learning. The results of all these are statistically significant and the statistical results in the appendices establish my thesis.

The statistical measures used have been kept to a minimum. For the first study the student 't' test is employed and for the other two, Wilcoxons Signed Ranks Test.

In presenting statistical evidence I have kept in mind Lumsdaine's comment:(81)

"A weakness of the statistical habits associated with the before-after and gain experiments is that statistical tests are addressed to hypothesis testing rather than to estimation. It is true that in determining the effect of a program, one wants to rule out the null hypothesis that observed gains can be dismissed as chance differences: i.e. one wants to show that the effects produced are statistically reliable. However what is obviously of more interest is a good estimate of the size of the gain merely showing reliable evidence for some gain can be trivial."

In all three of these studies, the gains are substantial and I have, in two of the three cases, graphically illustrated this - the estimations are by no means trivial.

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