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AN INVESTIGATION
INTO
THE MENTAL ABILITIES
OF THE CHILDREN
OF TRINIDAD

by

B. J. Bedell

Thesis presented for the degree of Ph.D.

University of Edinburgh

November 1950

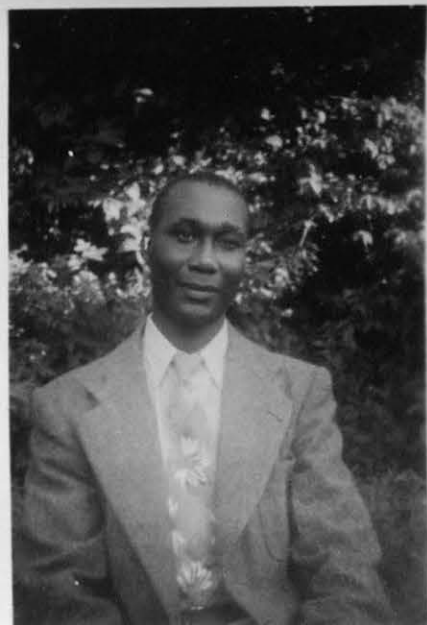


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A C K N O W L E D G E M E N T S

I wish to express my gratitude to Sir Godfrey H. Thomson, without whose encouragement and stimulus this research could not have been attempted; to Mr. A.P. Murrell, my senior assistant, whose photograph is given at the bottom of this page, for his invaluable help in all aspects of the work, his zeal and industry; to Mr. H. George, my second assistant whose likeness is depicted in one of the illustrations to Test 11, though it must be admitted that his complexion is not so dark and he does not smoke; to J. T. Placide, a very keen office boy, good at supervising the tests and a good typist; to The Education Department of Trinidad for allowing me to conduct the tests in the schools, and especially to Mr. I. M. Hopkins, the Assistant Director of Education, who has shown a genuine interest in the tests and who has given me helpful advice; to Messrs. R. Garner of the ^FFinancial Secretary's Office and J. Clarke of the Accountant General's Office who made financial matters easy for me; to Mr. R. M. Hamer, Principal of Queen's Royal College, who allowed me to test the boys of his school, and to the staff who co-operated; to Mr. Busby, the Superintendent of Crown Lands, who allowed his Printing Office to print the Picture Tests; and to Mrs. E. R. Pashley, a local artist, for helping with the drawings of Test 11.



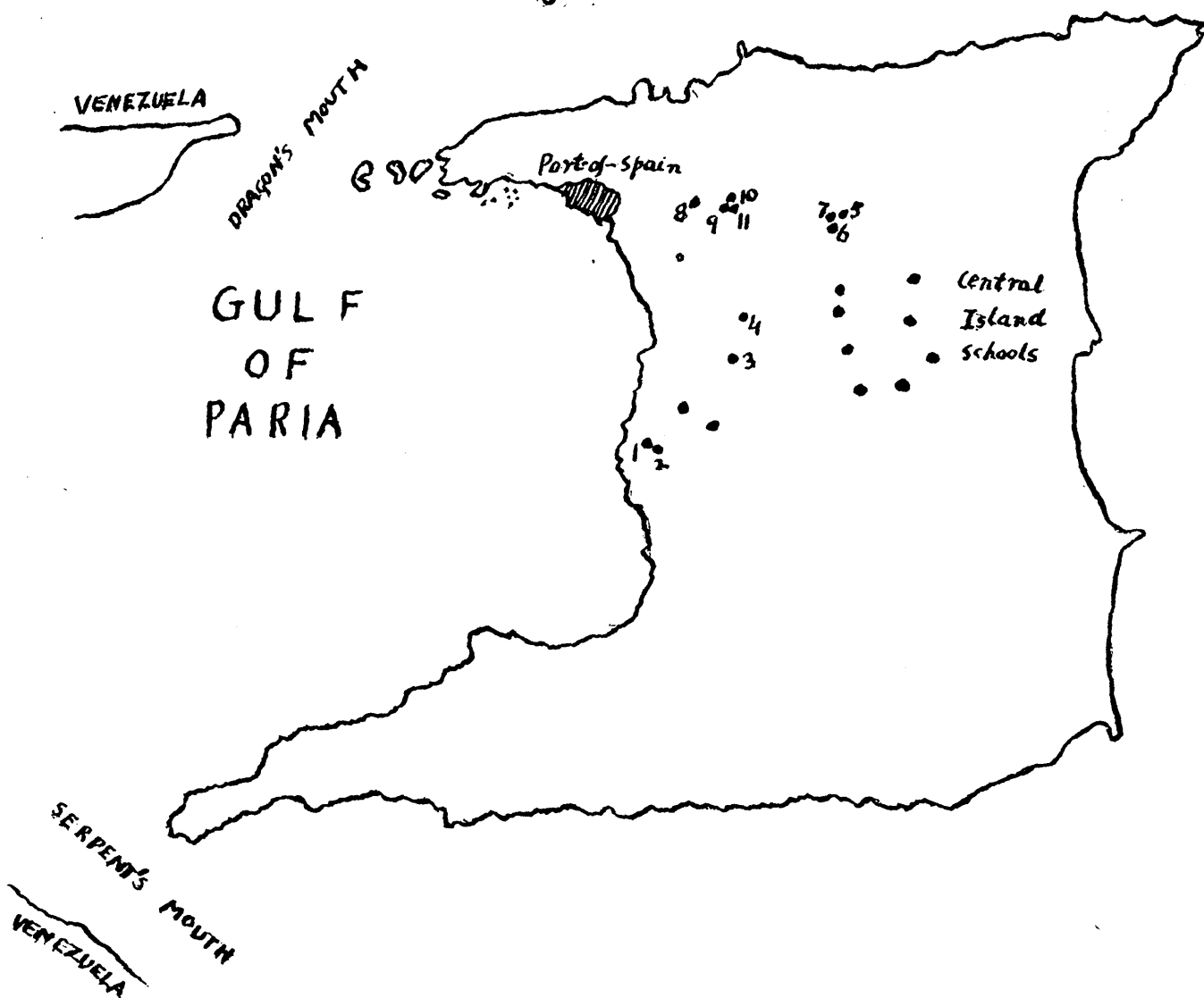
ABBREVIATIONS USED IN THE TEXT

| | |
|------------|--|
| a | absent |
| c | Disqualified for copying |
| C.A. | Chronological Age |
| C.D&W. | Colonial Development and Welfare |
| C.S.S.R.C. | Colonial Social Science Research Council |
| I.B. | Indian Boys |
| I.Q. | Intelligence Quotient |
| M.A. | Mental Age |
| M.H.J.I.T. | Moray House Junior Intelligence Test |
| N.B. | Negro Boys |
| N.G. | Negro Girls |
| Num | Numerical |
| (o.p.) | (outlining with pencil) |
| (p) | (pointing) |
| P | Probability |
| Q.R.C. | Queen's Royal College |
| S.D. | Standard Deviation |
| S.S.R. | Social Science Research |

For the sake of compactness all decimal points have been omitted where no ambiguity would arise. Before nearly all the numbers in the tables read a decimal point.

TRINIDAD

Showing Schools Tested



10 miles

THE RESEARCH PROJECT

ADMINISTRATION OF THE OFFICE

A letter from the Acting Colonial Secretary, Trinidad, dated 30th., June 1945, was received by me offering me a Colonial Research Scholarship, and a further letter, dated 10th., December 1945, inviting me "to undertake a course of training in research work which will entail one year's training in the United Kingdom to be followed by two years' research in this Colony". This invitation was unconditionally accepted, and I arrived at Moray House early in February 1946 to embark on the course of training. I studied there under Professor Godfrey H. Thomson, now Sir Godfrey Thomson, and Mr. W. G. Emmett, the technique of Mental Testing, and advanced Statistics under Professor A. C. Aitken, until I was directed to return to Trinidad in August 1947 to carry out the proposed two year's research work. However, it was not until December 1947 that money became available for the research scheme (Colonial Development and Welfare Scheme R93D) and not until January 1948 that an office, Colonial Social Science Research Laboratory, 33 Abercromby Street, Port-of-Spain, began functioning with equipment and one assistant, Mr. A. P. Murrell. This office was operated as a government department, expenses being met in the first place by government votes and recovered from Colonial Development and Welfare. The Director of Education undertook the administration of this sub-department, but, for convenience, I was allowed to sign vouchers etc. Communications to

the Secretary of State for the Colonies were made through the Director of Education who would use his discretion about sending them on.

In March 1948 Mr. H. E. George was selected from many applicants to the post of Second Assistant, for which money was available on the vote. Here was our first opportunity to put into practice a Mental Testing technique in which was incorporated a test of honesty. On the 2nd., September 1948, by which time there had developed a great deal of semi-skilled work to be done, permission was sought to appoint two more assistants to be paid from the sub-item of the vote: "Marking of Scripts by selected teachers". Permission was refused by the local authorities until February 1949 when it was learned that the Secretary of State had issued instructions that minor variations could be made in the allocations in the research grant. Immediately after this two office boys were appointed to the staff. So that from this time the assistants consisted of Mr. A. P. Murrell, Mr. H. E. George and the two office boys.

A letter, dated 16th., May 1949, from the Director of Education was received instructing me to make arrangements to sail to the United Kingdom by the first opportunity after 31st., July 1949. Accordingly notice to quit the premises was given to the landlord of the office and the equipment not needed in the United Kingdom was stored by the appropriate government departments. Notice that their services would not be required after 31st., July was given to my assistants, but in July 1949 I made an offer to employ them after July, at my expense if need be, to help me work

out the 513 correlation coefficients required for the subsequent factorial analysis. At the same time I wrote to the secretary of the Colonial Social Science Research Council to ask for unexpended money on the vote to be put at my disposal for this expense. The secretary promptly responded and saw to it that this money became available. A third of these correlation coefficients ^{was} were calculated before I left Trinidad on 20th., August, and I received the rest by Air Mail soon after I reached Edinburgh. I took with me to Edinburgh the calculating Machine, I had been using, a small filing cabinet and the used scripts. The first thing I was required to do in Edinburgh was to ^rwrite a Progress Report of the Work I had done so far, which was circulated among the members of the Social and Anthropological Section of the Colonial Social Science Research Council, to whom I gave a short talk on what I had been doing and the aims of the research. Centroid Analysis ^y to 5 factors was begun and the analyses of the three groups, Negro boys, Negro Girls and Indian boys were completed before December 1949. By this time also copies of Standardized scores had been prepared by my wife and sent with appropriate letters to the head teachers of the schools tested and to the Director of Education. Rotation of Axes was next begun. The scholarship terminated on 31st., December 1949 and from that date I was called upon to take 6 months' leave of absence. In March I sailed for Trinidad. This 6 months' leave, part of it in the United Kingdom and part in Trinidad, gave me the opportunity I needed

to complete the analysis of my results which I did by 20th., July 1950.

AIMS OF RESEARCH

It was largely left to me to decide what the aims of the research should be. At the Irvine Commission which visited Trinidad in 1944 I elected to give evidence. I expressed to Sir James Irvine my view that his commission would have been better equipped to advise on Higher Education if some study of the psychology of the West Indian, such as I myself had proposed making as long ago as 1932, had been made. I also expressed the view that comparison between the West Indian and other races would possibly be of not so much value as finding out how the West Indian might make the best use of the mental endowments he possesses.

Early in 1948 I submitted a programme of research to both the Director of Education and Professor Thomson. As no disapproval of this was expressed I planned my work accordingly.

1. My chief object was to investigate the innate mental abilities of the West Indian child. This I proposed doing by testing a sufficiently large sample of elementary school children from country districts with a large battery of tests measuring a wide range of abilities yet each designed to measure only one of them. The tests would fall into the a priori grouping of Non-Verbal, Space, Picture, Numerical, Verbal, Attainment. But the scores would be dealt with by the method of factorial analysis so that the actual way the tests of the battery should be grouped would be determined. This grouping might corroborate or refute the a priori grouping.

This grouping would be the manifestation of the mental factors operative and, within a certain group of tests, one might be expected to be purer in the factor found than others. It was also thought that possibly factors not previously found with other populations might emerge. The factors might remain as statistical abstractions, but by scrutiny of those tests most representative of the factors it might be possible, as is frequently the case, to express them in psychological terms.

2. This battery would take a long time to present, but, having determined what the abilities are of the West Indian child, it would be possible to construct a short battery of the best items of those tests most representative of the factors. Such a short battery, taking about 2 hours to give, would have a very practical value for use in a General West Indian Survey if one were ever to be made. The procedure described for constructing a wieldy battery of tests specially suitable for mentally unexplored populations seems to me to be the only scientific and rigorous one in the light of our present knowledge. Such a battery could be divided into sections, scores on each of which would yield estimates of the children's special abilities and serve as a guide to the types of school to which they should be sent.

3. It was proposed to try out the tests on the 450 boys ranging from 10 to 18 years of age at Queen's Royal College (Q.R.C.), the chief government secondary school of the Island from which I had been seconded from my post there as Assistant Master, before testing the elementary schools. It is impossible to know beforehand how difficult

a test is, so it was proposed to devise tests of items with a wide range in difficulty. The items too easy for the s-econdary school boys and some of the other easier items would constitute experimental tests for the elementary schools. But this testing of Q.R.C. boys would serve another purpose also; it would make possible the determination of age norms for the tests and, most important, would provide norms for the young adult. On the basis of these it might be possible eventually to give vocational guidance and help employers in the selection of employees. As a first step to the latter it was decided, when the time was ripe, to invite an employer to send to the laboratory for testing, his selection, by interview or otherwise, of candidates amongst whom he was unable to discriminate, when a rank order of them in respect of their mental ability would be sent him confidentially.

4. To attempt to determine whether personality traits were transmitted by heredity it was proposed to obtain personality assessments of the children in an orphanage and of as many of the mothers as could be traced who had had little contact with their children. The children of an orphanage would be subject to a constant environment and any significant association between the children's personality and the mothers' would be the result of heredity.

THE EXTENT TO WHICH THESE AIMS HAVE BEEN ACHIEVED

1. It was at first intended to test children of 11 years of age of country elementary schools. As an experiment 8 schools in the centre of the Island yielding 86, 11-year-olds were given Test Nos. 2, (3 & 4), 5, 6, 7, 10, 11, 12: all non-verbal.

These children of the centre of Trinidad were expected to be below average. Their performance was not very good and, as it was found impossible to devise easier items, it was decided, when the battery was completed, to use 12-year-old material. Early in May 1949 the battery of 19 tests was ready, and on 10th, 11th and 12th, the 12-year-olds of 2 schools were simultaneously tested with the Moray House Junior Intelligence Test (M.H.J.I.T.) and the 19 tests of the battery. This took $2\frac{1}{2}$ days. It was found that the verbal tests were very badly answered due to the inability of all the children of one of the schools and of most of the other to read with any comprehension at all. This was evident before the scripts were examined when the time taken for a child to write his name on the cover of a script was noted and their perplexity when given a test containing words. Their reading of English was as halting as a backward schoolboy's translation of Latin. It was felt that no verbal tests could be devised simple enough for the 12-year-old group. This meant discarding all verbal tests or, as was done, selecting only the children of V, VI and VII Standards. The findings by factorial analysis are little affected by selection (at all events the type of structure is little affected), so that the main purpose of the battery, to determine the mental factors, would still be achieved. The factors found, however, with these children might not be so innate as those we might find in younger children. Nor could the scores of these children be taken as typical of the population. From then on two schools at a time were tested for $2\frac{1}{2}$ days a

week from 25th., May to 7th., July 1949, yielding the data for the subsequent factorial analysis. At first it was intended to test only elementary schools in the heart of the country for two reasons: (i) it was thought that if any factors were found in these children they would be more likely to be innate than factors found in town children where the environment is more complex. (ii) A political reason: it was not at first known how the school teachers and parents would take to mental testing and it was thought that if disapproval were expressed in isolated districts this would matter less to the experiment than if a number of disapproving people could get together and discuss the tests. Experience has shown that reason (ii) need not be considered, for nothing but approval was met with.

However, one disadvantage of these country schools is that the numbers of children of the required standards are small so that when on 19th., May 1949 I was informed that I must sail for the United Kingdom as soon as possible after 31st., July, I had to modify my plans. So far I had been proceeding on the assumption that I should be granted an extension I had applied for to make up for the 5 months' delay in starting the research. I resolved to test, for the rest of the experiment, elementary school children of V, VI and VII Standards of small towns where many more children would be tested at a time.

By the 7th., July 1949 the children of V, VI and VII Standards of 11 elementary schools, yielding 575 children, had been tested with the battery of 19 tests for the factorial analysis and with the Moray House Junior Intelligence Test. Two schools at a time had been tested and

and the testing of a school lasted $2\frac{1}{2}$ days. The marking of the 11,500 scripts and entering of names and raw scores was done by my 4 assistants, my wife and myself during the testing period and on the days of the week not used for testing, so that by 12th., July all the raw scores were entered. A conversion table was then prepared by which raw scores in each test would be forced into standardized scores (normalized scores) of mean = 100 and Standard Deviation = 15.

In addition to determining the scores on the tests a record was made of the children's ages, but this was not of much use because the discrepancy between the age as given by the children and as given by the school record was in some cases as much as 3 years! and in only a few cases was it the same. The child's standard was recorded and an estimate of the child's race was also recorded. A 12 point scale was used for this, thus: "12 Ne" stood for pure Negro; "5Ne, 2 I, 3N, 2P" would stand for an hereditary make up of $\frac{5}{12}$ Negro, $\frac{2}{12}$ Indian, $\frac{3}{12}$ Nordic and $\frac{2}{12}$ Portuguese. The head teachers, who frequently knew the parents, were most helpful here, and I became so expert that frequently my estimate was closer to theirs than Mr. Murrell's. The sex, the rank order in the standard, the parents' prosperity on a 3 point scale and left-handedness in writing were also recorded, together with any remarks about the child concerning his interests.

It was realised that one was dealing with a number of populations. It is a principle in statistics not to mix populations, so it was resolved to classify the children into: Negro

boys (N.B.), Negro girls (N.G.), (for this 10/12 was counted as Negro), Indian boys (I.B.), Indian girls (I.G.), Etc., - the rest. I might refer to these as "groups" but I reserve this term for tests, so that in these pages I shall refer to them as "Populations" where, by the context, no ambiguity will arise between the statistical terms "Sample" and "Population".

By the 18th., July the N.B. standardized scores were entered and duplicated ($N = 152$). Meanwhile 1000 forms (a specimen is given in the Analysis of Results) for working out correlation coefficients by the diagonal method were duplicated and I had started teaching Mr. George and the office boys how to use logarithms for the final working out of the correlations. Mr. Murrell and I then taught them how to work out the correlations using the forms. By 20th., July we were all busy working out the 171 correlations, but before these were finished I had had prepared and duplicated the N.G. and I.B. "Normalized Scores" of Tables III, IV and V of the section on the Analysis of Results (q.v.). It was at this point that I took measures to continue to employ my staff for computing purposes after 31st., July, for, as I saw it, my work would be valueless without the correlations which would take one person months to work out. Fortunately my sailing was delayed until 20th., August which gave me the opportunity to co-opt the services of some intending students of statistics. Mr. Shenfield, the Government Economic Adviser in Trinidad, was soon to start giving a course of lectures in Statistics and I went to see him to ask if he would mind

giving me the names and addresses of those who wished to take the course. He kindly agreed. I found the students who came were very keen and soon learned the technique of computing correlation coefficients. So with the help of these and my staff the correlations of the N.B. and N.G. were all completed before I sailed, and on about 20th., September, when I was in Edinburgh, I received by air Mail the correlations of the I.B. as well. Mr. Murrell was in charge of these computers and entering and checking the results. I did not attempt the analysis of any but the N.B., N.G. and I.B. populations. The I.G. were not sufficiently numerous, and "Etc.," did not seem to be quite so important as the others for the present purpose.

The Analysis of Results shows that the psychological interpretation has not been entirely successful but that differences in mental machinery exist between the sexes and between the races.

2. In the last section of Analysis of Results is shown the selection of the tests for the shortened battery.

3. Mean Scores of Test Nos. 2, (3&4). 5, 6, 7, 9, 10, 11, 12 together with their standard deviations were obtained for age groups 11 - 18 from the Q.R.C. boys, and by drawing graphs these were smoothed. So that the age norms for these tests are known.

4. The investigation of hereditary transmission of personality traits has not been attempted.

CONSTRUCTION OF THE TESTS AND DESIGN OF THE BATTERY

Two of the tests, the Geometrical Analogies which has become a part of Moray House Junior Intelligence Test and Picture Analogies were constructed before I left for Trinidad in August 1947. During the waiting period of 5 months in Trinidad until January 1948 the general design of the battery was thought out and the plans for certain of the tests. But the main construction took place between January 1948 and May 1949.

Ready made tests were thought not to be suitable for the following reason none are to be found having all of the following characteristics:

- (i) Suitable for the West Indian child.
- (ii) Each testing a narrow range of ability.
- (iii) Collectively testing a wide range of abilities.

Furthermore it is not possible to discard unsuitable items from a test made by someone else.

However, the Moray House Junior Intelligence Test - Test 0 - was used though it does not enter into the correlation matrices for factorial analysis, and Mr. Renshaw's Space Test 4 - Test 8 - was used without alteration except in the instructions.

Accordingly it was decided to construct tests meeting the above requirements. Thus all the 19 tests but Mr. Renshaw's are composed of original items (two of Test 11 are borrowed from Moray House). Most of the tests are of well known types, but it is claimed that the types themselves are probably new in Tests 5, 6, 7, 9 and 17. The types of test were so chosen that they fell into the a priori groups, Non-Verbal, Space, Picture, Numerical, Verbal and ^Aattainment. It is the purpose of factorial analysis to correct or affirm this grouping.

It definitely was not my object to have tests overlapping so that they obviously called upon the same mental processes (Tests 1 and 10 being both Analogies are an exception to this). The production of factors could be assured in this way but such factors would only confirm the existence of what, a hypothesis, was obvious. If factors emerged with the present battery, the a priori grouping ^{being} is very doubtfully correct, and analysis may quite possibly lead to another grouping altogether. We shall see that this is to a certain extent the case.

The tests each consist of items which can be scored Right or Wrong unambiguously. The Multiple Choice method was largely used in which the the subject is required to choose the right answer from a number of alternatives.

The typical procedure used for constructing a test was as follows:

- (1) The Items were thought out and a rough draft made.
- (2) These were tried out on the rest of the staff, on my family and on our domestics.
- (3) A Roneo stencil was prepared and copies run off.
- (4) Instructions for carrying out the test were prepared and duplicated.
- (5) The tests were tried out on the 450 boys of Q.R.C.
- (6) The Scripts were Marked.
- (7) The Scores were subjected to an item analysis by which those items too difficult or too easy or not conforming to the internal consistency of the test were discarded as unsuitable for Q.R.C.

- (8) Norms (average marks for different ages and standard deviations) were prepared.
- (9) Those items discarded as too easy for Q.R.C. and some of the easier items retained were assembled and duplicated again to constitute experimental tests for the elementary schools.
- (10) The test was tried out on elementary school children from the centre of the Island.
- (11) The scripts were marked.
- (12) A further item analysis was carried out.

The test then became ready to form one of the battery of 19. (The above procedure was adopted in most of the Non-Verbal tests, but was cut short for some of the other tests).

During the statistical analysis of the tests various experiments suggested themselves, some of which have been carried out (for instance on Reliability and Incidence of Guessing and an article is to appear in the December issue of Psychometrika this year, 1950, entitled, The Optimum Number of Items to retain in a Test measuring a Single Ability) and others which/a-re soon to be carried out such as on scatter in Multiple Choice Tests.

All the pages of those tests which had more than one leaf were stapled into jackets on which Instructions and questionnaires for personal details were printed. All the tests except Nos. 15, 16, 18, 19 started with Practice Tests which were gone through with Verbal Instructions of greater length than those printed on the jackets. In addition, for the elementary schools, copies of the Practice Tests of Test Nos. 2, 3, 4, 5, ⁶5, 10, 11, 12, were separately duplicated with special instructions for the teachers.

Social Science Research Lab.,
 Temple Building,
 33 Abercromby Street,
 Port-of-Spain.

The Headteacher,

Dear

Towards the end of last year you received from the Education Office, I am informed, Circular A17/1948. In paragraph 1 mention is made of my conducting Mental Tests. I should like to visit your school for this purpose on

The Tests will take $2\frac{1}{2}$ days to administer and I shall be at your school from 9.30 - 11.30 a.m. and from 1.00 - 3.00 p.m. on these days. I shall be testing all the children (boys and girls) who are at present in Standards V, VI & VII.

Enclosed is a copy of Practice Test Instructions. On I shall personally deliver to you a number of copies of Practice Tests - one for each child and one for yourself. I should be obliged if by then you would have ready for me a list of the children of the required Standards arranged in order of merit, within Standards, as far as you can determine it from their school work, *and their ages in years and completed months on*

The Tests proper which will be given on the are some of them of the kind exemplified in the Practice Tests the purpose of which is to prepare the children for what they are to expect, and to economise upon the time required for giving instructions on the day of the test. As explained in (2) of the last page of the Instructions the children may be trained in answering these Practice Tests. They should also be instructed in how to fill in the data required on the covers.

On the day of the test I should like a black-board to be at my disposal.

I am sure that I can count on your cooperation, and I am looking forward to meeting you on when I shall try to answer any points arising out of the Instructions which may not have been clearly put.

Yours sincerely,

(B.J. Bedell)

RESEARCH OFFICER

ADMINISTRATION OF THE TESTS

1. To Queen's Royal College. The whole school received a test at the same time. Permission was first obtained from Mr. R. M. Hamer, the Principal, to give the test. A few hours before the test each Form Master was provided with a copy of the Verbal Instructions, so as to familiarise him with them. Just before the time of the test Mr. Murrell and I delivered the tests in bundles of 35 and 20 scripts according to the size of the forms and distributed them to the form masters who took them to their forms and read out the Verbal Instructions and gave the test to their forms. The returned scripts were all counted to make sure that none had gone astray. Mr. Murrell and I would visit the classrooms during the testing to see that everything was satisfactory.

2. To the Elementary Schools. A circular had been sent by the Director of Education to all the head teachers of elementary schools in Trinidad (about 300) warning them that they might expect a visit from me at some time. The head teacher of a selected school was visited and permission to test asked for. There were no refusals. The head teacher was told to expect a letter from me in a few days. A copy of this letter is to^{be} seen on the opposite page. The Practice Tests were delivered to the head teacher about 10 days before the testing, with Instructions. These were returned later with remarks on the children's interests and other details concerning them filled in by the head teacher.

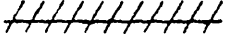
PRACTICE TESTS (For boys who were ¹²~~11~~ years old last birthday)

INSTRUCTIONS TO TEACHERS.

Assemble all boys ~~who were 11 years old last birthday~~, and have short-sighted ones in front. Say to class: "Is there anyone who has not got a sharp pencil?" If there is anyone lend him one. Say to class: "You will each be given a book of test puzzles do not open it until you are told. These puzzles will be like some more which you will be given by a gentleman who is coming to visit us soon, and I am now going to show you what to expect when he comes." Give out the PRACTICE TEST booklets at the same time saying to the class, "Do not open this until you are told." When they all have their booklets say to class, "On the line marked 'Name' write your full name (I mean all your names); write your surname (or title) last and write in block letters (these are capital letters) so that they may be easily read. On the line marked 'Age last birthday' write in figures your age before the word 'years'. On the line marked 'Date of birthday' write the date of the month and the month of your birthday. On the line marked 'Standard' write down the standard you are in at school." Inspect booklets to see that the children have done all this correctly. Pay especial attention to their surnames and their age in years being correctly entered.

S.S.R. Does Not Belong. Have booklet open at first page. Say to class: "Now open the book at the first page. Test No. 1 has three rows of drawings. In each row there are six drawings; five of these have something alike about them but there is one which has not got this. The puzzle is to try to find out which is the drawing in each row which has not got the thing the other five drawings have, and to underline this drawing. Let us look at No.1 of Test 1. Here we have 6 drawings of squares; five of them are shaded but one is not so we draw a line under the square that is not shaded. Will you all do that." Go round class and see that each has done this.

"Someone might say 'Why not put a line under the largest square because there is only one largest square.' But this would be wrong for the question is to find out how 5 squares are alike and to underline the one which has not got this likeness. Now look at No.2 and see if you can find out which 5 drawings have something alike about them, then draw a line under the one which has not got this likeness." Go round class and see if everyone has underlined the last drawing; if there are any children who have not done this correctly explain to them that 5 of the drawings are alike because they consist of lines which are standing upright but that this last drawing is different as it consists of a line which is lying down. Say to class; "Be careful not to underline two drawings in any one row as this will be counted wrong. If you make a mistake and want to change your mind, clearly cross out the line you have drawn like this - "



Say to class : "Now do No.3" After the class has had some time to do it go round and see if every child has underlined the first drawing. If there are any who have not done so explain to them that 5 of the drawings are alike because they consist only of straight lines but that the first drawing contains a curved line.

S.S.R. Recognition of figures. "Now let us look at Test No.2. In the first row you see an 'A' on the left. To the right of it, on the other side of the line, there are 6 drawings; two of these have an 'A'. You see this drawing has an 'A' (pointing to the 2nd drawing) and so has this one." (pointing to the last drawing. "You also see that a line has been drawn under both of the drawings which have an 'A'. The 'A' need not be of the same size as the 'A' on the left of the line, for this one (pointing to the last drawing) is much larger but it must be exactly the same shape and the same way up. Now see if you can underline the two drawings in the next row which have a 'B' in them. To get the answer right you must underline two of the drawings but no more." As before, go round class and see if everyone has underlined the 3rd and 5th drawings. If there are any who are wrong explain the right answer to them.

"Now see if you can do the 3rd row and underline the two drawings which have a 'C' in them." Go round class and explain to those who are wrong why the 4th and 6th drawings are the ones to underline.

S.S.R. Matrix Test. "Now turn over the page to Test No.3. You see a large square (pointing) divided into 9 small ones and the last of these is empty. (pointing) On the right. (pointing) you see 5 small squares. The puzzle is to choose which of the 5 small squares would be the best one to put into the empty square and to draw a line under the square you choose. If you look at the large square again, you see that the top small square on the left (pointing) has a line in it. The next one to the right of it (pointing) has 2 lines, and the next (pointing) 3 lines. "Now look at the small square on the left of the middle row (pointing). It has a small line in it. The one on the right of it (pointing) has 2 small lines and the next (pointing) three small lines. Now look at the small square on the left of the bottom row (pointing). It has one dot in it. The one on the right of it has 2 dots (pointing); what do you think the empty square (pointing) should have in it? (Class answers) "Yes, 3 dots - but how should they be arranged - by the side of each other or one above the other? (class answers). "Yes, by the side of each other.

"Let us make sure we are right by looking down instead of across. The first column (pointing) has one long line (pointing) then one short line (pointing) and then a dot (pointing). The second column (pointing) has 2 long lines beside each other (pointing), 2 short lines beside each other (pointing) and then 2 dots beside each other (pointing). The 3rd column (pointing) has 3 long lines beside each other (pointing) and 3 short lines beside each other (pointing). Surely the empty square (pointing) should have 3 dots beside each other as we said before. So we underline the 4th small square on the right." (pointing) When the class has done this correctly say: "Now look at No.2, here the large square is not divided into 9 small squares but there is still a small empty square at the bottom corner." (pointing) "Which of the small squares on the right (pointing) would fit into the empty square so as to make the pattern right?" (class answers) "Yes, the last small square so we draw a line under it." Go round class and see that this is done correctly.

"Now try to do No.3 by yourselves." After the class has had some time, see if everyone has underlined the 3rd drawing and to those who have not explain why it is the 3rd drawing which should be underlined. "Now try to do No.4 by yourselves." Give them some time then see if all have underlined the last small square. To those who have not explain that in the last row and last column there must be 2 dots. The dots are placed higher as they go from left to right and in the last column the dots are placed at the top of the squares. "Now try to do No.5, this one is more difficult." When they have had some time go round class. To those who have not underlined the 3rd drawing, explain that the squares of the last column must have 1 dot; the last row has the shortest lines, and the last column has the lines which are most curved (bent).

S.S.R. Space Test. "Now turn over the page to test No.4. At the top of the page you see a row of 6 drawings each with a little letter inside (pointing). Look at the one with 'A' inside it (pointing), under you see the same drawing but it is turned round a little; never mind how it is turned round it is still marked 'A'. Under that again is another drawing of 'A' (pointing) turned round a little more, and if you look down you see 'A' turned round to many different positions (pointing)."

"In the one before the last in the 'A' column (pointing) you see 'A' turned round and made larger; it is still marked 'A' because it is the same shape as 'A' and in the last drawing of the column 'A' is quite small. Do you think you could recognize 'A' whichever way it is turned and whether it is large or small? Well, we shall see."

"Now look at the drawing with 'B' inside in the top row. Under it you see 'B' turned round into many positions (pointing) also large and small (pointing). Try not to get 'A' and 'B' mixed up when you come to do the test, for no matter how 'B' is turned round it never turns into 'A'. It is true that if we cut 'B' out and turned it over (indicating with the hand) we should get 'A' but you must not think of the drawings turned over (indicating with the hand) only turned round (making a circular

movement with the hand), or made larger or smaller. The same thing with the other drawings marked C, D, E & F."

"Now look at the first drawing over here." (pointing to the boxed-off drawing marked 'B') "It is the same as 'P' that is why a 'P' has been put in it. The second drawing is 'A' (pointing), the third is 'F'. What letter shall we put into the next drawing?" (class answers) "Yes, 'C' will you all put a capital 'C' in that drawing. Always use capital or block letters."
What letter shall we print in the next drawing? (pointing) (class answers) Yes 'E', do this. And in the next (pointing) (class answers) Yes 'D', do this. And in the next (pointing) (class answers) Yes 'F', do this. You see that this last one is the same as 'F' in the top row (pointing) but turned round a little."

"When I tell you to start go on by yourselves printing the right letter in each of the drawings marked 1 to 20. You may turn the book round if you think it will help you, but I do not think that it will. If you wish to change a letter do not alter it: cross it out then write the next one. You will be given 10 minutes to do the test which is plenty of time and you will get no more marks for doing it fast than for doing it slowly. Do not waste time over any but pass on to the next if you can't do it: when you have finished look over what you have done until you are told to stop. Are you all ready? START!"

At 9 minutes say "1 minute more". At 10 minutes say "time up" and see that no more writing is done. Collect the Practice Test booklets and give out the S.S.R. Practice Picture Test sheets face downwards saying to the class, "Do not turn these sheets over until you are told." When they all have their Practice Picture Test Sheets say to class, "Turn over your paper and fill in your Christian names and Surname at the top of the page." As before, go round class and inspect sheets to see that the children have done this correctly.

S. S. R. Picture Test 1. Look at the first two pictures in the first row: these two pictures go together in some way and we have to find out how they go together. A cat is a kitten after it is grown up. The next picture is a cock. What becomes a cock when it is grown up? Does a coop (pointing) grow into a cock?" (class answers) "No!" "Does a rabbit (pointing) grow into a cock?" (class answers) "No!" "Does a feather (pointing) grow into a cock?" (class answers) "No!" "Does a puppy (pointing) grow into a cock?" (class answers) "No!" "Does a chick (pointing) grow into a cock?" (class answers) "Yes!" "So we put a line under the square with the picture of the chick." Go round class and see that they have all underlined the correct picture.

"Say after me 'cat is to kitten' (class repeat) 'as cock is to chick' (class repeat). You see we must have the first two pictures before we know which one to underline so in each case work out how the first two pictures go together." "Now let us look at the second row; how do pencil and notebook go together?" (class answers) "Yes, a pencil writes on a notebook, then we must think of what a piece of chalk writes on." (class answers) "Yes, on a blackboard so we put a line under the square with the picture of the blackboard - not under the pen, note-pad, ink, nor paint box." As before, go round and see that all have done this correctly. "Say after me 'pencil is to notebook' (class repeat) 'as chalk is to blackboard' (class repeat)."

"Now do the next one by yourselves. Sheep is to grass as boy is to --- underline the right picture by yourselves." "Yes, a sheep eats grass and a boy eats bread, so you should all have drawn a line under bread." "Now see if you can do the next one. I am going to give you no help at all with this one." After they have had time go round the class and explain to any who have not underlined the picture of the boy lying down why this is the correct answer. Say to class: "Say after me 'standing top is to top lying down' (class repeat) 'as standing boy is to boy lying down' (class repeat). Again I want to tell you how important it is to study the first two pictures because unless we had done this, we could not possibly know which of the other five pictures to underline. Now the last one is rather tricky so watch out. See if you can do it."

After they have had time to do this go round and explain to any who have not done it correctly why the clock showing 10 minutes to four is the one to underline.

"Say after me, '5 to 8 is to 5 to 9' (class repeat) 'as 10 to 3 is to 10 to 4' (class repeat). On the day of the real test you will have 18 more of these to do by yourselves. They start easy and get more difficult. I want to tell you again, be very careful to study the first two pictures well before you draw a line under the picture which you think is the right one."

"Now turn over to Picture Test 2. You see four pictures which tell a little story the same as you might find in a comic strip in the newspaper, but the pictures are not in the right order. The puzzle is to find out what the story is about and to put numbers in the little squares beneath the pictures to show in what order the pictures should be put." "The square beneath the 4th picture has had the figure 1 put inside it to help you. Now what do you think this story is about?" (class answers) "Yes, a motor-car accident. A car is being driven along and as it reaches the side of a cliff it falls over, hits the ground beneath, and the ambulance is sent for the injured. That is the story so the figure 1 comes in the little square beneath the fourth picture where they are driving along in the car. This has been filled in for you already so you don't have to write anything in that little square. The car then reaches the side of the cliff and is just going to fall over so put a 2 in the little square beneath the ~~first~~ ^{second} picture. It falls through the air and is about to hit the ground so we put a 3 beneath the ~~second~~ ^{third} picture. The ambulance is sent for and comes along to pick up the injured people, so we put a 4 beneath the first picture."

"On the day of the real test you will have 10 more stories to work out for yourselves in the same way as this has been done. Most of them will have more than four pictures and you must put the right numbers in all of the little squares of a story before it is counted as right.

"For instance, if in the story we have just done someone filled the little squares like this:" Draw four squares on blackboard and put 1 in the fourth square, 2 in the first square, 3 in the second square and 4 in the third. "That would be counted wrong."

"Now let us look at Picture Test 3. In each row there are 5 pictures; two of these are alike in what they do or in what they are used for. The puzzle is to find which of the two are alike in what they do or in what they are used for and to underline those two."

"In the first row you see pictures of a dog, horse, cow, lion and goat. Which two of these are used for the same thing? A cow and goat are both used for giving milk so we draw two lines - one beneath cow and one beneath goat. Draw your lines just below the bottom line enclosing the pictures." Go round and see that all the children have done this correctly. "Now see if you can do the second row by yourselves."

After the class has had time to do it go round and see if every child has underlined the 2nd and 5th pictures. If there are any who have not done so explain to the class that the tea-cup and tea-pot both do the same thing because they both hold tea.

Say to class: "To underline kettle and tea-pot because they both have handles would be wrong because the puzzle is to find which two things do the same thing - not which have the same thing. To underline saucer and teacup is also wrong. A cup certainly is put into a saucer, but they don't do the same thing nor are they used for the same thing. To get your answer correct you must underline two pictures. In the real test you will have 18 other puzzles like this one to do."

ATTENTION should be paid to the following details:

- X (1) Remarks are to be entered in the space provided on the cover of the Practice Test Booklets. Such remarks should include:
 - (a) How the child reacted to the test. (Leave blank if no reaction)
 - (b) Child's performance in school. (Clever, mediocre or dull)
 - (c) Does he possess any special aptitudes.
 - (d) Are the child's parents relatively prosperous or poor. (Leave blank if they are average or if information is not available)
 - (e) Any other remarks concerning child which you think may be of interest.
- * (2) After these Practice Tests have been performed according to the instructions it is optional whether you repeat the Practice Tests or in any way train the children in doing them, for it is felt that by the time the actual tests are presented the children cannot know too much about what they are required to do.
- X (3) Tell the children that on the day of the test each must come supplied with at least 1 sharply pointed pencil and no rulers nor erasers will be required. (There is no objection, however, to them bringing a pencil with an eraser fitted to the end of it.)
- X (4) Emphasize that when the test proper is taking place there must be no talking whatsoever, even to themselves, and no looking over each other's paper.
 - * The children might, for instance, be given practice with the verbal analogies contained in the West Indian Reader Book IV page 242.

S.S.R. PRACTICE TEST

NAME _____
Christian names in BLOCK LETTERS Surname (Title)

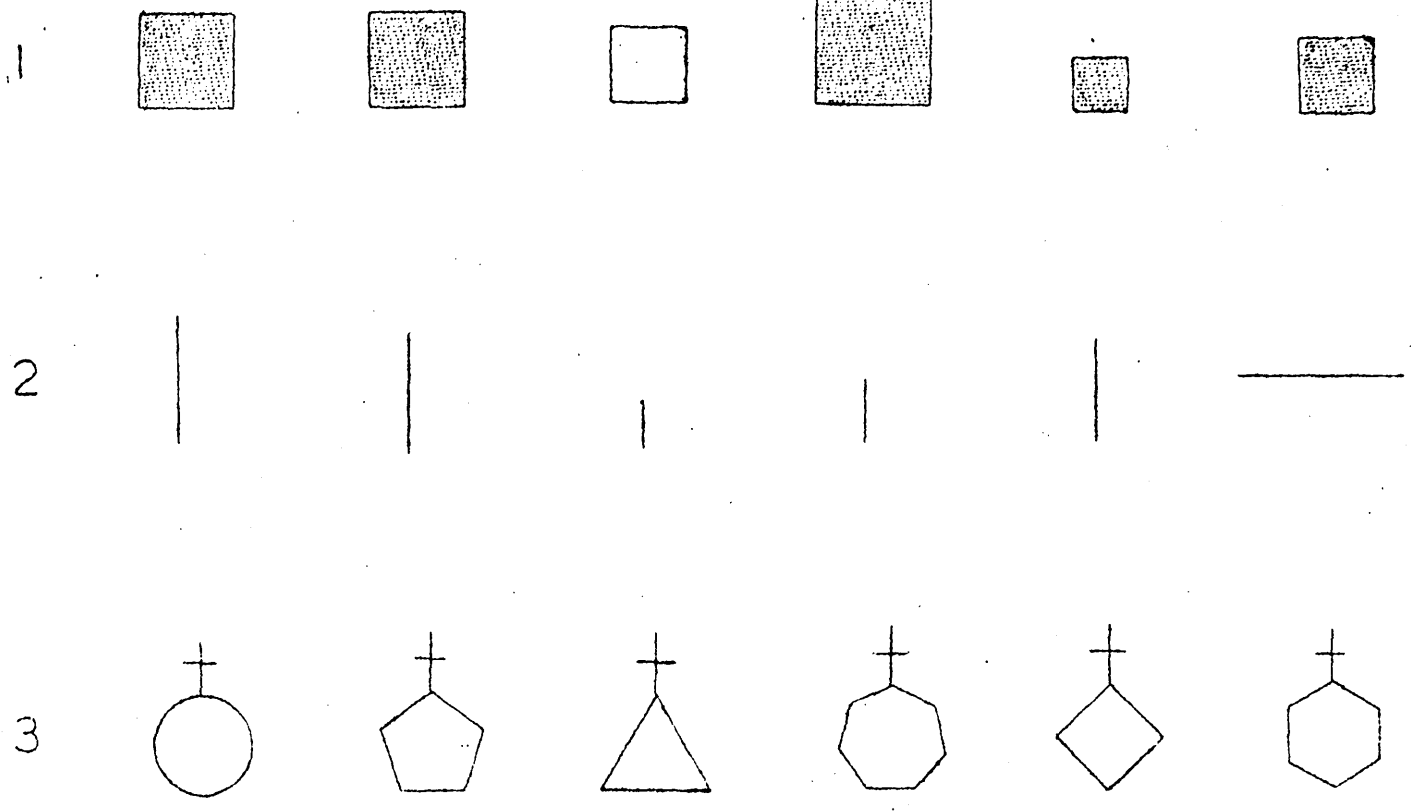
AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
Date Month

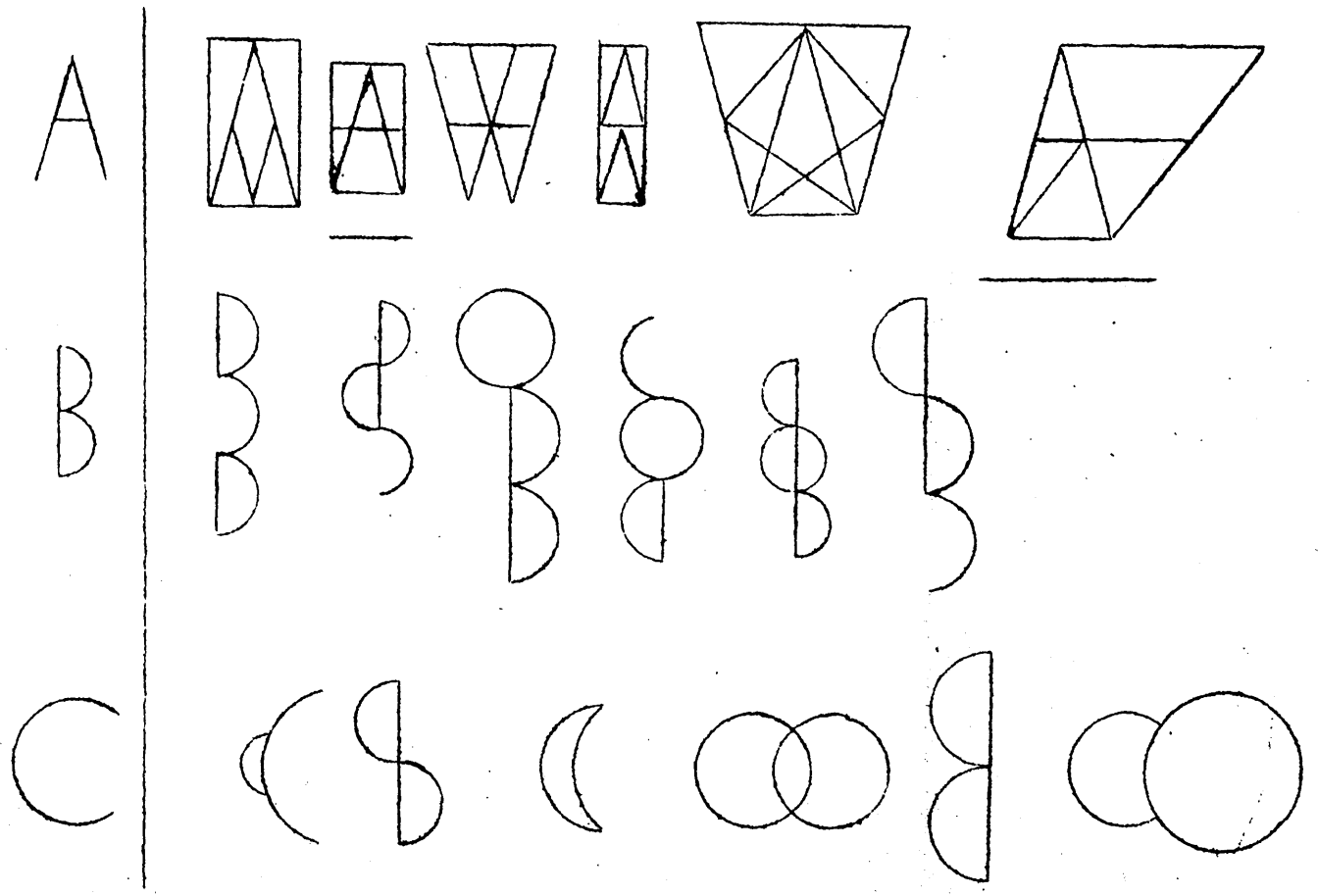
STANDARD _____ SCHOOL _____

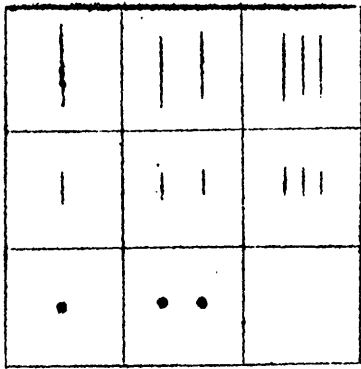
REMARKS.

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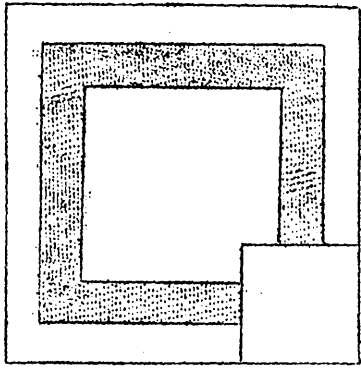


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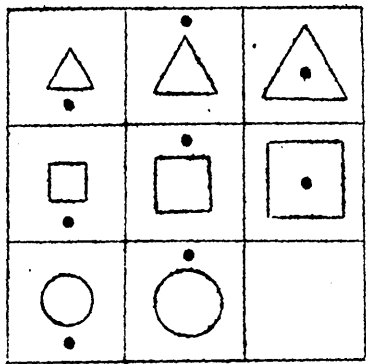
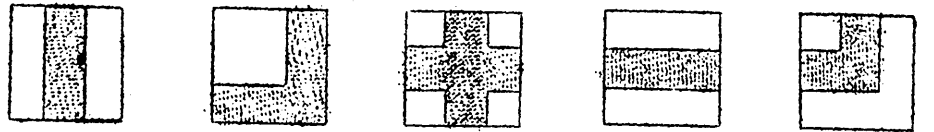




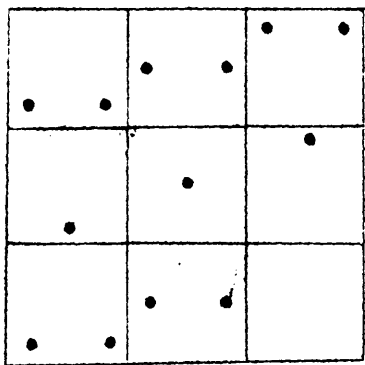
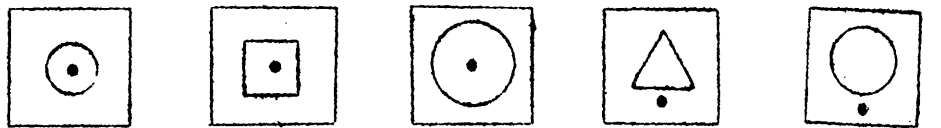
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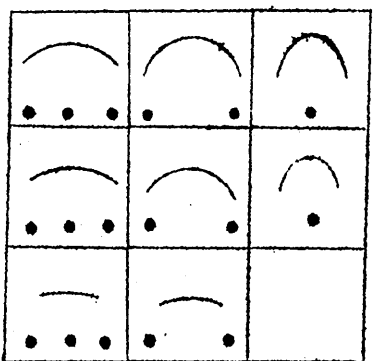
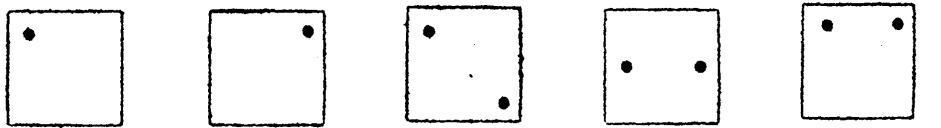
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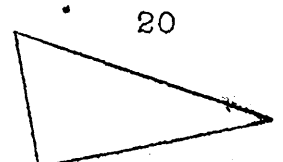
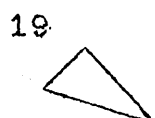
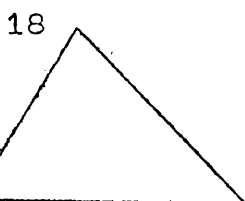
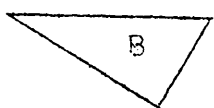
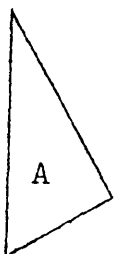
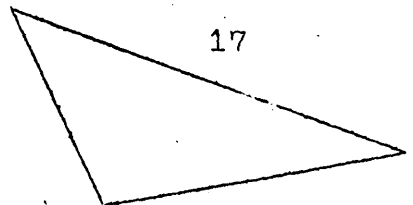
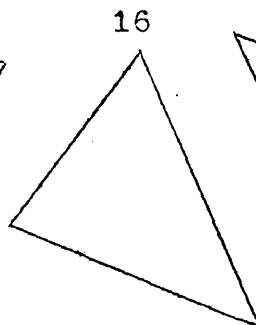
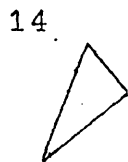
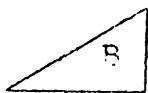
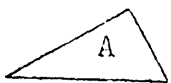
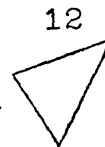
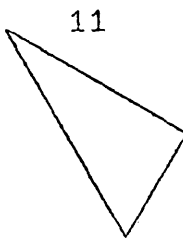
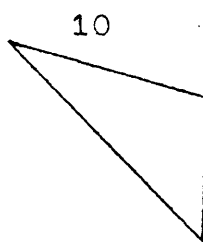
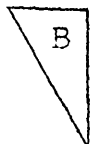
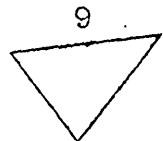
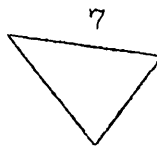
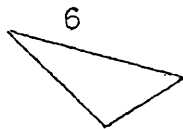
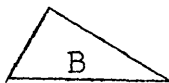
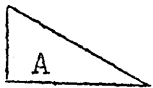
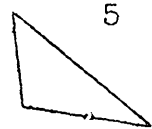
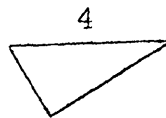
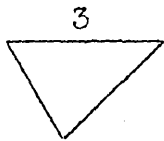
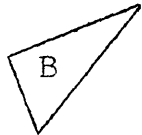
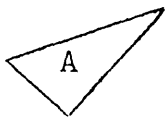
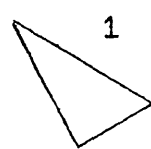
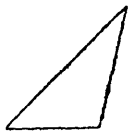
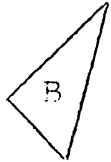
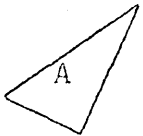
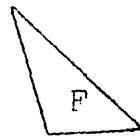
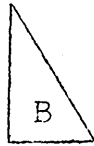
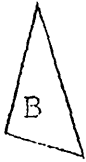
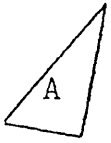
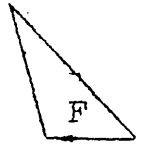
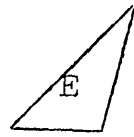
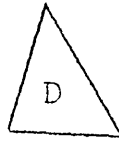
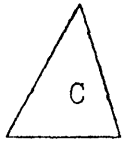
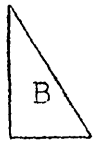
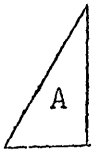


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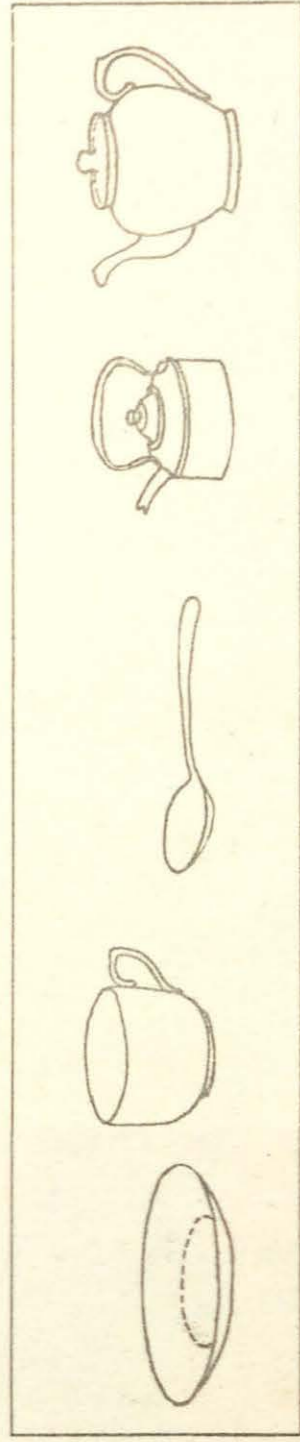
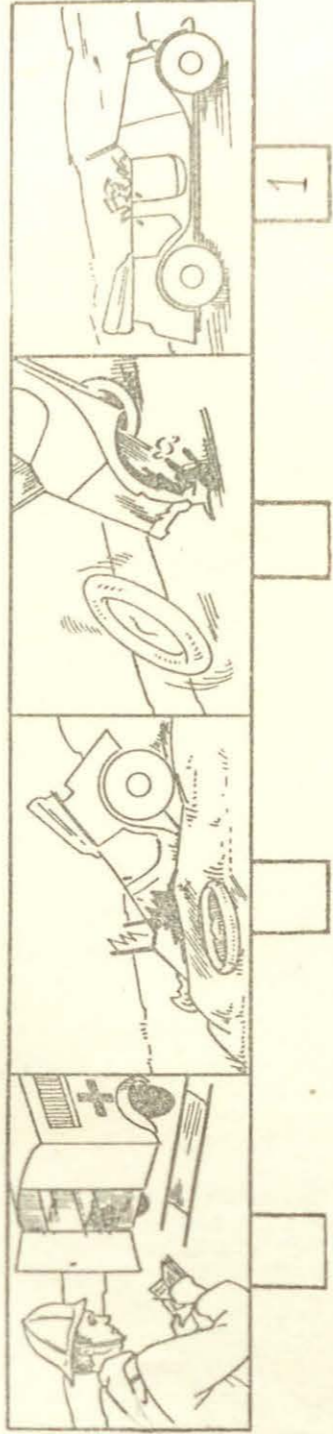
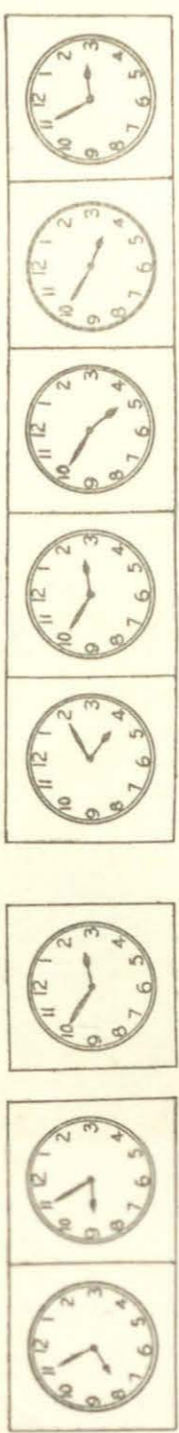
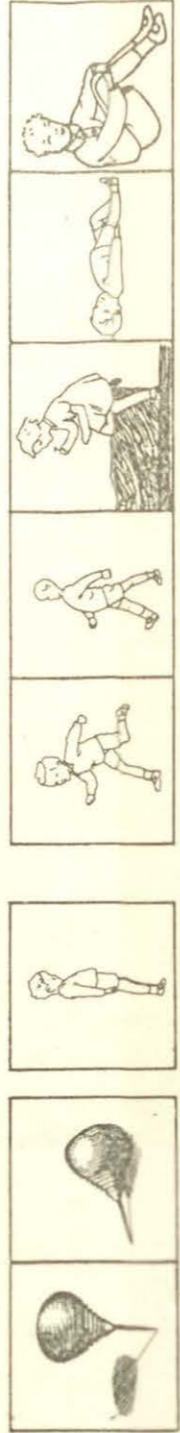
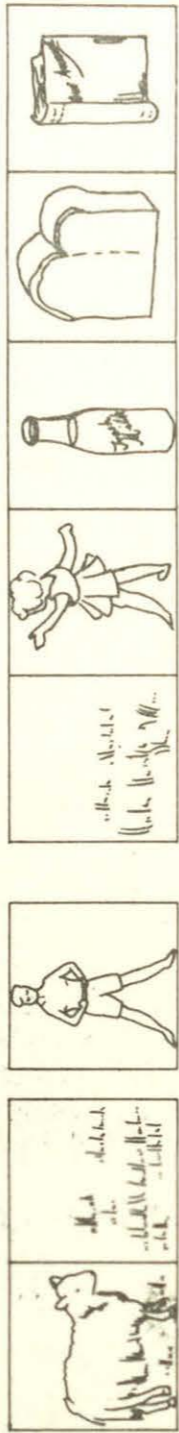
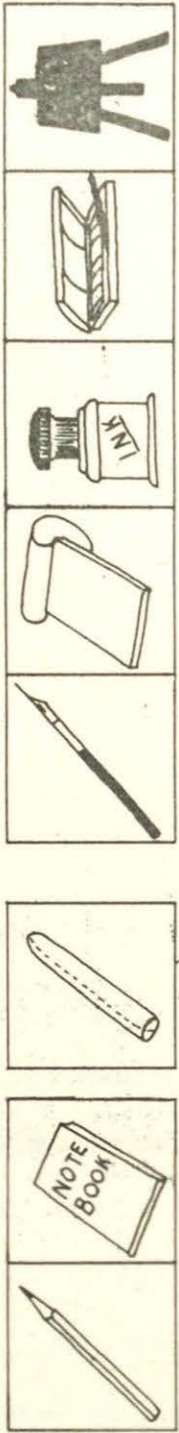
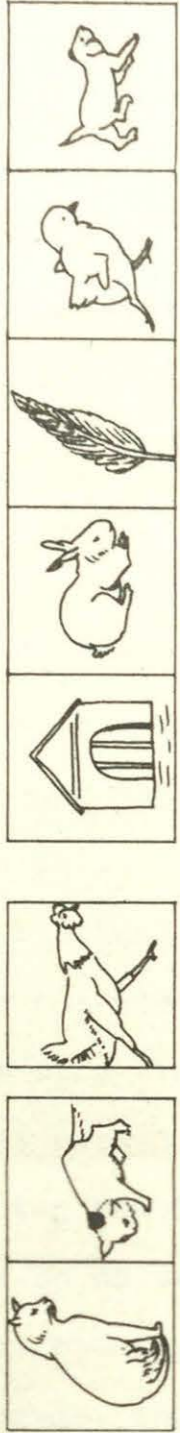


5





DO NOT TURN OVER UNTIL YOU ARE TOLD.



There are several advantages in providing these Practice Tests before the test proper. The testing takes less time. The children learn how to fill in the covers of the scripts. They learn what kind of thing to expect. The teachers, being made to take part, became very keenly interested and made one very welcome.

The hours of work at most of the elementary schools are from 9 to 12 and from 1 to 3.30, though in two of the schools the times were half an hour earlier than this. As a rule one had to allow at least a quarter of an hour for the children to settle down. Usually the attendance is only about three-quarters of those on roll but, perhaps it was due to the practice tests being supplied beforehand, the attendance for the tests was much better than this.

Testing a school was each time quite an adventure. The scripts for the two and a half days testing of two schools at a time which usually started on a Tuesday were packed in paper parcels into the boot of the car the previous day. The four assistants were picked up at convenient places and we drove out into the country along, for the most part, excellent roads, through very beautiful scenery. Sometimes through rice fields whose small squares of young grass-green were like the squares of paint in a paint box. And next to the rice fields, swamps of broom^{ωn} headed sedges lit by the early sun, clothing the mud beneath with a golden quilt. Then perhaps through an Indian village where the white washed and palm thatched mud dwellings of the poor coolie contrast with the pretentious concrete erections he builds when he becomes rich enough.

The road may lead through rain forests so matted and thick that they are almost dark inside and through some of which good progress would be made at the rate of a mile a day with a cutlass to cut the undergrowth. One may then emerge into one of the sugar cane districts. At the right season these gigantic grasses produce their flowers, called arrows, which are white plumes borne proudly by each member of the multitude. Perhaps at another time the road is blocked, if it is narrow, by water buffaloes drawing slowly~~but~~ powerfully their burden of cut canes to the nearest factory: humped black cows with horns like sickles.

The two schools we are looking for will not be more than a few miles apart, for we always take two together. They may be in a small town or village or sometimes almost alone in a forest so that one wonders where the children come from. As you enter the school a bell rings and all the children stand and say, "Good morning, Sir". It is a royal welcome and tends to be given each time you make your way in or out through the classrooms of those schools fortunate in possessing partitions. The children seem to like falling in with the head teacher's friendly drill, it is a diversion and most have not spoken to an Englishman before. Also there is a friendly and somewhat amused expression to be seen on the faces of some of the bolder children. This deference on the part of the children must not go to your head for as you are leaving in the car they have nicknames for all of us. Sometimes when the testing is finished you are called upon to 'say a few words'. These having been said, one head teacher then called upon the whole school

to sing a song for, or to, me. It was, "Drink to me only with thine eyes". After this display of affection during which I pondered the appropriateness of the song, followed hymns and the Lord's Prayer.

The head teachers, except in one Roman Catholic Girls' school where the head teacher was a nun, were none of them pure white. Some were apparently pure Negro or pure Indian and one was Chinese, the others were mixtures of these races with usually some European, Venezuelan, Portugese or Carib blood as well. In fact they were Trinidadians. As I have explained I made my first contact with a head teacher when I asked him permission to test the children. The next meeting was when I delivered the Practice Tests, but it was during the $2\frac{1}{2}$ days testing that we really got to know each other.

On the opposite page is given Mr. Murrell's time table. Mr. George's is very much the same but a slight modification was made so that the Links Apparatus could be demonstrated at each school. For the "11 Schools Experiment" the typical procedure was for me to leave Mr. Murrell with scripts at one school to give the verbal instructions with one of the office boys to assist him supervise, and Mr. George with scripts at the other with an assistant. It is a fact that the Englishman on first arriving in Trinidad does not understand the Trinidadian dialect, an example of which will be found in the last question of the last of the 19 tests. It is not surprising, therefore, that children who have not come into contact with Englishmen should not understand English as they speak it. Though I have lived

T I M E T A B L E Mr. Murrell

| A. M. (First Day) | Time allowed for test in minutes. Bracketed numbers are minutes for giving verbal instructions. | | TIME |
|-------------------------------|---|-------|-------|
| M. H. J. I. T. | 111 | = 111 | 9.15 |
| Num. II Series | 20 +(1) | = 21 | 11.11 |
| Doesn't Belong | 10 +(8) | = 18 | 11.37 |
| Lunch | | | 12.00 |
| P. M. | | | |
| Picture | 36 +(15) | = 51 | 1.15 |
| Space (Triangles) | 40 +(10) | = 50 | 2.06 |
| Synonyms | 33 +(1) | = 34 | 2.56 |
| | | | 3.30 |
| A. M. (Second Day) | | | |
| Proverbs | 50 | = 50 | 9.15 |
| Rows & Columns | 18 +(5) | = 23 | 10.10 |
| Pattern Completion | 10 | = 10 | 10.38 |
| Num. I Arith. Restorations | 35 +(1) | = 36 | 10.53 |
| Lunch | | | 11.34 |
| P. M. | | | |
| Links | 20 +(20) | = 40 | 1.15 |
| Recognition of Figures | 25 +(5) | = 30 | 2.01 |
| Space. 4 | 30 +(10) | = 40 | 2.36 |
| | | | 3.21 |
| A. M. (Third Day) | | | |
| English | 75 | = 75 | 9.15 |
| Arith. (Mechanical) | 40 | = 40 | 10.35 |
| Arith. (Problems) | 40 | = 40 | 11.20 |
| Lunch | | | 12.00 |

for 27 years in Trinidad, I must confess that I cannot speak Trinidadian, so it was evident that the tests would have to be administered by my assistants, whom I had carefully trained for this purpose. Mr. Murrell tended to put too much expression into what he said, Mr. George too little, but after a time I more or less equalized them.

While one of the first tests was in progress at one of the two schools visited in a day, and later in the other school, I made a rough plan of the desks, assigning in it numbers to each of the seats. The scripts were to be collected in the same order as the numbers showed in the plan. Then, when I received them back with the names of the children on them it was possible to relate a number on the plan with the name of a child. When I had completed the plan and either before or after the scripts had been collected I had a talk with the head teacher, or sometimes with a senior assistant if the head was not available, and asked him to help me with assigning to each child its racial composition on the 12-point scale already described. As a rule the teacher lived near the school and knew the children's parents, so that a fairly accurate estimate was made. Far from the teachers' demurring, they were very willing indeed to cooperate. I found a considerable amount of pride of race among them, so infectious was it that, isolated from other white men, at times I felt almost as if I was lacking in not possessing a pigmented skin. By now I can myself form an estimate of a child's racial composition by inspection which is very close to the teacher's. The racial composition of each child was placed opposite its number in the plan so that without the child being aware of its being the subject of dis-

cussion this information was obtained. In addition to estimating a child's racial make-up the head teacher provided me with its rank order in the class, its age from school records, any particular interests and his estimate on a 3-point scale of the parent's prosperity. On my own account I had taken note of the sex and whether writing was done with the left hand.

There is a strong tendency for Trinidad children to copy from each other. Only having had teaching experience in Trinidad I cannot tell whether this tendency is stronger here than elsewhere. A bright child frequently willingly helps its less bright neighbour, which makes copying more difficult to detect than if the dull ones were stealing answers. Some of the tests did not lend themselves to copying and during such tests marking of other scripts was done. As the scripts had been collected in the order in which the children sat it was frequently possible to spot two consecutive scripts with the same wrong answers. The children were warned that if two such scripts were found each of the pair would get no marks. This certainly acted as a deterrent. But nevertheless if such pairs of scripts were found a decision would have to be made about which child did the copying. If this could not be decided both would score 0 for the test. "c" was entered in the book where copying had taken place. I must here compliment one of the office boys, Placide, on his eagle eye for spotting cheats.

Another thing very common in Trinidad, and I suspect in English ^{and} too, is the prevalence of guessing. As is shown by an experiment I conducted with the boys of Q.R.C., in nearly all cases where a child does not know the correct answer it guesses. From

my teaching experience in Trinidad this seems the obvious thing for a child to do, but I know that there are some makers of tests who will not admit that guessing takes place to anything like the extent I have found it does.

The head teachers and s-enior assistants showed a keen interest in the testing and they were shown each test as it was set. In spite of ^{their} ~~the~~ almost universal wish to retain the s-scripts shown them, however, they were required to return them and to make no copies. As a result not a single script has left our possession. The head teachers, of course, expressed ^a desire to know the results of the tests and these were promised as soon as the marks were standardized and copies made. All of them have received the "Normalized Scores[#]" of their children arranged in alphabetical order in their standards.

The talks with the head teachers were by no means confined to the subject of mental testing. They are mature of mind and interested in education. But some of them are rather frustrated. In one of the schools in the centre of the Island there were the usual pictures of the Royal Family, Winston Churchill, Roosevelt and the Houses of Parliament. I asked the head teacher whether the children ever saw any other pictures. He did not think they had. Whether there were any local newspapers for the senior children? He said, "No". He held the view that of the children who learn to read, few after leaving school would come into contact with reading matter and that they would become almost as illiterate as if they had never been to school. A-nd this is my own experience. One of my servants, and she is

by no means exceptional, not only cannot read but when shown a perfectly naturalistic picture, will hold it upside down as likely as the right way up and will be as perplexed as the average person is when confronted with a cubist painting.

MARKING THE SCRIPTS FOR THE 11 SCHOOLS EXPERIMENT

Some of the marking was done while other tests which did not need much supervising were being given. The rest were marked on those days between the periods of visiting schools. In this way my four assistants, my wife and I succeeded in having all the 20 tests of all the schools marked a few days after the last school had been visited. The marking of a few tests at random was checked but there was not time for a complete checking. Each of us became specialists in the marking of certain tests. Marking keys were used which did not obscure the items so that after a short time the correct answers became memorized. This was found to be much quicker than using masks.

THE TESTS

TEST O. Moray House Junior Intelligence Test
(M.H.J.I.T.) 100 Items

This test was not given to Q.R.C. and, except for pages 7 and 8, it is not given here. It is an "omnibus test" constructed for 11-year-old children in the United Kingdom and, not being designed to measure a single ability, did not have a place in the battery of 19 tests. One reason for giving it to the children of the "11 Schools Experiment" was that it served as a good introduction of the tests to the children. Since some of the items are of the same kind as are found in later tests they serve as practice items.

The 12-year-old children of 2 schools were tested with the complete battery and this test helped in the decision to continue with the children of only the V, VI and VII standards in subsequent schools. The mean score in one of the two schools on this test with 26 12-year-olds was 50.0 and in the other with 9 12-year-olds was 24.9. It was observed, however, that the second school was not very inferior in the non-verbal tests but very much inferior in the verbal ones. Their mean in the "Proverbs" test was 0.2 as against the other school's 8.0. It was in fact in this second school that it was observed that the children could not read. It seemed clear that the children's low score in the second school in the M.H.J.I.T., could be explained by assuming that this test demanded the ability to read. It can be further argued that if all the children of the first school had been able to read with better comprehension

NOTE: In the Verbal Instructions for the tests
(p) stands for (pointing).

their score would have exceeded 50. On the basis of this and taking 50 to be the mean score of 11-year-old children in the United Kingdom (?) it cannot be argued that the intelligence of the 12-year-olds tested in Trinidad is inferior to that of children in U.K. But of course with such a small sample no arguments can significantly hold at all. So far as correlations of this test with others of the battery have been worked out it does seem to correlate with the tests of a verbal nature most.

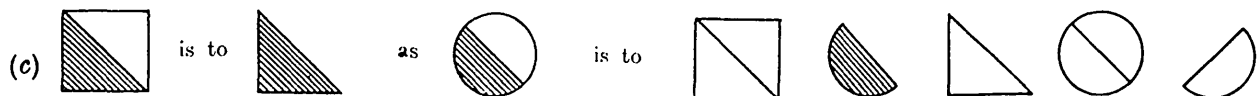
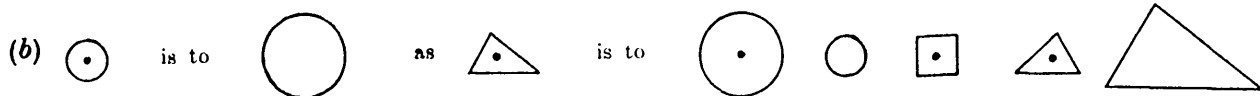
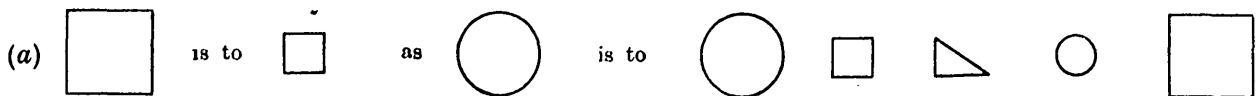
TEST 1. Geometrical Analogies (14 Items)
(Pages 7 and 8 of M.H.J.I.T.)

I constructed this test before I left Edinburgh in August 1947 and it was later made a part of M.H.J.I.T. The scores on it were abstracted from the scores on the whole test. The items are new and an original feature of the design of the test is that the third figure alone gives no clue as to the correct answer. Thus the relationship between the first two figures must be found before the correct answer is obtainable, carrying out the true principle of analogy. For example (a) of the practice examples does not conform to this: if the first two figures on the left, the large and the small square, were blocked out the circle alone would reduce the possible alternatives to only two, namely the large circle and the small one. Now take the easiest item in the test proper: the third figure, the semicircle with the curved side down, gives no clue at all as to the correct alternative to underline.

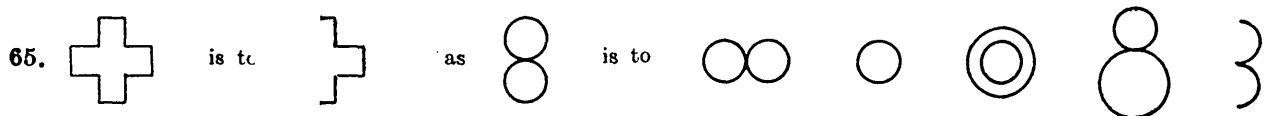
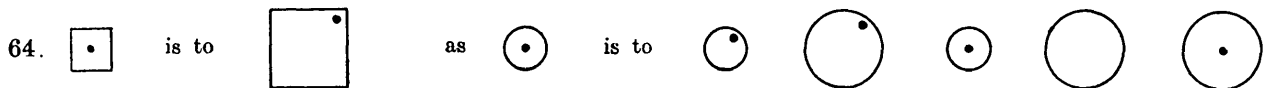
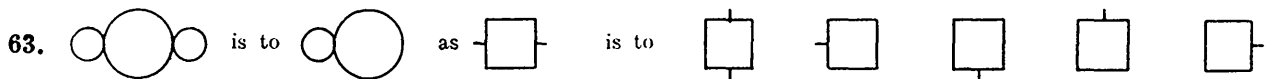
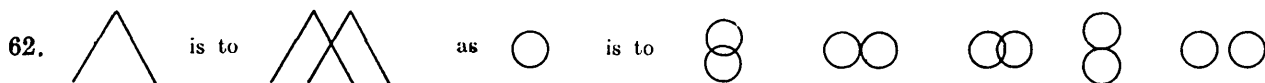
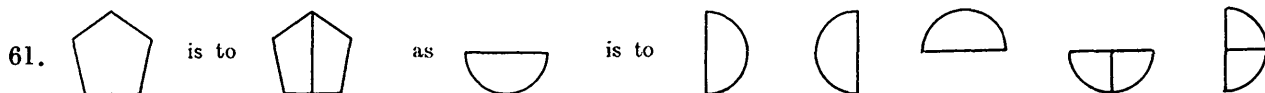
SECTION TWO

Examples

Answers.—Underline ONE



Answers.—Underline ONE



GO STRAIGHT ON TO THE NEXT PAGE

Look at this square :—

| | Columns | | |
|-------|---------|---|---|
| | 1 | 2 | 3 |
| Row X | S | E | Q |
| Row Y | E | A | R |
| Row Z | A | T | A |

In this square the rows read across. The rows are named X, Y and Z.

For example the first row SEQ is called Row X.

A column reads up and down. The columns are named 1, 2 and 3.

For example the first column SEA is called Column 1.

Now write in the brackets the correct answers to these questions.

56. Which letter comes most often inside the square? . . . (.....)
57. What is the name of the column which does not form a word when read downwards? . . . (.....)
58. What is the name of the row which forms a word? . . . (.....)
59. What is the name of the column which has not the letter E in it? . . . (.....)
60. Write the word formed by the letters in column 2 . . . (.....)

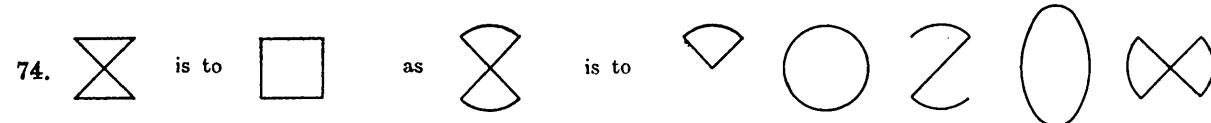
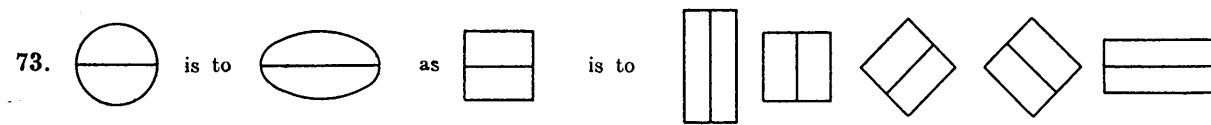
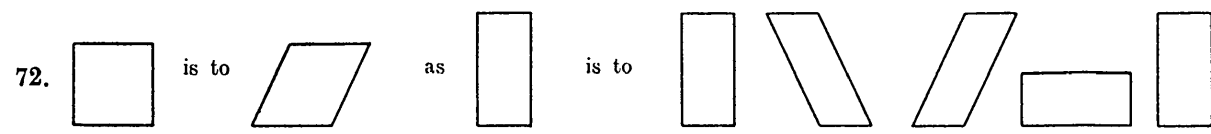
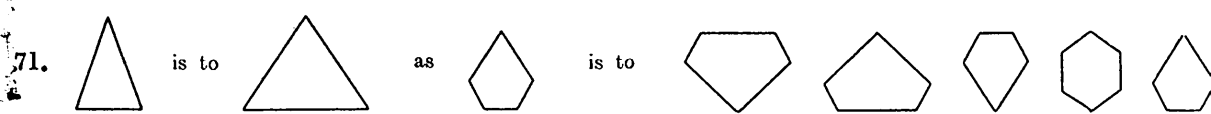
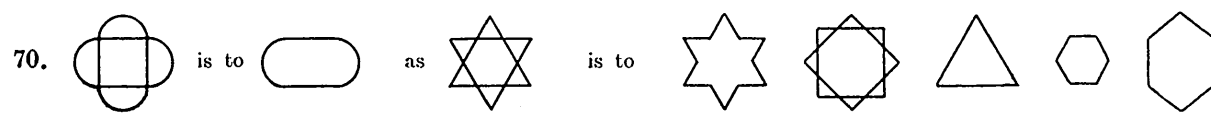
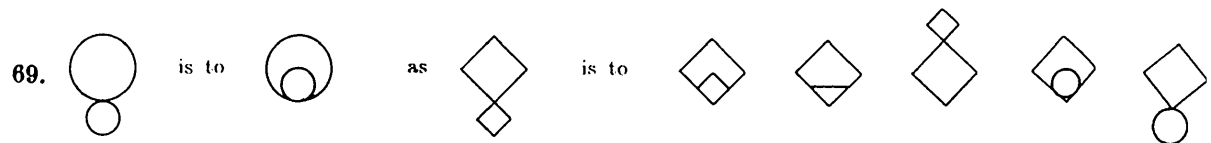
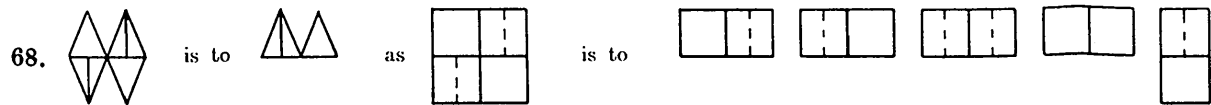
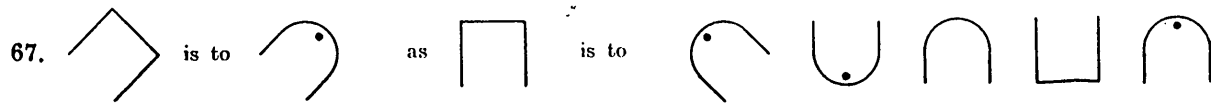
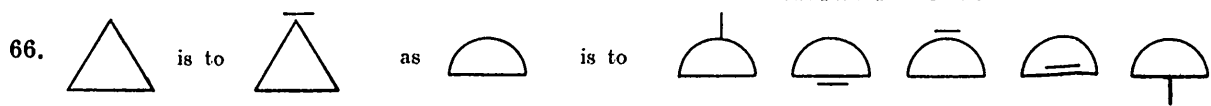
Look over your work until you are told to stop

END OF SECTION ONE

**DO NOT TURN OVER
UNTIL YOU ARE TOLD**

8

Answers.—Underline ONE



Look over your work until you are told to stop

DO NOT TURN OVER UNTIL YOU ARE TOLD

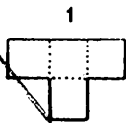
For items 61-74, we are indebted to Mr B. J. BDELL

You see drawings below which are made up of small squares like the first drawing, marked A. Point to the drawing marked A. You have to write down how many small squares, each the same size as A, would be needed to make up each drawing.

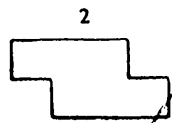
Look at the examples. - Point to number 1. It is made up from four small squares like A, so 4 is the answer. We have written 4 in the brackets under the drawing.

Now see if you can do examples 2 and 3. Write in the brackets the number of squares needed. Do not try any more just now.

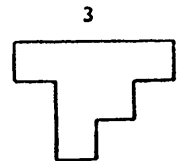
Examples



(...4...)

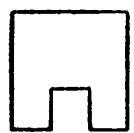


(.....)

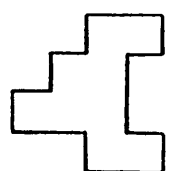


(.....)

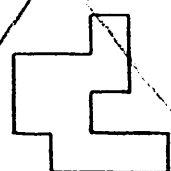
DO NOT GO ON TO THE NEXT DRAWINGS UNTIL YOU ARE TOLD



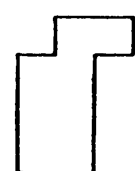
75. (.....)



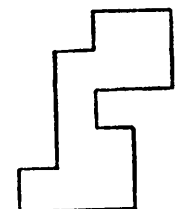
76. (.....)



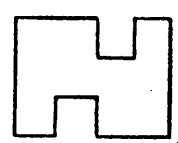
77. (.....)



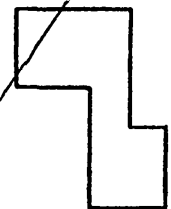
78. (.....)



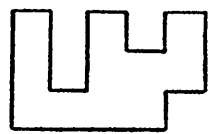
79. (.....)



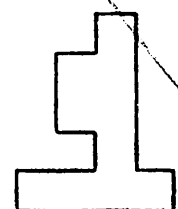
80. (.....)



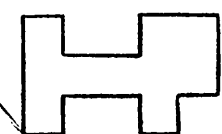
81. (.....)



82. (.....)



83. (.....)



84. (.....)

Look over your answers until you are told to stop

DO NOT TURN OVER UNTIL YOU ARE TOLD

Does not Belong (Geometrical) set to 409 boys of Queen's Royal College (ages 10+ to 18+) on 23rd., January 1948.

53 items, each consisting of 6 geometrical figures, were presented in booklets. Verbal instructions were read by supervisors, in addition and in case children wished to refer to them, instructions were printed on the covers of the booklets. The children were instructed that, "In each row (item) there are 6 drawings. Five of these have something alike about them, but there is one which has not got this. The puzzle is to try to find out which is the drawing in each row which has not got the thing the other five drawings have, and to underline this drawing." In the verbal instructions Item Nos. 1, 2 & 5 were worked out as examples. 25 minutes was allowed. This length of time proved adequate. The test was not intended to be a speed test. However, one of the supervisors regarded it as such and timed the boys of his form with the boys' knowledge. This form, and three others, to determin^e practice effect, were/s-et the test again two weeks later. After deducting the practice effect the boys who had regarded the test as a speed test were found to have obtained scores not significantly differ^en^t from what they had obtained before, so that their original scores were allowed to stand.

ANALYSIS

The number of times each wrong response was made was determined. If a particular wrong response to an item was given in a large number of cases the item was examined for an alternative solution, and, if one was found, the item was discarded.

Answer Patterns, taking each age group separately and also amalgamating 10 and 11 year-olds as these had small numbers of children, were made and facility values (proportion of children giving correct response) and efficiency coefficients (using total score as criterion) were determined for each item left in. Facility values were also determined for the whole school and the items ranked in order of difficulty. Those items which for no age group had facility values between .8 and .2 or efficiency value less than .54 (Item 25 with efficiencies of .33 and .32 for 10, 11 and 12 year-olds was left in) were discarded as being too easy, too difficult or correlating too little with the criterion. However, this does not mean that items which had facility values outside these limits or efficiency coefficients below ^{.54} ~~.54~~ for any age group were necessarily discarded, provided that for one age group at least they were satisfactory.

As a result of this 14 of the easiest items were found suitable for the 10, 11 & 12 year-olds; 6 of the easiest were not suitable as tests for the 13, 14 & 15 year-olds but the 2 next most difficult items were found suitable, making 10 items suitable as tests for the 13, 14 & 15 year-olds; the 2 easiest items of these were found unsuitable as tests for the 16, 17 & 18 year-olds and the 2 next most difficult items were added, making 10 items suitable as tests for the 16, 17 & 18 year-olds. So that altogether of the 53 items presented only 18 remained: (re-numbering) Nos 1 - 6 suitable for ages, 10 - 12, 7 & 8 suitable for ages 10 - 15, 9 - 14 suitable for all ages, 15 - 18 suitable for ages 13 - 18, 17 & 18 suitable for ages 16 - 18.

But though an item may function efficiently through a particular^{ar} range of ages it was desired that each child of the school should have the opportunity of doing every item - a child of age 10 with the brain of a child of 16 should not be handicapped by not being allowed to attempt the items unsuitable for the 10 - 12 age groups to which he belongs. Nor should a child of 16 with the brain of a child of 10 not attempt the tests suitable for the 10 - 12 age groups. So that it was decided that the older boys should count all the correct responses to items too easy for their age groups, though it is to be borne in mind that only 10 of these items (or 14 if he fall within the 10 - 12 mental age groups) are testing him efficiently. The problem is not so easy when it comes to the younger boys. When an item becomes hard the probability of a correct response being the result of guessing is increased. It is obvious that if the probability of guessing correctly is evenly distributed among the 6 alternatives of an item and the facility value is $1/6$ the item is valueless. It, therefore, became necessary to disallow correct responses to the more difficult items when these were probably the result of guessing.

The following gives the means of scores obtained on items 1 - 14 (the last which is suitable for all age groups):

| Age groups | Mean | Mid point between means |
|------------|------|-------------------------|
| 16, 17, 18 | 11.4 | |
| 13, 14, 15 | 10.3 | 10.85 |
| 10, 11, 12 | 7.8 | 9.05 |

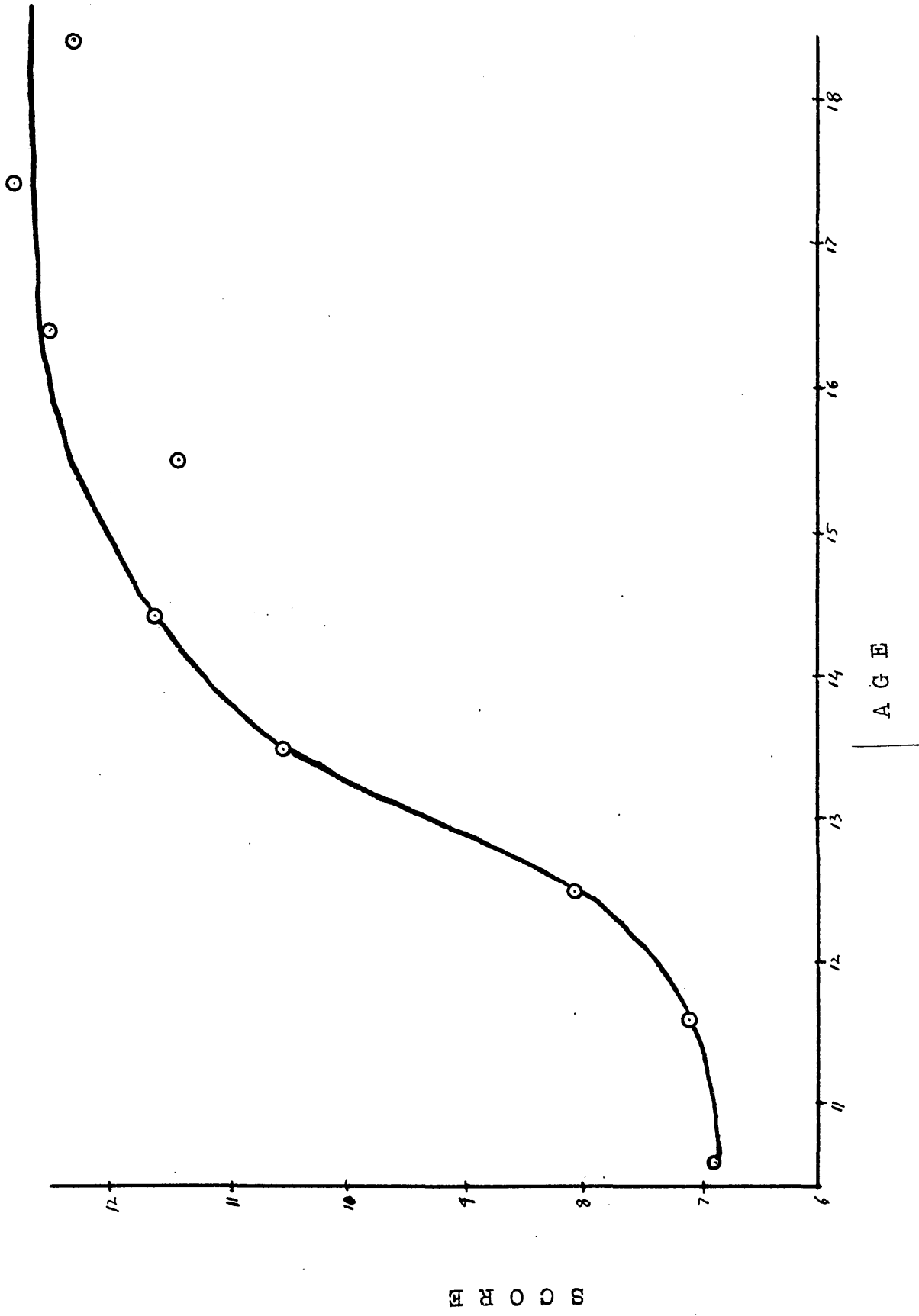
So that if, for instance, a child scored 8 out of 14 his score would be near to the mean of the 10 - 12 year age groups, and it has been seen that these are not efficiently tested by allowing them to do items 14 - 18. He should, therefore, have any correct responses within this range cancelled. Accordingly the following scheme of marking was adopted: For items 1 - 14 and a score equal to or less than

| | | | | | | | | | |
|----|--------|---------|-----------|----|-------|-----|-----|-----|----|
| 10 | cancel | correct | responses | to | items | 17, | 18 | | |
| 9 | " | " | " | " | " | 16, | 17, | 18 | |
| 8 | " | " | " | " | " | 15, | 16, | 17, | 18 |

The mean ages of each year group and the mean scores using the above scheme were determined and plotted against each other in the graph on the opposite page. The mean score for the 15-year-age group was found to be significantly lower than expected from the general trend of the curve^{ve}.

This is possibly to be accounted for by the changing types of entrance exams to the school set in the past.

New facility values were next found for the 18 items based on, not the number from the whole passing an item, but on the unweighted facility values of each of the following age groups: 10 + 12, * 12, 13, 14, 16 + 17 + 18 (omitting age group 15 as it seemed to be anomalous), for each of these composite age groups would thus be made to contribute equally to the estimates of facility of the items. Otherwise, for instance, the large number of children of 16 - 18 would mask the true facility of the easier items. The order of difficulty of the items was slightly modified by this procedure and they were accordingly re-numbered again in order of difficulty.

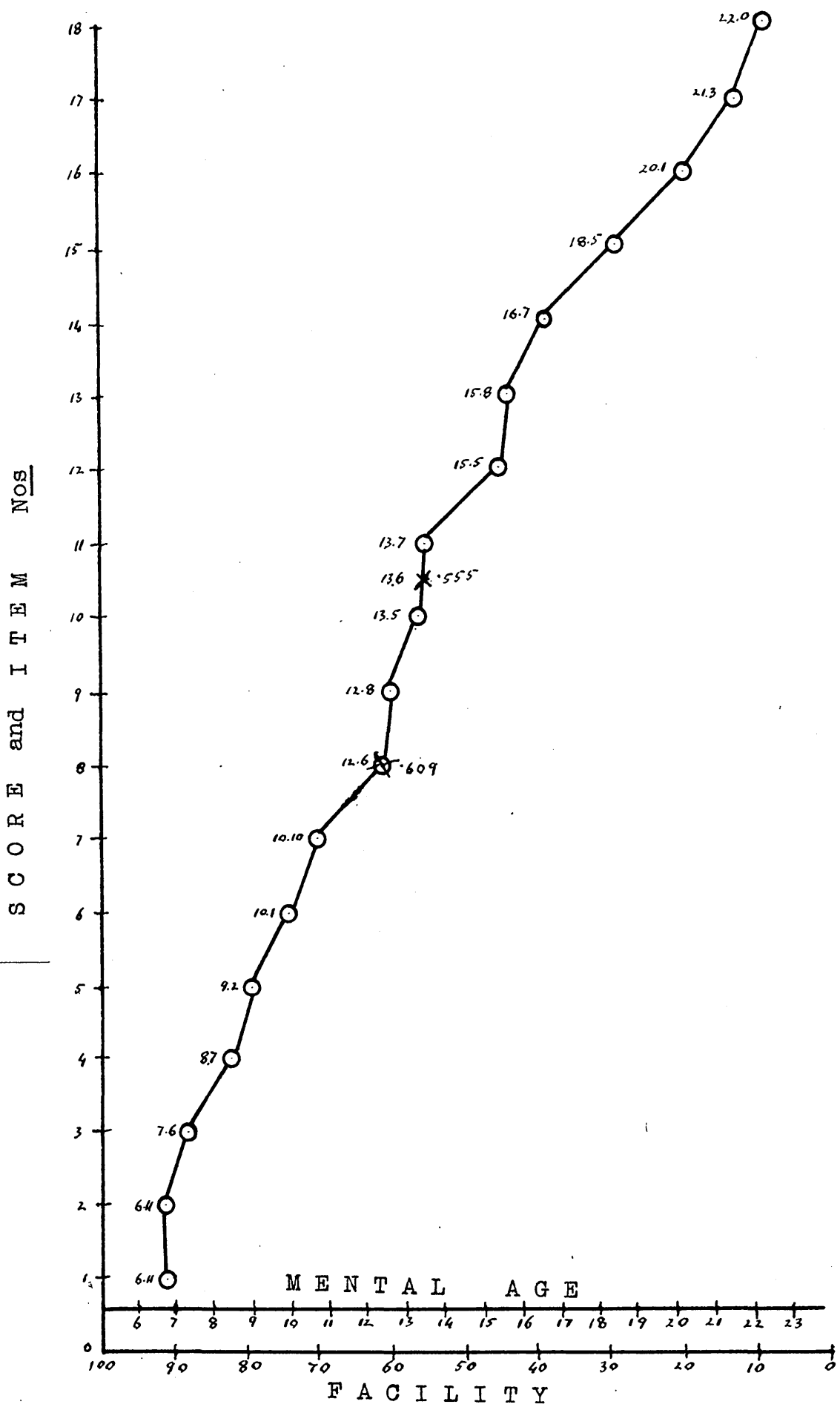


Determination of Mental Ages and I.Q.'s

From the school point of view Mental Ages are probably of more interest to the teachers than I. Q.'s and the latter mean more when they are in reality quotients of Mental Age divided by Chronological Age rather than when they are taken relative to an arbitrary mean and an arbitrary standard deviation. Accordingly an attempt was made to determine these. It should be emphasised that the Mental Ages and I. Q.'s will be those of the population of Queen's Royal College. It may well be that this is not representative of the population of other secondary schools and it almost certainly will not be the same as the population of Trinidad. The item numbers were plotted against the facility values (arranged in diminishing order). The point corresponding to Item No. 14 was found to lie to the left of the line representing the general trend, and it was decided to add to the scheme of marking: "equal to or less than 7 cancel correct responses to items 14, 15, 16, 17, 18". This lowered the facility value of Item No. 14 with a slight rearrangement of items 12, 13 & 14. A final re-numbering of items was then done in which A, B, C, D, E were substituted for items 14, 15, 16, 17, 18 for the sake of making clear to those marking the test in the future which correct responses are liable to be cancelled. The amended scheme thus becomes: For items 1 - A and a score equal to or less than

| | | | | | | |
|----|--------|---------|-----------|----|-------|---------------|
| 10 | cancel | correct | responses | to | items | D, E |
| 9 | " | " | " | " | " | C, D, E |
| 8 | " | " | " | " | " | B, C, D, E |
| 7 | " | " | " | " | " | A, B, C, D, E |

The graph on the opposite page shows Item Nos. Plotted against the final facility values (arranged



in diminishing order).

The assumption may be made that the average child scoring, say, 9 answers all the items 1 - 9 and no more. That this is not so in the majority of cases is simply an instance of the fact that the average child is hard to find. The ordinates in the graph are, therefore, taken to represent also the s-cores. Thus the average child of 13 (mean 13-6) who is found to have a mean score of 10.55 will be represented on the graph by the point "13-6, .555" (.555 being the facility value corresponding to a score of 10.55) and, being the average child, his Mental Age is also 13-6. Also the average child of 12 (mean 12-6) who is found to have a mean score of 8.09 will be represented on the graph by the point "12-6, .609" and his Mental Age is 12-6. Thus in one year the average child increases in mental power to the extent of being able to perform a test $.609 - .555 = .054$ more difficult in facility value. A difference of .054 in facility value is, therefore, taken to represent an increase or decrease of one year of mental age. On this basis the Mental Age scale is marked off in the graph, and the Mental Ages corresponding to each score made. These Mental Ages are entered on the graph at its points of construction. The mean score of age groups 16 - 18 whose scores do not differ very much is 12.52. This corresponds on the graph to a Mental Age of 15:7. This age was, therefore, taken to be the average adult mental age. Mental ages greater than this are, of course, artificial, in that they are not based directly upon performances of average persons of those chronological ages.

Yet, by using the divisor 15:7 one may obtain I. Q's consistent with those obtained at earlier ages.

In order to assist in the computation of the Mental Ages and I. Q's of the 409 boys and for future use, the I. Q's being of the Binet type (i. e. M. A. / C. A.), a nomogram was constructed from which, knowing a child's score on the test and his chronological age in years and months, his Mental Age and I. Q. are read off at a glance.

Reliability of the Test

The "split-half" method was employed, the odd and even items being correlated, the coefficient obtained being corrected to give an estimate for the whole test by the Spearman-Brown formula.

In order to obviate the effect of age to a great extent upon the correlations these were done for each group separately (putting 10 & 11 year-olds together however) corrected by the Spearman-Brown formula and averaged by Fisher's "z technique".

This was thought to be a quicker method than

"partialling out" age and probably nearly as good.

The average reliability coefficient was found to be .74. Considering that only 14 items were being efficiently used for testing the 10 - 12 year groups and only 10 for the 13 - 18 year groups this reliability is not too low.

The mean standard deviation of score was found to be about 3. Hence, from $P.E. = .6745 s\sqrt{(1 - r_{11})}$, the P. E. works out to be ± 1 . Hence, from the tables of Normal Frequency Distribution:

| | | |
|--------------|--------|-----------------|
| $P(e > 1)$ | = .5 | = $\frac{1}{2}$ |
| $P(e > 2)$ | = .18 | = 1/5.6 |
| $P(e > 3)$ | = .043 | = 1/23 |
| $P(e > 4)$ | = .007 | = 1/143 |

Where the first line reads: "The probability of the error of score being either greater than +1 or less than -1 is a half". Or, taking the third line, and supposing a score of 10 to have been made: if we were to set to the same boys many other forms of the same test (correcting for any practice effect) once in 23 times would the boy scoring 10 be expected to score less than 7 or more than 13. (The probability that he would score in a single attempt one of these alternatives, say more than 13, is, of course, 1/46). These values of the probability are only approximate and cannot be taken as at all accurate with very small or very large scores.

Distribution of I. Q.'s.

The distribution of the 409 I. Q.'s shown in the graph on the opposite page is very nearly normal. The mean I. Q. is 100.5, the Standard Deviation (after applying Sheppard's correction) is 20.67 and the coefficient of skewness β_1 is .026.

Connection between I. Q.'s obtained and I. Q.'s based on a mean of 100 and Standard Deviation 15

Frequently nowadays and partly on account of the difficulty of obtaining reliable Mental Ages and partly for uniformity I. Q.'s have been made to lose their fundamental meaning as quotients and are taken to be standard scores with mean = 100 and Standard Deviation = 15. To relate the I. Q.'s obtained here (I.Q₁) with such I. Q.'s (I.Q₂) the following formula is to be used:

$$I. Q_2 = 100 + 15 (I. Q_1 - 100.5) / 20.67$$

The following table gives the conversions worked out for every 5th., I. Q:



H I S T O G R A M O F I . Q ' s

| I.Q. | I.Q ₂ | I.Q. | I.Q ₂ |
|------|------------------|------|------------------|
| 160 | 143 | 100 | 100 |
| 155 | 140 | 95 | 96 |
| 150 | 136 | 90 | 92 |
| 145 | 132 | 85 | 89 |
| 140 | 129 | 80 | 85 |
| 135 | 125 | 75 | 82 |
| 130 | 121 | 70 | 78 |
| 125 | 118 | 65 | 74 |
| 120 | 114 | 60 | 71 |
| 115 | 111 | 55 | 67 |
| 110 | 107 | 50 | 63 |
| 105 | 103 | 45 | 60 |
| | | 40 | 56 |

It will be observed that the higher I.Q.'s become smaller and the lower ones greater.

Note on the Efficiency of Difficult Items

As was pointed out when the probability of guessing correctly is equally distributed among the 6 alternatives and when the facility value is about $1/6$ the item is valueless, and very nearly so if it is less than .2. It would not be so if the children omitted such an item if they could not reason out the correct answer but actually it was found that very few did omit any items. Therefore it would seem to be a necessary condition for an item with facility value ^{of} ~~of~~ about .2 to possess a high efficiency that the probability of guessing correctly should not be distributed equally among the six alternatives, i.e. that the item shall include one or more ^r wrong and very tempting alternatives (making sure that these are indeed wrong). For instance in Item 42 (original numbering):

| Age Group | Facility Value | Efficiency Coefficient |
|-----------|----------------|------------------------|
| 16 | .24 | .28 |
| 17 | .18 | .46 |
| 18 | .32 | .88 |

the fairly good efficiency of .46 is to ^{be} ~~be~~ accounted for by the unequal distribution of the frequencies of the wrong responses which were 8, 140, 17, 34, 112 (the 3rd., drawing being the correct one to underline). Evidently, for some unknown reason the 2nd., and 5th., alternatives proved tempting.



Again Item (original numbering), another difficult item, had frequencies of 12, 129, 22, 63, 34.

Here the second alternative was very attractive. On the other hand an item like Item 52 (original numbering) is certainly very hard and has baffled all adults to whom it has been shown and who were asked to give the reason for their answers. Its efficiency was too low and it had to be discarded. The distribution of wrong responses was 37, 66, 57, 26, 21: too even and not providing a sufficiently tempting ^rwrong response.

It would obviate the inaccuracy inherent in Multiple Choice Tests due to guessing if the probability of guessing a correct response were lessened by each item possessing two correct responses both of which must be given for a score to be made. But the construction of such items is difficult in most cases.

Norms

The following table gives the mean score for the ages given obtained from the best curve through points plotted on a Score-Age graph, the mean standard deviation per year group was 2.94*:

| Age | Score on 18 Items |
|------|-------------------|
| 11.0 | 7.5 |
| 12.0 | 8.6 |
| 13.0 | 9.7 |
| 14.0 | 10.8 |
| 15.0 | 11.7 |
| 16.0 | 12.4 |
| 17.0 | 12.6 |
| 18.0 | 12.7 |

* A score of x S.D's above the mean corresponds to a "percentile score" of y:

| | | | |
|----------------|----|-----------------|----|
| $2\frac{1}{2}$ | 99 | $-\frac{1}{2}$ | 31 |
| 2 | 97 | -1 | 16 |
| $1\frac{1}{2}$ | 93 | $-1\frac{1}{2}$ | 7 |
| 1 | 84 | -2 | 3 |
| $\frac{1}{2}$ | 69 | $-2\frac{1}{2}$ | 1 |
| 0 | 50 | | |

By this is meant that if a person makes a percentile score of 84, say, his place on a list of 100 boys of the same age would be 16th., or 84% would score less than he.

VERBAL INSTRUCTIONS.

See that you have _____ copies of booklets. Say to class, "Is there anyone who has not got a sharp pencil?" If there is anyone lend him one. Say to class, "You will each be given a little book of test puzzles, do not open it until you are told." Give out booklets. Say to class, "On the line marked 'Name' write your full name (I mean all your names); write your surname last and write in block letters (these are capital letters) so that they may be easily read. On the line marked 'Age' write in figures your age before the word 'years'. On the line marked 'Date of birthday' write the date of the month, and the month of your birthday. On the line marked 'Form' write down the form you are in at school.

"Now open the book at the first page. The test has a lot of numbered rows of drawings. In each row there are 6 drawings; five of these have something alike about them but there is one which has not got this. The puzzle is to try to find out which is the drawing in each row which has not got the thing the other five drawings have, and to underline this drawing. Let us look at No. 1. Here we have 6 drawings of squares; five of them are shaded but one is not so we draw a line under the square which is not shaded. Will you all do that. Someone might say, 'Why not put a line under the largest square because there is only one largest square.' But this would be wrong for the question is to find out how five squares are alike, and to underline the one which has not got this likeness. "Now look at No. 2. All the lines except one are standing upright but the last one is lying down so this is the one we underline. Will you all do this. Now look at No. 5. Each drawing has a cross on top of it, so that cannot have anything to do with finding the right answer. But we notice that all the drawings except the first are made up of straight lines so we underline the first drawing. Will you all do this. Again I must tell you that it would be wrong to underline the triangle with the cross on top of it saying that this the only one with three sides, because we might equally well underline the diamond with the cross on top of it saying that it is the only one with four sides and so on."

Go round the class and see that each child has underlined drawings of items Nos. 1, 2, and 5 correctly. Give explanations where necessary then say: "Be careful not to underline two drawings in any one row as this row will be counted as wrong. If you make a mistake and want to change your mind, clearly cross the line you have drawn like this." Draw a line on the blackboard and cross it out like this: ~~++++++~~

"Rows Nos. 16, 41 and 48 have been crossed out. Do not do these rows. You need not hurry as you will be given 25 minutes to the test which is plenty of time. Nevertheless, do not waste a long time over any one row but get on with the next. When I tell you to start, start with No.3 then go on to No.4; No.5 you have already done so go on with No.6 and try to get as far as you can. The rows become more difficult as you go on. You may not ask any questions at all during the test, but if you have forgotten what you have been told you may look at the cover of your book where you will find the instructions printed. When you have finished hold up your hand. Are you all ready? START!"

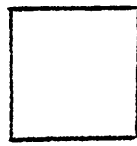
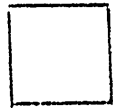
Make a record, for future timing of the test, of the length of time taken by the boy who is 3rd. in finishing. Take time of starting and at 20 minutes say "5 minutes more". At 24 minutes say "1 minute more". At 25 minutes say "time up", and see that no more writing is done. Collect booklets alphabetically putting blanks (if any) on top and see that you get back _____ copies.

For marking key see the bottom of page 44

For Norms see the bottom of page 51

Items with crosses against them to be omitted

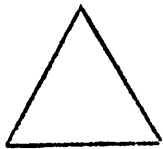
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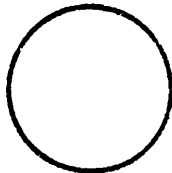
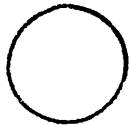
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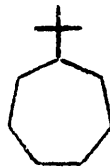
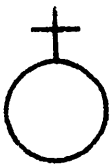
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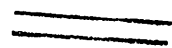
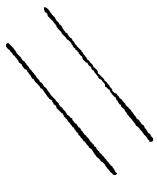
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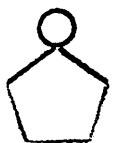
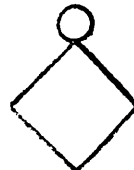
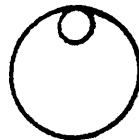
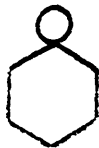
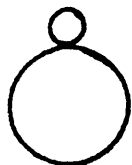
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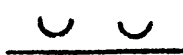
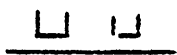
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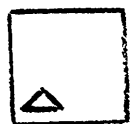
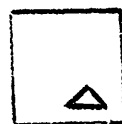
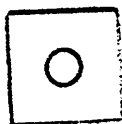
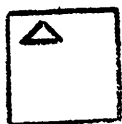
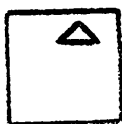
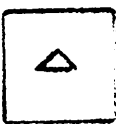
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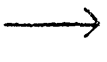
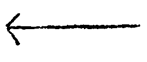
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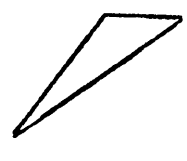
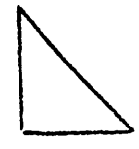
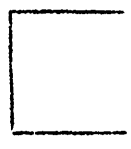
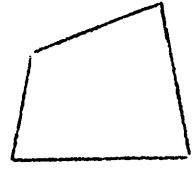
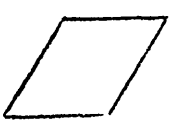
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10x →



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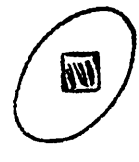
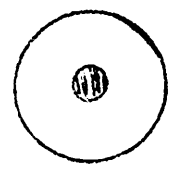
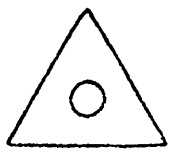
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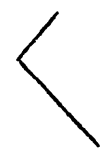
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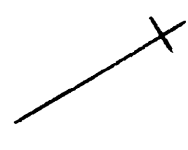
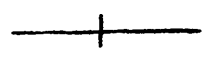
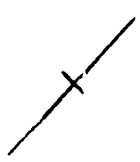
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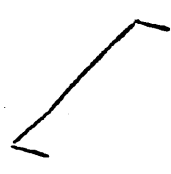
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16x

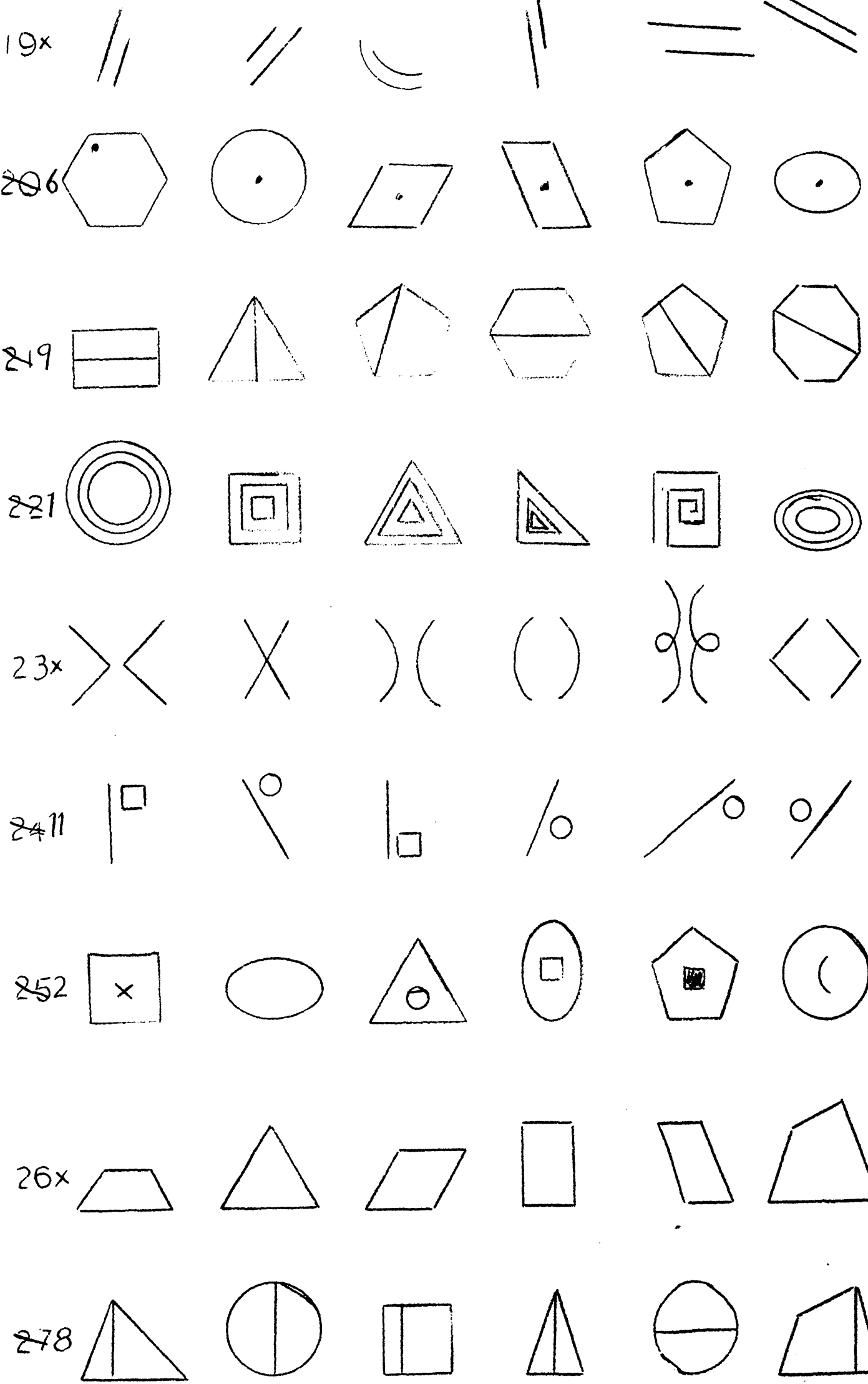


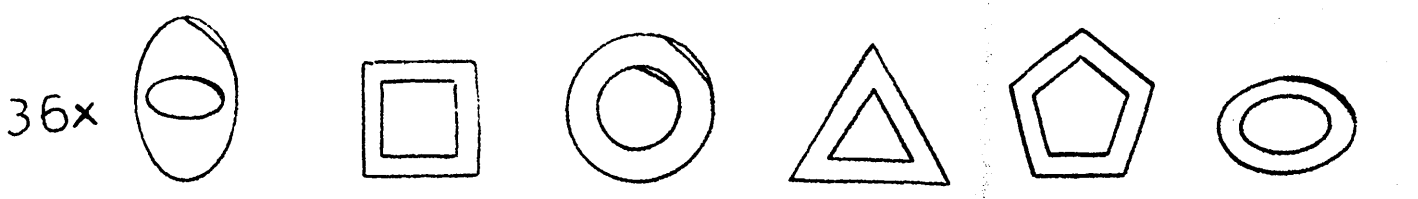
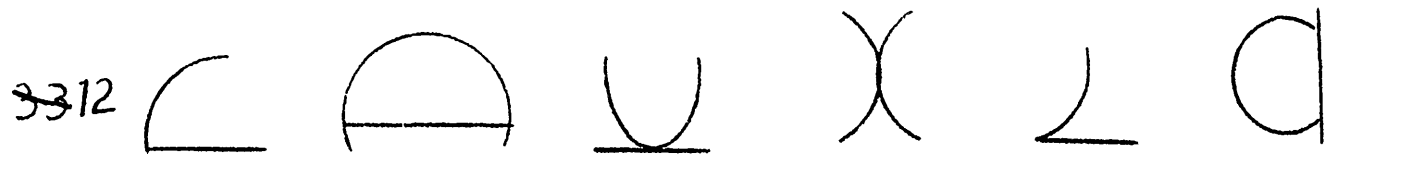
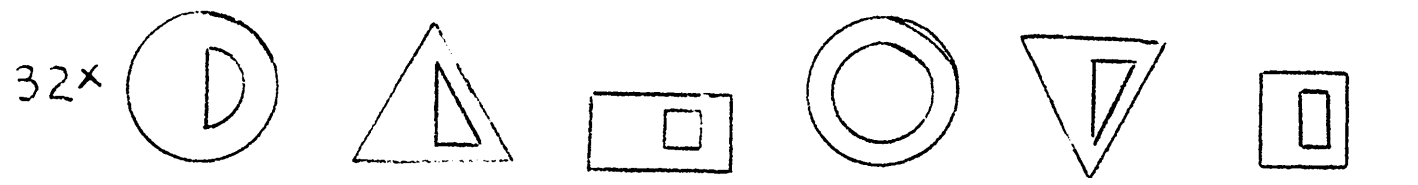
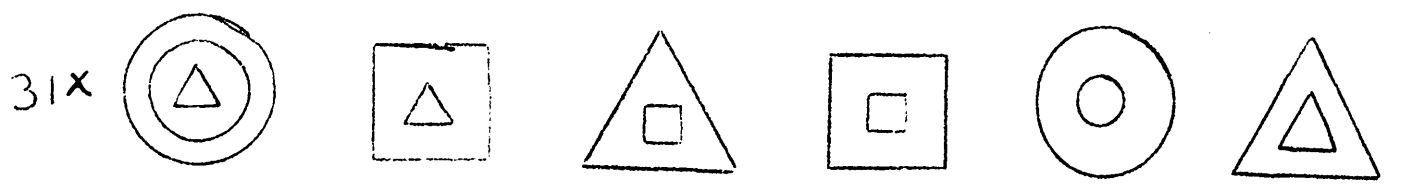
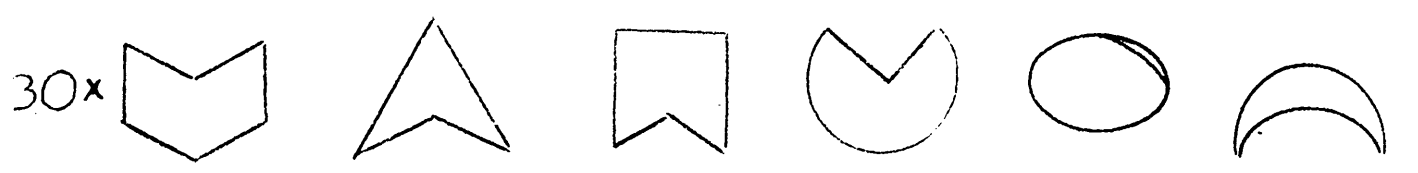
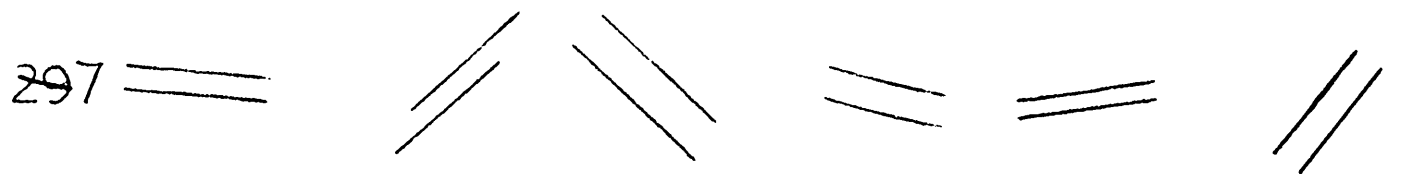
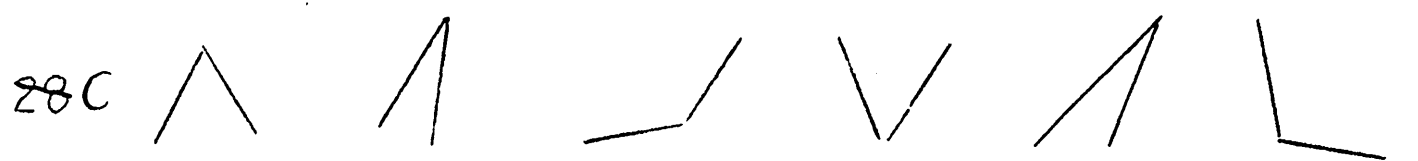
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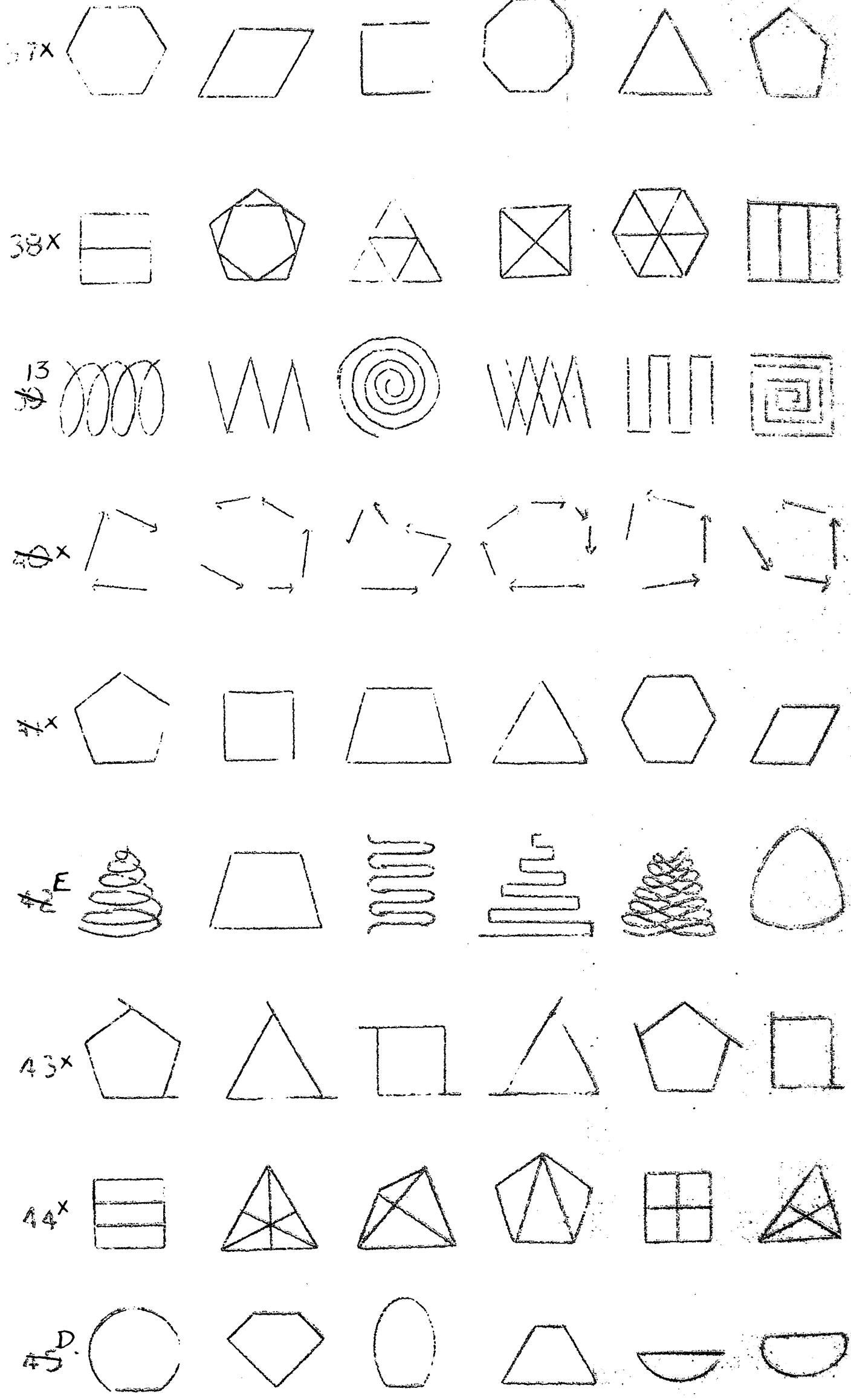


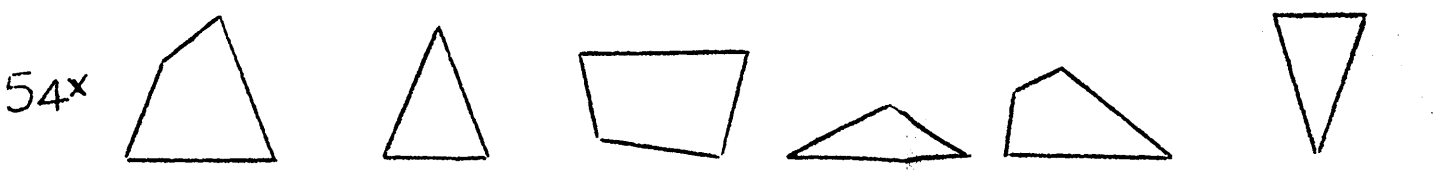
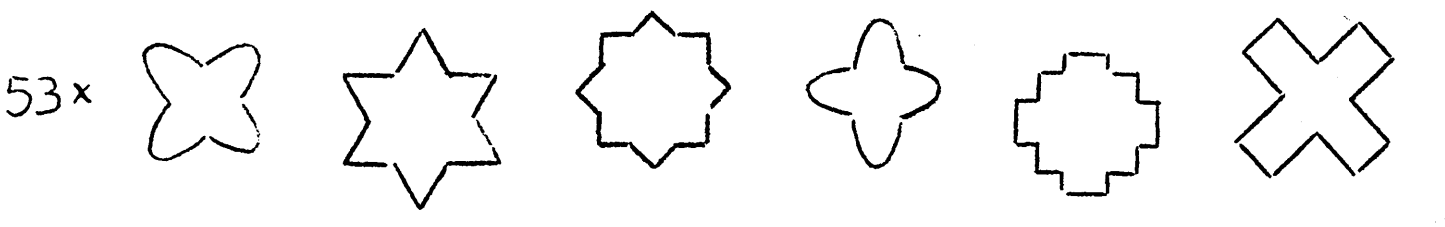
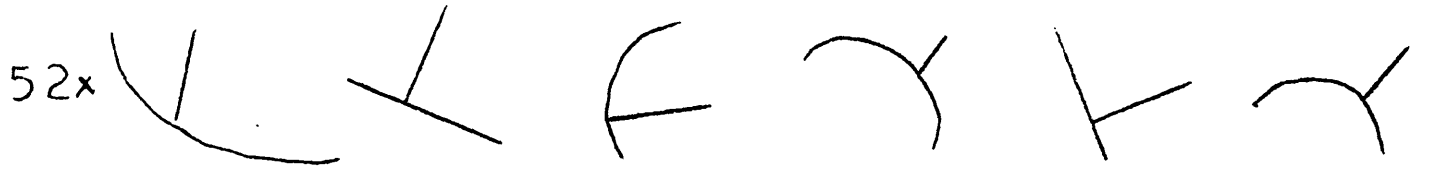
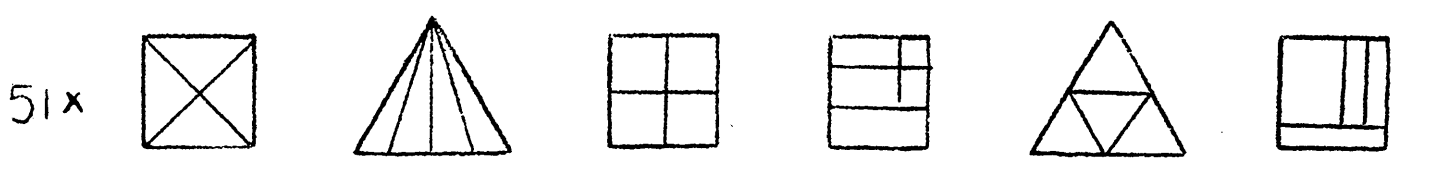
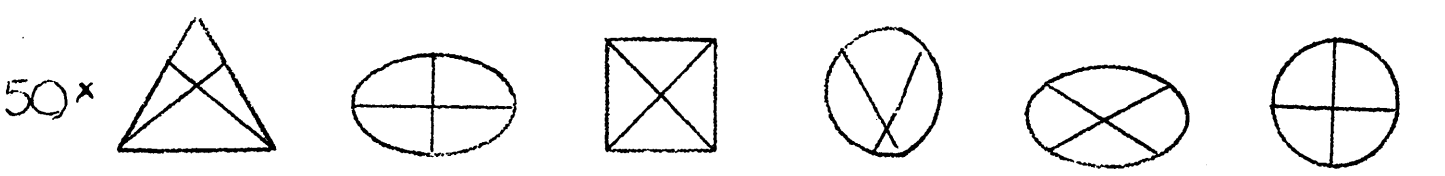
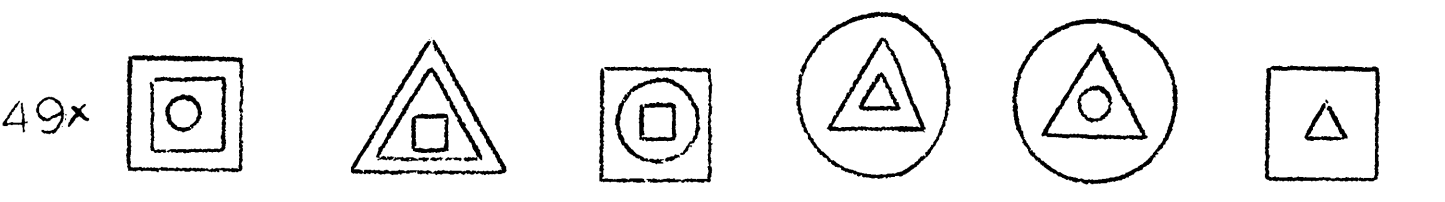
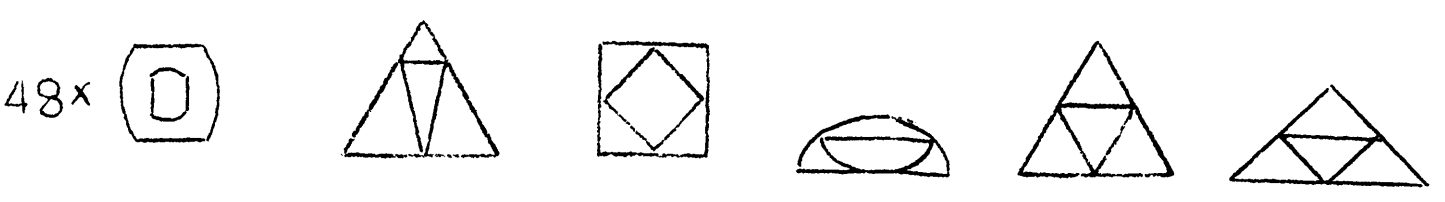
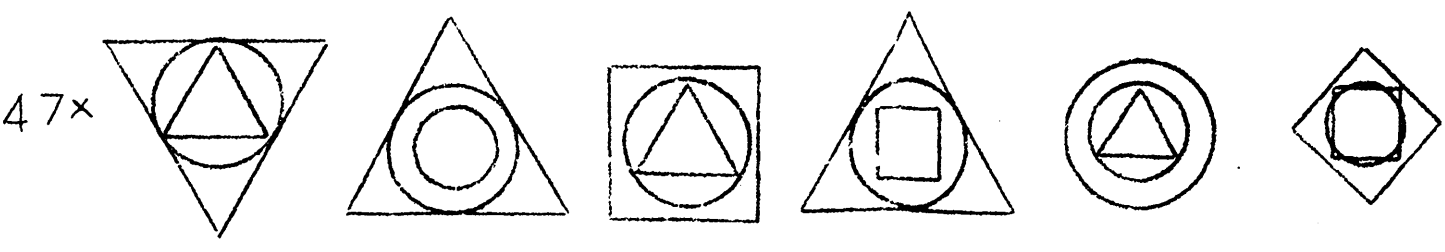
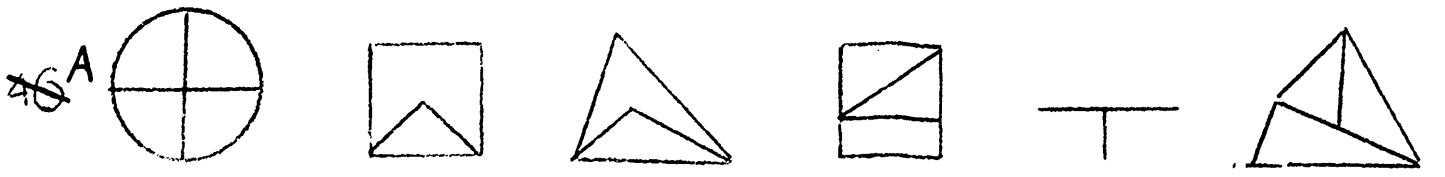
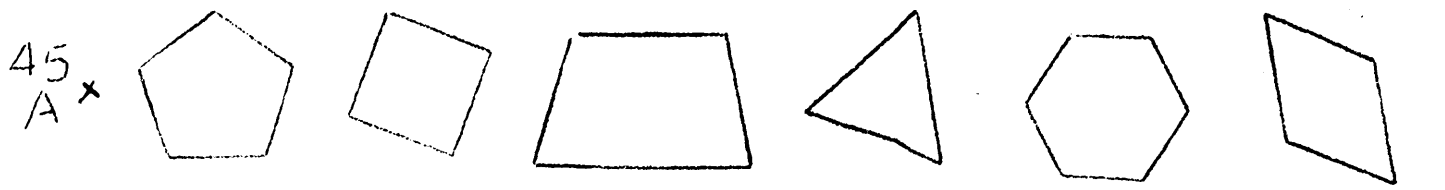
18x











TEST 2. Does not Belong (Geometrical)**"11 Schools Experiment" (29 Items)**

From the experience gained from the Q. R. C. results a shortened version of the test was prepared for the elementary schools.

Verbal Instructions

Give out booklets. Say to class, "Fill in the cover of your book as your teacher has shown you. Now open the book at the first page. The rows numbered 1, 2 & 3 your teacher has already shown you how to do. In No. 1 five squares are shaded so we put a line under the one that is not, like this (p). You must remember that we must always find out what is alike in five of the drawings and underline the one which has not got this likeness. It would be wrong to underline this drawing (p) because it is the largest or this one (p) because it is the smallest. In No. 2 five lines are standing up but this first one (p) is lying down so we put a line under the last one. In No. 3 all of these (p) are made with straight lines and have a cross on top, but this one (p) is made with a round line and has a cross on top so we underline it. When I tell you to start I want you to go on and do each of the rows numbered 4 to 32 of this little book. You will have 10 minutes to do this test. Are you all ready? **START!** At 8 minutes say "2 minutes more", at 10 minutes say "Time up" and see that no more writing is done. Collect booklets.

TEST, 2

DOES NOT BELONG (GEOMETRICAL)

NAME Christian names in BLOCK LETTERS Surname (Title)

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY
Date Month

STANDARD _____ SCHOOL _____

10
TIME ALLOWED : ~~15~~ MINUTES

INSTRUCTIONS

In each row there are 6 drawings. Five of these have something alike about them but there is one which has not got this. The puzzle is to try to find out which is the drawing in each row which has not got the thing the other five drawings have, and to underline this drawing.

Let us look at No. 1. Here we have 6 drawings of squares. Five of them are shaded but one is not; so we draw a line under the square which is not shaded. Someone might say, "Why not put a line under the largest square because there is only one largest square!" But this would be wrong, for the question is to find out how five squares are alike, and to underline the one which has not got this likeness.

Be careful not to underline two drawings in any one row, as this row will be counted as wrong. If you make a mistake and want to change your mind clearly cross out the line you have drawn like this:

#####

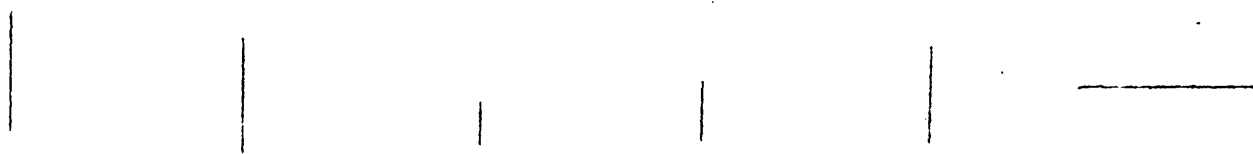
You need not hurry as you will be given 15 minutes to do the test which is plenty of time. Nevertheless do not waste a long time over any one row but get on with the next.

| | | | |
|----------|--------------|-------|-------|
| | Raw SCORE on | Items | _____ |
| | " " " | " | _____ |
| Standard | " " | " | _____ |

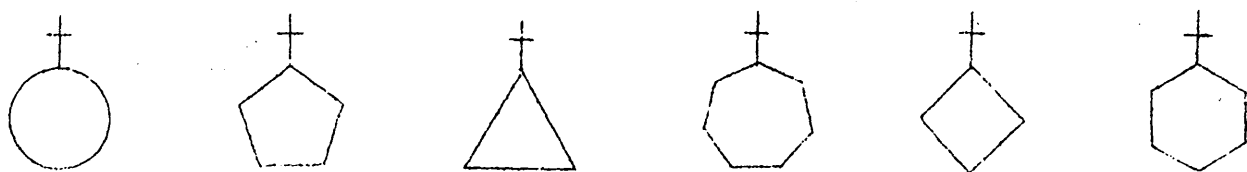
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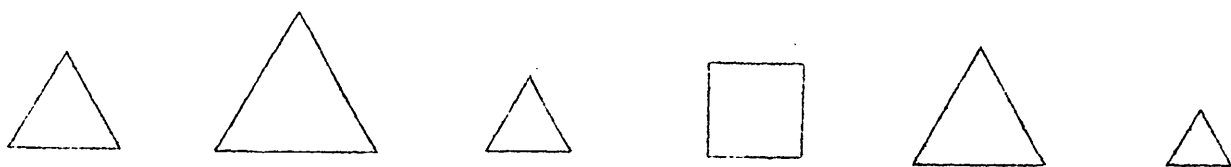
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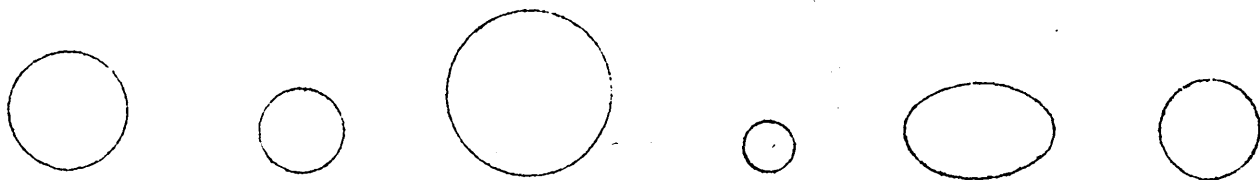
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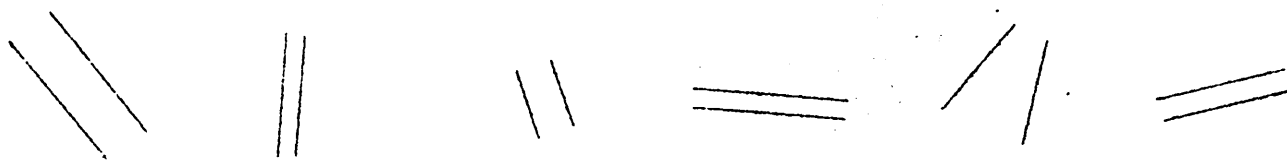
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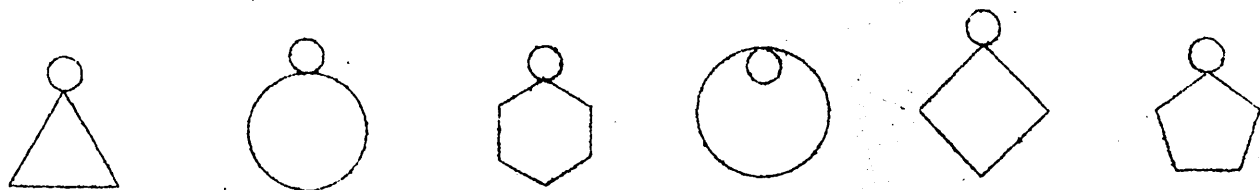
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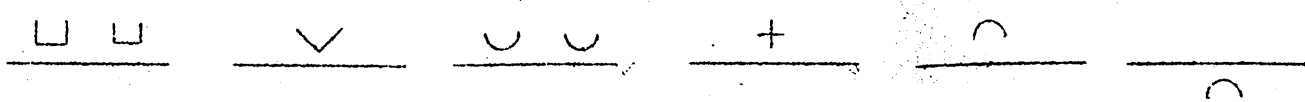
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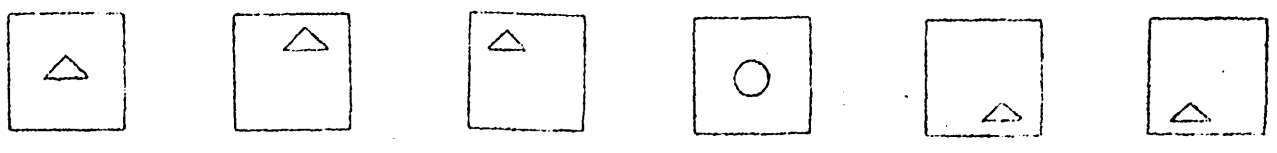
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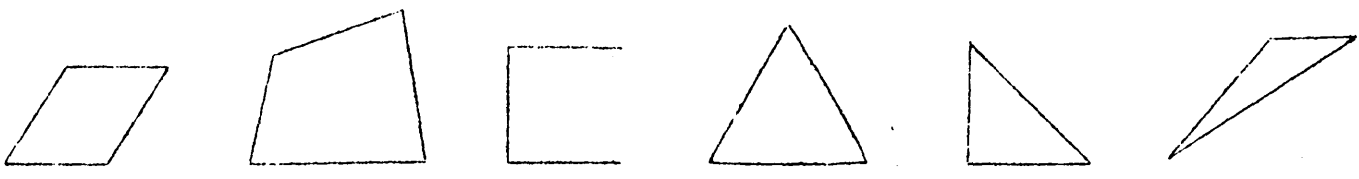
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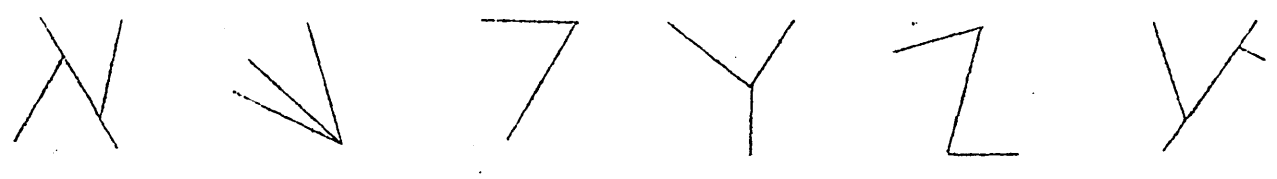
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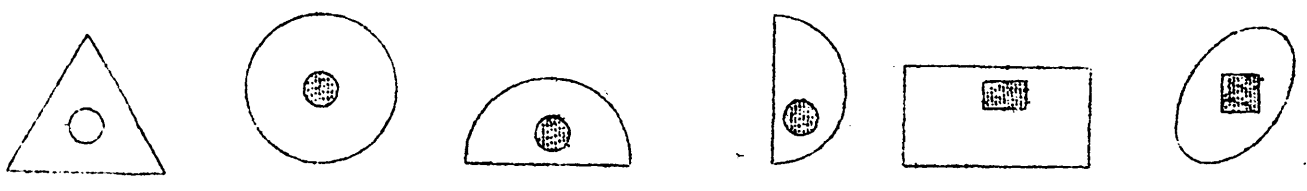
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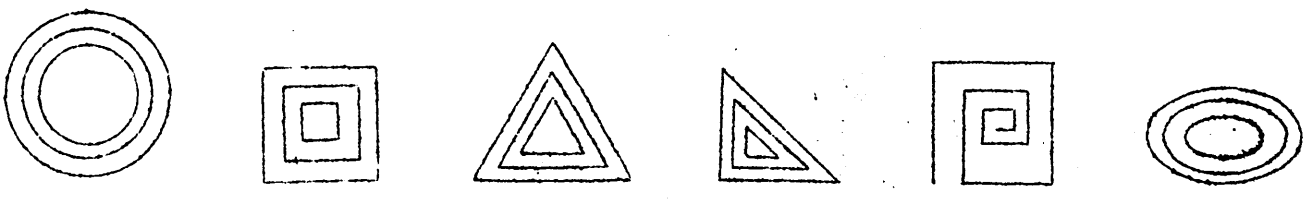
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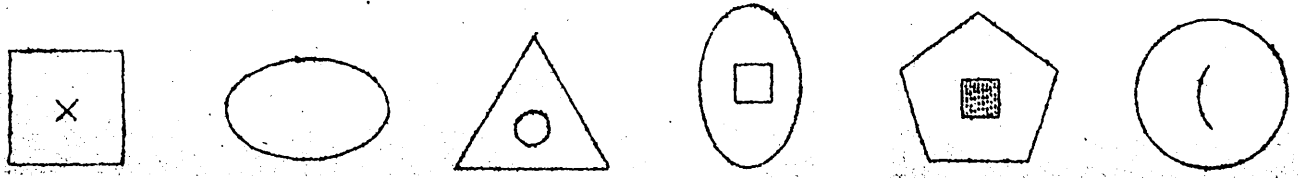
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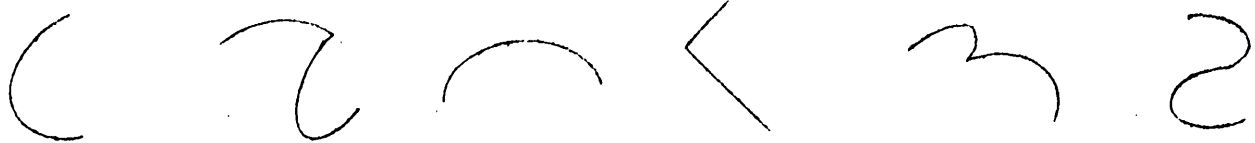
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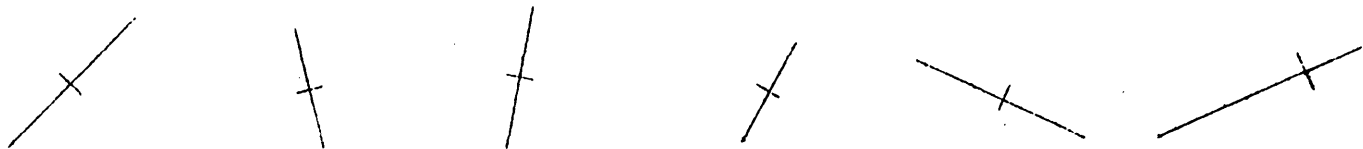
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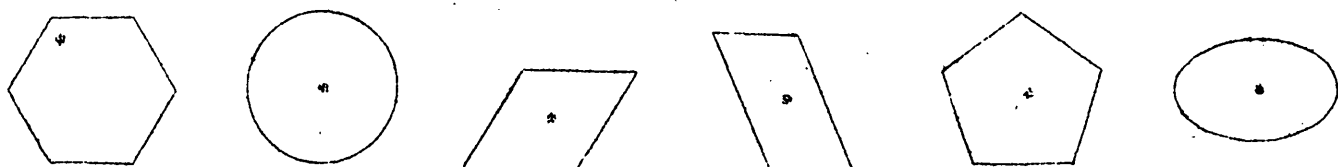
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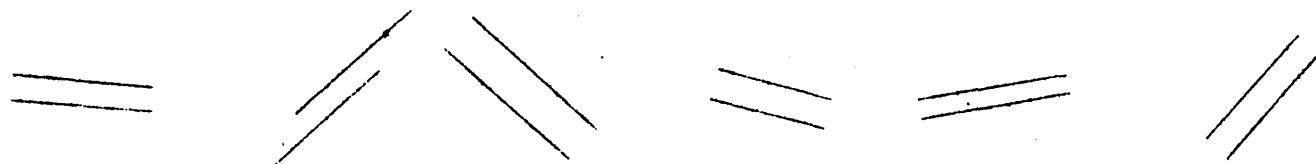
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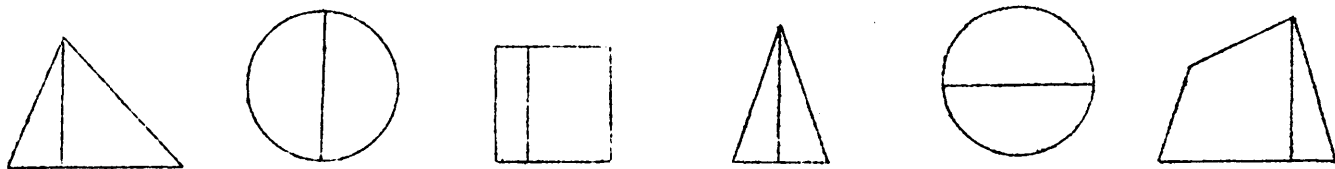
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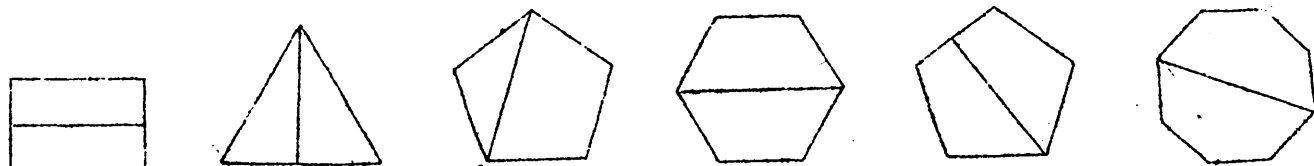
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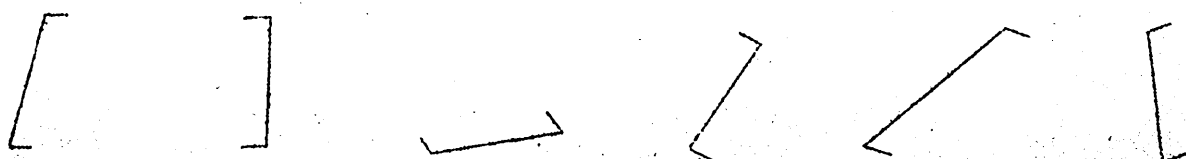
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23



24



25



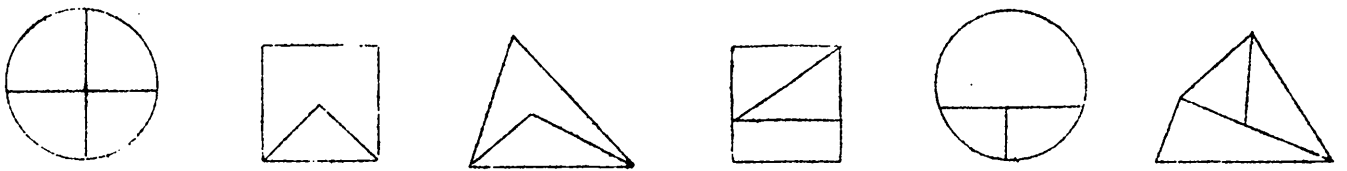
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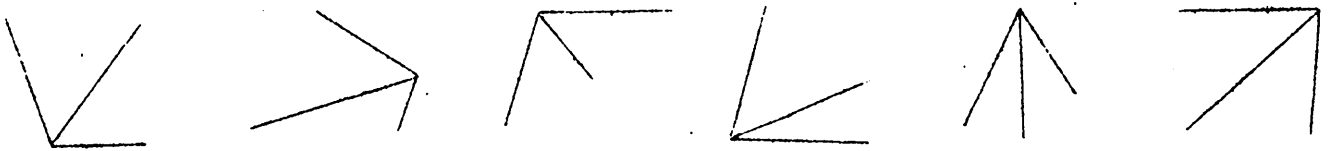
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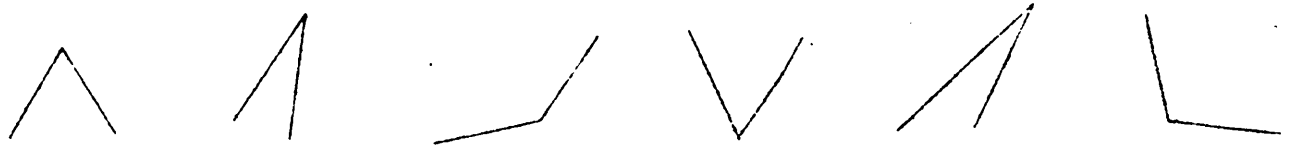
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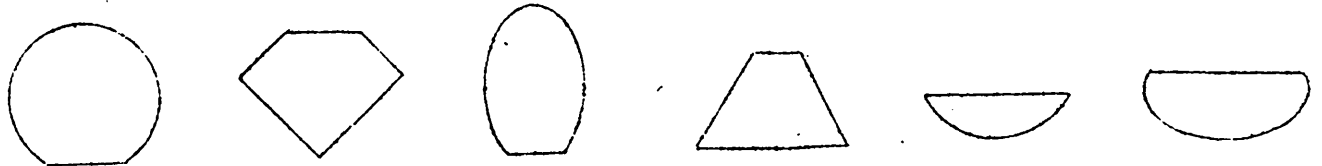
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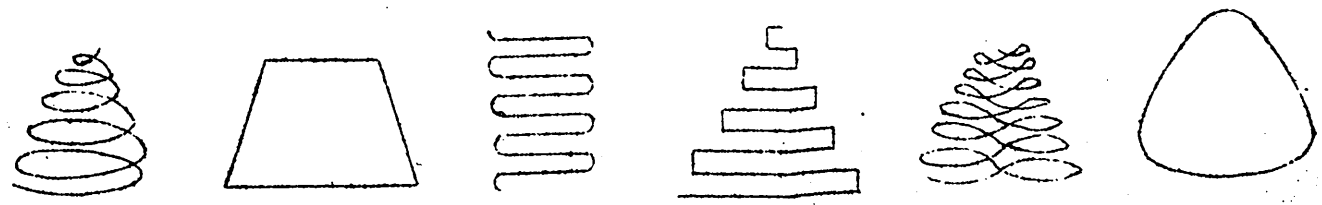
30



31



32



Matrices* (set to the boys of Queen's Royal College
on 8th., June 1948)

This test consisting of new items is of somewhat the same form as Raven's Progressive Matrices, but none of the alternatives are the same as any of the 9 squares of the "matrix" and none of them can be ruled out at once as absurd.

This test was not subjected to such a comprehensive Item Analysis as the last test but answer patterns for each age group were worked out as a result of which only 22 items were retained for the scoring. A Score-Age graph was made and from the smoothed curve through the points norms (given at the bottom of the second page of Instructions to Supervisors) were obtained.

* The name "Matrix" has been dropped as it may be J. C. Raven's copyright. However, this form of test is not originally/due to him.

S.S.R. MATRICES

INSTRUCTIONS TO SUPERVISORS.

Have short-sighted children in front. See that you have 35⁻ copies of booklets. Say to class, "Is there anyone who has not got a sharp pencil". If there is anyone lend him one. Say to class "You will each be given a little book of test puzzles do not open it until you are told." Give out booklets. Say to class "On the line marked 'Name' write your full name (I mean all your names); write your surname (or title) last and write in block letters (these are capital letters) so that they may be easily read. On the line marked 'Age last birthday' write in figures your age before the word 'years'. On the line marked 'Date of birthday' write the date of the month, and the month of your birthday. On the line marked 'Form' write down the form you are in at school."

Have booklet opened at first page. Say to class, "Now open the book at the first page and look at the first drawing. You see a large square (pointing) divided into 9 small squares and the last of these (pointing) is empty. On the right (pointing) you see 5 small squares. The puzzle is to choose which of the 5 small squares would be the best one to put into the empty square (pointing), and to draw a line under the square you chose. If you look at the large square again, you see that the top small square on the left (pointing) has a line in it. The next one to the right of it (pointing) has 2 lines, and the next (pointing) 3 lines. Now look at the small square on the left of the middle row (pointing). It has a small line in it. The one on the right of it (pointing) has two small lines, and the next (pointing) three small lines. Now look at the small square on the left of the bottom row (pointing). It has one dot in it. The one on the right of it (pointing) has two dots: what do you think the empty square (pointing) should have in it? (class answers). Yes, three dots but how should they be arranged, by the side of each other or one above the other? (class answers). Yes, by the side of each other."

"Let us make sure we are right by looking down instead of across. The first column (pointing) has one long line (pointing) then one short line (pointing) and then a dot (pointing). The second column (pointing) has two long lines beside each other (pointing), two short lines beside each other (pointing) and then two dots beside each other (pointing). The third column (pointing) has three long lines beside each other (pointing) and then three short lines beside each other (pointing). Surely the empty square (pointing) should have 3 dots beside each other as we said before. So we underline the fourth small square on the right (pointing) like this (drawing 4th. square on blackboard and underlining). Will you all do this in your books. Now look at No. 2. In the first row of small squares we see that there is a small triangle (pointing) - that is a drawing with 3 sides - a larger triangle (pointing), and a still larger triangle (pointing). In the second row (pointing) there are squares small (pointing), larger (pointing), and still larger (pointing). In the third row there is a small circle (pointing) and next to it a larger, what do you think the empty square (pointing) should have in it? (class answers). Yes a larger circle, but you notice that each drawing has a dot with it.

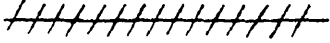
"In the first column (pointing) the dots are all under the drawings in the second column (pointing) they are all above the drawings, and in the third column they are inside the drawings shown (pointing). Where should the dot be for the large circle we think should go into the empty square, beneath it, above it or inside it? (class answers) Yes, inside it so draw a line under the 3rd. square on the right, where there is a large circle with a dot inside it. Now look at No. 3. Here the large square is not divided into 9 small ones but there is still a small empty square at the bottom corner (pointing). Which of the small squares on the right (pointing) would fit into the empty square so as to make the pattern right? (class answers). Yes, the last small square (pointing) so we draw a line under it.

"Now look at No. 4. The first and last rows (pointing) have two dots in each of the squares, but in the first column (pointing) the dots are all at the bottom of the squares. In the next column (pointing) they are half-way up and in the last (pointing) they are at the top. What do you think the empty square should have in it? (class answers) Yes, two dots at the top; so draw a line under the last small square on the right (pointing).

"Now look at No. 5. This is rather a difficult one. As we look across the rows (pointing) we see that the lines get more and more curved or bent. As we look down the columns (pointing) we see the lines get shorter and shorter also, there are 3 dots in the squares of the first column, 2 dots in the squares of the second column and one in the square of the third column. Therefore the empty square should have put into it a short, very curved line with one dot. Which square is the one to underline? (class answers). Yes, the 3rd. square.

"When I tell you to start go on by yourselves to the end of the book, drawing a line under the square you think should best fill the empty space. Do not draw a line under two squares of any row because you will be counted wrong if you do this. You will be given 30 minutes which is plenty of time. There is no need to hurry but if you find you can't do one go on to the next. You will not score any more marks if you finish before you are told to do so. I do not want to know when you are finished but when you do, just keep your book in front of you and try to work out those numbers you couldn't do.

"If you want to change your mind about which drawing is correct, cross out the line you have drawn like this:

(Indicating on blackboard. )

"You may not ask any questions at all during the test, but if you have forgotten what you have been told you may look at the cover of your book where you will find the instructions printed. Are you ready, STAR

Make a record for future timing of the test, of the length of time for about a third of the class to finish - as judged by the children's attitudes - without letting the class know you are interested in the time they are taking.

At 25 minutes say "5 minutes more". At 29 minutes say "1 minute more". At 30 minutes say "time up" and see that no more writing is done. Collect the books and arrange in alphabetical order. Return all 35 copies.

Form I Special.

Time taken by first third of class: 27 min.

S. S. R. M A T R I X T E S T

NAME _____
 Christian names in block letters _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
 Date _____ Month _____

FORM _____ **NAME OF** _____
SCHOOL _____

TIME ALLOWED 30 MINUTES.

INSTRUCTIONS.

In the large square on the left of each row there is a small empty square in the right hand bottom corner. The puzzle is to choose which small square of the five on the right would be best to put into the empty square, and to underline the square chosen. In cases where the large square is divided up into 9 small squares the square chosen should be the correct one for completing both the last row and the last column.

Numbers 1 - 5 are for practice. In No.1 the fourth square is the one to underline, in No. 2 the third square, in No.3 the fifth, in No. 4 the fifth, and in No. 5 the third square.

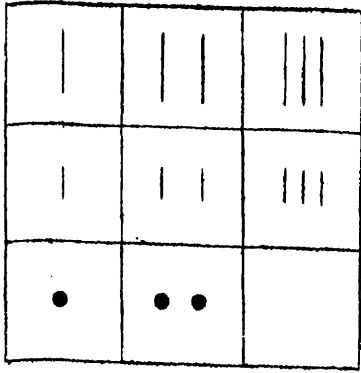
Be careful not to underline two drawings in any one row as this row will be counted as wrong. If you make a mistake and you wish to change your mind, clearly cross out the line you have drawn like this :-

#####

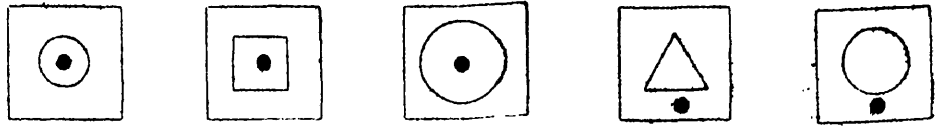
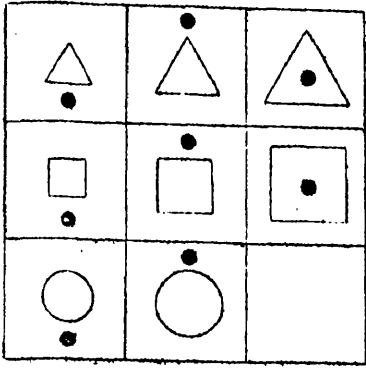
You need not hurry as you will be given 30 minutes to do the test which is plenty of time. Nevertheless, do not waste a long time over any one row, but get on with the next.

Raw SCORE on ²²~~55~~ Items _____
 Raw SCORE on _____ Items _____
 Standard SCORE on _____ Items _____

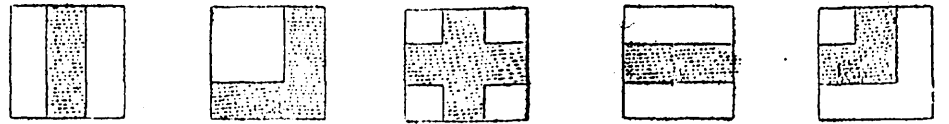
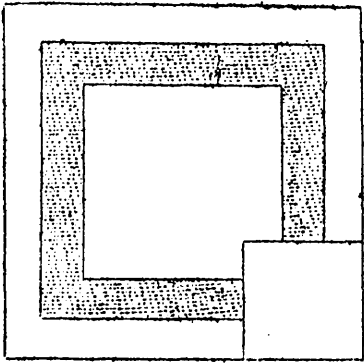
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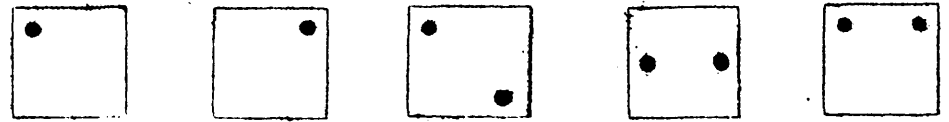
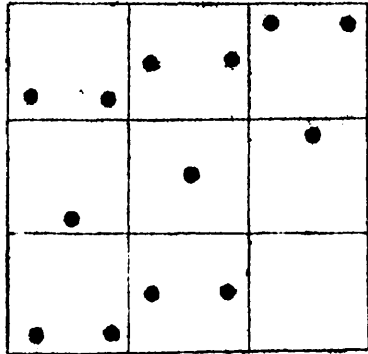
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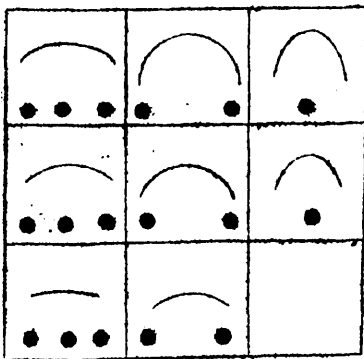
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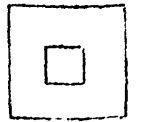
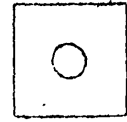
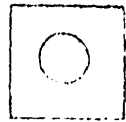
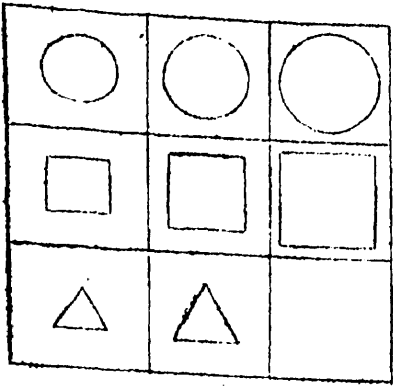
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5

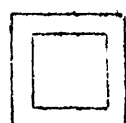
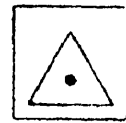
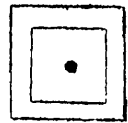
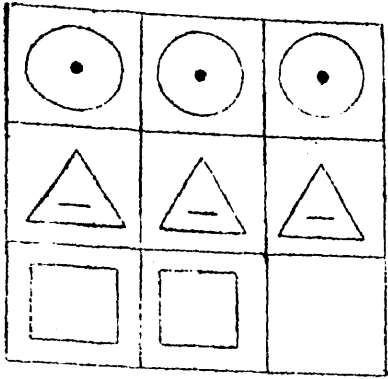


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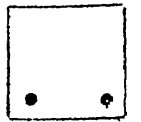
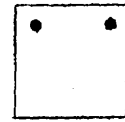
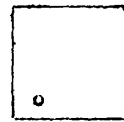
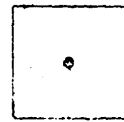
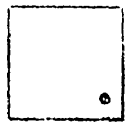
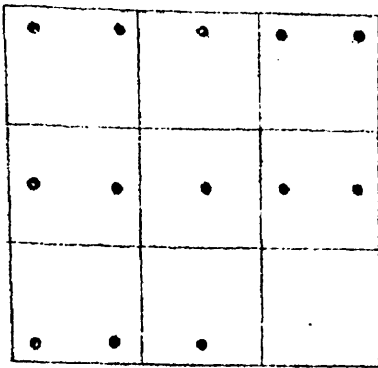


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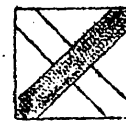
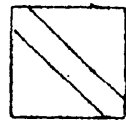
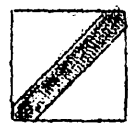
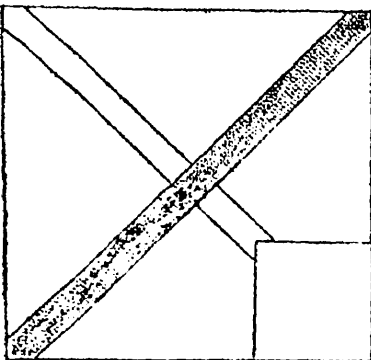
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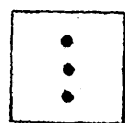
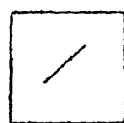
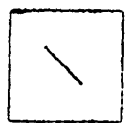
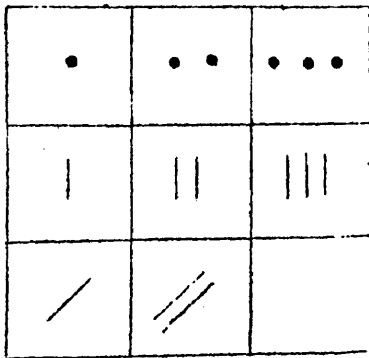
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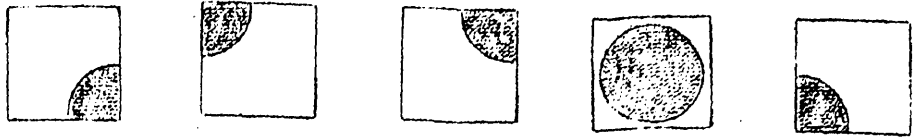
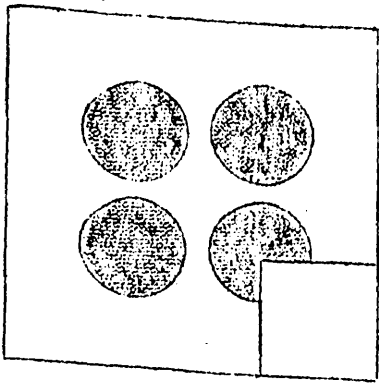
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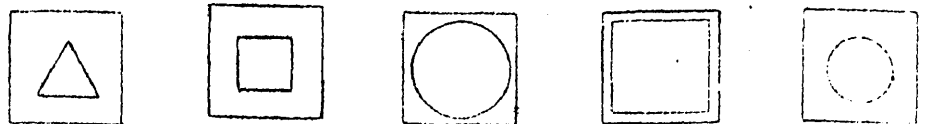
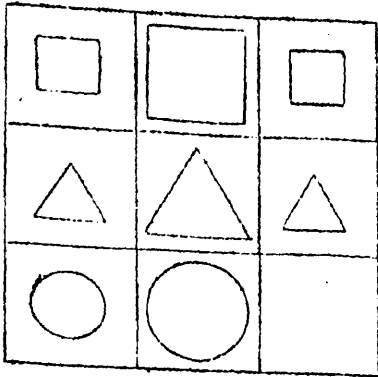


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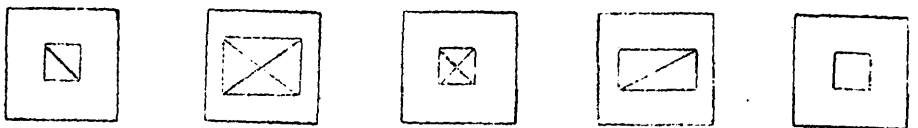
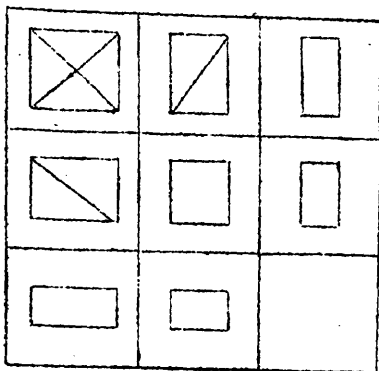


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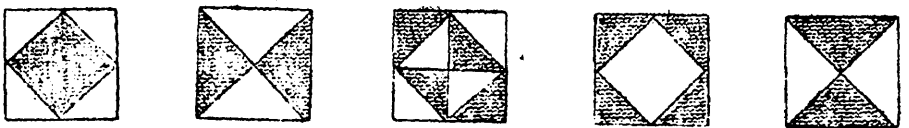
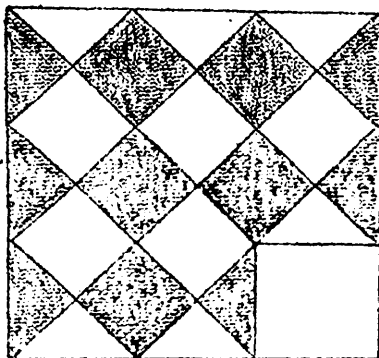
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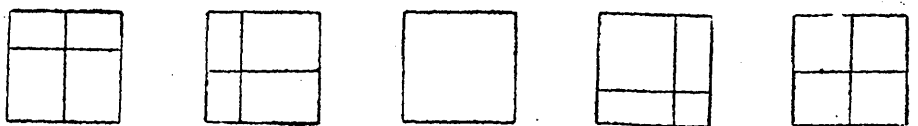
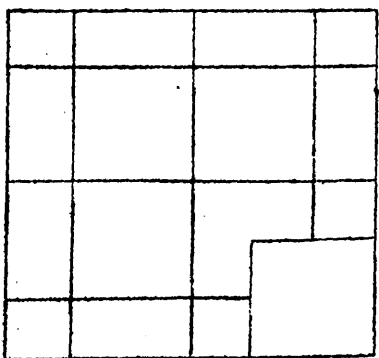
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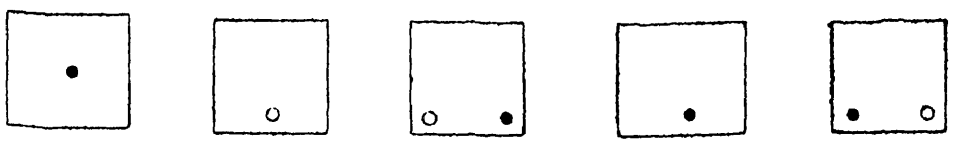
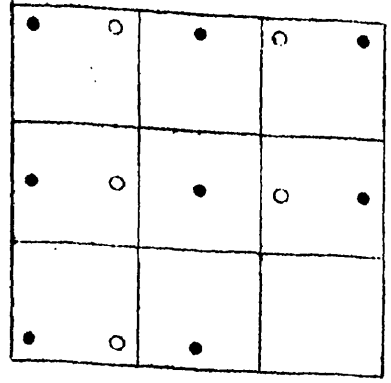
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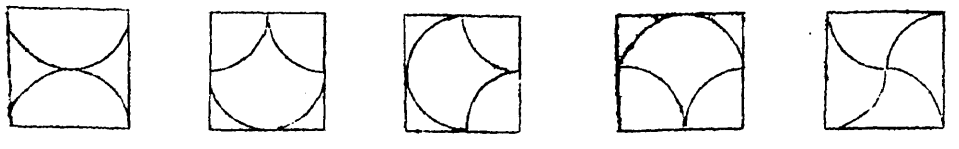
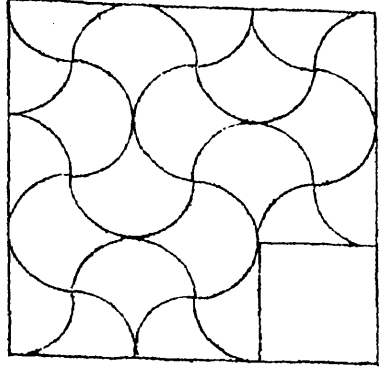
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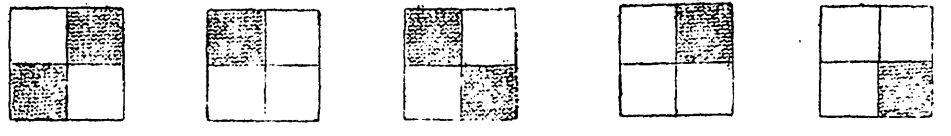
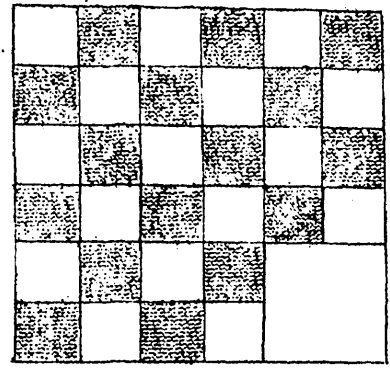
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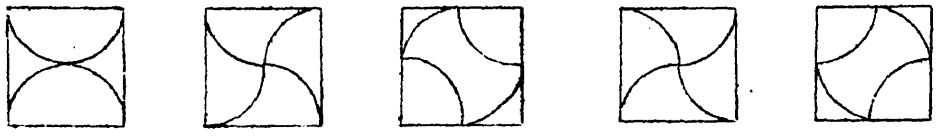
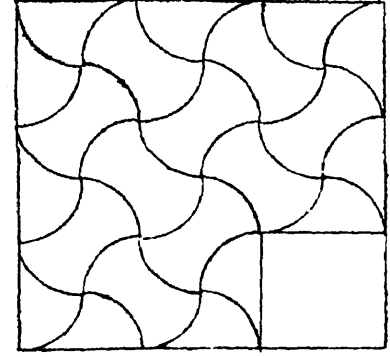
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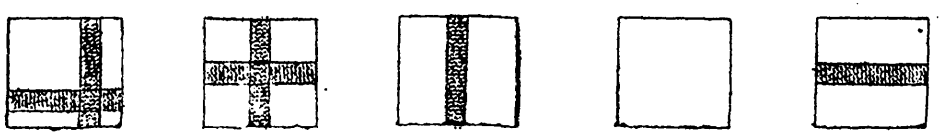
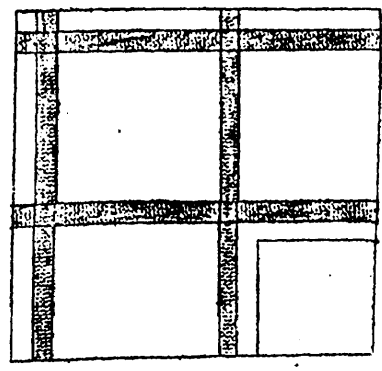
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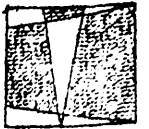
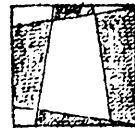
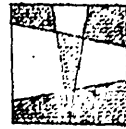
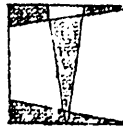
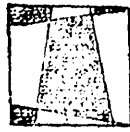
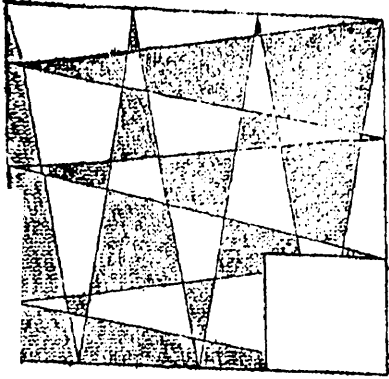
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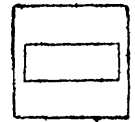
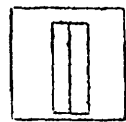
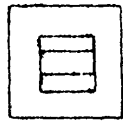
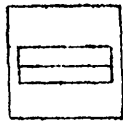
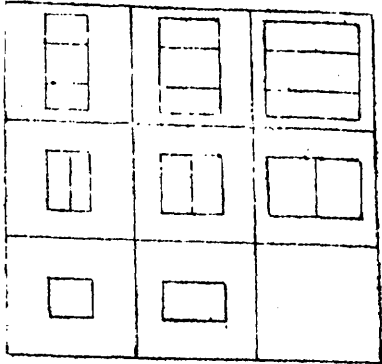
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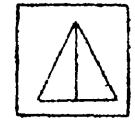
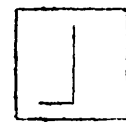
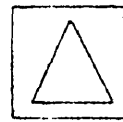
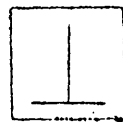
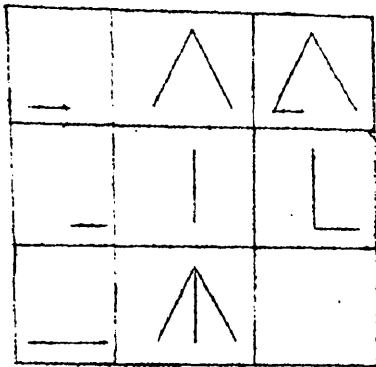
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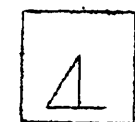
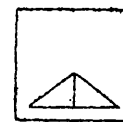
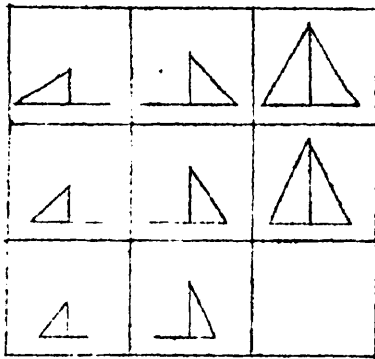
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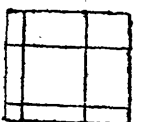
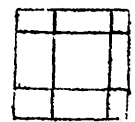
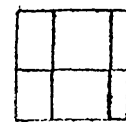
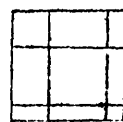
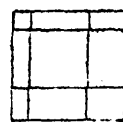
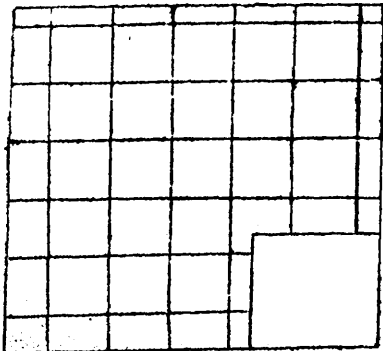
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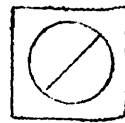
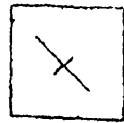
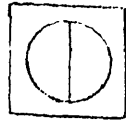
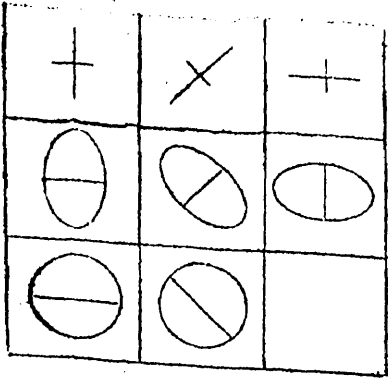
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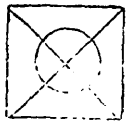
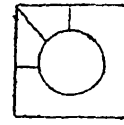
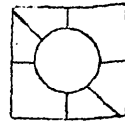
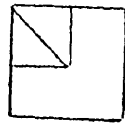
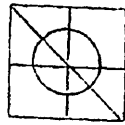
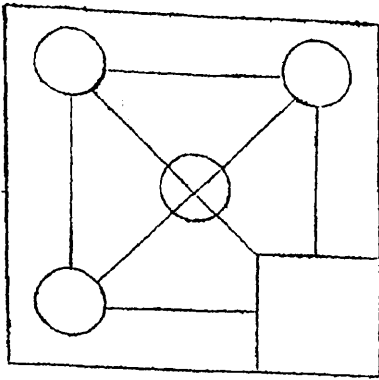


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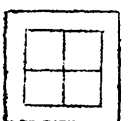
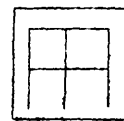
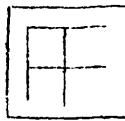
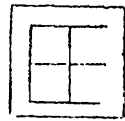
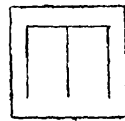
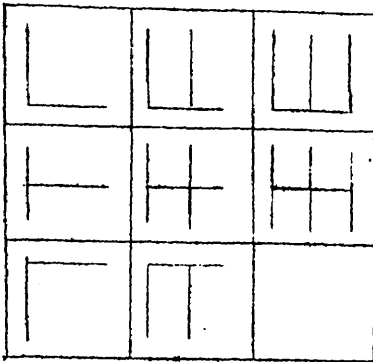


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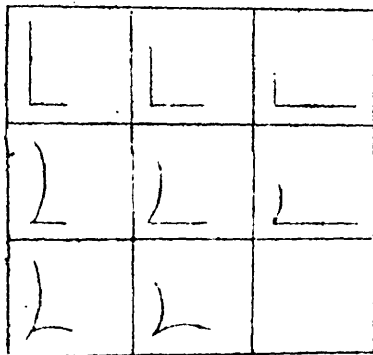
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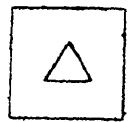
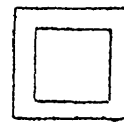
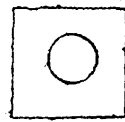
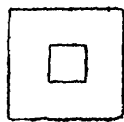
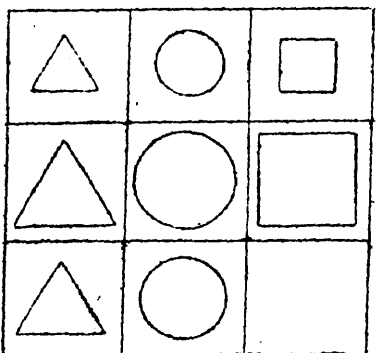
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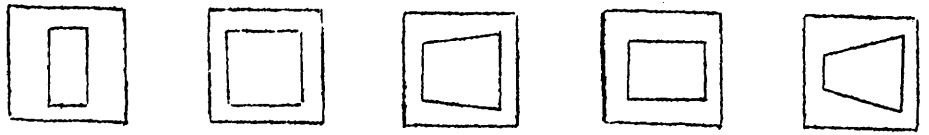
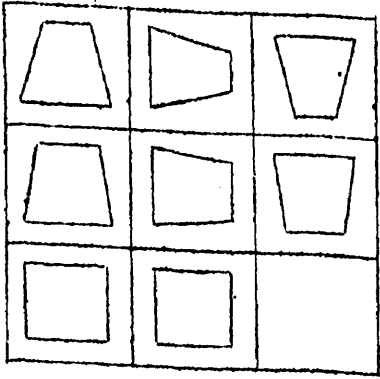
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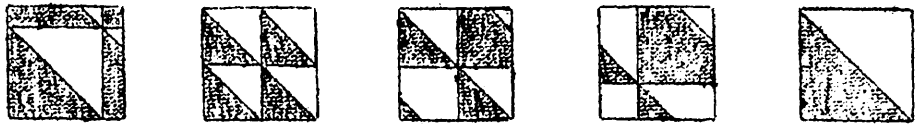
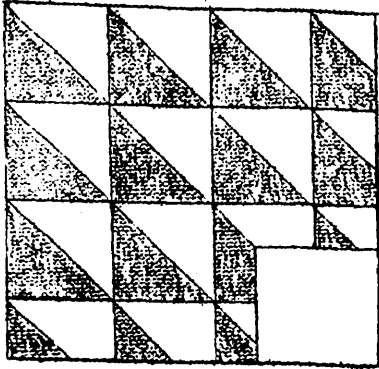
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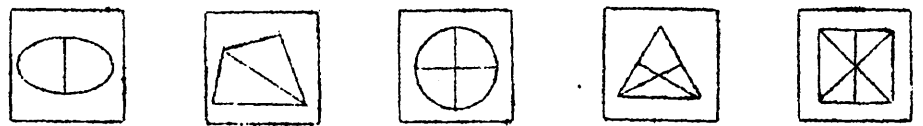
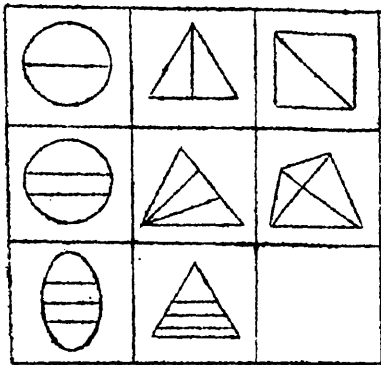
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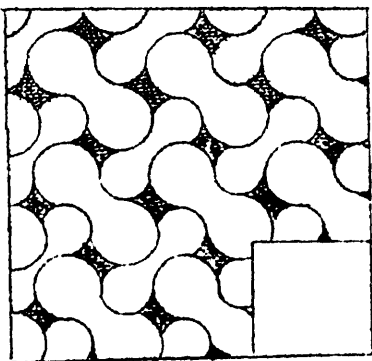
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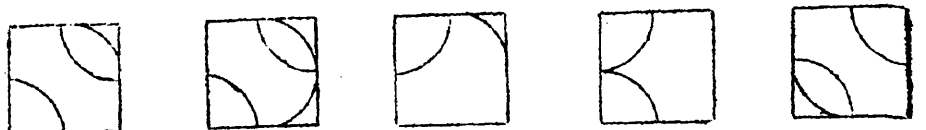
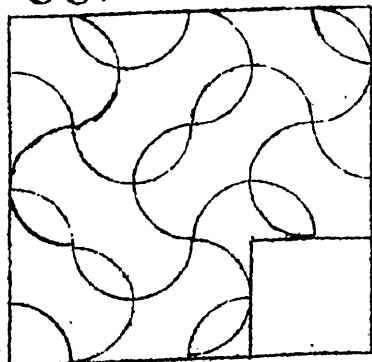
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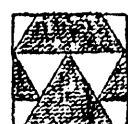
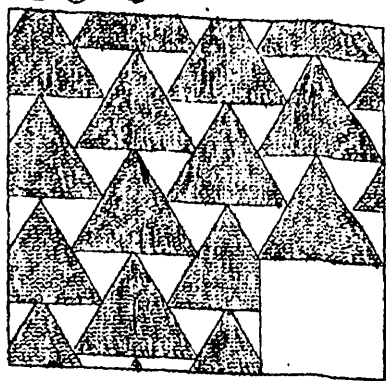
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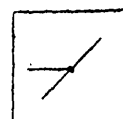
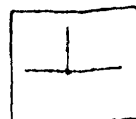
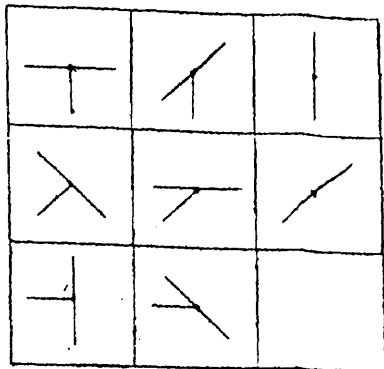
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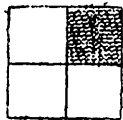
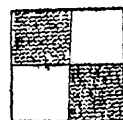
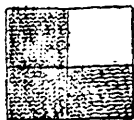
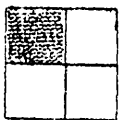
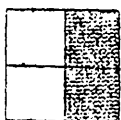
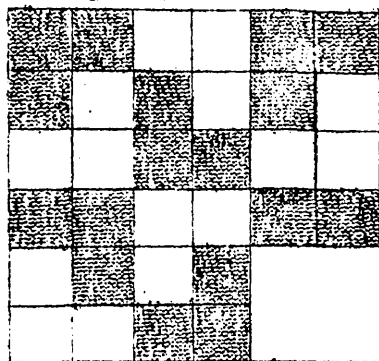
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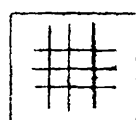
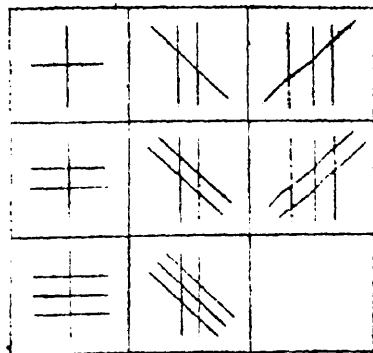
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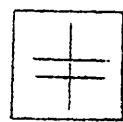
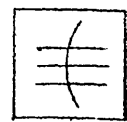
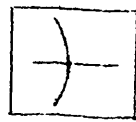
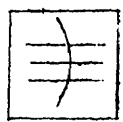
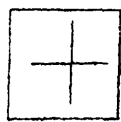
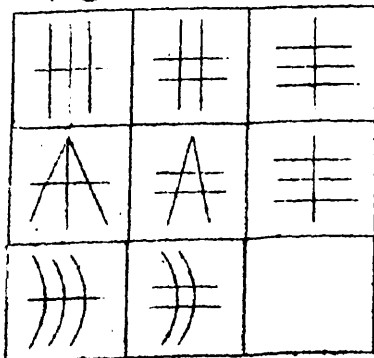
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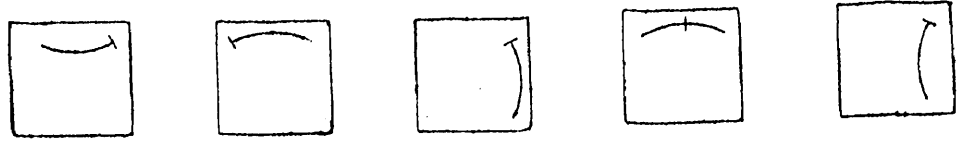
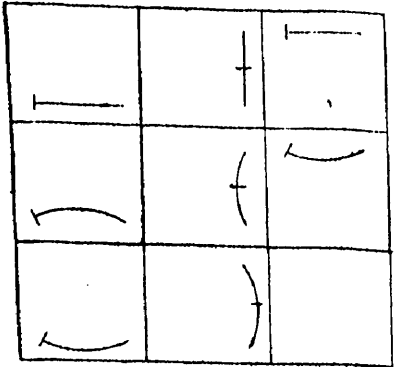
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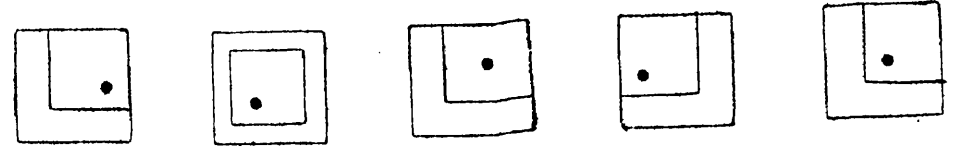
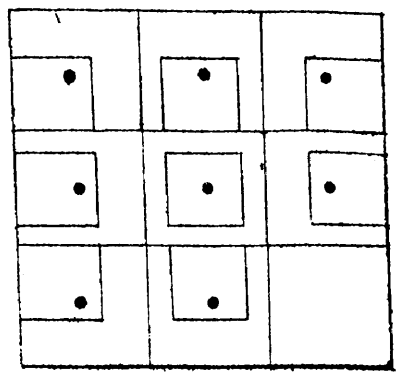
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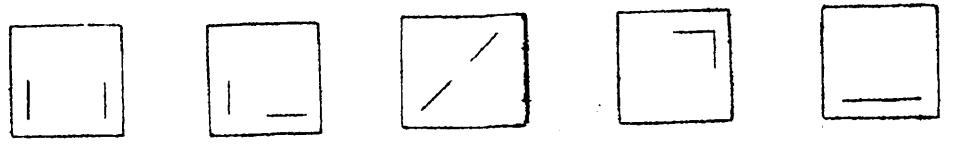
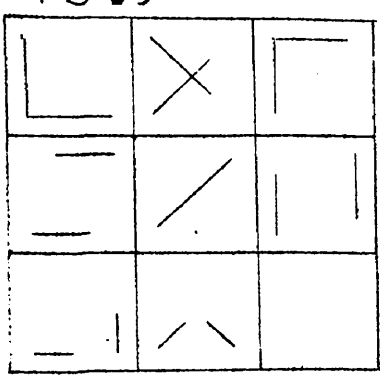
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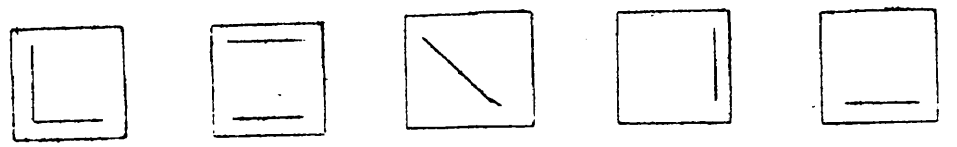
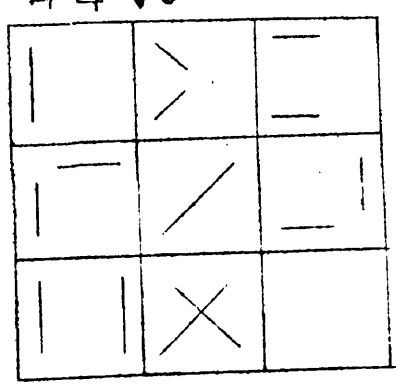
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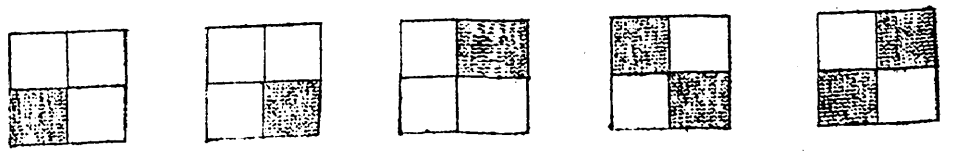
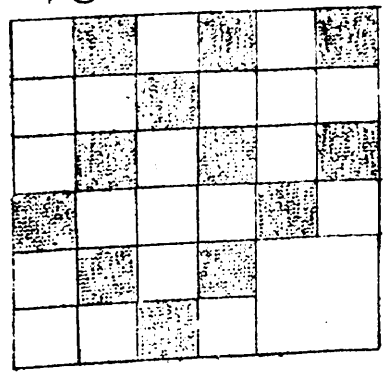
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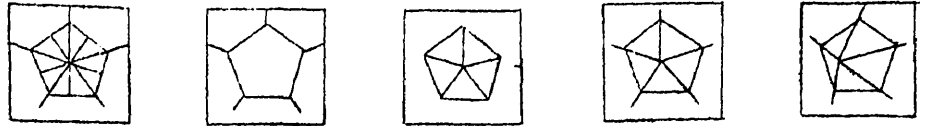
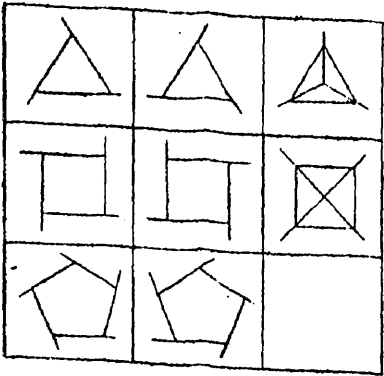


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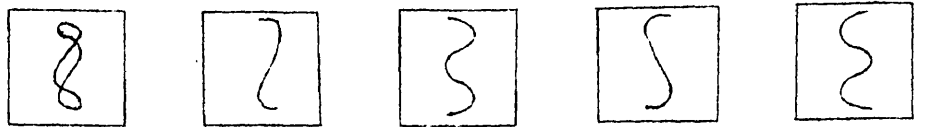
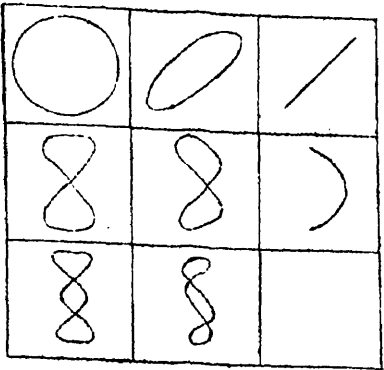


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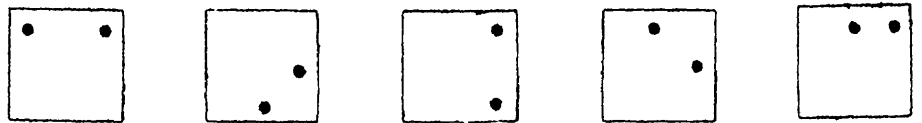
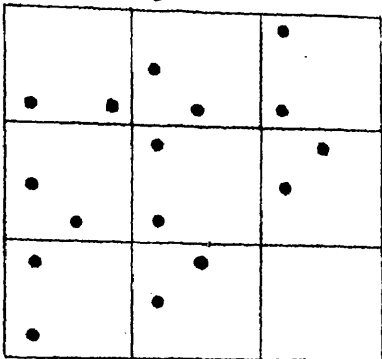
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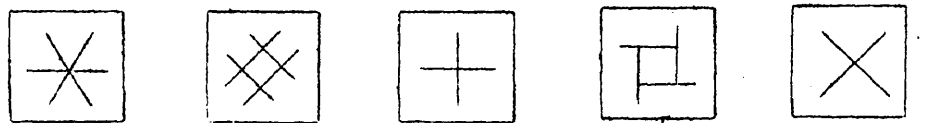
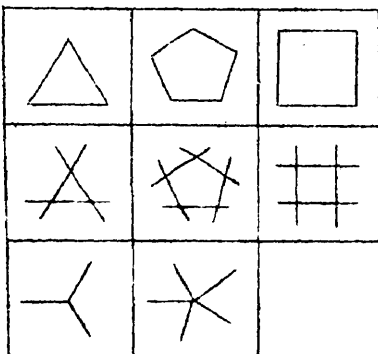
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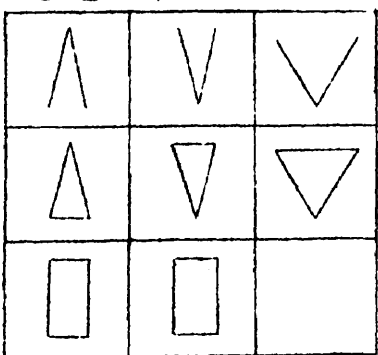
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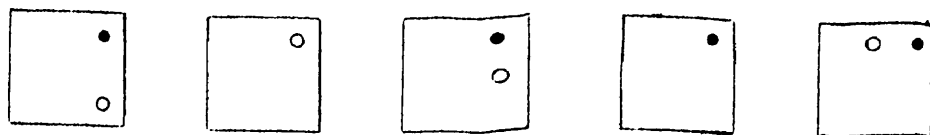
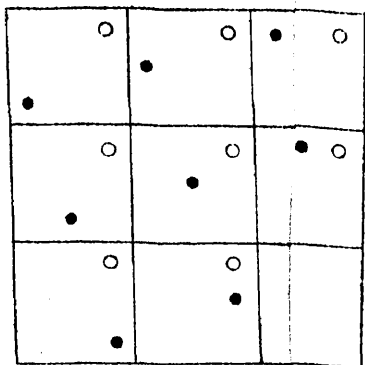
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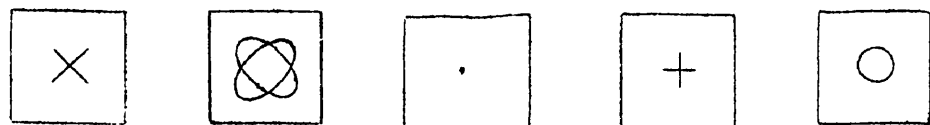
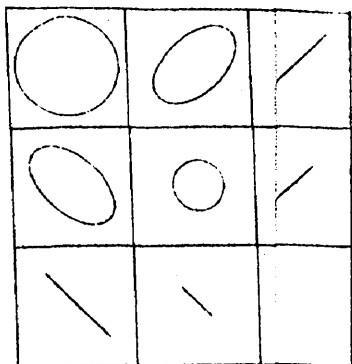
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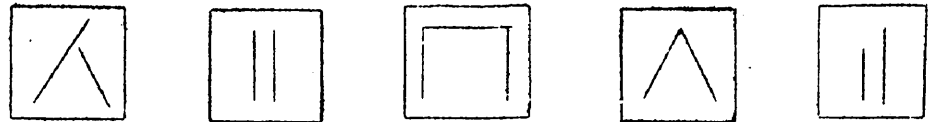
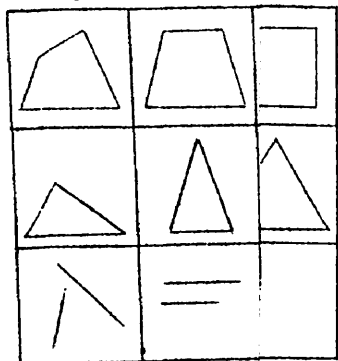
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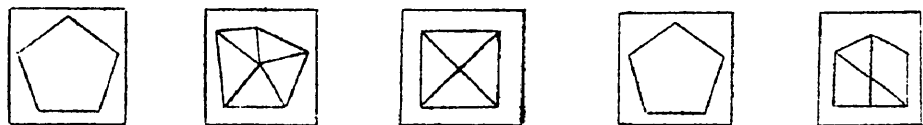
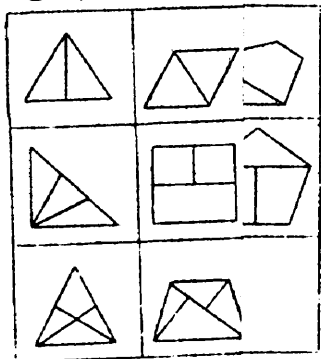
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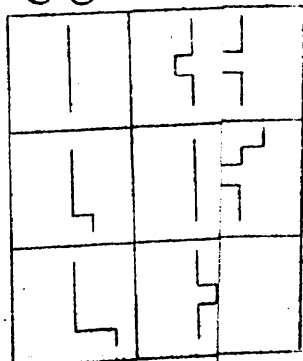
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5440



5542



TEST 3. Rows and Columns "11 Schools Experiment"
(22 Items)

And

TEST 4. Pattern Completion "11 Schools Exp."
(15 Items)

The items of the previous test are of two kinds:

The elements of the "Matrix" are related but separate entities.

The large square depicts a pattern.

For the elementary schools these two kinds of item were separated to make up two tests after rearrangement of the items and deletion of some.

Verbal Instructions

Give out booklets. Say to Class, "Fill in the cover of your book as your teacher has shown you. Now open the book at the first page. As your teacher has told you, in the large square on the left of each row there is a small empty square in the right hand bottom corner (p). The puzzle is to choose which small square of the five on the right would be best to put into the empty square and to underline the square chosen." Go through the Practice Items 1 - 5 with the class. No further instructions are necessary with Test 4. With Test 3 say to class, "You will be given 18 minutes to do this test". At 15 minutes say, "3 minutes more". With Test 4 say, "You will be given 10 minutes to do this test." At 8 minutes say, "2 minutes more".

TEST 3

82

S.S.R. ROWS AND COLUMNS TEST

NAME _____
Christian names in block letters _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
Date _____ Month _____

STANDARD _____ SCHOOL _____

TIME ALLOWED 18 MINUTES.

INSTRUCTIONS.

In the large square on the left of each row there is a small empty square in the right hand bottom corner. The puzzle is to choose which small square of the five on the right would be best to put into the empty square, and to underline the square chosen. The square chosen should be the correct one for completing both the last row and the last column.

Be careful not to underline two drawings in any one row as this row will be counted as wrong. If you make a mistake and you wish to change your mind, clearly cross out the line you have drawn like this :-

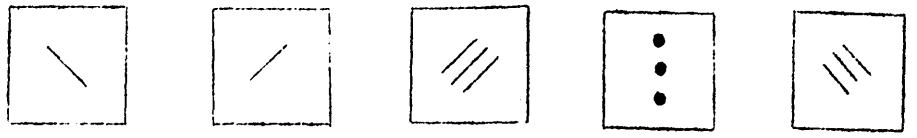
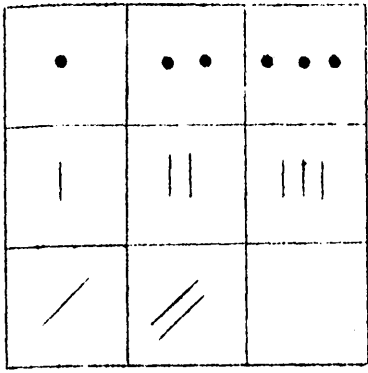
#####

You need not hurry as you will be given 18 minutes to do the test which is plenty of time. Nevertheless, do not waste a long time over any one row, but get on with the next.

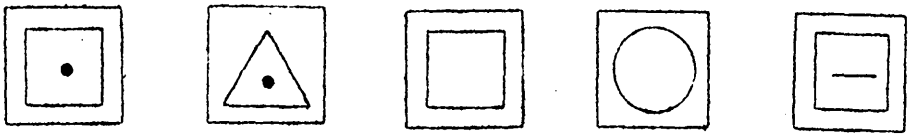
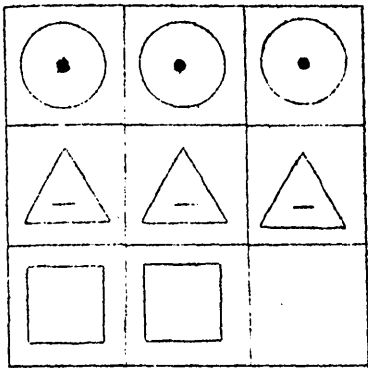
Raw SCORE ON Items _____

Standard SCORE on Items _____

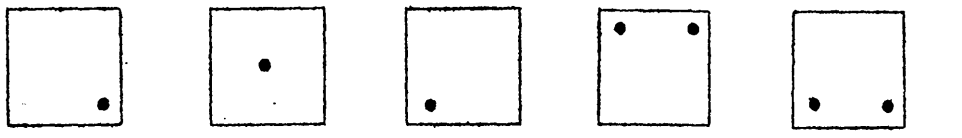
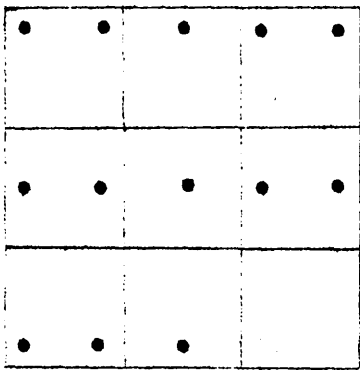
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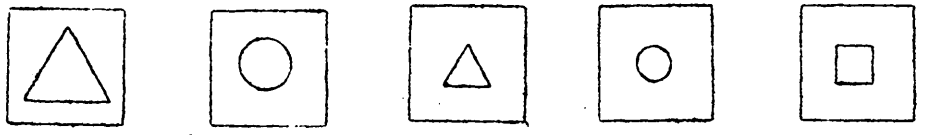
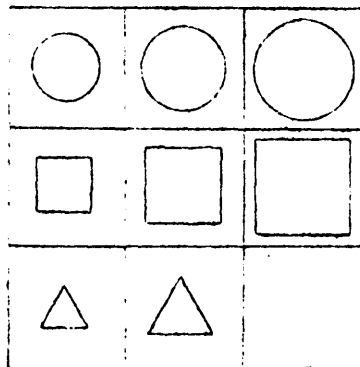
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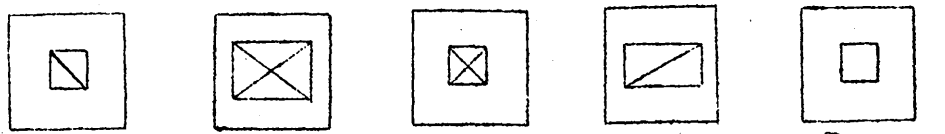
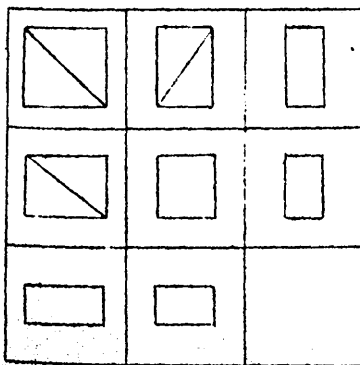
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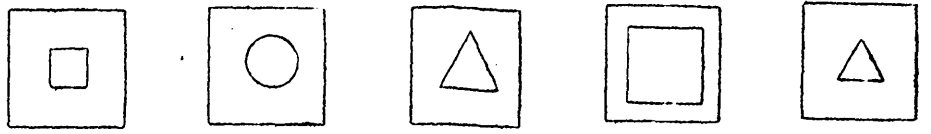
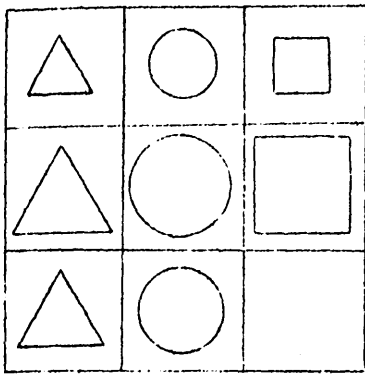
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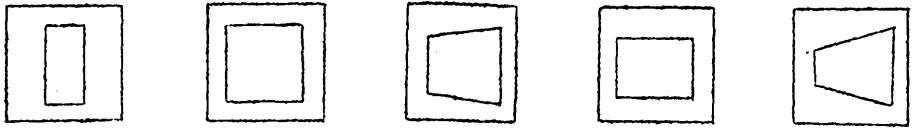
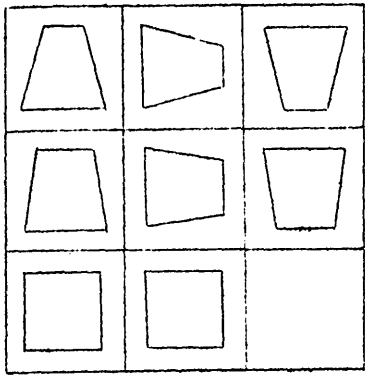
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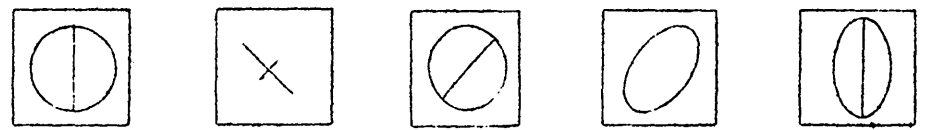
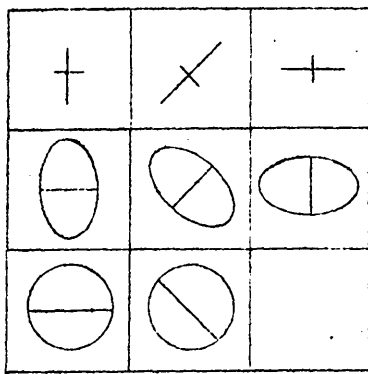
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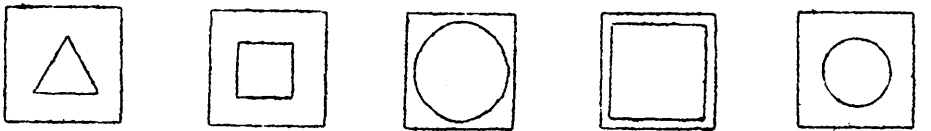
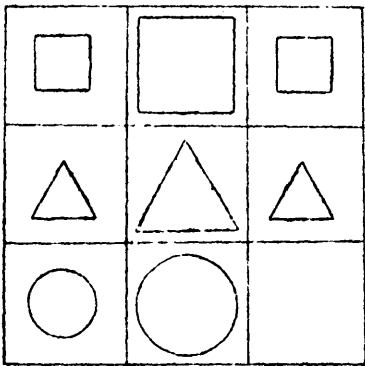
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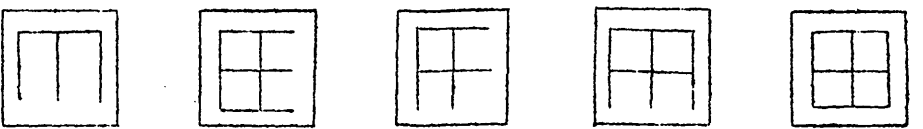
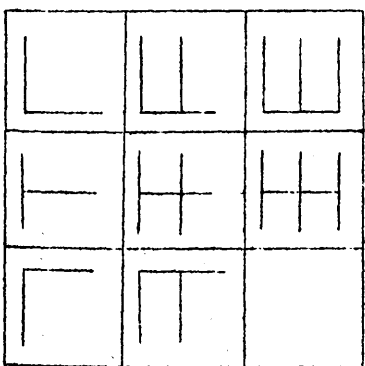
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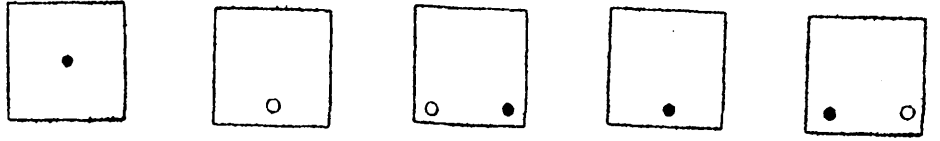
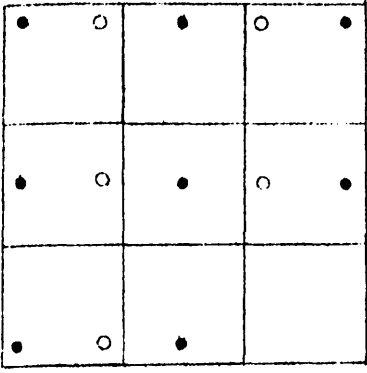
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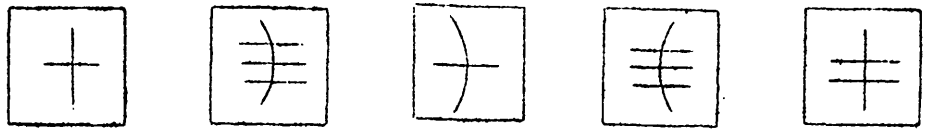
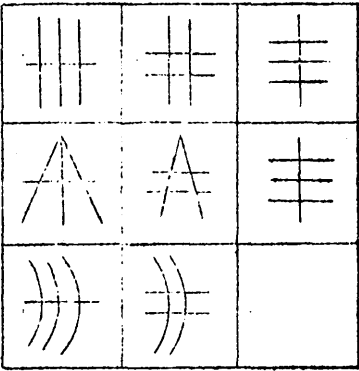
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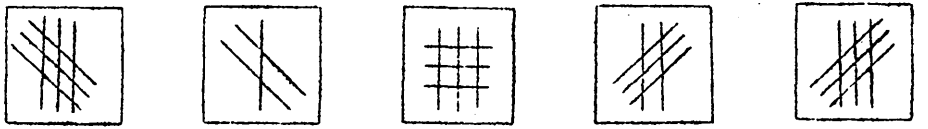
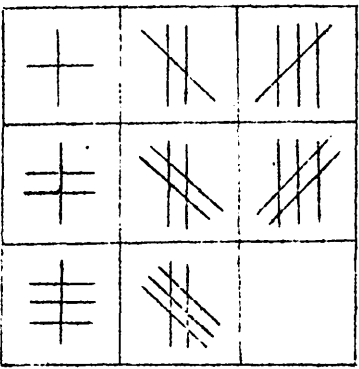
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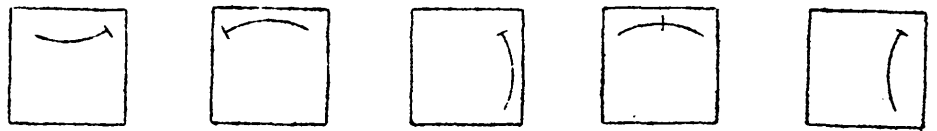
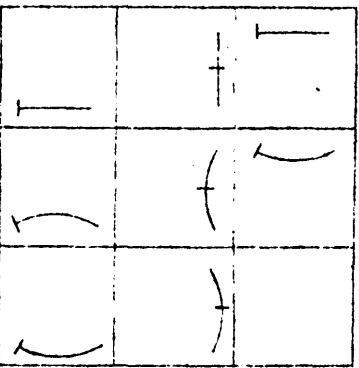
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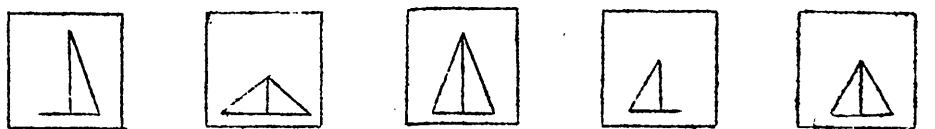
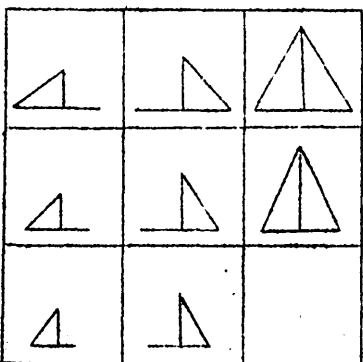
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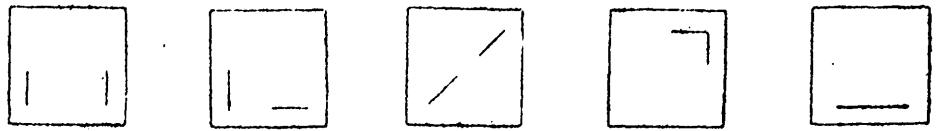
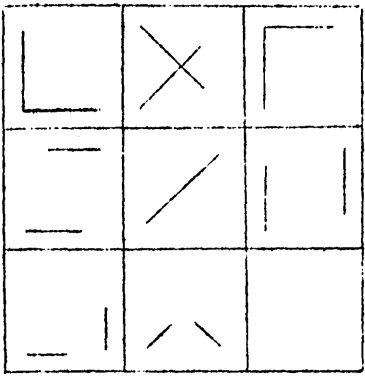
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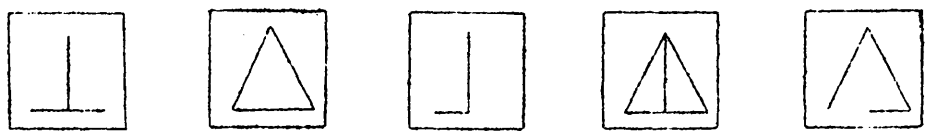
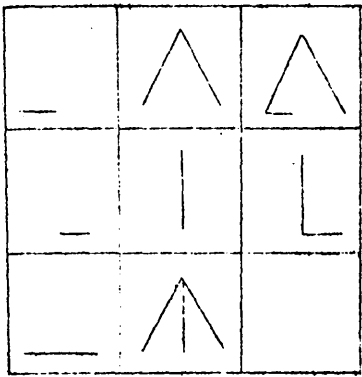
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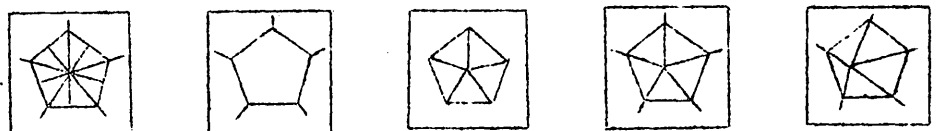
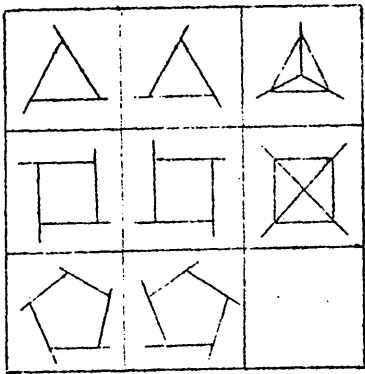
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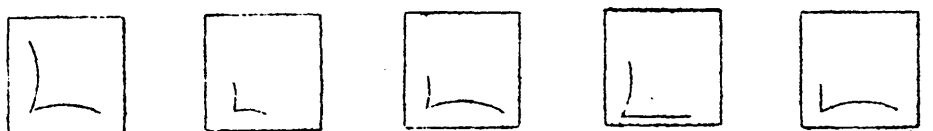
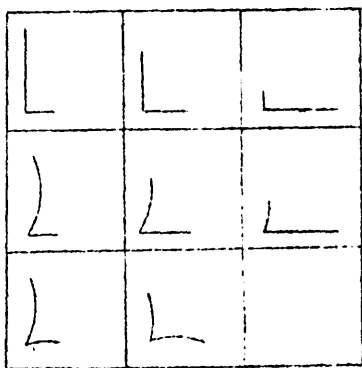
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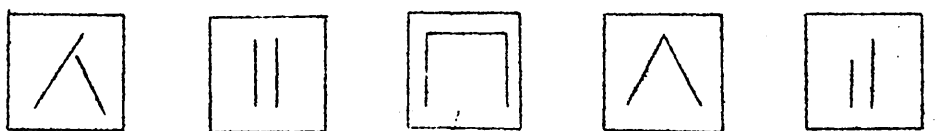
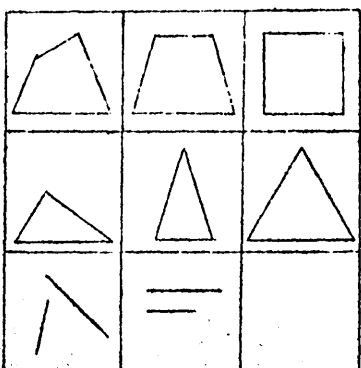
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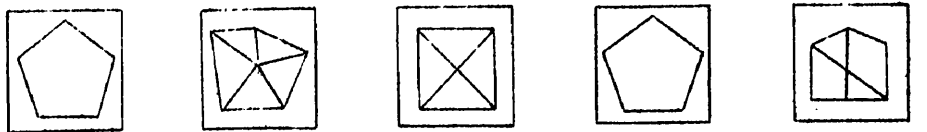
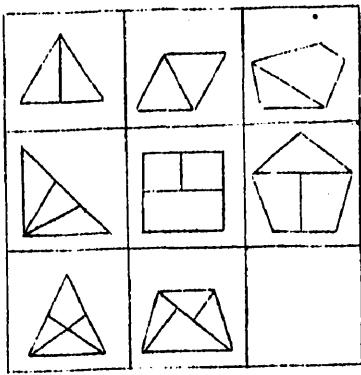
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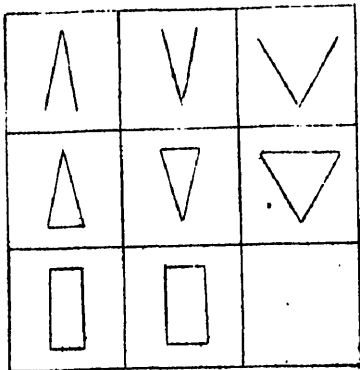
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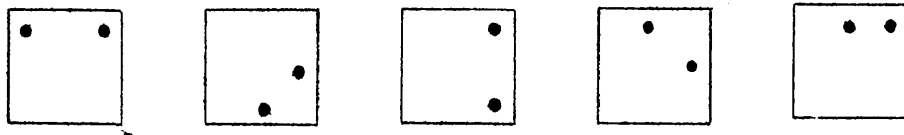
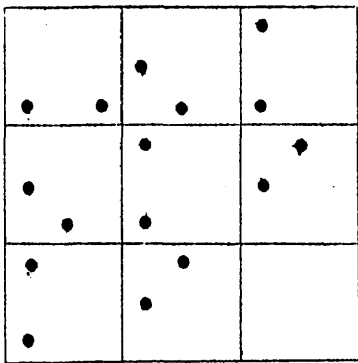
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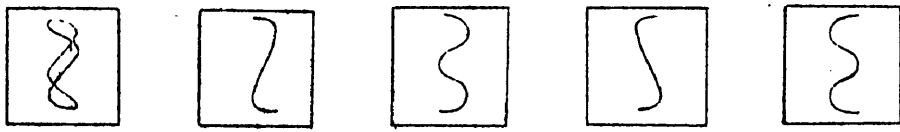
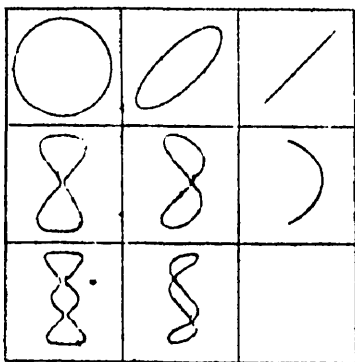
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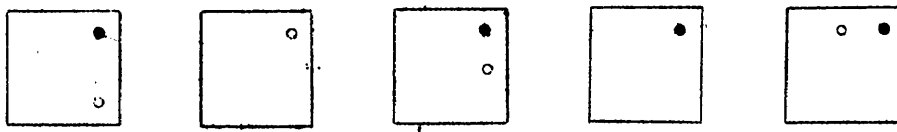
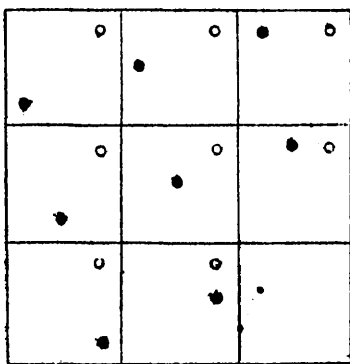
23



24



25



S.S.R.(TRINIDAD) PATTERN COMPLETION TEST.

NAME _____
 Christian names in block letters _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
 Date _____ Month _____

STANDARD _____ SCHOOL _____

TIME ALLOWED ~~12~~¹⁰ MINUTES.

INSTRUCTIONS.

In the large square on the left of each row there is a small empty square in the right hand bottom corner. The puzzle is to choose which small square of the five on the right would be best to put into the empty square, and to underline the square chosen. The square chosen should be the correct one for completing the pattern.

Be careful not to underline two drawings in any one row as this row will be counted as wrong. If you make a mistake and you wish to change your mind, clearly cross out the line you have drawn like this :-

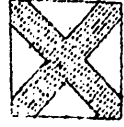
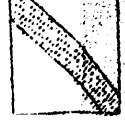
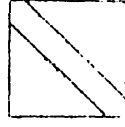
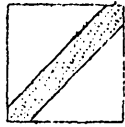
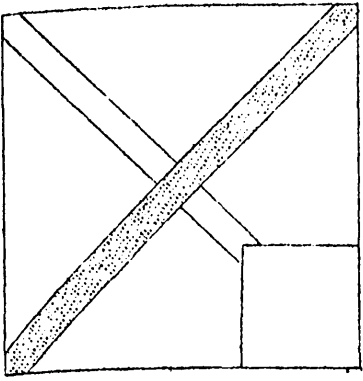
//////

You need not hurry as you will be given 12 minutes to do the test which is plenty of time. Nevertheless, do not waste a long time over any one row, but get on with the next.

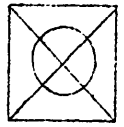
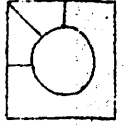
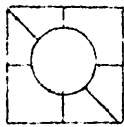
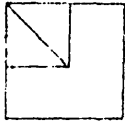
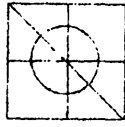
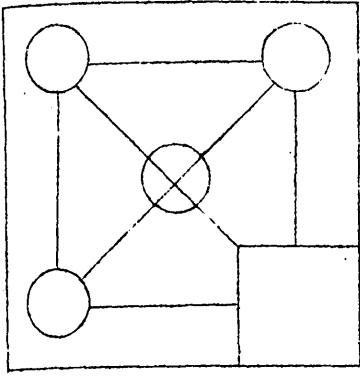
Raw SCORE on Items _____

Standard SCORE on Items _____

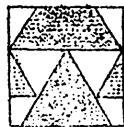
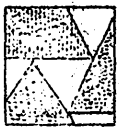
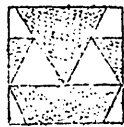
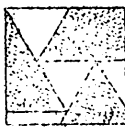
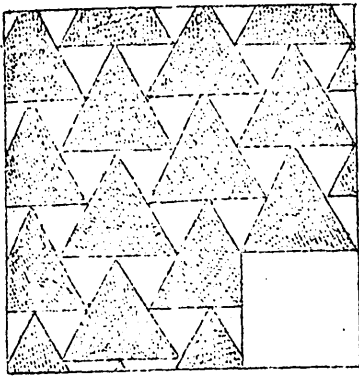
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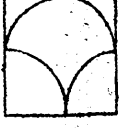
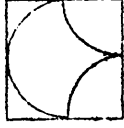
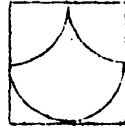
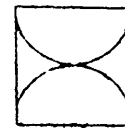
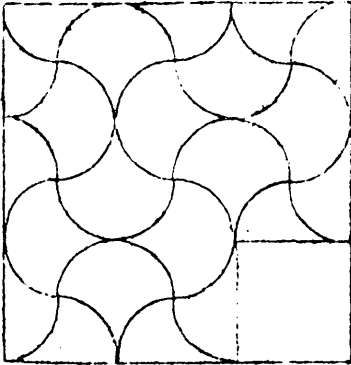
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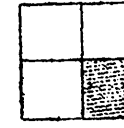
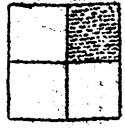
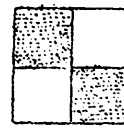
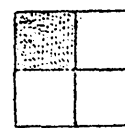
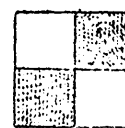
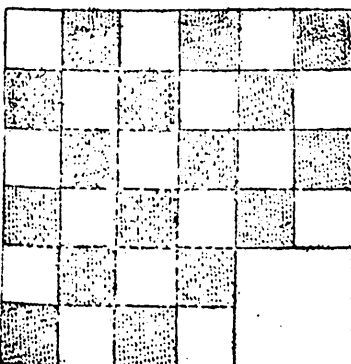
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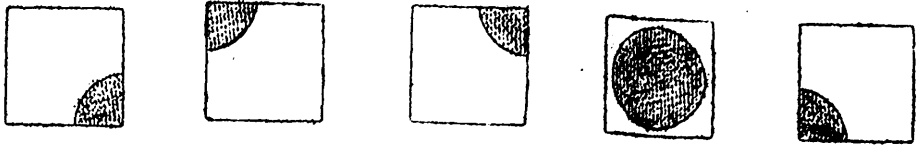
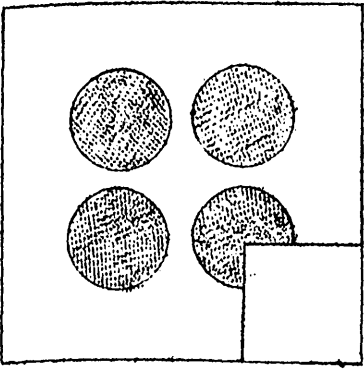
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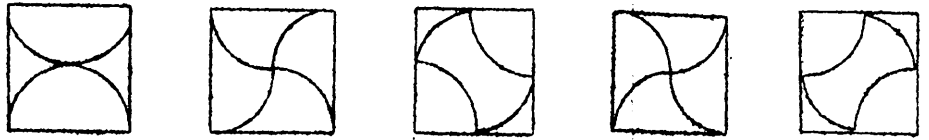
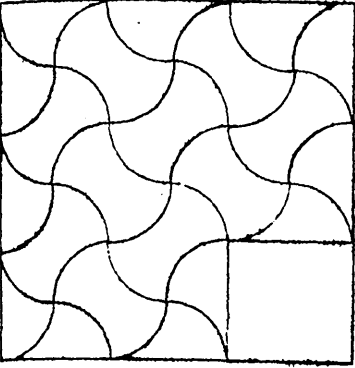
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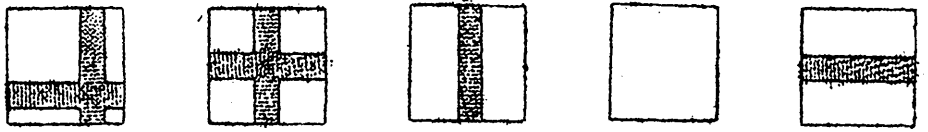
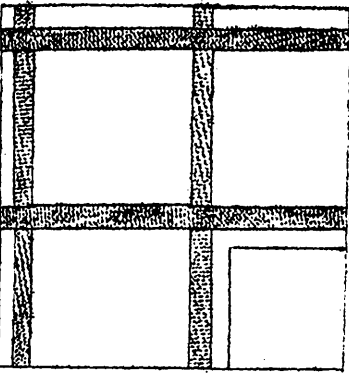
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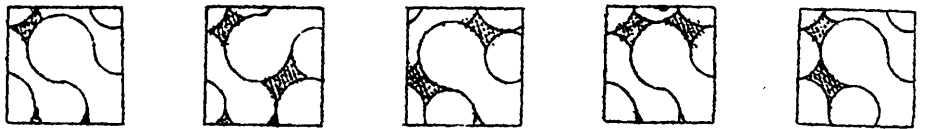
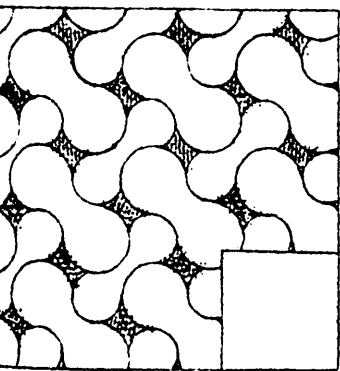
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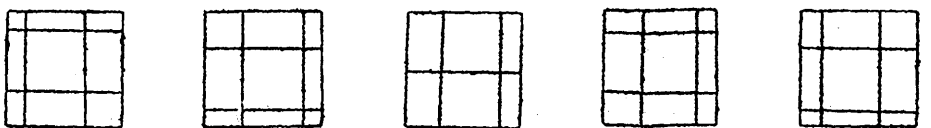
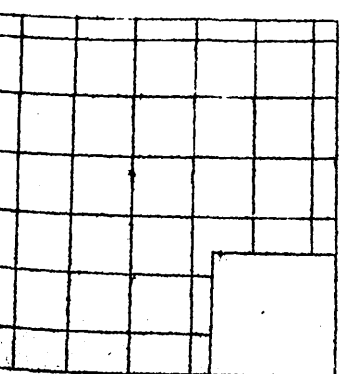
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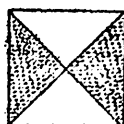
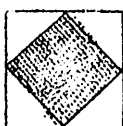
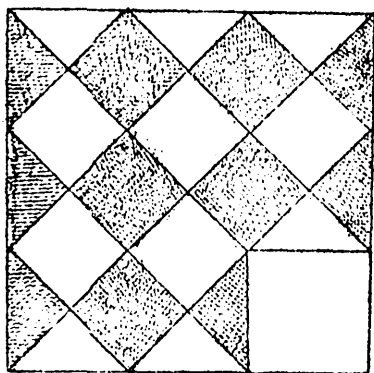
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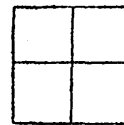
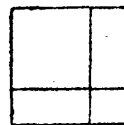
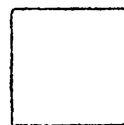
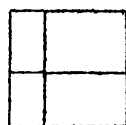
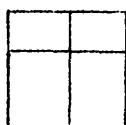
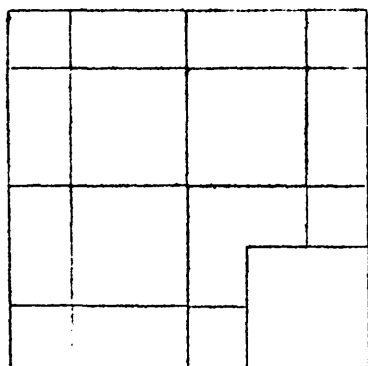
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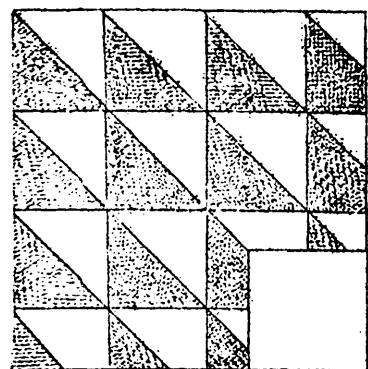
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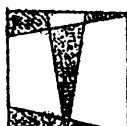
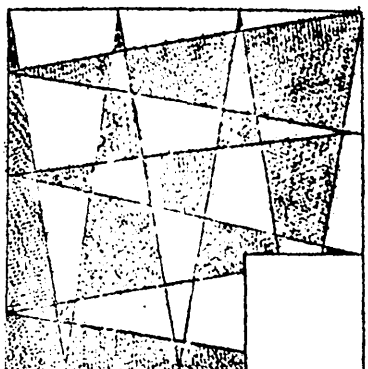
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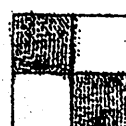
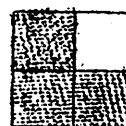
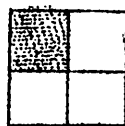
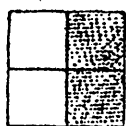
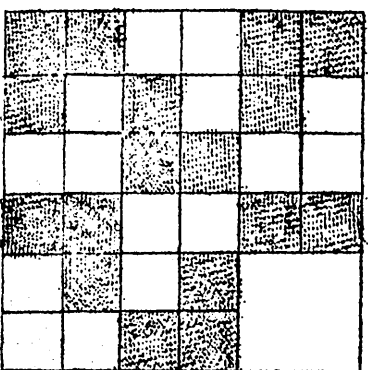
13



14



15



- Test 5 Recognition of Figures
 Test 6 Space Triangles (Form)
 Test 7 Space Triangles (Orientation)
 Test 9 Links

It was intended that these tests should form a series:

Test 5 was intended to call for ability to recognise shapes, the same way up but differing in size,

Test 6, ability to recognise shapes when they are turned round,

Test 7, ability to recognise shapes turned over^e (Mirror Images),

Test 9, ability to visualise change in shape.

Tests 5, 6 and 7 were given to both Q.R.C. and the elementary schools without alteration.

Only the easier items of Test 9 were given to the elementary Schools.

It must be borne in mind when reading the instructions that the elementary schools had done practice examples with their teachers before-hand. This accounts for the instructions to Q.R.C. being longer.

Recognition of Figures set to the boys of Queen's Royal College on 21st July 1948.

Mean Standard Deviation per year group = 5.71

| <u>Norms</u> | Age | Score on 42 Items (D - 19) |
|--------------|------|----------------------------|
| | 11.0 | 26.7 |
| | 12.0 | 28.2 |
| | 13.0 | 29.7 |
| | 14.0 | 31.2 |
| | 15.0 | 32.5 |
| | 16.0 | 33.4 |
| | 17.0 | 34.1 |
| | 18.0 | 34.4 |

I was rather surprised that no boys of this secondary school scored full marks on what I should have thought was a test too easy for them.

S.S.R. RECOGNITION OF FIGURES TEST

INSTRUCTIONS TO SUPERVISORS.

Have short-sighted children in front. See that you have 35 copies of booklets. Say to class "Is there anyone who has not got a sharp pencil?" If there is anyone, lend him one. Say to class "You will each be given a little book of test puzzles do not open it until you are told." Give out booklets. Say to class "On the line marked 'Name' write your full name (I mean all your names): write your surname (or title) last and write in block letters (these are capital letters) so that they may be easily read. On the line marked 'Age last birthday' write in figures your age before the word 'years'. On the line marked 'Date of birthday' write the date of the month, and the month of your birthday. On the line marked 'Form' write down the form you are in at school."

Have booklet opened at first page. Say to class "Now open the book at the first page. At the top of the page you see an 'A' and to the right of it, the other side of the line, you see six drawings. Two of these have an 'A'. You see this drawing has an 'A' (pointing to the 2nd drawing) and so has this one (pointing to the last drawing.) You see also that a line has been drawn under both of the drawings which have an 'A'. The 'A' need not be of the same size as the 'A' on the left of the line (pointing) for this one (pointing to last drawing) is much larger, but it must be exactly the same shape and the same way up. Now look at the 'B'. Can any of you see which two drawings have a 'B' of exactly the same shape? (class answers). Yes the 3rd drawing (running round the 'B' with a pencil) and the 5th drawing (running round the 'B' with a pencil). So draw a line under each of these two drawings. Now look at 'C'. Note that it is about three-quarters of a circle or round. In which two drawings do we find at least three-quarters of a circle? (class answers) Yes the 4th drawing and the 6th (pointing). So draw a line under each of these two drawings."

"Now turn over the pages to the page with 'Z' on it. You see the rows past 'Z' have numbers to them (pointing). When you have done 'Z' go straight on with the numbered rows. These are just the same except that there are drawings instead of letters. You still have to draw lines under the two drawings to the right of the line which have the drawing on the left of it.

"When I tell you to start go on by yourselves putting lines under the correct two drawings in each row. You will only be counted right if both the correct drawings have lines under them. If you put a line under only one, you will be counted wrong and if you put lines under three or more, you will also be counted wrong. If you wish to change your mind about a line you have drawn cross it out like this :-

#####

(indicating on blackboard).

You will be given 25 minutes to do the test which is plenty of time so there is no need to hurry, but if you find you can't do one go on to the next. You will not score any more marks if you finish before you are told to do so. I do not want to know when you have finished but when you do, just keep your book in front of you and try to work out those rows you couldn't do. You may not ask any questions at all during the test, but if you have forgotten what you have been told you may look at the cover of your book where you will find the instructions printed. Are you all ready? START!"

Make a record for future timing of the test, of the length of time for about a third of the class to finish - as judged by the children's attitudes - without letting the class know you are interested in the time they are taking.

At 20 minutes say "5 minutes more". At 24 minutes say "1 minute more". At 25 minutes say "time up" and see that no more writing is done then collect the books and arrange in alphabetical order. See that you return all 35 copies.

TEST 5. Recognition of Figures "11 Schools Experiment"

(42 Items)

Verbal Instructions

Give out booklets. Say to class, "Fill in the cover of your book as your teacher has shown you. Now open the book at the first page. As your teacher has explained to you in this test two drawings in each row must be underlined. He has shown you how to do the rows numbered A, B & C. At the top of the page you see an 'A' (p) and to the right of it on the other side of the line you see six drawings. Two of these have an 'A' (outlining letter with pencil = o.p.) so these have been underlined for you. In the second row these two have a 'B' (o.p) so underline them. In the third row this one has a 'C' (o.p.) and this one also has a 'C' (o.p.) so underline these. Now turn over the pages to the page with 'Z' on it. You see the rows past 'Z' have numbers to them. When you have done 'Z' go straight on with the numbered rows; these are just the same except that they are drawings instead of letters. You still have to draw lines under the two drawings to the right of the line which has the drawing on the left of it. The letters may be larger or smaller but always the same shape and the same way up. Turn back to the first page. When I tell you to start go on by yourselves ^u putting lines under the correct two drawings in each row. You will only be counted right if both the correct drawings have lines under them. You will be given 25 minutes to do the test. Are you all ready? START! At 20 minutes say "5 minutes more", at 25 minutes say "time ^m up" and see that no more writing is done. Collect booklets.

TEST, 5

95

S. S. R. RECOGNITION OF FIGURES TEST.

NAME

Christian names in block letters

Surname (Title)

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY

Date

Month

STANDARD

SCHOOL

TIME ALLOWED 25 MINUTES.

INSTRUCTIONS.

Each of the first 26 items starts with a letter of the alphabet. To the right of the line there are 6 drawings opposite each letter. Two of these possess the letter in exactly the same shape and the same way up but it may be larger or smaller. The puzzle is to underline both the drawings possessing the letter. The numbered rows after 'Z' are exactly the same, except that the two drawings to be underlined are those which have the drawing instead of the letter on the left of the line.

Items A-C are for practice. In 'A' the 2nd and 6th drawings are already underlined, in 'B' the 3rd and 5th are the ones to underline, and in 'C' the 4th and 6th are the ones to underline.

One drawing underlined, or more than two (in any row) will be counted wrong. If you make a mistake and wish to change your mind clearly cross the line you have drawn like this :-

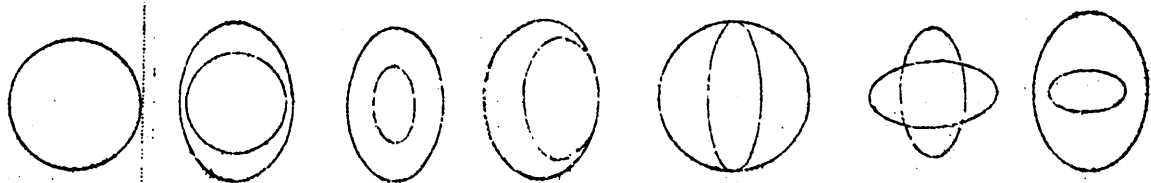
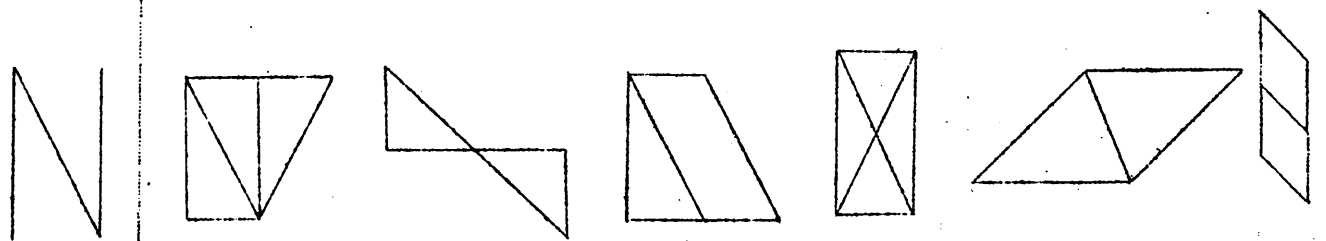
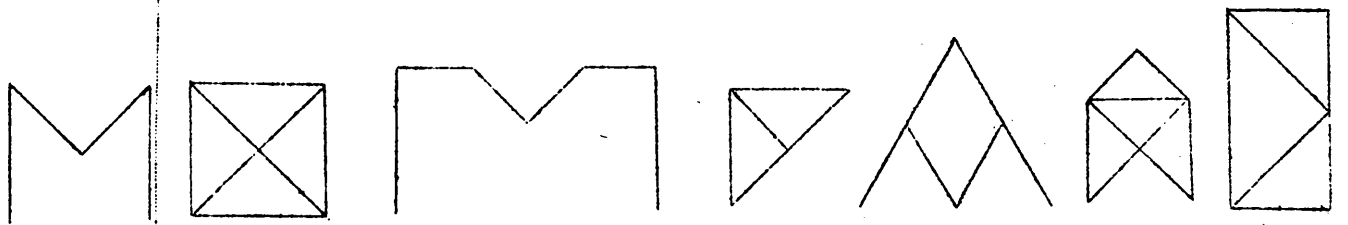
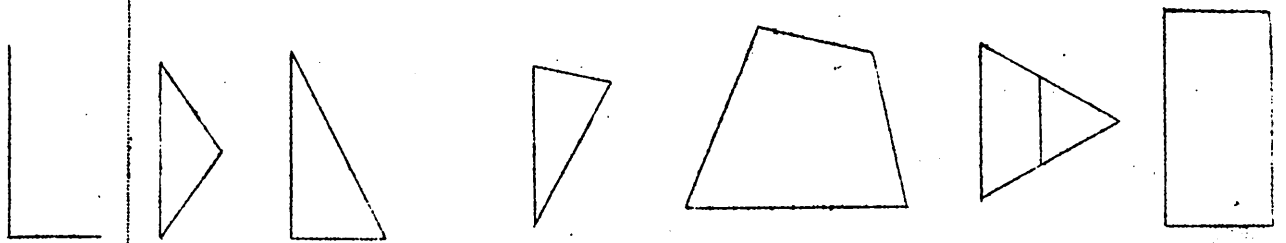
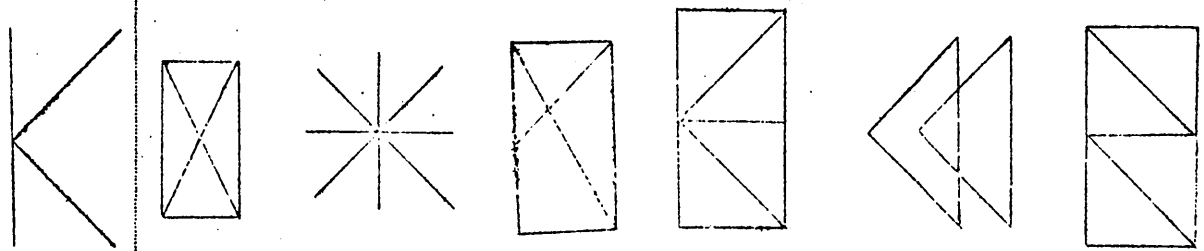
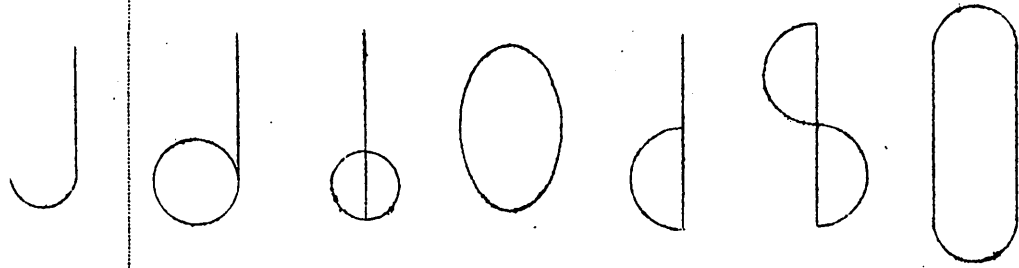
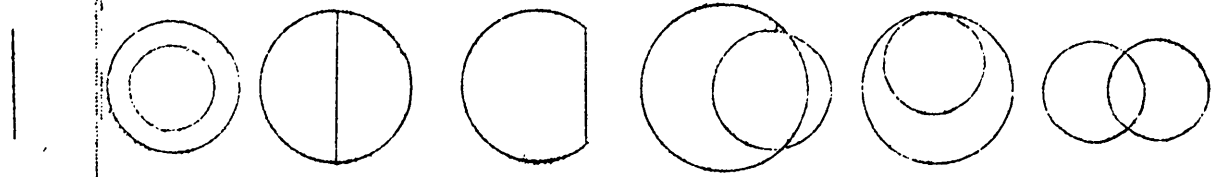
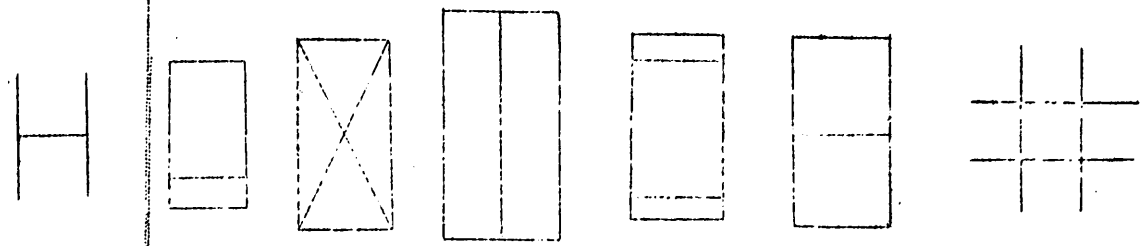
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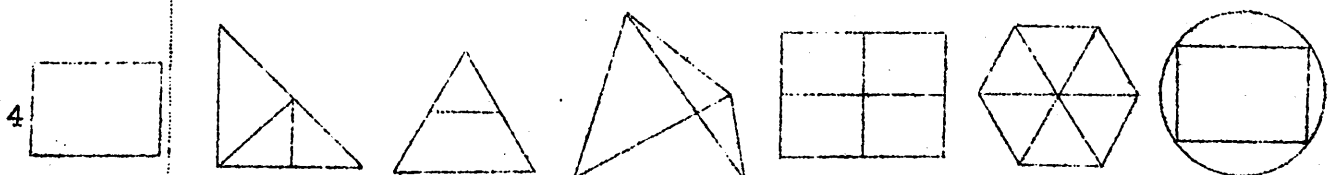
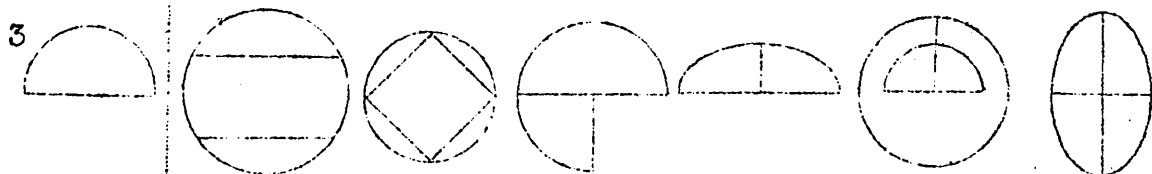
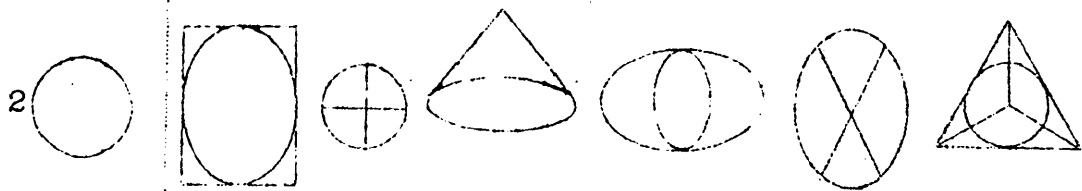
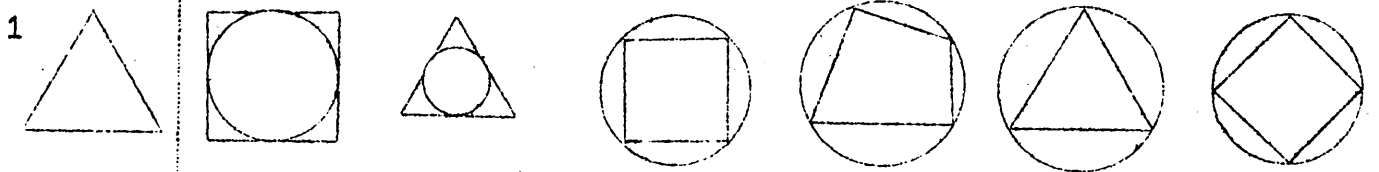
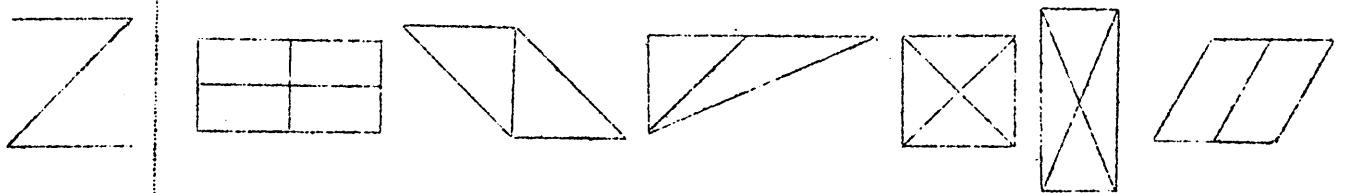
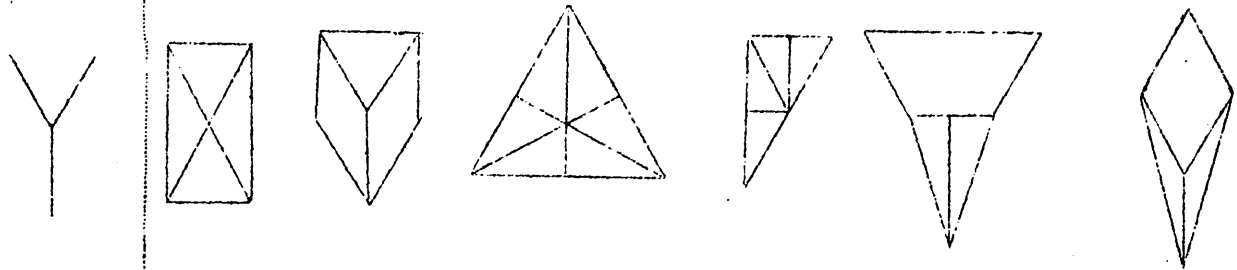
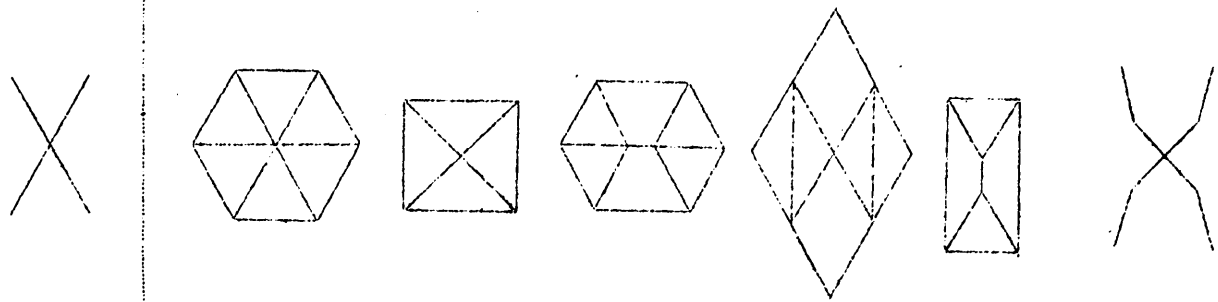
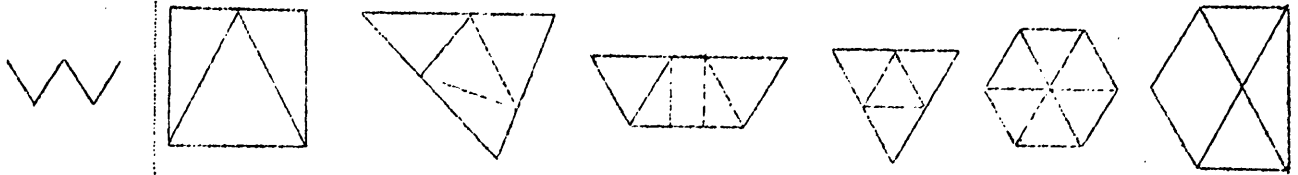
You need not hurry as you will be given 25 minutes to do the test which is plenty of time. Nevertheless, do not waste a long time over any one row, but get on with the next.

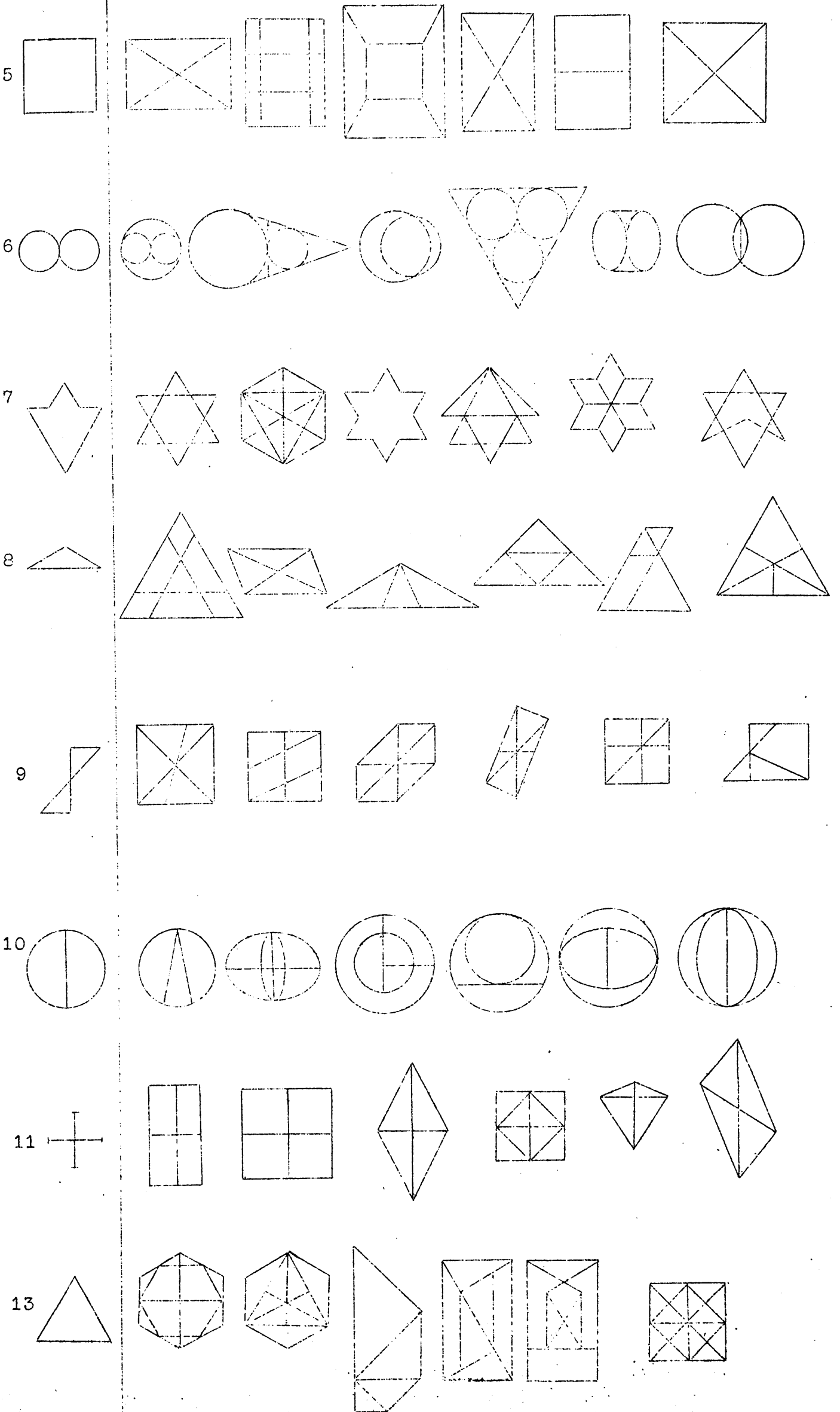
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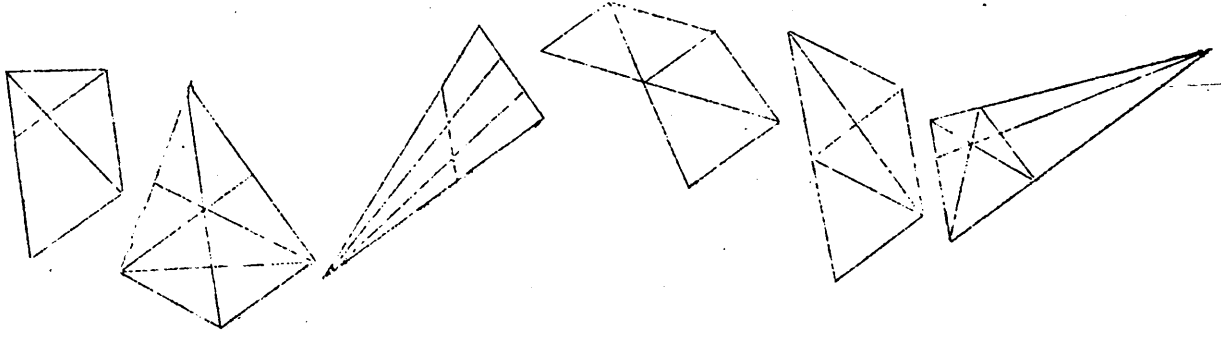
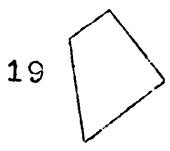
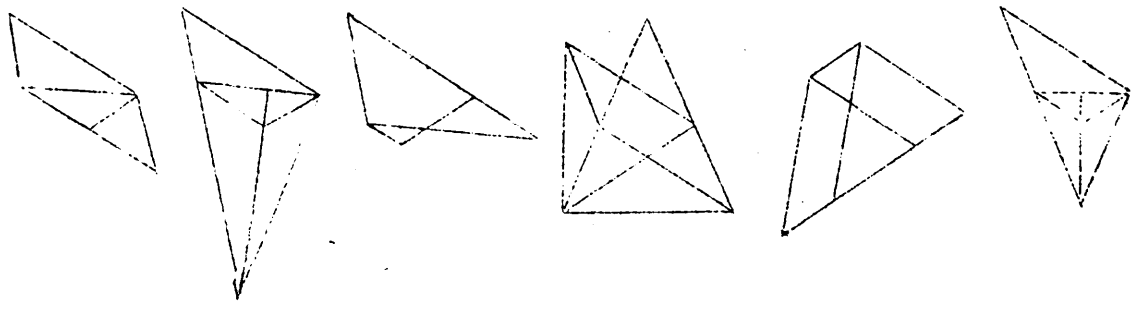
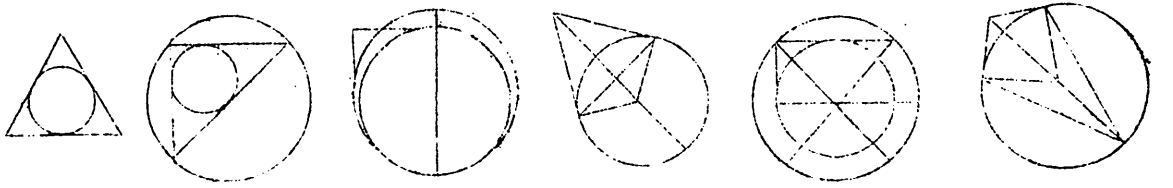
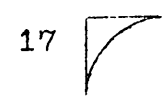
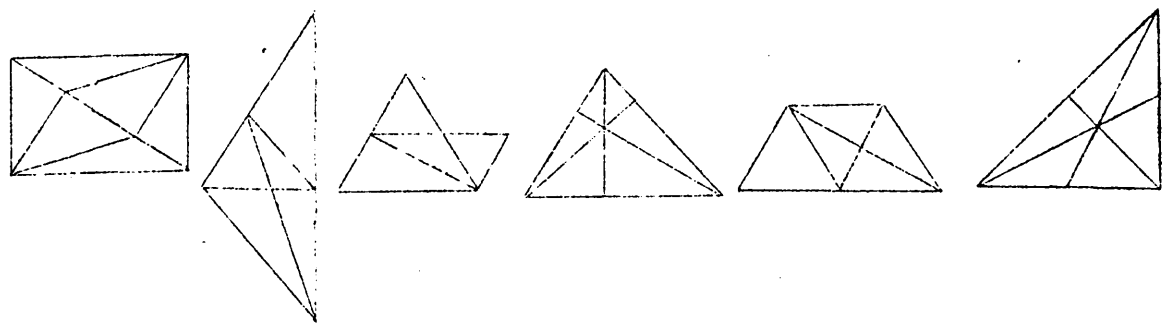
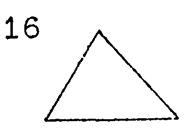
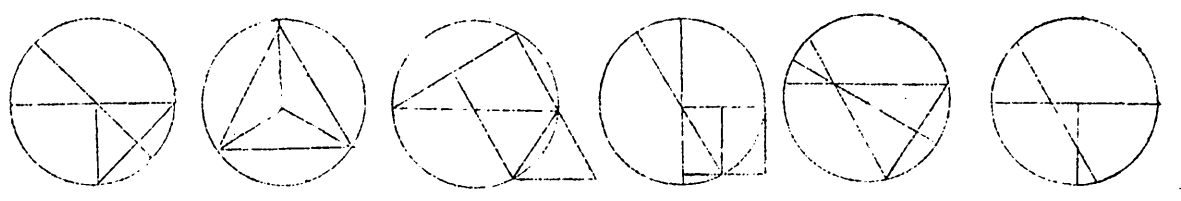
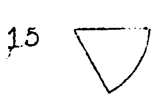
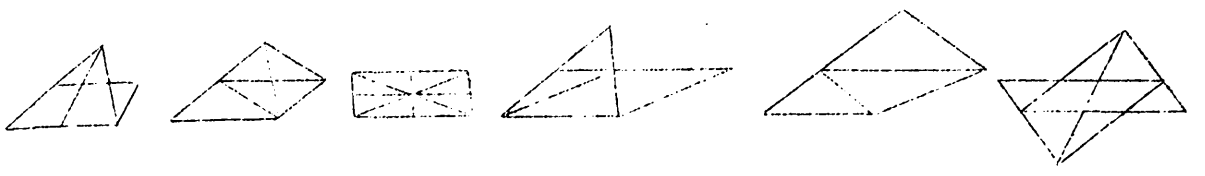
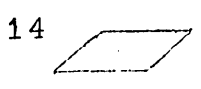
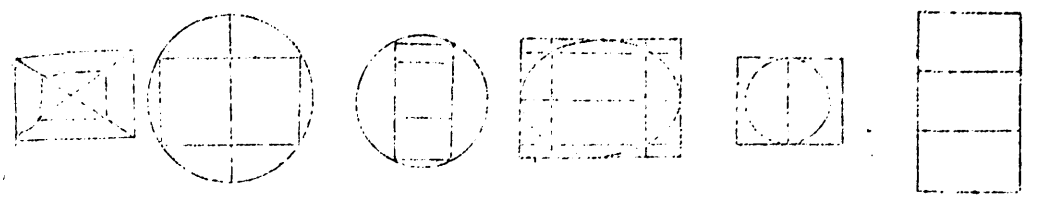
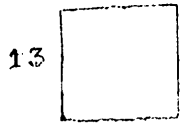
" " " " _____

Standard " " " " _____









Test 6. Space, Triangles (Form)

and

Test 7. Space, Triangles (Orientation)

The same scripts were marked in different ways to produce the scores on these two tests.

On the top of each page of the test are 6 triangles lettered A to F. A & B, C & D, E & F are pairs of mirror images. The first 20 items consist of 2 triangles each, the next 20 of 3 triangles each, and since each correctly lettered triangle scores a mark the maximum is 100.

For Test 6 either member of a pair is scored correct.

Thus B when it should be A is scored right.

For Test 7 the number of perfectly correct letters is counted. But as the maximum of these could only reach what was scored on Test 6 by an individual, the final score is the number of perfectly correct answers expressed as a percentage of the score on Test 6. This makes Tests 6 and 7 statistically independent.

Tests 6 and 7 were given to the boys of Q.R.C., and they were found to be too easy for the older boys many of whom scored full marks. Date, 21st. July 1948.

The principle of the test I believe to be new.

| Q. R. C. Norms: | Test 6 | | Test 7 | |
|-----------------|--------|---------------------------|--------|-------|
| | Age | Score on items 21 - 60 | Age | Score |
| | 11.0 | 57.7 | 11.0 | 60.9 |
| | 12.0 | 64.6 | 12.0 | 66.0 |
| | 13.0 | 71.5 | 13.0 | 71.2 |
| | 14.0 | 78.4 | 14.0 | 76.3 |
| | 15.0 | 82.6 | 15.0 | 80.8 |
| | 16.0 | 84.6 | 16.0 | 83.5 |
| | 17.0 | 85.2 | 17.0 | 84.6 |
| | 18.0 | 85.4 | 18.0 | 84.8 |

| | | |
|------------|-------|-------|
| Mean S. D. | 15.95 | 15.51 |
| per year | | |
| group | | |

S.S.R. SPACE TEST (TRIANGLES)

INSTRUCTIONS TO SUPERVISORS.

Have short-sighted children in front. See that you have copies of booklets. Say to class, "Is there anyone who has not got a sharp pencil?" If there is anyone lend him one. Say to class, "You will each be given a little book of test puzzles do not open it until you are told." Give out booklets. Say to class, "On the line marked 'Name' write your full name (I mean all your names); write your surname (or title) last and write in block letters (these are capital letters) so that they may be easily read. On the line marked 'Age last birthday' write in figures your age before the word 'years'. On the line marked 'Date of birthday' write the date of the month, and the month of your birthday. On the line marked 'Form' write down the form you are in at school."

ITEMS 1-20. Have booklet opened at first page. Say to class "Now open the book at the first page. At the top you see a row of 6 drawings each with a little letter inside (pointing). Look at the one with 'A' inside it (pointing). Under it you see the same drawing (pointing) but it is turned round a little; never mind how it is turned round it is still marked 'A'. Under that again is another drawing of 'A' (pointing) turned round a little more, and if you look down you see 'A' turned round to many different positions (pointing). In the one before the last in the 'A' column (pointing) you see 'A' turned round and larger. It is still marked 'A' because it is the same shape as 'A'. In the last drawing of the column (pointing) 'A' is quite small. Do you think you could recognize 'A' whichever way it is turned and whether it is large or small? Well we shall see. Now look at the drawing with 'B' inside in the top row (pointing). Under it you see 'B' turned round into many positions (pointing) also large (pointing) and small (pointing). Try not to get 'A' and 'B' mixed up when you come to do the test, for no matter how 'B' is turned it never turns into 'A'. It is true that if we cut 'B' out and turned it over (indicating with the hand) we should get 'A', but you must not think of the drawings turned over (indicating with the hand) only turned round (making circular movement with the hand), or made larger or smaller. The same thing with the other drawings marked C, D, E & F. Now look at the first drawing in the box (pointing), it is the same as 'B' that is why a 'B' has been put in it. The second drawing is 'A' (pointing), the third is 'F' (pointing). What letter shall we put into the next drawing? (pointing) (class answers). Yes 'C'. Will you all put a capital 'C' in that drawing. Always use block, that is capital letters. What letter shall we print in the next drawing (pointing) (class answers). Yes 'E' do this. And in the next (pointing) (class answers). Yes 'D' do this. And in the next (pointing) (class answers). Yes 'F' do this. You see that this last one is the same as 'F' in the top row (pointing) but turned a little. When I tell you to start go on by yourselves printing the right letter in each of the drawings marked '1' to '20'. You may turn the book round if you think it will help you, but I do not think it will. Take your time and go carefully. If you wish to change a letter cross it out and write it again, do not alter it. You will be given 10 minutes which is plenty of time to do the test without hurrying, and you will get no more marks for doing it fast than for doing it slowly. Still do not waste time over any but pass on to the next if you can't do it. Do not tell me when you have finished but just keep the little book in front of you without turning over the page. Are you all ready? START!"

Make a record, for future timing of the test, of the length of time for about a third the class to finish, as judged by the childrens' attitudes without letting the class know you are interested in the time they are taking.

At 9 minutes say "1 minute more". At 10 minutes say "time up", and see that no more writing is done.

TURN OVER

ITEMS 21 - 40. "Now turn over the page. You see the same six drawings at the top. Beneath these are (pointing to the next line) drawings made up of two of the drawings in the top row or one of the drawings twice over, turned round but not turned over. The first (pointing) has 'A' printed in one part because it is like 'A', and 'B' printed in the other part. In the second drawing (pointing) this part (pointing) is 'A' and this part (pointing) is 'D' turned round a little. What two letters shall we put into this drawing? (pointing to the third drawing) (class answers). Yes 'E' and 'F' (pointing to each part in turn) do this. And in this drawing (pointing to fourth drawing) (class answers). Yes 'B' and 'A' (pointing to each part in turn). You see 'B' has been turned round like this (indicating by the hand) and 'A' has been turned round like this (indicating again). Print the 'B' and the 'A' in the correct parts. What two letters shall we put into this drawing (pointing to the fifth drawing) (class answers). Yes 'A' and 'A'. For you see the lower part (pointing) is easily like 'A' in the top row and the upper one (pointing) is the same as 'A' turned upside down. Put in the 'A's.

"When I tell you to start go on by yourselves printing the right letters in each of the drawings marked '21' to '40'. Take your time as before. You will be given 15 minutes, and remember to go carefully for there is no purpose in finishing before the time is up. Do not tell me when you have finished but just keep the little book in front of you. You are not allowed to look back to the last page nor turn over to the next, but you may refer to the instructions printed on the cover at any time during the test. Are you all ready "START!"

Make a record as before of the length of time for about a third of the class to finish. See that children do not turn over pages. At 13 minutes say "2 minutes more". At 15 minutes say "time up" and see that no more writing is done.

ITEMS 41 - 60. "Now turn over the page. You see the same six drawings at the top but turned round and of different sizes. Beneath them (pointing to the next line) are drawings made up of three of these or any drawing of the top row may be used more than once to make up the three. The first (pointing) is made up of 'D', 'D' and 'B' so these letters have been printed in the correct spaces. What letters should we print in the next drawing? (class answers). Yes 'E', 'B' and 'C' (pointing) print these in.

"When I tell you to start go on by yourselves putting the right three letters in each of the drawings marked '41' to '60'. You are not allowed to look back to the two previous pages. Do not tell me when you have finished but just keep the little book in front of you. You will be given 25 minutes. Take your time. Are you all ready? START!"

Make a record as before of the length of time for about a third of the class to finish. See that the children do not turn back to the first two pages.

At 20 minutes say "5 minutes more". At 25 minutes say "time up" and see that no more writing is done. Collect the books and arrange in alphabetical order. Return all copies.

Time for class = 15 min

"11 Schools Experiment"

TEST 6. Space, Triangles (Form)

and

TEST 7. Space, Triangles (Orientation)

Verbal Instructions

Give out booklets. Say to class, "Fill in the covers of your books as you have been doing. Now open the book at the first page. Your teacher has already shown you how to put letters into each of these triangles. I am not going to ask you to do this first page again but turn over to the second page. At the top you see the same six triangles again. Between the two lines you see five drawings without numbers (p). In the first two drawings of that row the correct letters have been printed in the triangles. What letter should go into this triangle? (Class answers). Yes 'E'. Into this one (p)? (Class answers) Yes 'A'. When I tell you to start do those questions numbered 21 - 40, printing letters into each triangle that you see. If you have finished do not turn over the page until I tell you. You will have 15 minutes to do the test. Are you all ready? START!! At 12 minutes say "3 minutes more", at 15 minutes say "Time up", now turn over to the next page".

"At the top there are the same six triangles but they are turned round in different ways. What letter should be put here (p)? Yes 'E'. In this (p) Yes 'B'. And in this one (p)? Yes 'C'. When I tell you to start do those questions numbered 41 - 60, printing letters into each triangle that you see. You will be given 25 minutes to do this test. Are you all r-eady? START! " At 20 minutes say "5 minutes more", at 25 minutes say "Time up" and see that no more writing is done. Collect booklets.

TESTS, 6 and 7

S. S. R. S P A C E T E S T (TRIANGLES)

NAME _____
Christian names in block letters Surname (Title)

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
Date Month

Name of last School _____

Standard or Form at time of leaving _____

TIME ALLOWED 50 MINUTES.

INSTRUCTIONS

Items 1-20

Each of the drawings 1 to 20 consists of one of the lettered drawings in the top row, turned round (but not turned over) and made larger or smaller. Print (using block letters) in each of the drawings 1 - 20 the correct letter. You may turn booklet round. Time allowed 10 minutes.

Items 21-40

Each of the drawings 21 to 40 is composed of two of the lettered drawings in the top row (or one of them used twice) turned round (but not turned over) and made larger or smaller. Print the correct letters in the two parts of each drawing marked 21 - 40. You are not allowed to turn back to the previous page. Time allowed 15 minutes.

Items 41-60

Each of the drawings 41 to 60 is composed of three of the lettered drawings in the top row (or any drawing of the top row may be used more than once to make up the three) turned round (but not turned over) and made larger or smaller. Print the correct letters in the three parts of each drawing marked 41 - 60. You are not allowed to turn back to the previous pages. Time allowed 25 minutes.

Raw SCORE on Items 1-20. _____

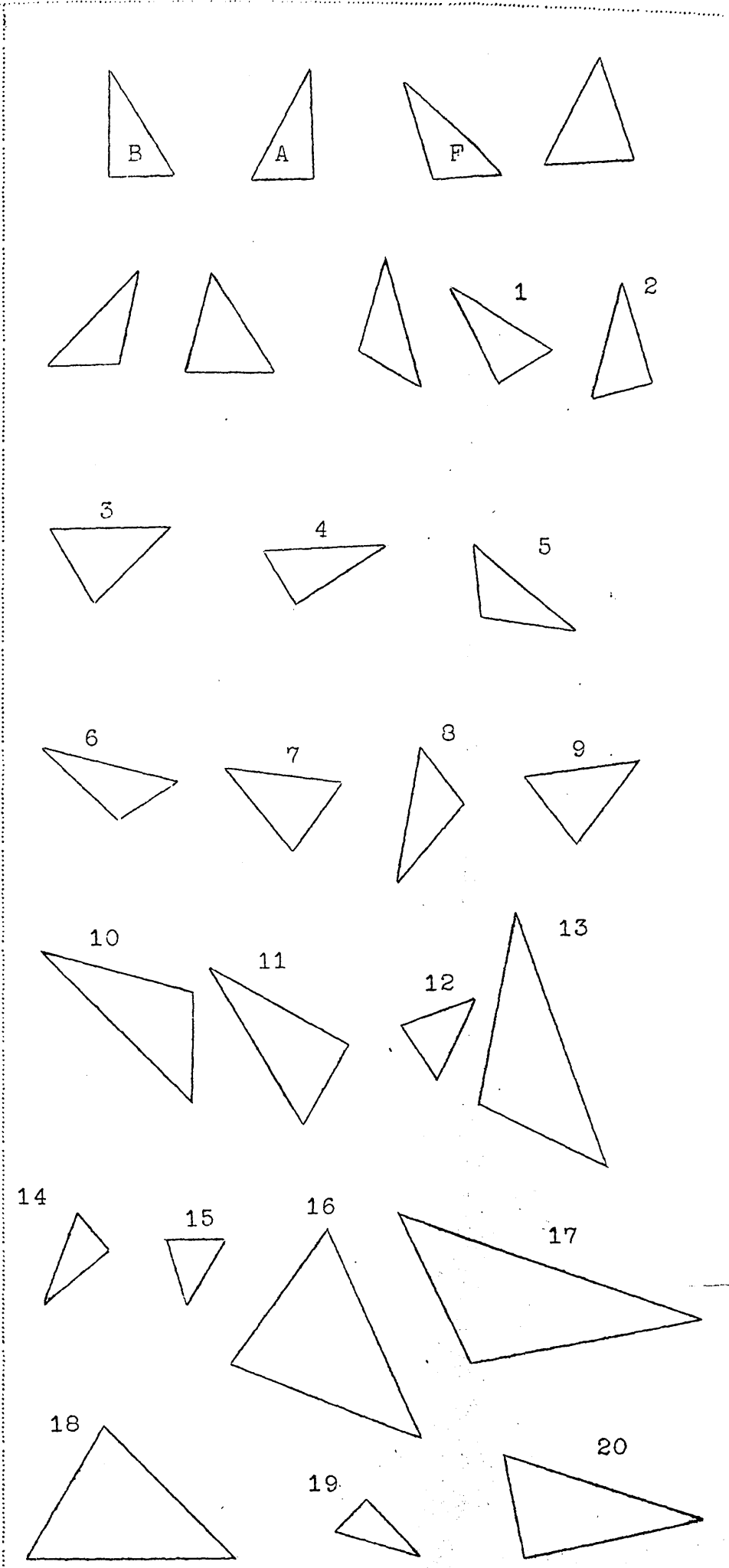
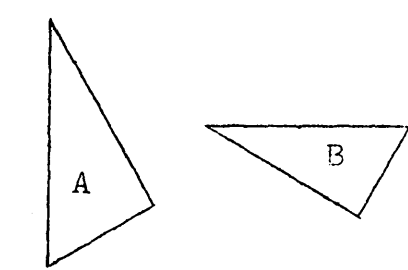
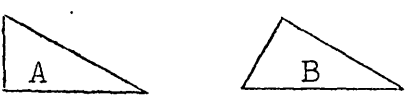
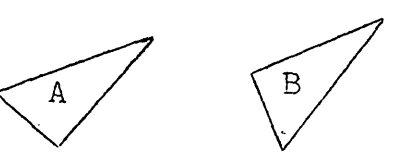
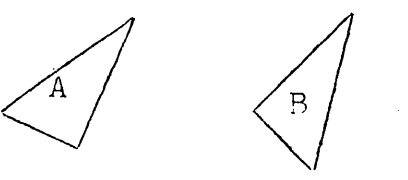
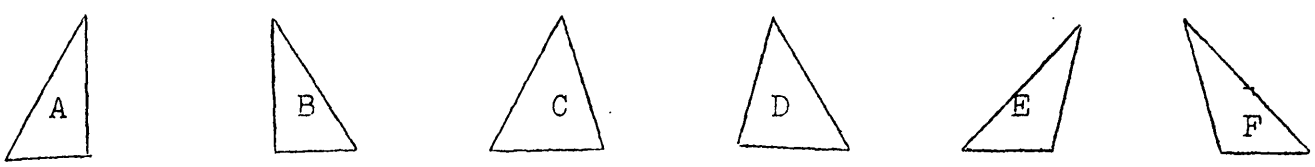
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" " " " 41-60. _____

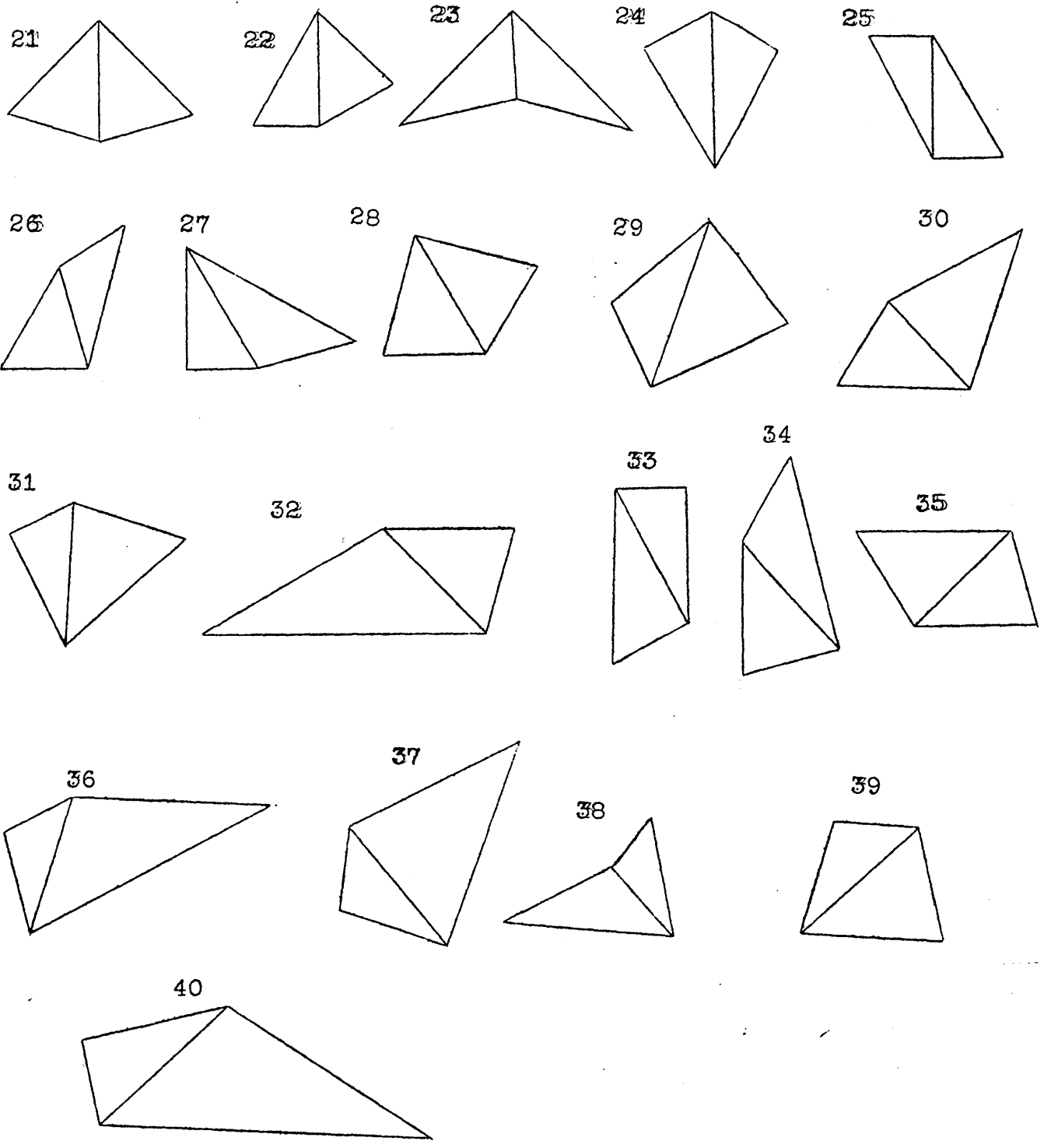
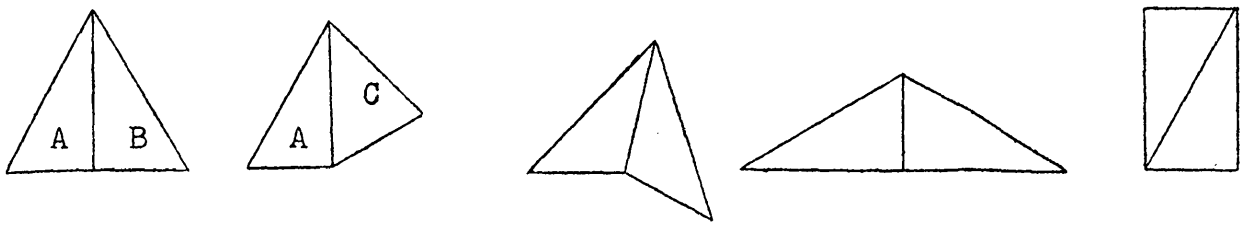
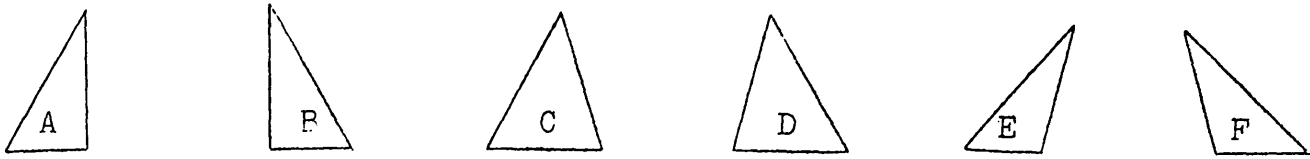
Social Science Research Laboratory,

TRINIDAD, B.W.I.

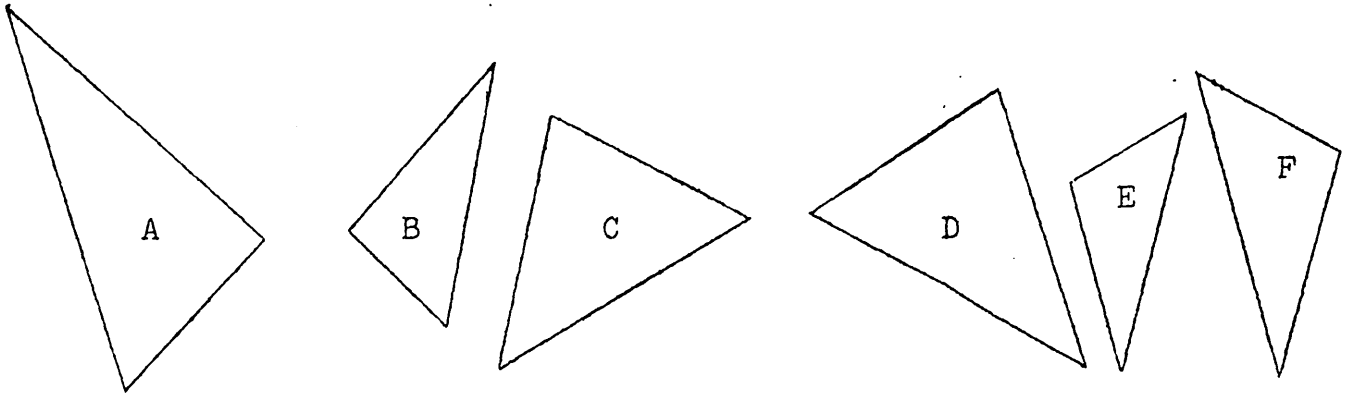
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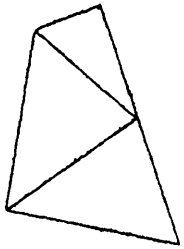
DO NOT TURN OVER UNTIL YOU ARE TOLD.



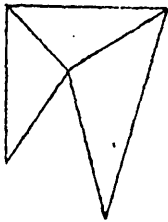
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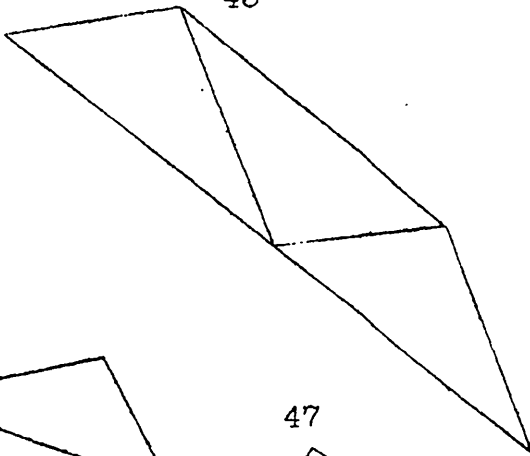
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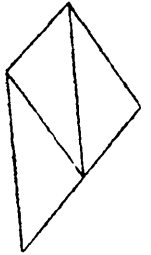
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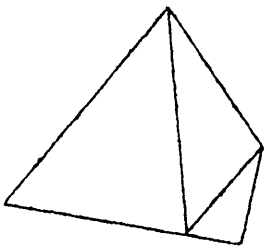
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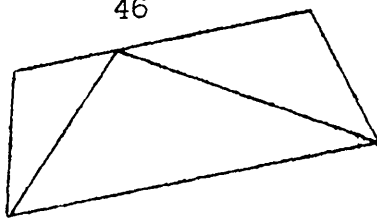
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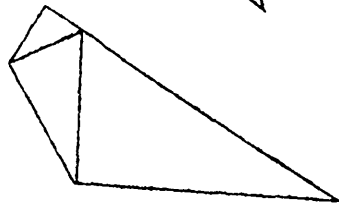
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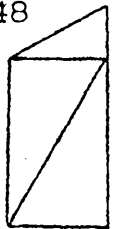
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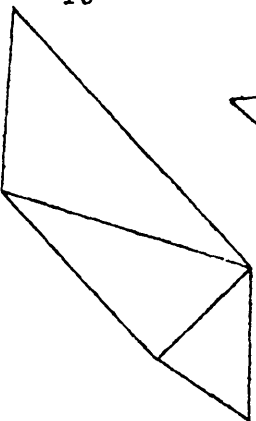
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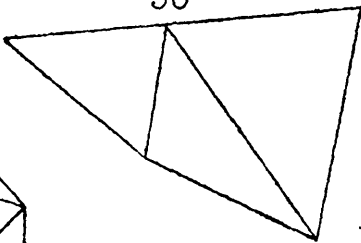
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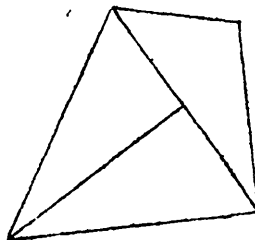
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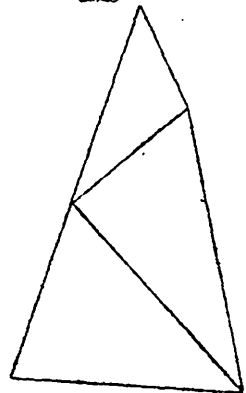
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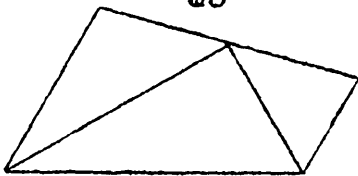
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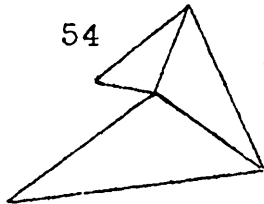
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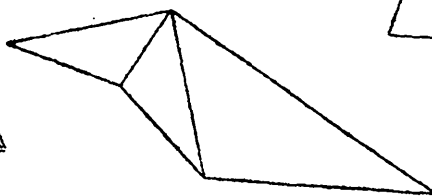
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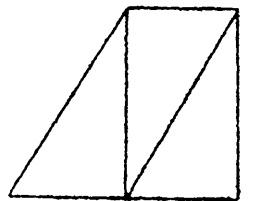
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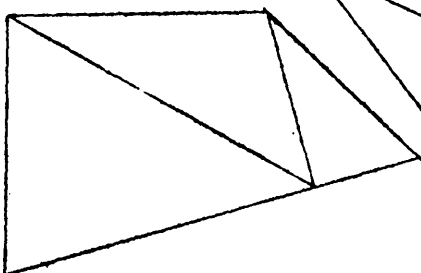
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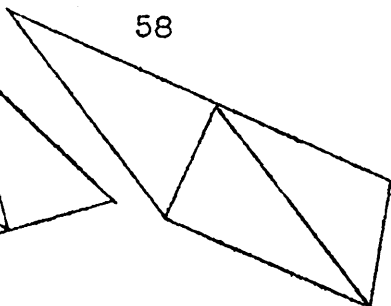
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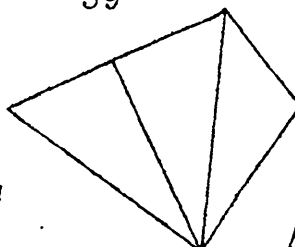
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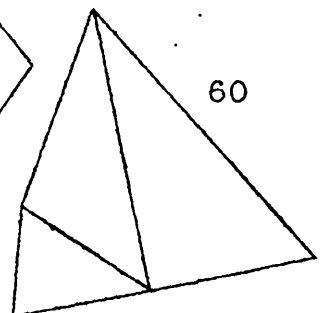
58



59



60



TEST 8. Moray House Experimental Space Test 4.

(100 Items)

This test is due to Mr. T. Renshaw, a Ph.D. student of Moray House who kindly gave me permission to copy it. It is a 3-dimensional Space Test.

After using this test and following the instructions provided with it (given on page 111) in the first four of the "11 elementary schools experiment" and examining the results it was found that most children did not know what they had to do. On this account the instructions were modified and the scores obtained in the first four schools were disregarded for the correlations. The children of the rest of the schools understood better what the test was about but still there were a number who did not. The distribution was unusual, but it is possible that understanding what is required should constitute part of the success of those who did well.

This test was not given to the boys of Q. R. C.

The followings are the modified Verbal Instructions:

The drawings below show models which have been built with blocks. All the blocks are of the same shape and size. Notice that some of the blocks have been lettered.

You have to find out how many blocks are touched by each of the lettered blocks and write the answers in the blank space underneath:

For example, in the first model, block A touches *and this one marked B at the side of it (p)* two other blocks; this one below it (p), [^] And so we have written 2 below A in the blank space underneath the first drawing.

See if you can find out how many blocks are touched by block B in the same model. Write the answer below B in the blank space underneath. Yes it touches 3

blocks. It touches block A (p), the block under A (p) and this block on the left of it (p). So a 3 should have been put in the blank space as you see here (p).

Now do the same for each of the lettered blocks in the second model.

You should have put, A "2", B "3" and C "3" into the blank spaces as is shown here (p), for; A touches this block on the left of it (p) and C which lies partly on top of it, B lies on this block (p) beneath C (p) and touches this block to the right of it (p), C lies on block B (p) on this one (p) and on A (p).

Make sure that you have counted all blocks touched by the lettered blocks.

Check your answers. They are:-

(see page 111)

Now read the Following carefully:-

1. All the questions in this test are like those you have just done.
2. When you are told to begin, turn over to page 2 and start working at once.
3. Work as quickly and as carefully as you can.
4. You will be allowed 30 minutes.

STOP HERE AND WAIT UNTIL YOU ARE TOLD TO BEGIN THIS TEST

TEST 8

112

MORAY HOUSE EXPERIMENTAL SPACE TEST 4.

NAME _____
Christian names in BLOCK LETTERS Surname (Title)

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
Date Month

STANDARD _____ SCHOOL _____

TIME ALLOWED : 30 MINUTES

RAW SCORE ON 100 ITEMS _____

STANDARD " " " _____

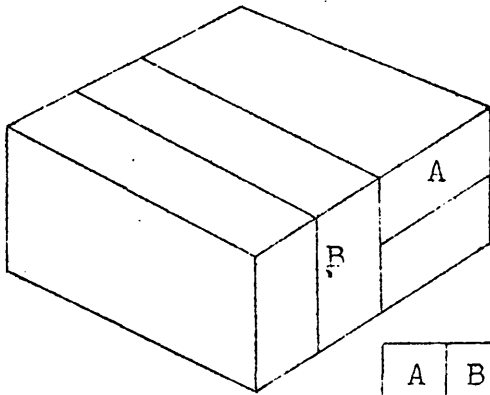
The drawings below show models which have been built with blocks. All the blocks are of the same shape and size. Notice that some of the blocks have been lettered.

You have to find out how many blocks are touched by each of the lettered blocks and write the answers in the blank space underneath.

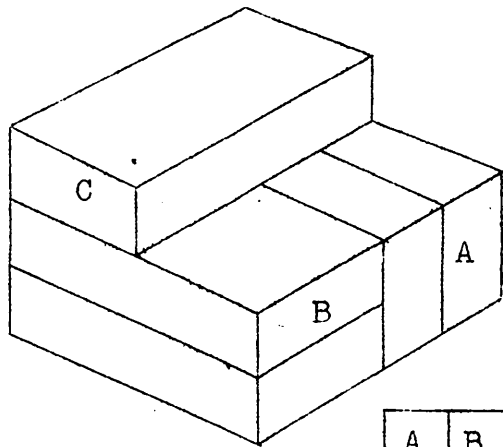
For example, in the first model, block A touches two other blocks; and so we have written 2, below A, in the blank space underneath the first drawing.

See if you can find out how many blocks are touched by block B, in the same model. Write the answer, below B, in the blank space underneath.

Now do the same for each of the lettered blocks in the second model.



| | |
|---|---|
| A | B |
| 2 | |



| | | |
|---|---|---|
| A | B | C |
| | | |

Make sure that you have counted all blocks touched by the lettered blocks.

Check your answers. They are :-

| | |
|---|---|
| A | B |
| 2 | 3 |

and

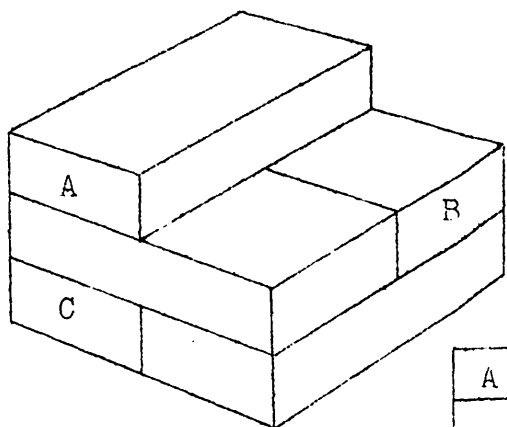
| | | |
|---|---|---|
| A | B | C |
| 2 | 3 | 3 |

Now Read the Following Carefully:-

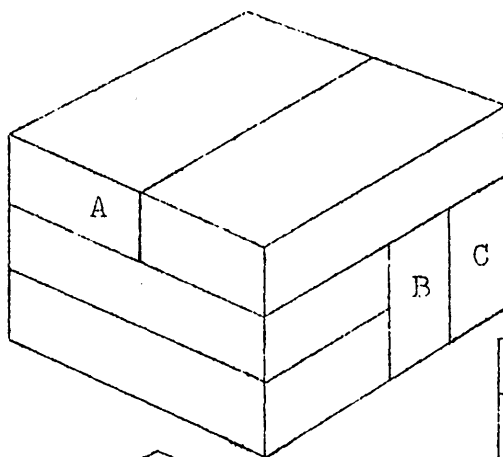
1. All the questions in this test are like these you have just done.
2. When you are told to begin, turn over to page 2 and start working at once.
3. Work as quickly and as carefully as you can.
4. You will be allowed 30 minutes.

STOP HERE AND WAIT UNTIL YOU ARE TOLD TO BEGIN THIS TEST.

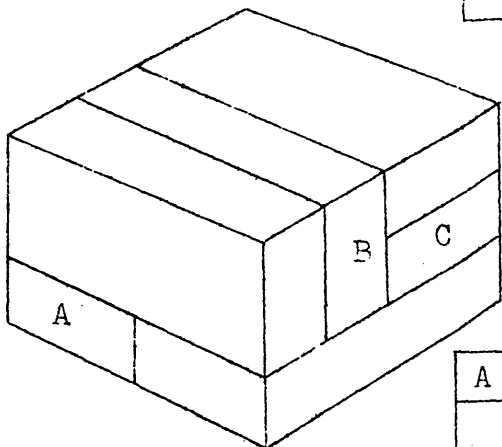
Write in the blank space below to show how many blocks each of those lettered touches.
 Remember the blocks are all of the same size.
 Make any alterations in your answers clearly.



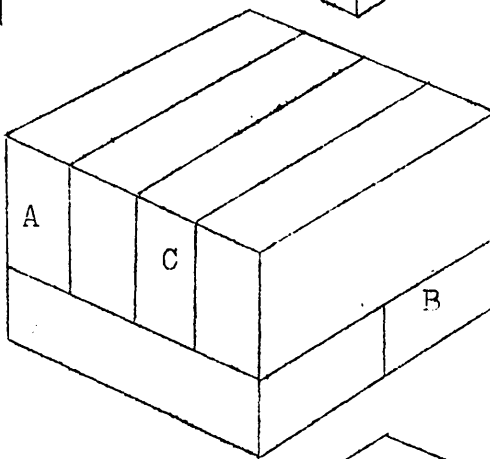
| | | |
|---|---|---|
| A | B | C |
| | | |



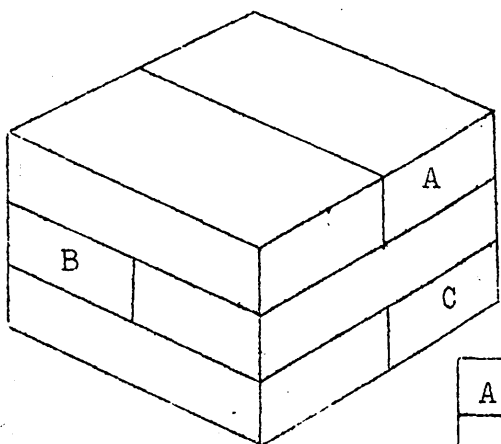
| | | |
|---|---|---|
| A | B | C |
| | | |



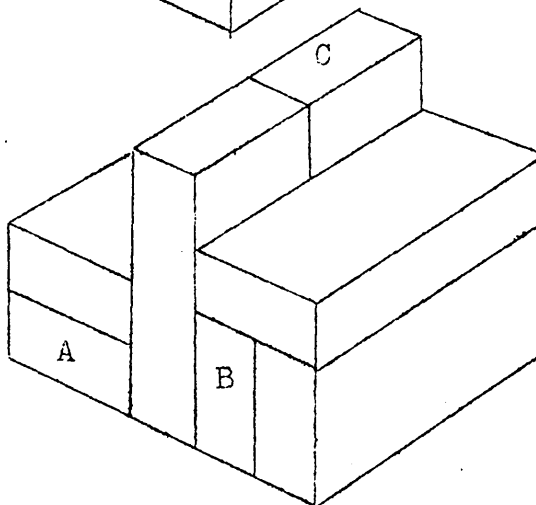
| | | |
|---|---|---|
| A | B | C |
| | | |



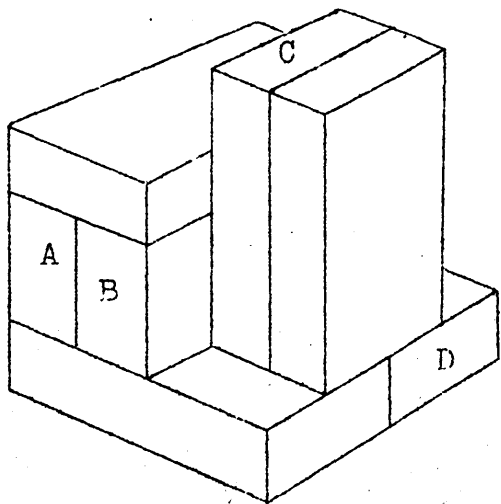
| | | |
|---|---|---|
| A | B | C |
| | | |



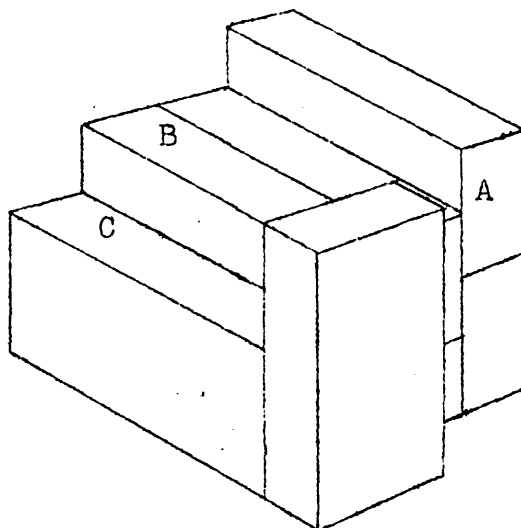
| | | |
|---|---|---|
| A | B | C |
| | | |



| | | |
|---|---|---|
| A | B | C |
| | | |

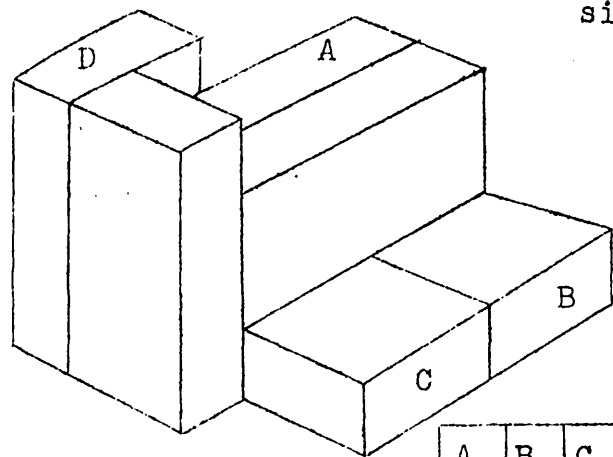


| | | | |
|---|---|---|---|
| A | B | C | D |
| | | | |

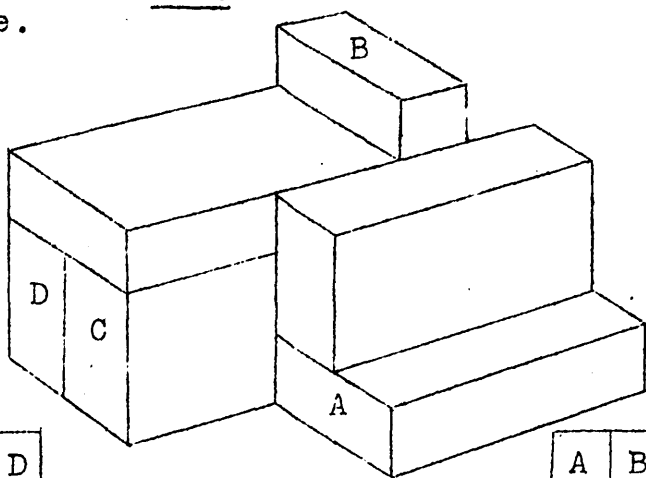


| | | |
|---|---|---|
| A | B | C |
| | | |

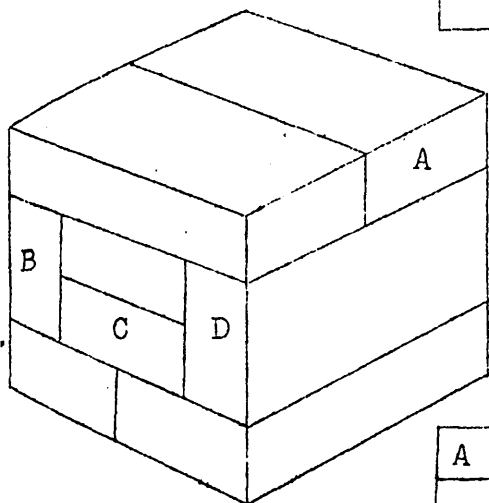
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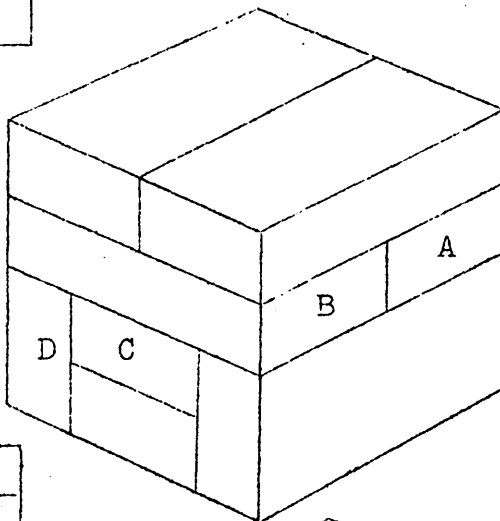
| | | | |
|---|---|---|---|
| A | B | C | D |
| | | | |



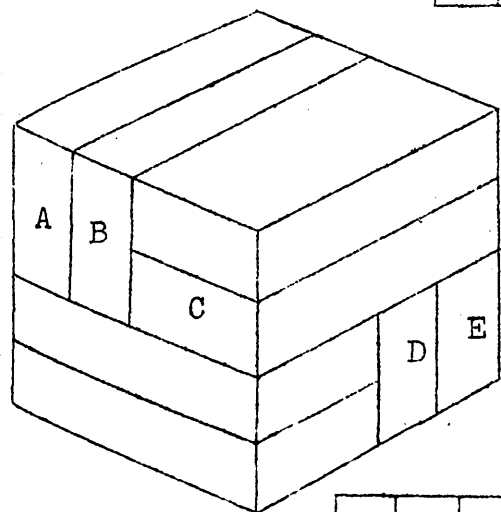
| | | | |
|---|---|---|---|
| A | B | C | D |
| | | | |



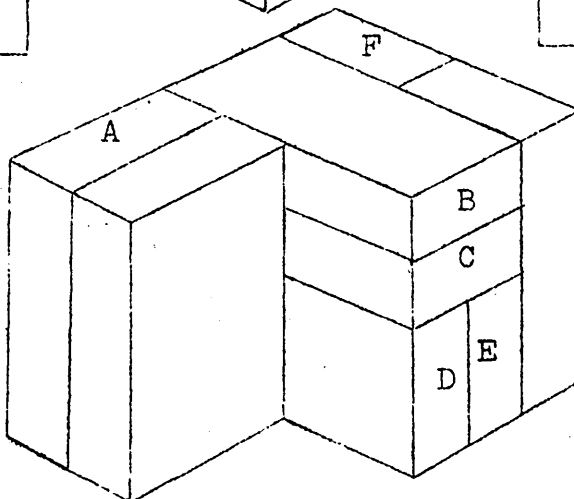
| | | | |
|---|---|---|---|
| A | B | C | D |
| | | | |



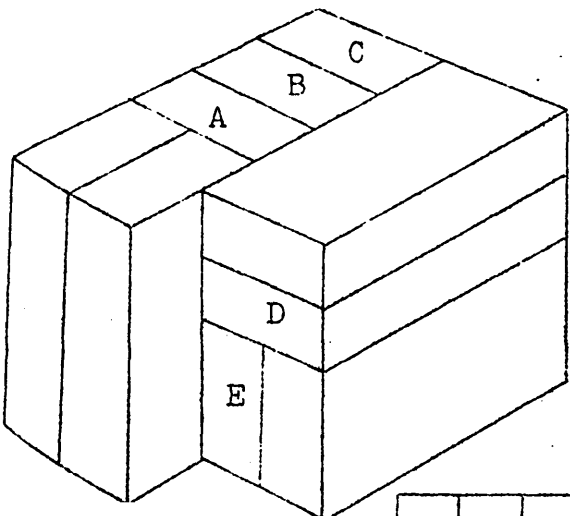
| | | | |
|---|---|---|---|
| A | B | C | D |
| | | | |



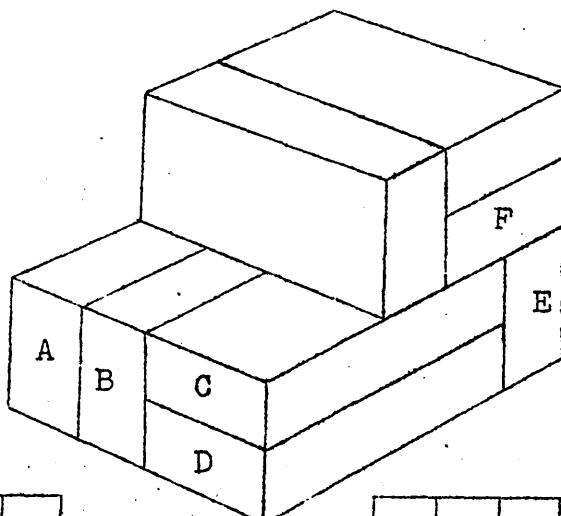
| | | | | |
|---|---|---|---|---|
| A | B | C | D | E |
| | | | | |



| | | | | | |
|---|---|---|---|---|---|
| A | B | C | D | E | F |
| | | | | | |

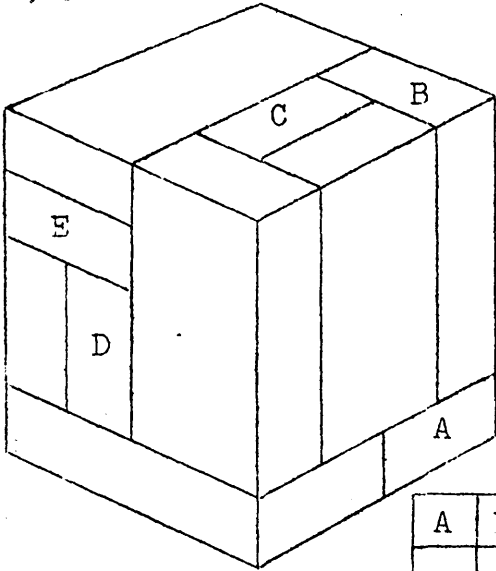


| | | | | |
|---|---|---|---|---|
| A | B | C | D | E |
| | | | | |

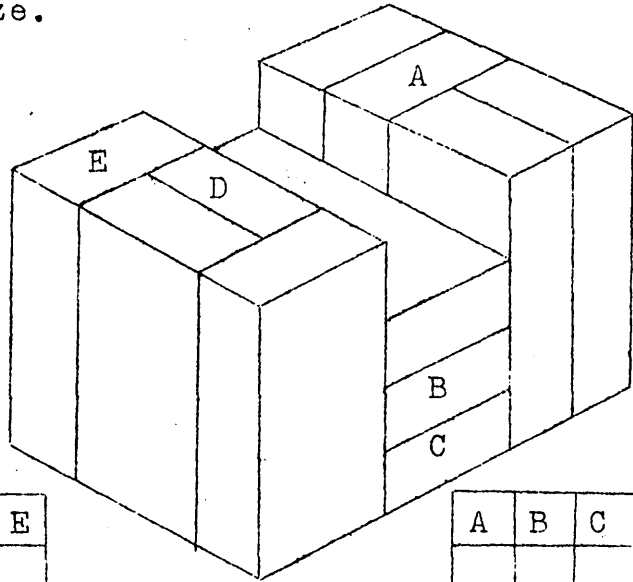


| | | | | | |
|---|---|---|---|---|---|
| A | B | C | D | E | F |
| | | | | | |

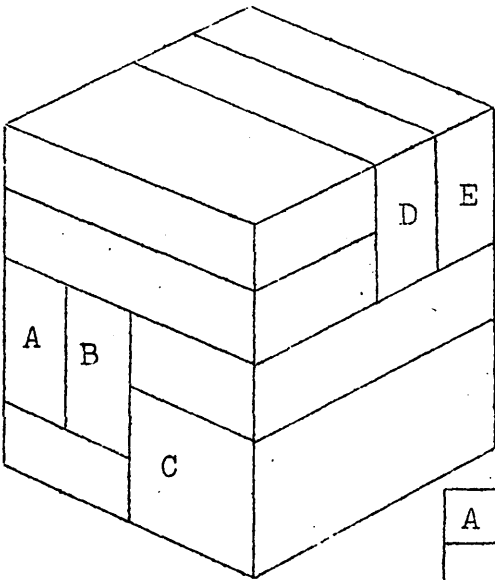
The blocks below are all of the same size.



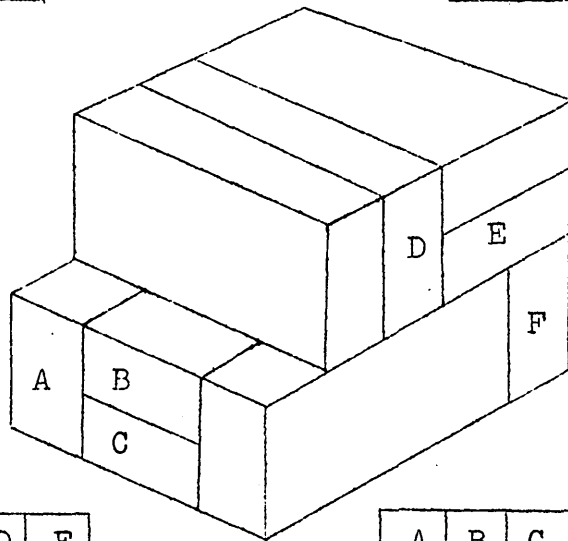
| | | | | |
|---|---|---|---|---|
| A | B | C | D | E |
| | | | | |



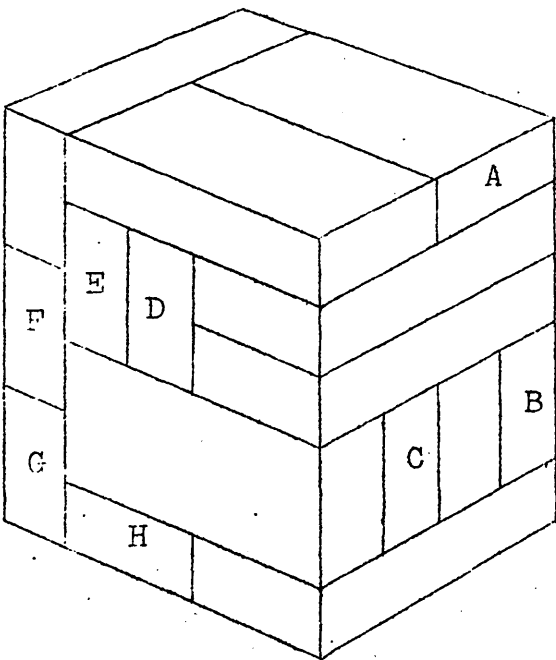
| | | | | |
|---|---|---|---|---|
| A | B | C | D | E |
| | | | | |



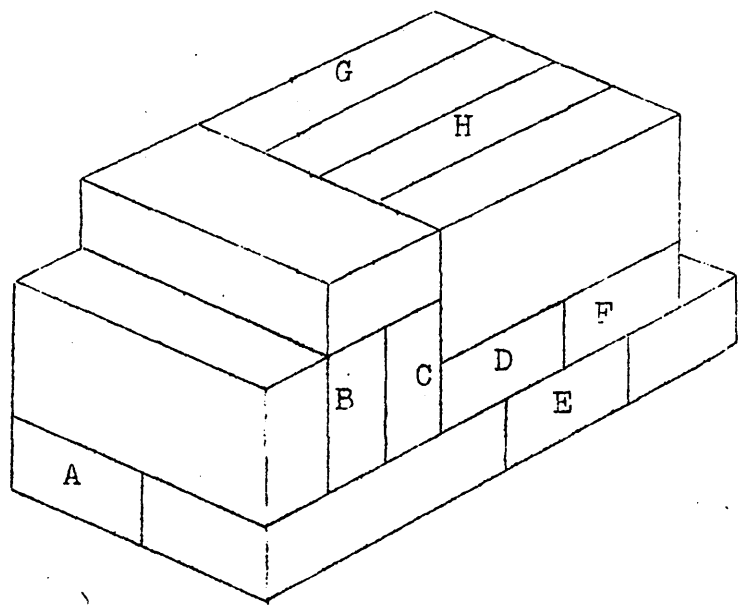
| | | | | |
|---|---|---|---|---|
| A | B | C | D | E |
| | | | | |



| | | | | | |
|---|---|---|---|---|---|
| A | B | C | D | E | F |
| | | | | | |



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H |
| | | | | | | | |



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H |
| | | | | | | | |

STOP HERE AND LOOK OVER YOUR WORK UNTIL TIME IS UP.

Links. Set to the boys of Queen's Royal College
on 2nd., February 1949

(45 Items)

The design of this test is new. A wooden apparatus consisting of the parts shown at the top of page 122 had been constructed. By the use of small bolts different jointed frameworks could be made. An "X" could also be bolted to any joint or where there was a hole. The question is where does the "X" go when a specified movement of another part (or other parts) is made.

With the Q. R. C. boys owing to all the Forms being tested at the same time and because there was only one piece of apparatus it was not possible to show it working as was done with the elementary schools. So that two sets of Verbal Instructions were prepared, one when the apparatus was not available and one when it was. The Q. R. C. supervisors were given copies of the former, together with Practice Test Booklets so that they could familiarise themselves with the instructions they would have to give and which were rather lengthy.

I was showing this test to an engineer friend of mine, and after a long time he gave all the answers correctly. However, his wife happened to glance at two of the most difficult of the items and immediately and without apparent thought gave the correct answers. She claims to be not at all mechanically minded. It may have been due to luck that she pointed to the correct dots or she may have chosen those dots which seemed to her to be the most unlikely ones, suspecting a catch. However, I thought that perhaps some people might possess the gift of seeing at once in their minds the apparatus as it changed its shape, instead of working out the final position of the X by the ped-

estrain method which I should adopt of laboriously working out the changes in position of each joint and visualising the arcs described. So I thought it would be of interest to investigate whether some minds tended to use a Gestalt method and others, possibly those with training in geometry, to use an analytic one. In fact this seems to me to be a rather important consideration which must apply to mental tests generally. The trained mind can be at a disadvantage in a speed test, because it tends to check each answer, and not to be satisfied unless it can be analysed. So I decided to test the boys of Q.R.C. in two ways. They were provided with coloured pencils and had to do as much as they could in 10 minutes. After this the coloured pencils were taken away and they continued for 40 minutes using ordinary pencils. A complete analysis of the results of this has not been made^e but there were a few who scored scarcely any more in the 50 minutes than in the 10, and of these a few scored fairly high marks. A very few altered their 10 minutes results and scored less in the 50 minutes than in the 10.

Q. R. C. NORMS

The mean standard deviation per year group = 6.08

| Age | Score on 45 items |
|------|-------------------|
| 11.0 | 10.7 |
| 12.0 | 13.5 |
| 13.0 | 16.0 |
| 14.0 | 18.3 |
| 15.0 | 20.0 |
| 16.0 | 21.1 |
| 17.0 | 21.5 |
| 18.0 | 21.5 |

} Mean Standard Deviation = 7.4

VERBAL INSTRUCTIONS TO SUPERVISORS (When the apparatus is not available)
 See that you have copies of booklets. Have short-sighted boys in front. See that no geometrical instruments are in use during the test, only pencils or pens are to be allowed. Say to class, "As this is not an intelligence test but probably a test of Mechanical Ability, you will all be told your scores. You must put away any geometrical instruments - rulers, compasses, protractors - you may have, as you will not be allowed to use them. Is there anyone who has not got a sharp pencil or a pen?" If there is anyone lend him one. Give out booklets, Have booklet open at the first page. Say to class, "These are puzzles about a simple piece of machinery made of wood. It is made of four thin strips of wood (pointing to these in the illustration of parts) with holes in them (pointing). As you see two are long (pointing), one is medium (pointing) and one is short (pointing). There are also two pieces of wood, one straight (pointing) and one curved (pointing). There are slots in these (pointing) and small blocks of wood can be pushed along these slots. The two larger blocks in each slot (pointing) can move easily and they have a screw sticking up in the middle, the three smaller ones in each slot (pointing) are hard to move, and stop the larger ones from moving when they come up against them. There is also a round piece of wood (pointing) with a screw sticking up in the middle. This piece and the pieces with the slots in them can be fixed to a blackboard or table with drawing pins. Now look at the picture P1 (i). The round piece of wood (pointing) and the curved one with a slot (pointing) are to be thought of as fixed to a blackboard or a table, and a long strip is placed, as you see, so that it has the screws of the fixed round (pointing) and of the movable block in the slot (pointing) through the holes at the ends of it. The other blocks in the slot are pushed to the other end (pointing). Now the question is, Where does the point marked with an "X" (pointing) move when the movable block in the slot is pushed as far as it will go along the slot? The arrow shows how the piece is moved and the tip of the arrow (pointing) shows how far the screw in the middle of the moving block will get when it is stopped by the small block on the right (pointing). Which dot will "X" move to? This? (pointing to the nearest dot). This? (pointing to the furthest dot). Up to this? (pointing to upper dot). Down to this? (pointing to lowest dot). Look at the picture P1 (ii) (pointing). The strip has moved a little way. Look at P1 (iii), it has moved further, and now look at P1 (iv) (pointing) it has moved as far as it will go and the screw through the bottom end of the strip has got to where the arrow was. We see that the point "X" has got to the middle dot. So in P1 (i) (pointing) put a ring like this . round the middle dot to show that the "X" would go there if the strip were moved as the arrow shows. Now turn over the page and look at P2 (i) (pointing). This time we have the two long strips jointed at their top ends by a little nut and bolt (pointing to nut and bolt in drawing of parts). This is the point marked with the "X" (pointing). Where does "X" go when the lower end of the strip is moved as the arrow shows? You see the answer by looking at P2 (ii) and P2 (iii) (pointing). It does not move at all. So in P2 (i) make a ring round the point marked "X" like this (illustrating). I want you to remember this very carefully when you are doing the test: When the long strips are used in the curved slot the top point will always stay still. Look at P3 (i) (pointing). Here both strips move, and, by looking at P3 (ii) and P3 (iii) (pointing) we see that the top point marked with the "X" stays still, as I said it would do. "X" is the answer to this question too. But when we use the straight slot the top point will not stay still. For turn over the page and look at P4 (i). The "X" will move right across when both strips are moved in the direction of the arrows, as P4 (ii) and P4 (iii) show it will do, and the dot on the right is the one to put a ring round. In P5 the strips are moved both together towards the middle of the straight slot. P5 (ii) and P5 (iii) show that the "X" rises straight up to the dot at the top. Some of the questions you will find very easy but others are difficult. Turn over the page. P6 is a difficult one. In this all four strips are used. The dot to put a ring round is the lowest one as P6 (ii), P6 (iii) and P6 (iv) show. Remember while doing the test that in each question you must draw a ring round the dot where you think the "X" will go when the blocks have been moved in the slots as shown by the arrows. If the "X" does not move draw a ring round it. Also remember that the top point will never move when the curved slot is used, but it will when the straight slot is used. ~~It~~

TURN OVER

"When I tell you to start, first of all you will be given exactly 10 minutes to do the test as fast as you can using the blue pencil you have been provided with. While doing the test quickly like this try to imagine how the apparatus would change its shape for you will have no time to work out where the "X" will go in any other way.

"When the 10 minutes is gone you will be told to stop work and close booklets. You must do this at once and the blue pencils will be collected. You will then do the whole test over again using ordinary pencils for which you will be given another 40 minutes. If you wish to change your mind about a ring you have made clearly cross it out and make another one, but do not cross out a blue ring with an ordinary pencil.

"If you finish before I tell you to stop I don't want to know but go on trying. Are you all ready? START!" At 9 minutes say "1 minute more" at 10 minutes say "stop working" and see that they all close their booklets.

After collecting the blue pencils say to class, "When I tell you to start re-open your booklets and do every question over again using ordinary pencils. If you already have a blue ring round a dot or an "X" and you still think that is the right place for the ring, make a ring in pencil round the blue ring you have already made and do not on any account rub out or cross out the blue ring.

"Are you all ready? START!" At 35 minutes say "5 minutes more" at 40 minutes say "time up" and see that no more writing is done. Collect booklets seeing that you get back copies.

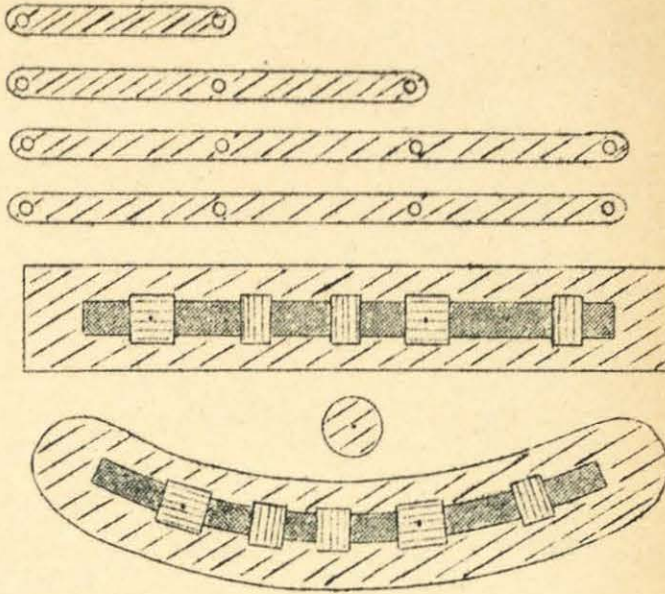
ADDENDUM

After the words ' Give out booklets ' insert :-
' and blue pencils then say to class, "Fill in what is required on the cover of your booklet!'

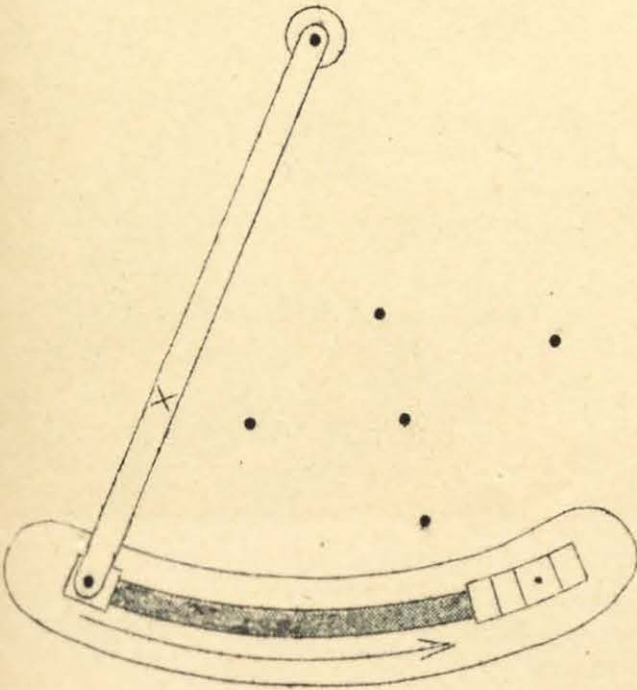
S.S.R. (TRINIDAD) LINKS TEST

practice Tests Booklets for Supervisors. To be returned.

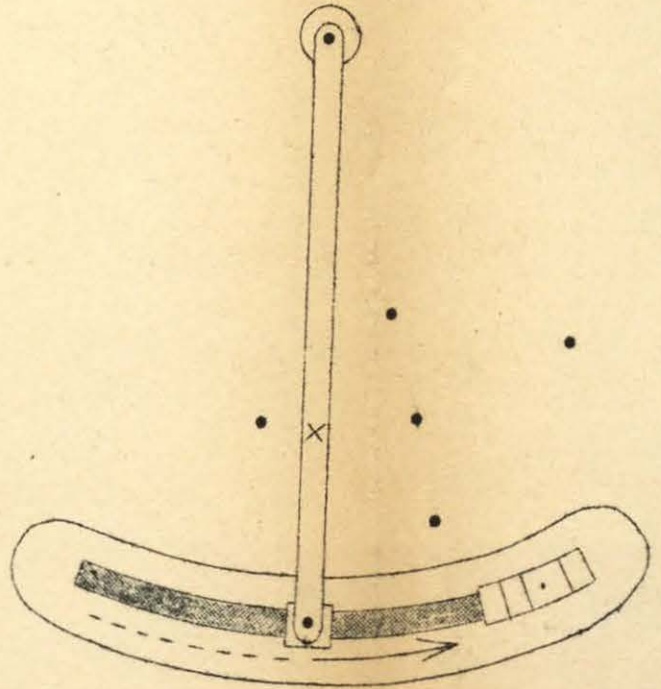
PARTS



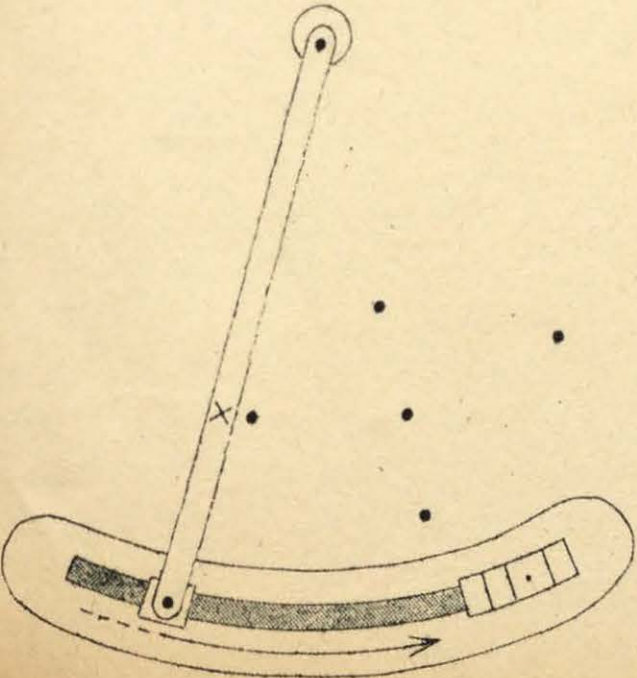
P - 1 (i)



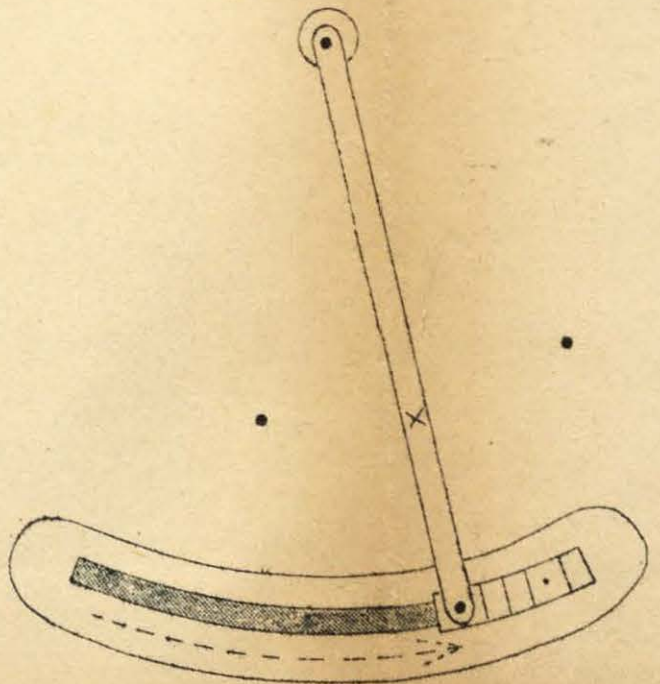
P - 1 (iii)



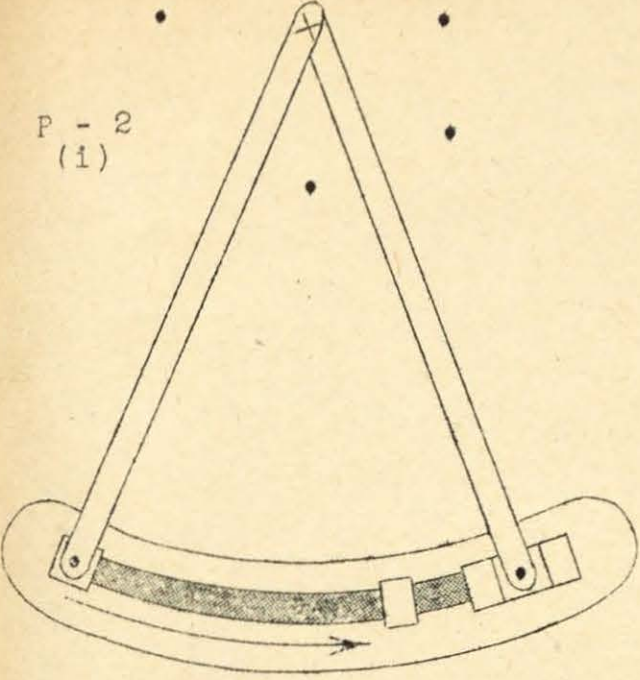
P - 1 (ii)



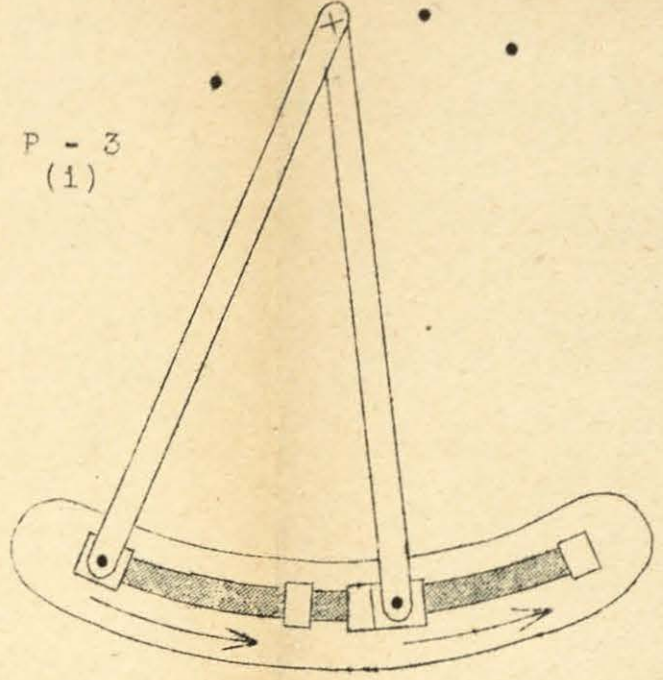
P - 1 (iv)



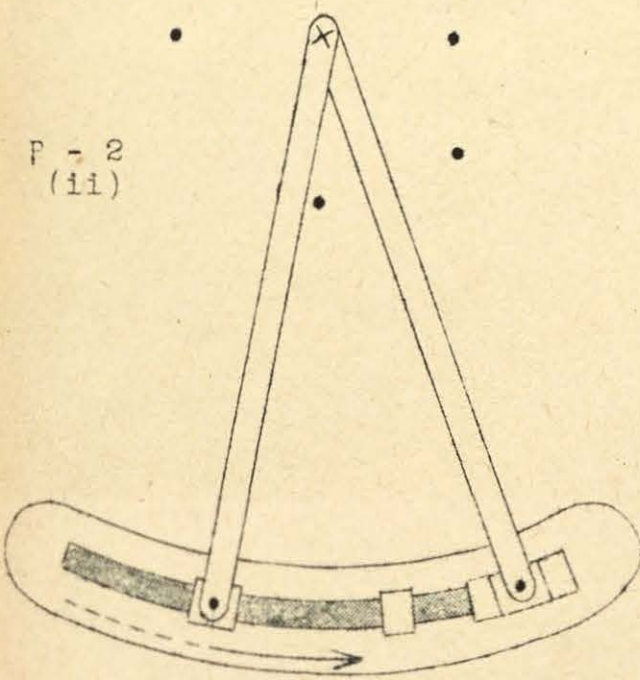
P - 2
(1)



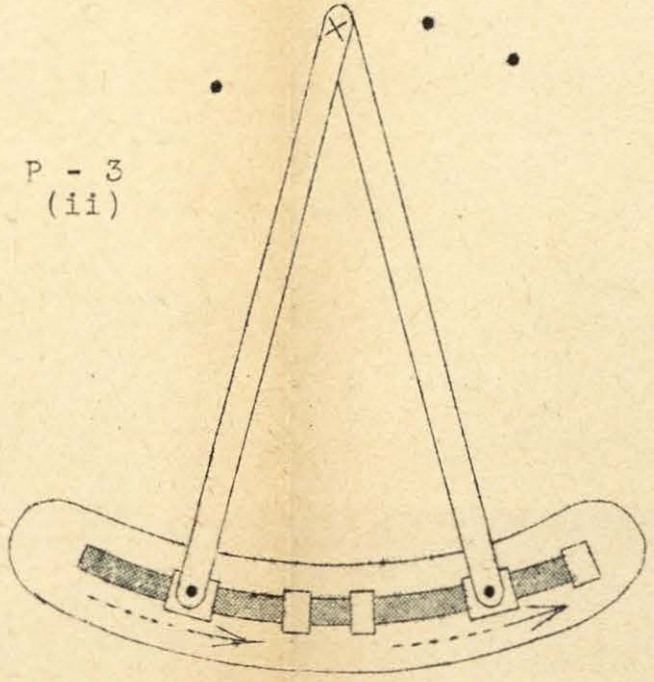
P - 3
(1)



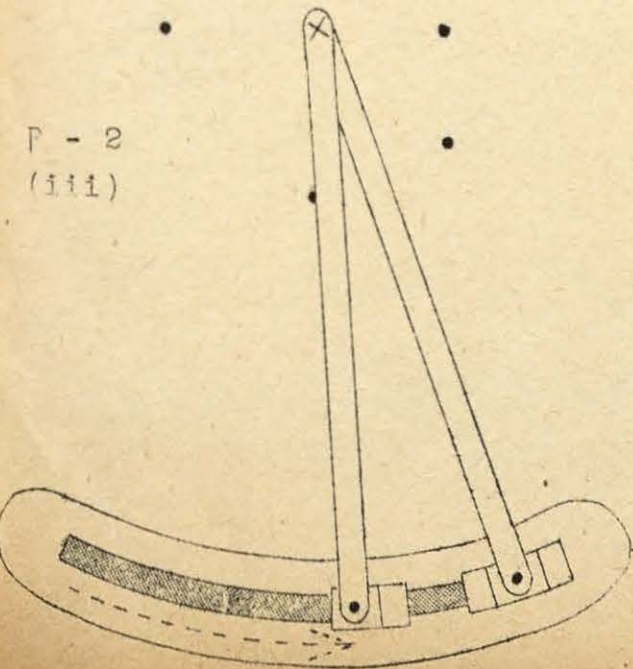
P - 2
(ii)



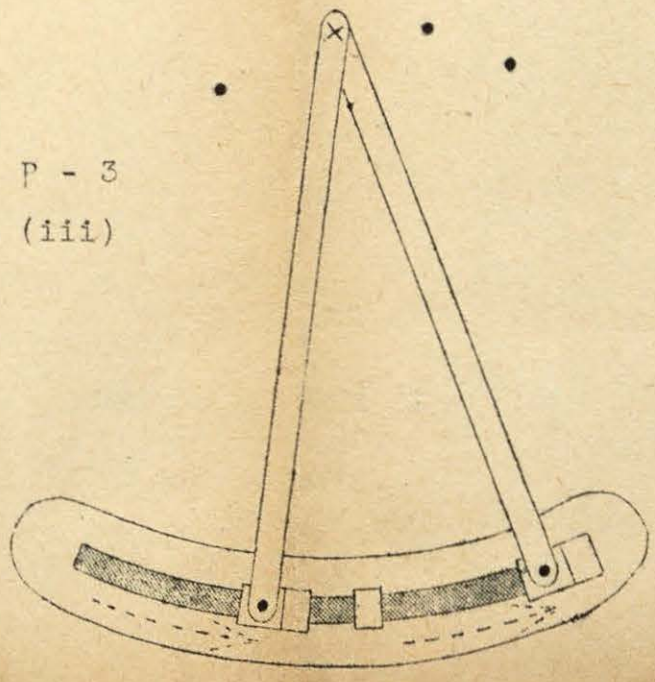
P - 3
(ii)



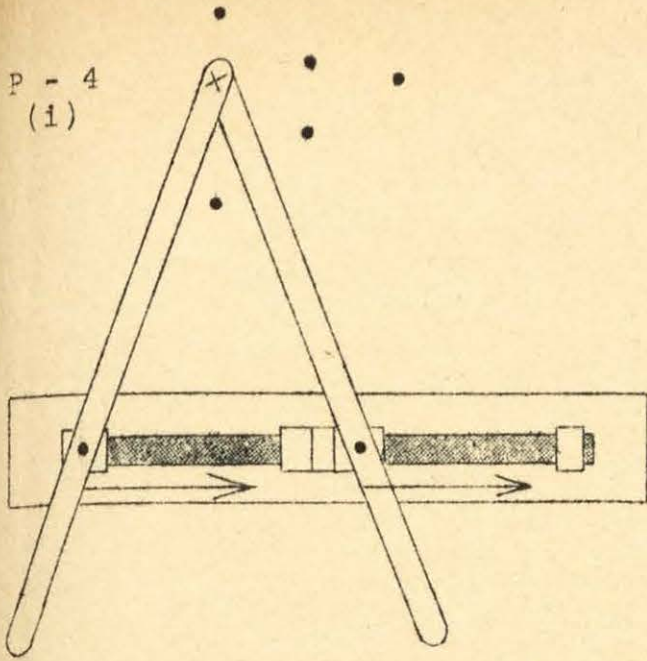
P - 2
(iii)



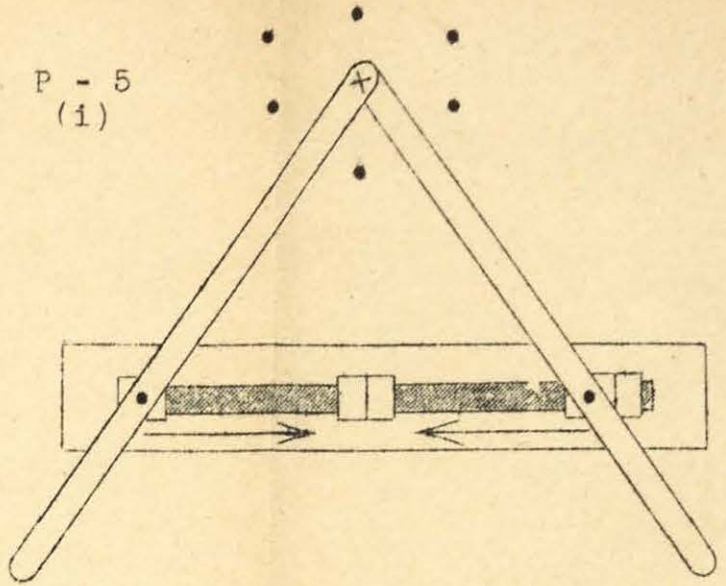
P - 3
(iii)



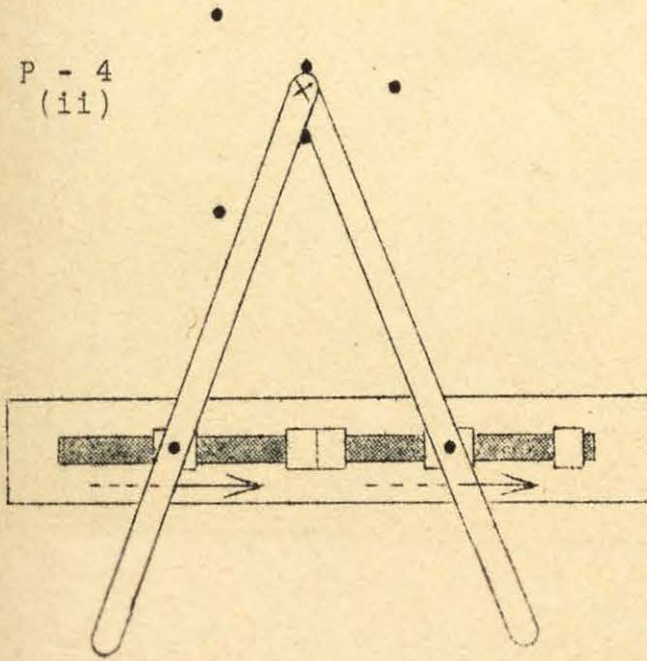
P - 4
(i)



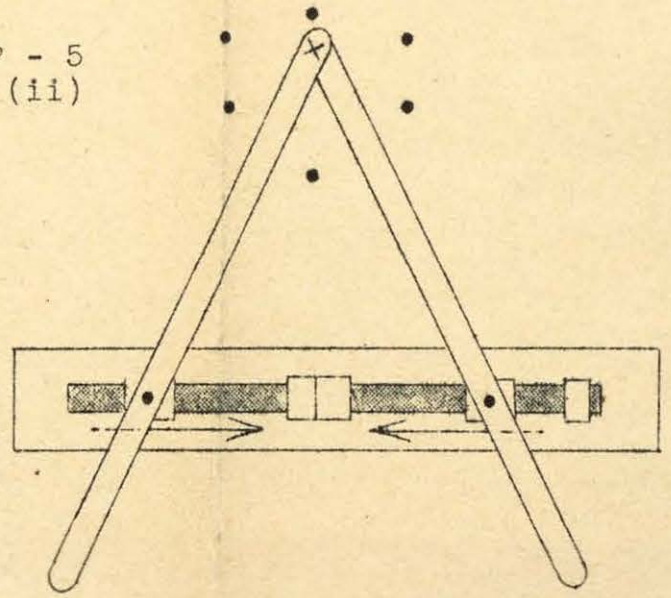
P - 5
(i)



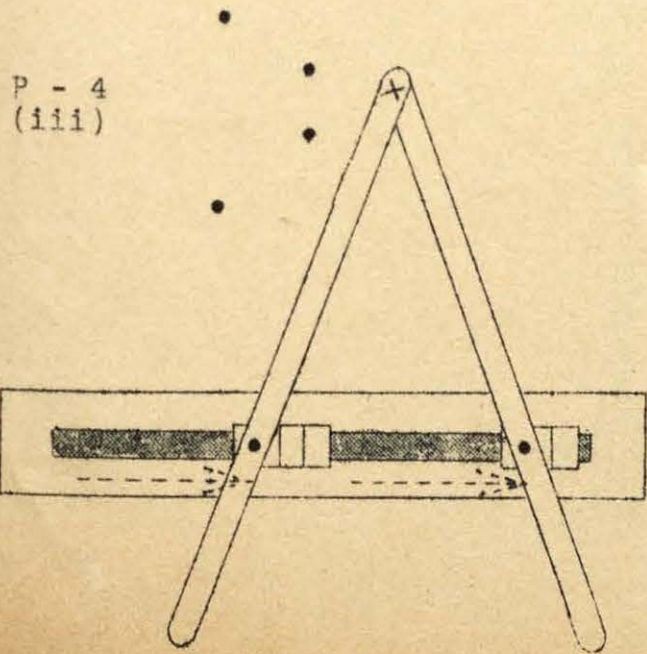
P - 4
(ii)



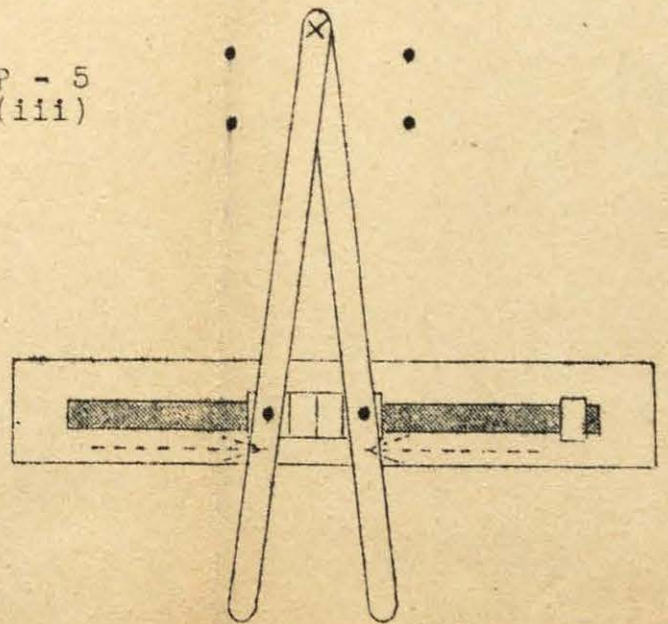
P - 5
(ii)



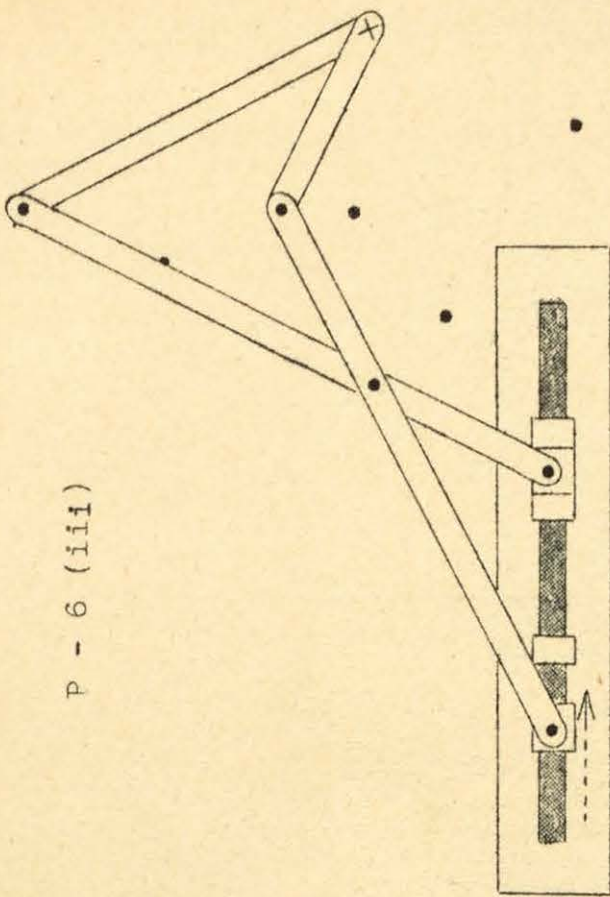
P - 4
(iii)



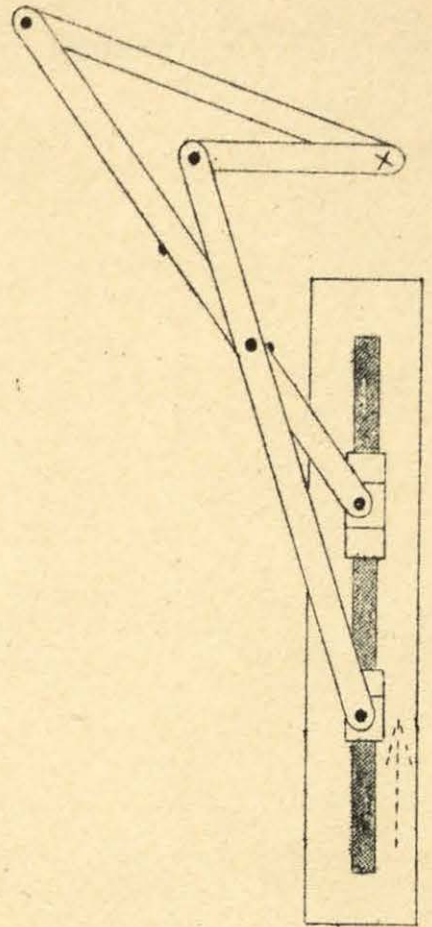
P - 5
(iii)



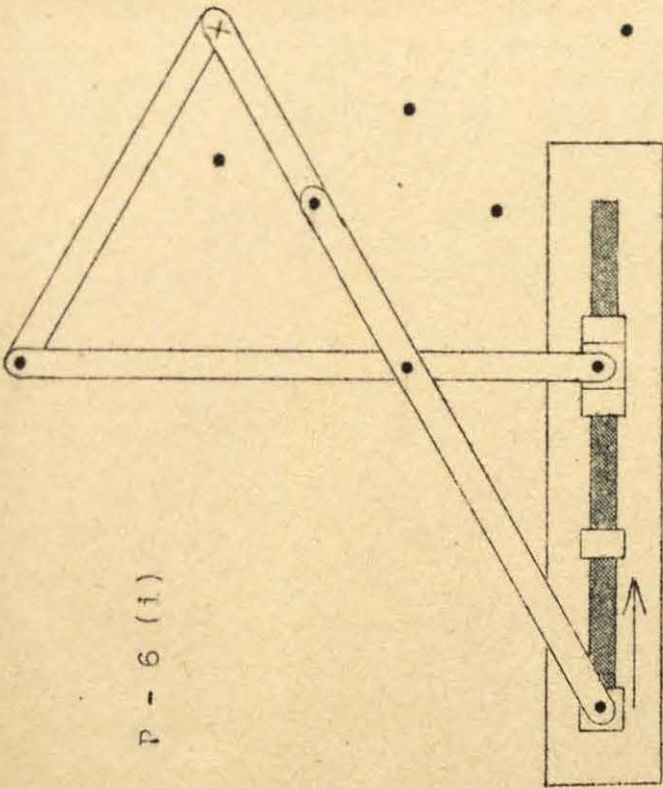
P - 6 (iii)



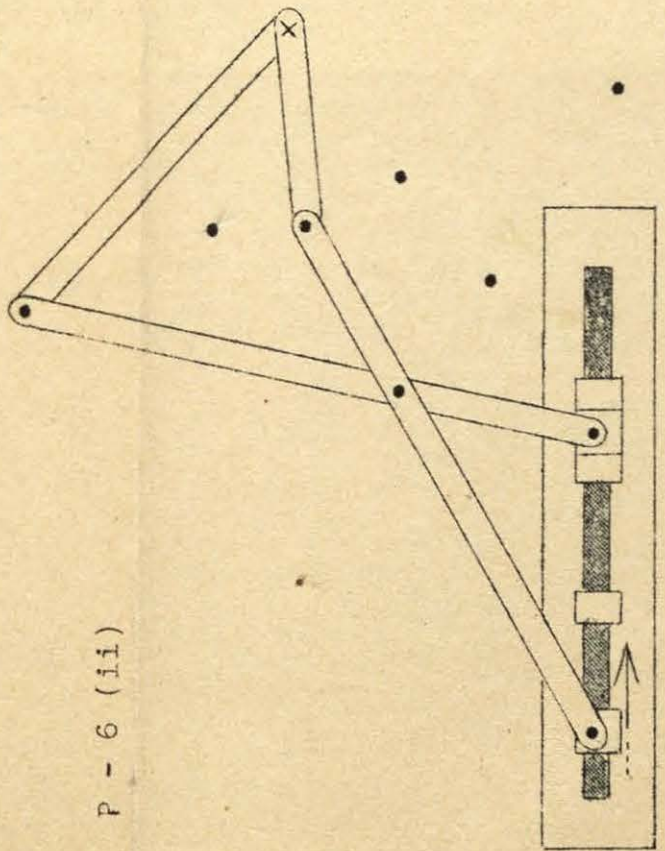
P - 6 (iv)



P - 6 (i)



P - 6 (ii)



S.S.R. (TRINIDAD) LINKS TEST

NAME _____
 Christian names in block letters _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
 Date _____ Month _____

FORM _____ SCHOOL _____

10
 TIME ALLOWED : ~~20~~ minutes for RED pencils
 and another 40 minutes for LEAD pencils.

INSTRUCTIONS

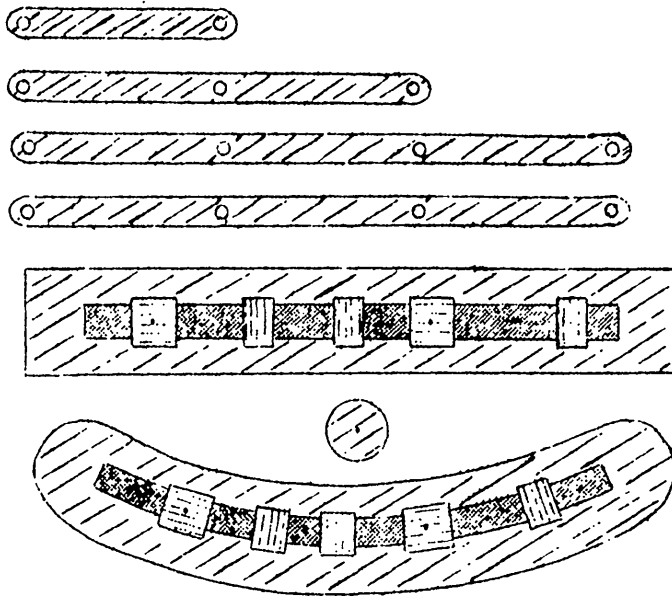
The apparatus consists of the parts as shown in the first figure - 4 wooden slats with holes, 2 long, 1 medium and 1 short, two pieces of wood, one straight and one curved with slots in them in which small wooden blocks can move. The two larger blocks in each slot which have screws sticking up in the middle can move freely; the three smaller ones move with difficulty and act as stops. There is a circular piece of wood with a screw sticking up in its middle. The slats can be bolted together with small nuts, bolts and washers.

Each question consists of determining, without using geometrical instruments of any kind to which dot the point marked with the "X" will go when the movable blocks are moved in their slots in the directions indicated by the arrows. The tip of an arrow shows the position reached by the screw of a block when it comes against a stop. The question is answered by making a ring round the dot to which the "X" will move. In the cases where the "X" remains stationary or comes back to its original position, the ring is made round it.

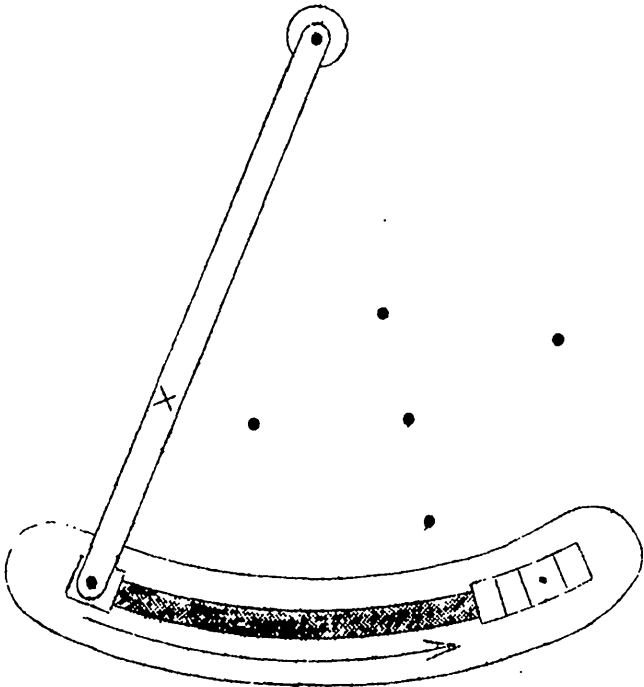
The various parts of P1 - P6 illustrate the motions. It will be observed that when the curved slot is used the top point never moves. This is true for all the questions of the test.

Score for ¹⁰~~20~~ mins. _____
 50
 Score for ~~1~~ hour. _____

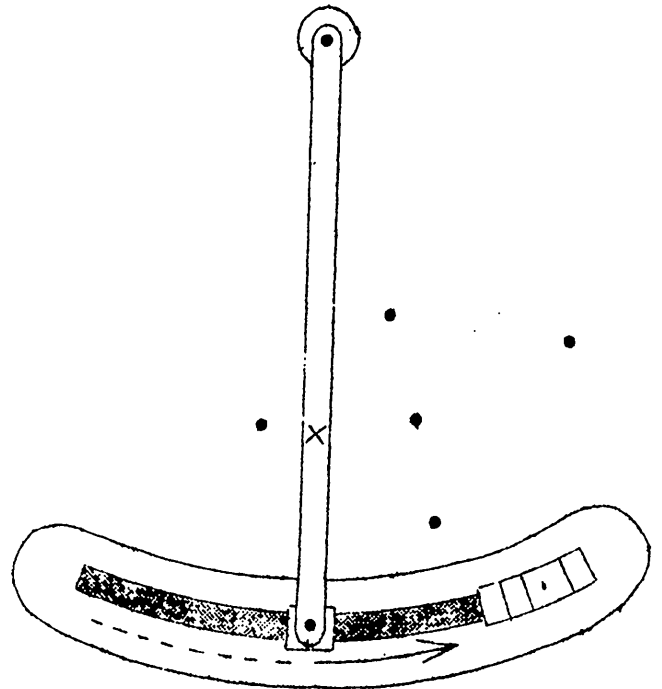
PARTS



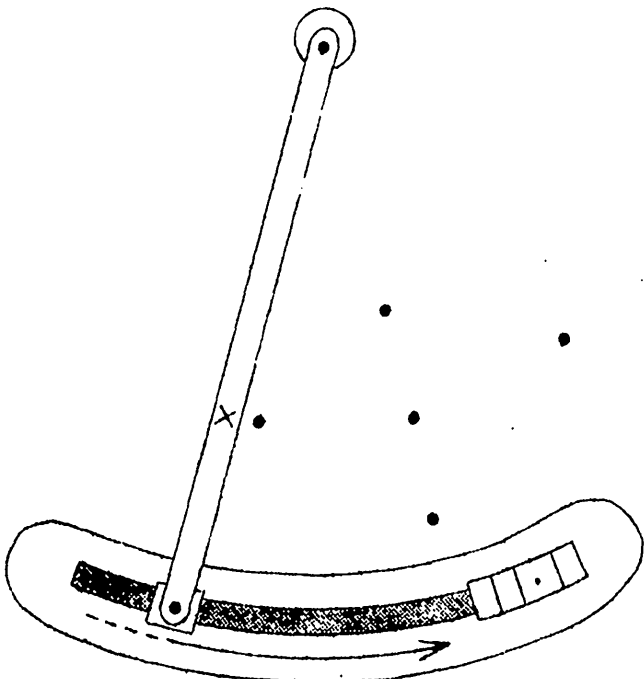
P - 1 (i)



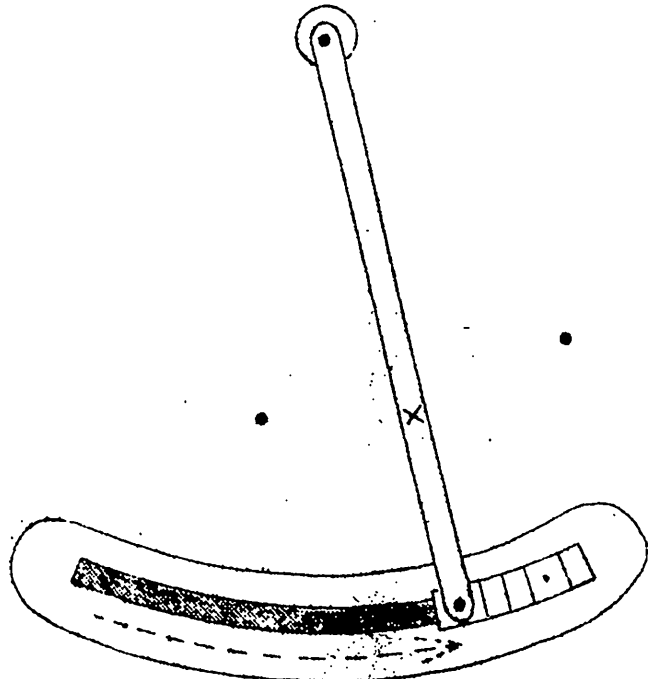
P - 1 (iii)



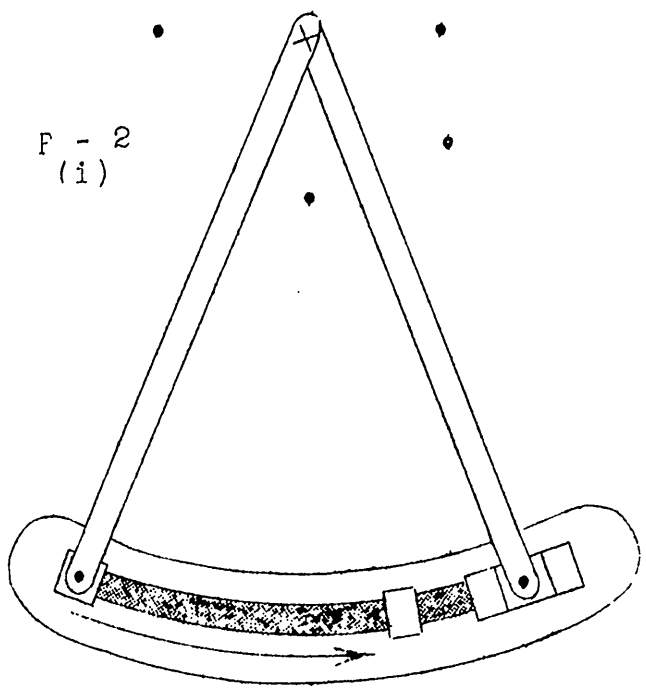
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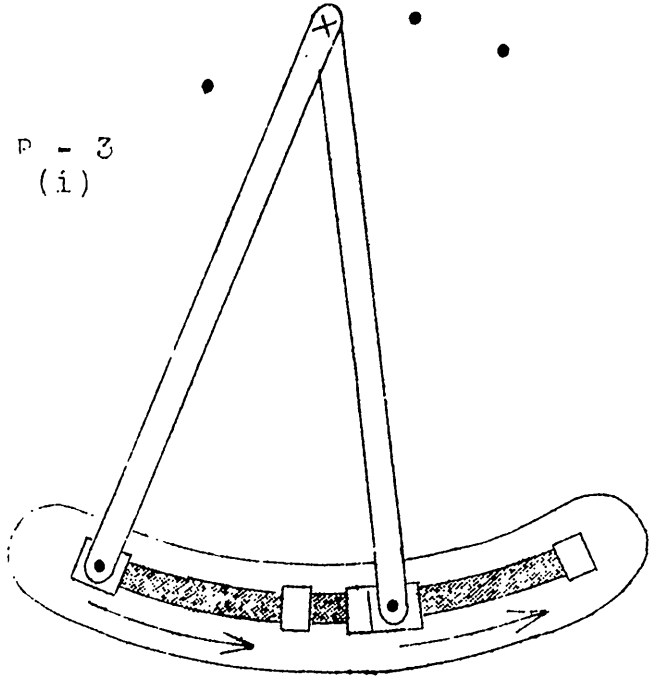
P - 1 (iv)



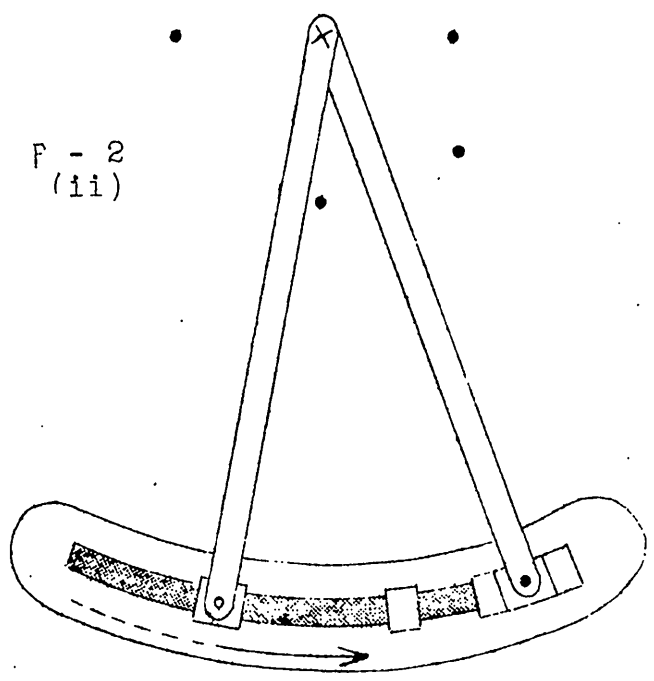
P - 2
(i)



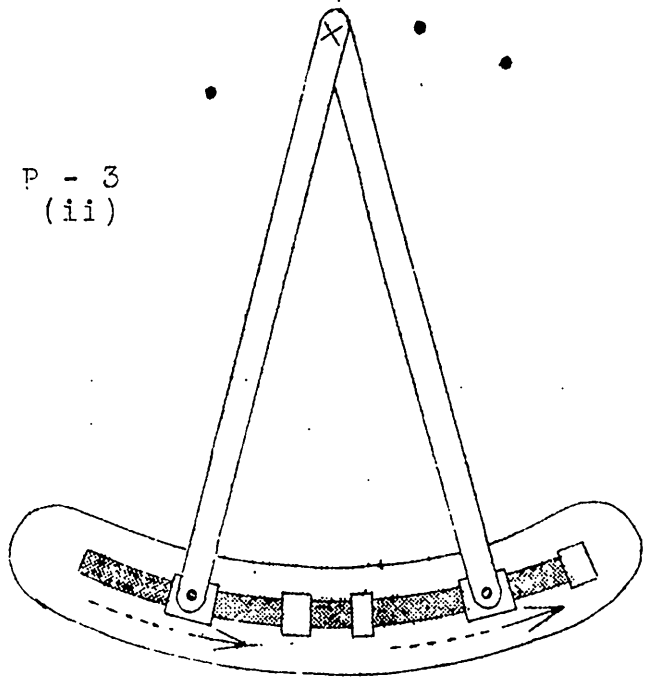
P - 3
(i)



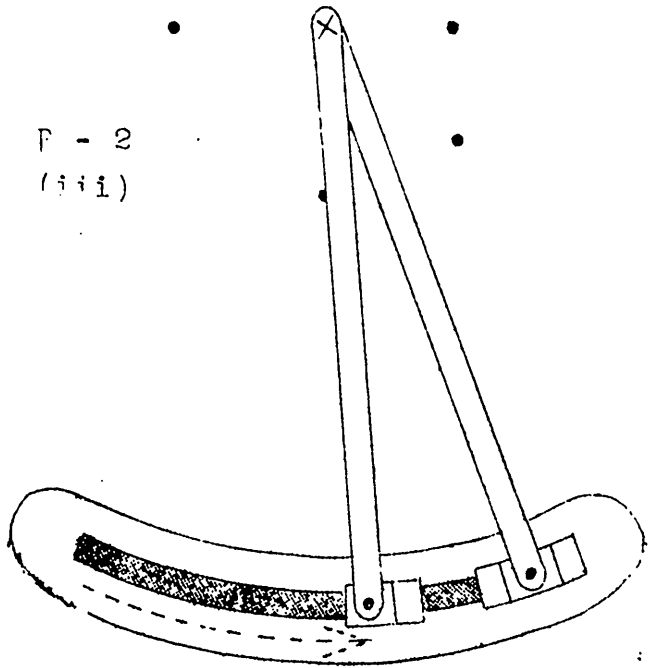
P - 2
(ii)



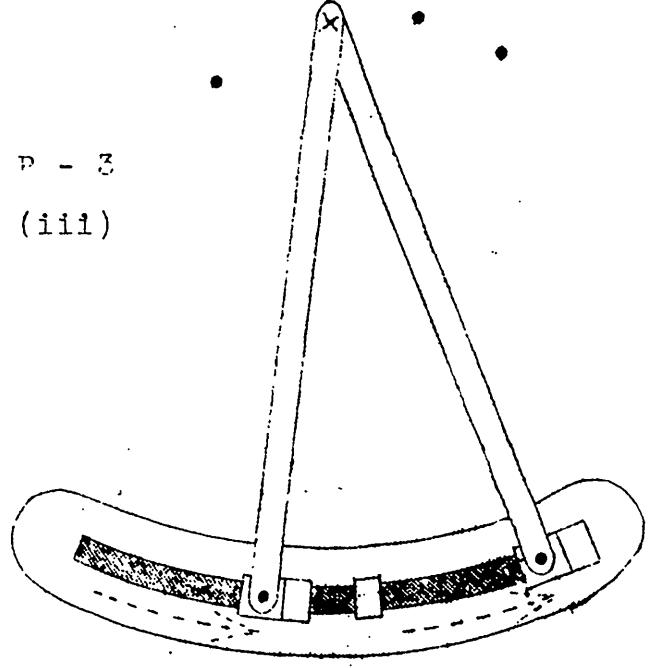
P - 3
(ii)



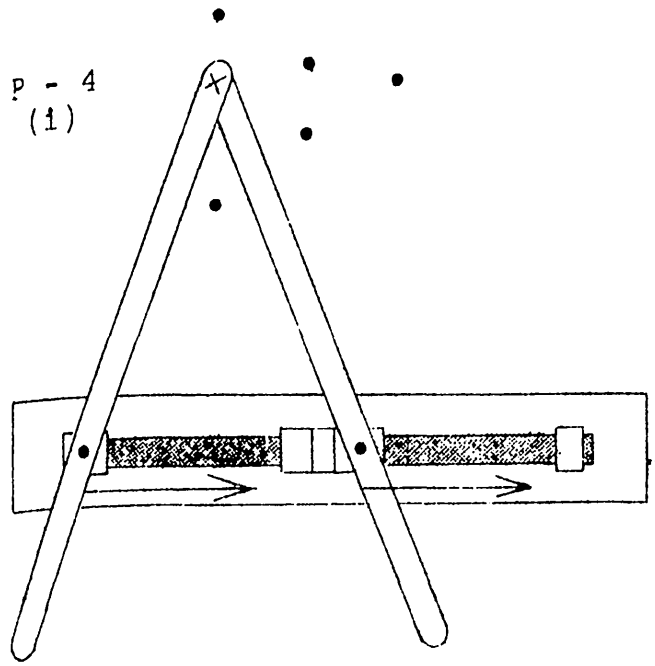
P - 2
(iii)



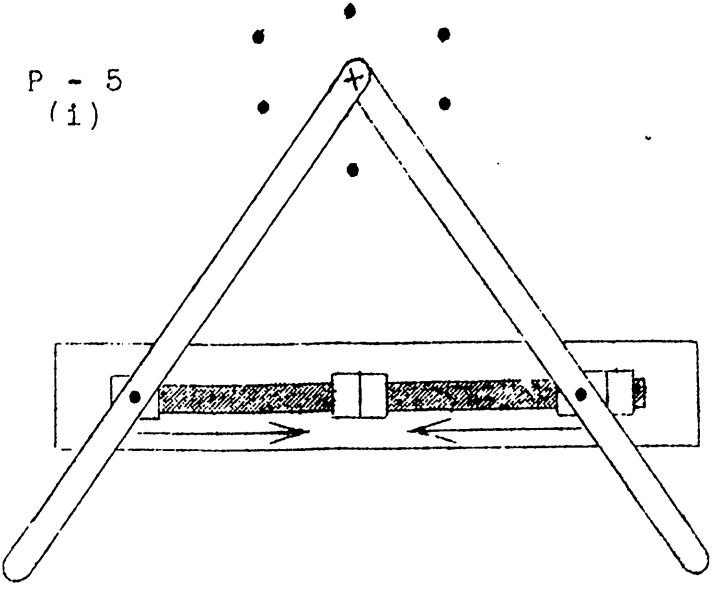
P - 3
(iii)



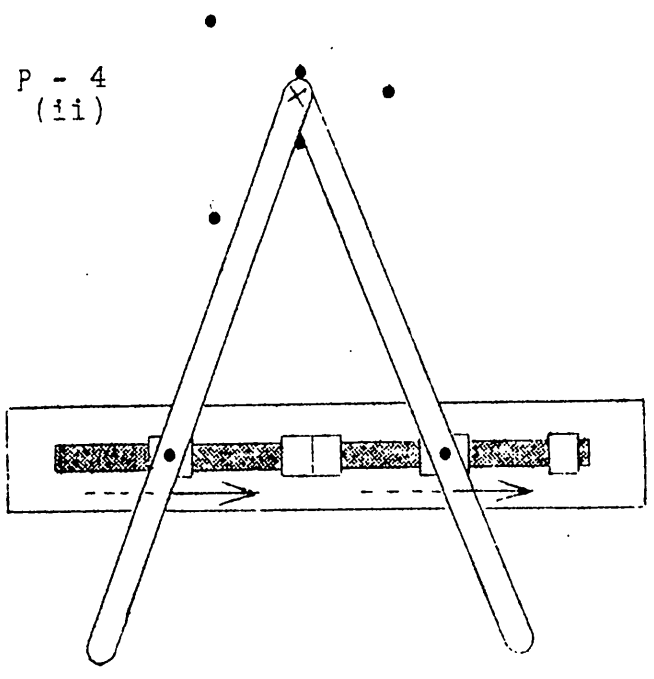
P - 4
(i)



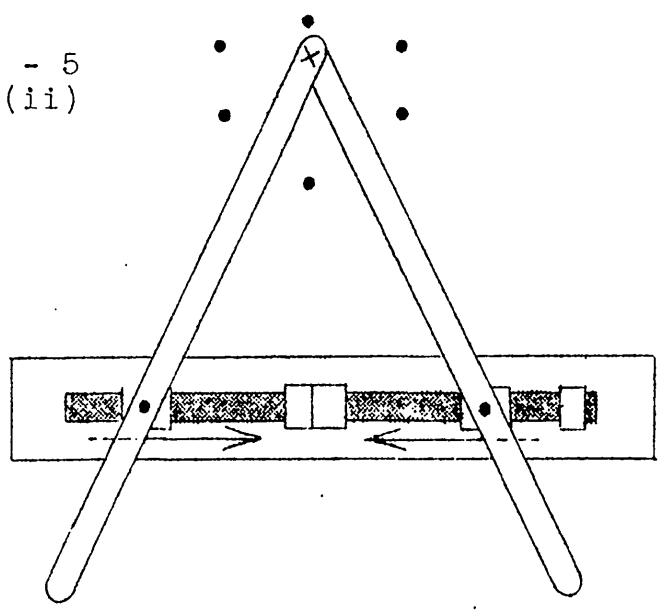
P - 5
(i)



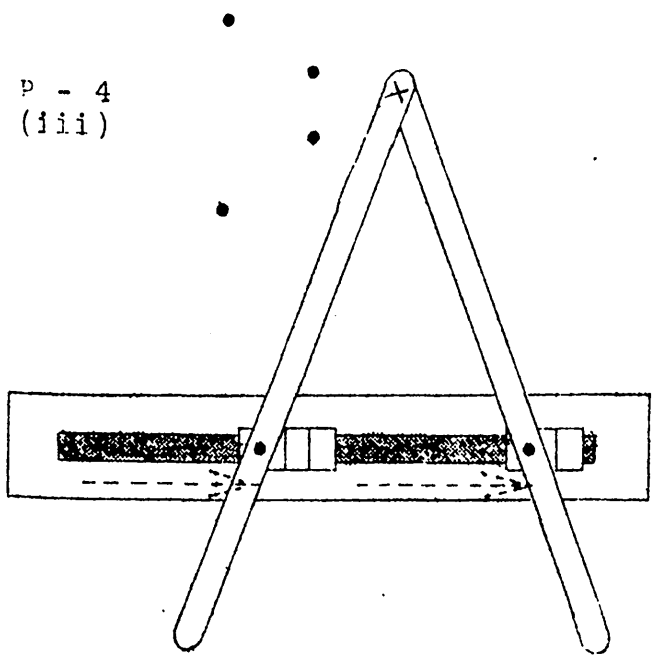
P - 4
(ii)



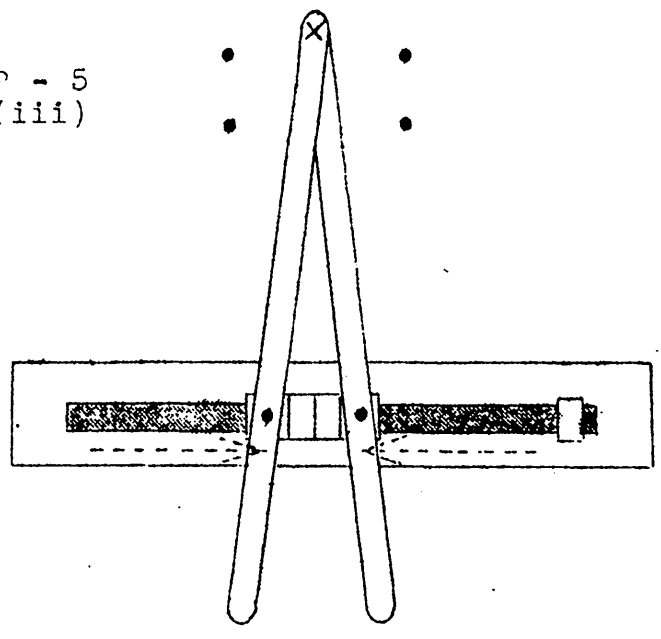
P - 5
(ii)



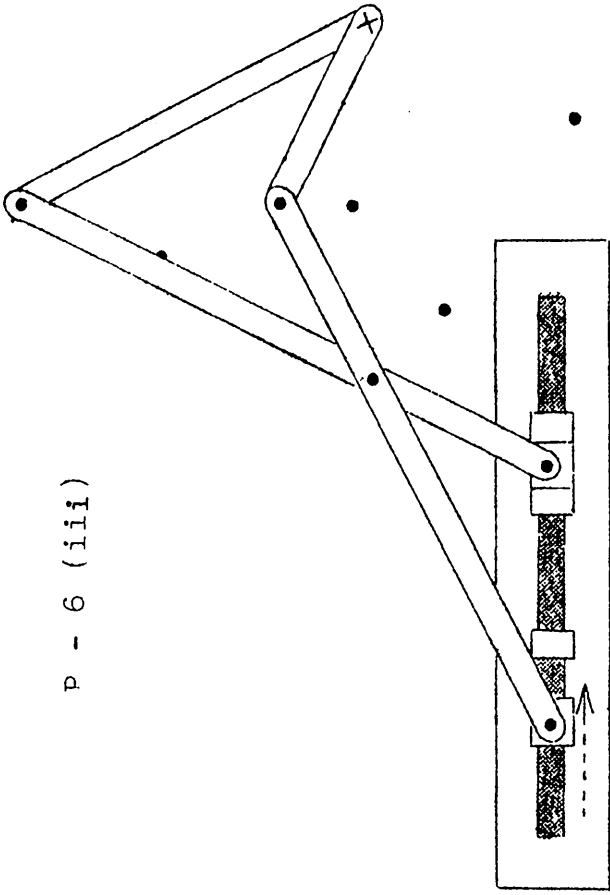
P - 4
(iii)



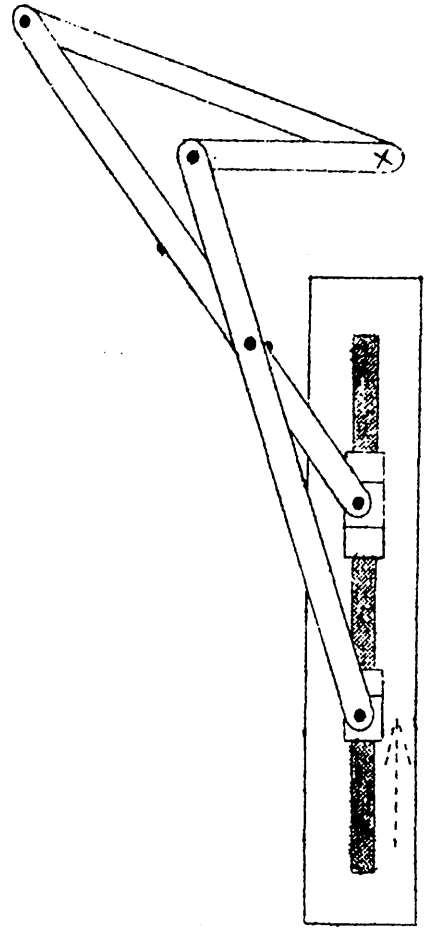
P - 5
(iii)



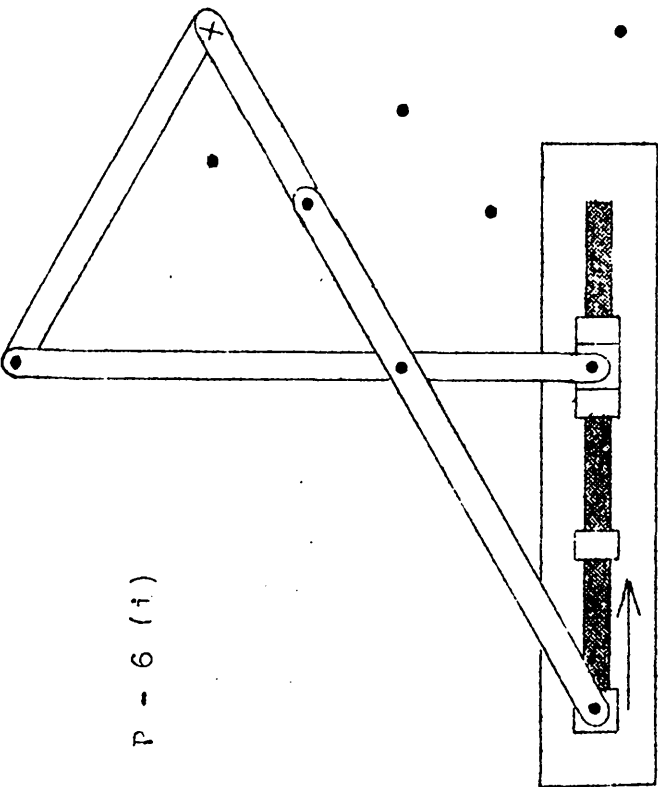
P - 6 (iii)



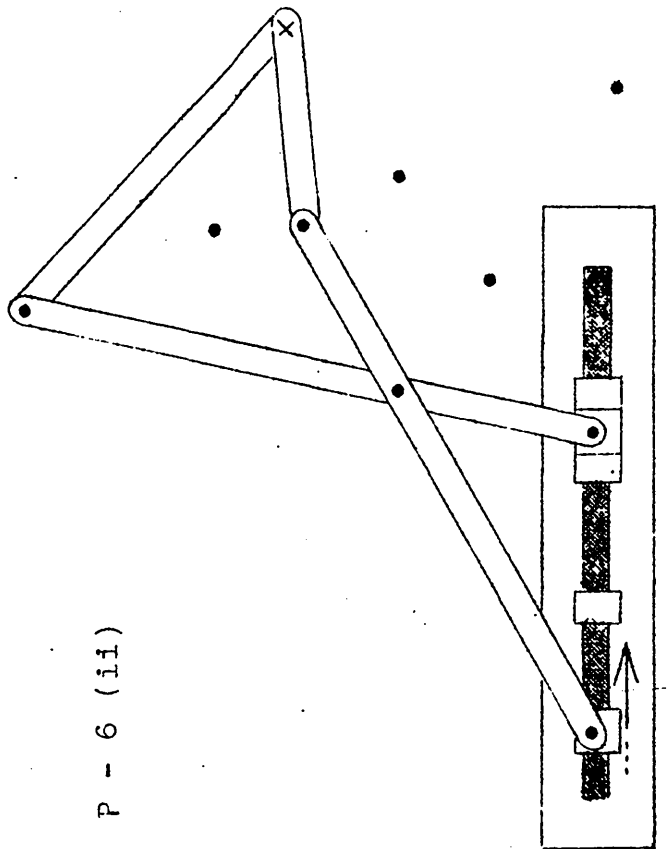
P - 6 (iv)



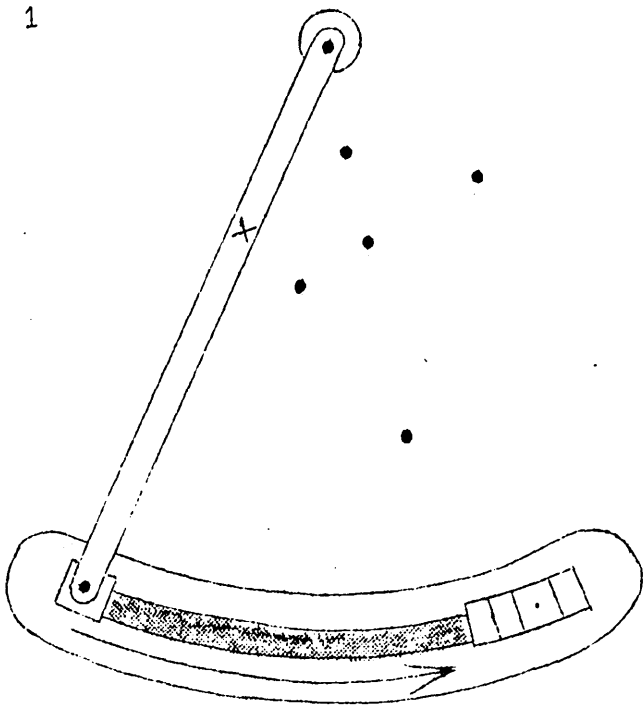
P - 6 (i)



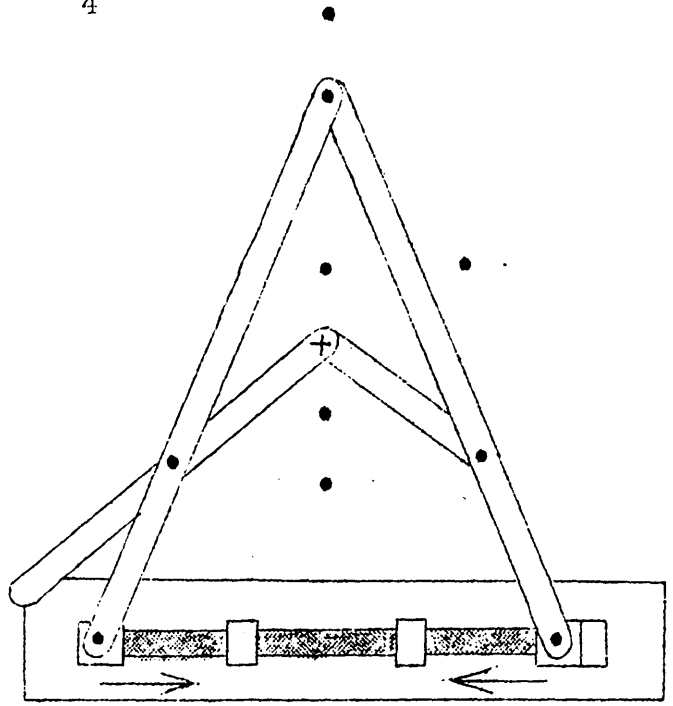
P - 6 (ii)



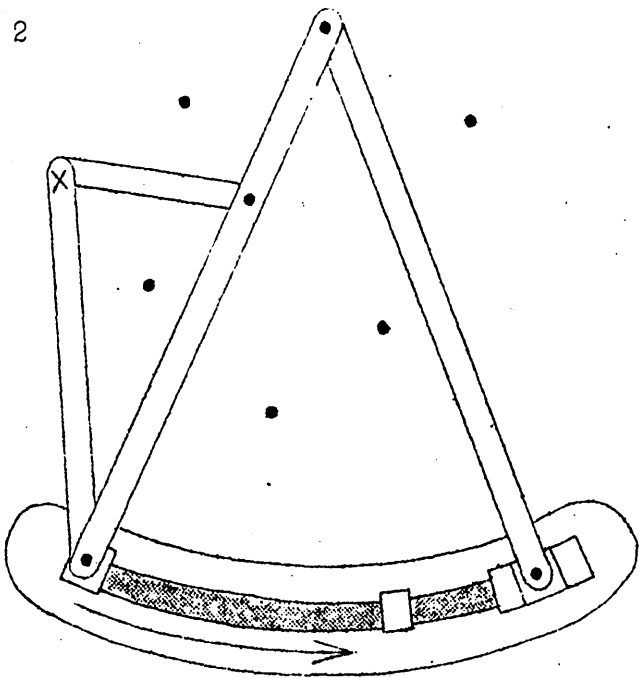
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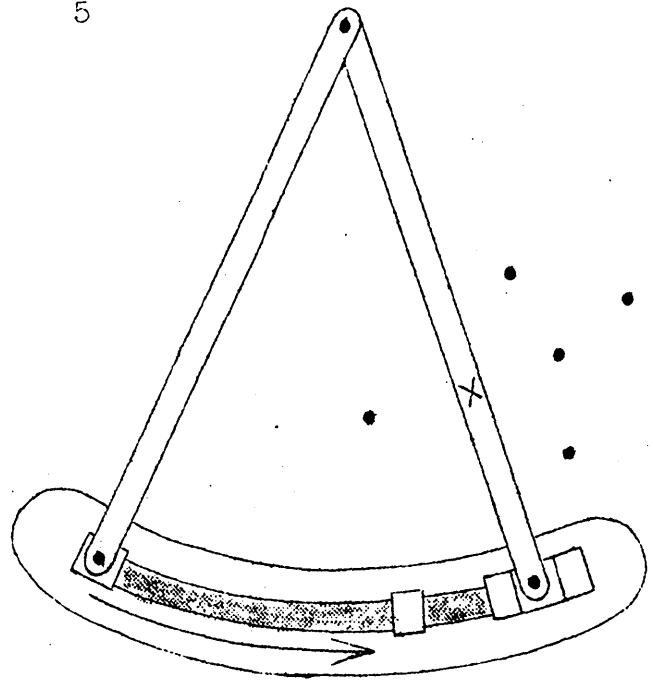
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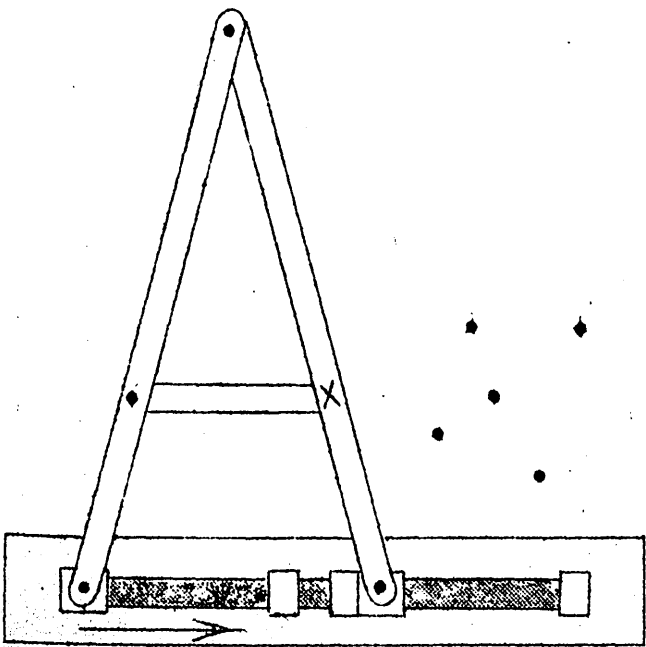
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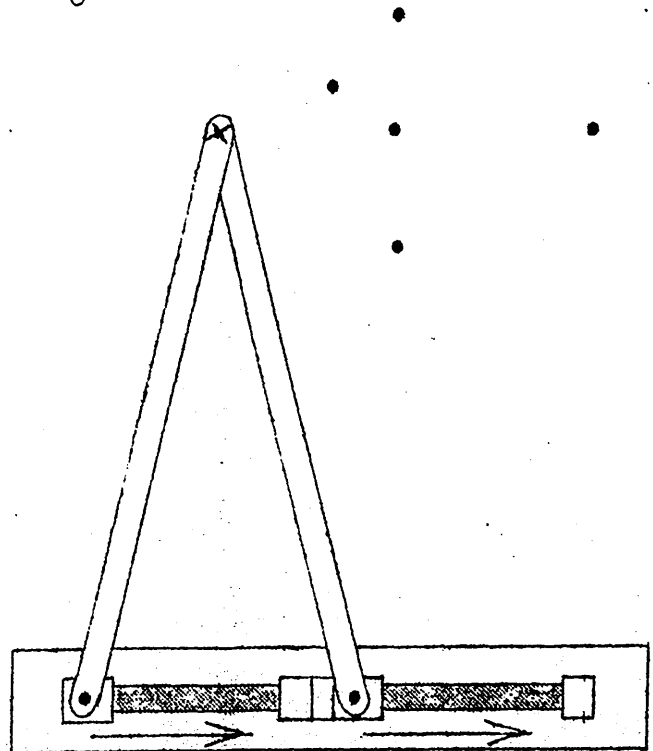
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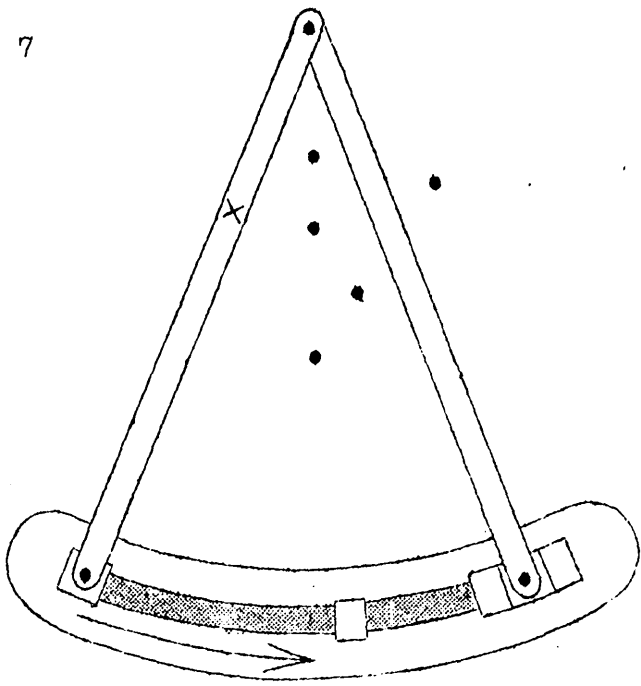
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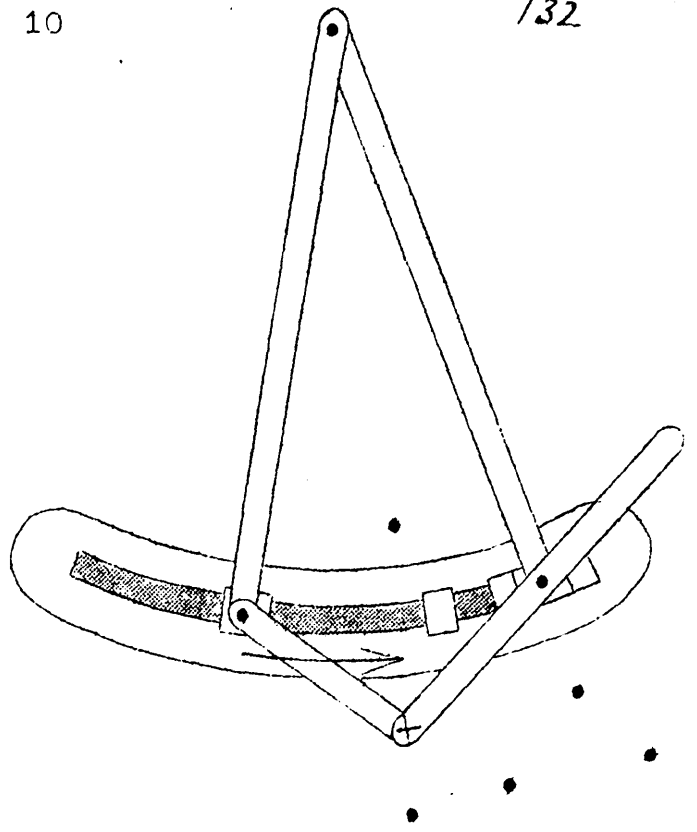


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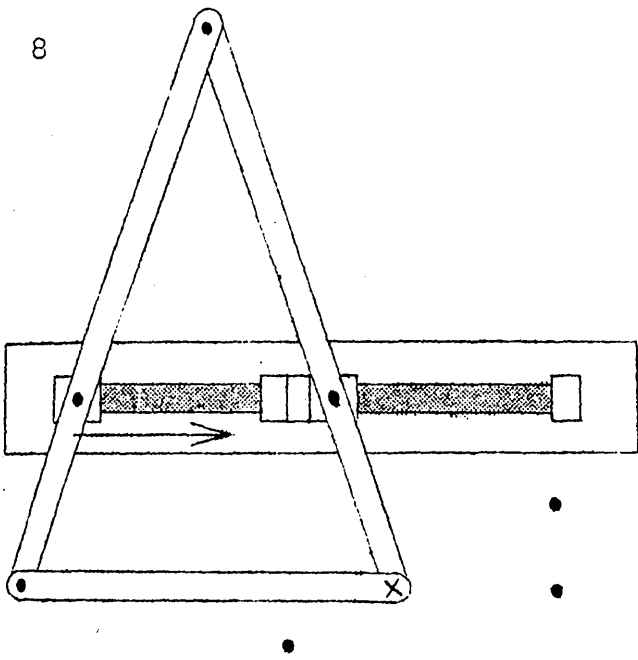


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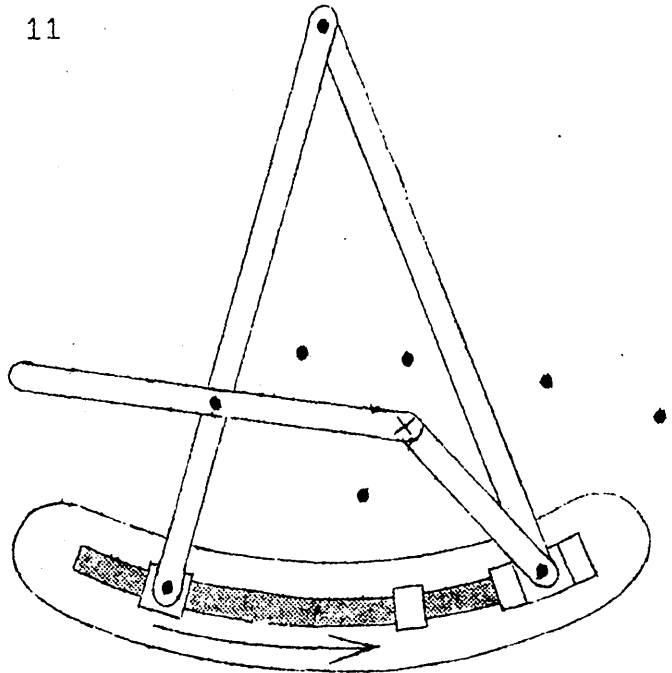
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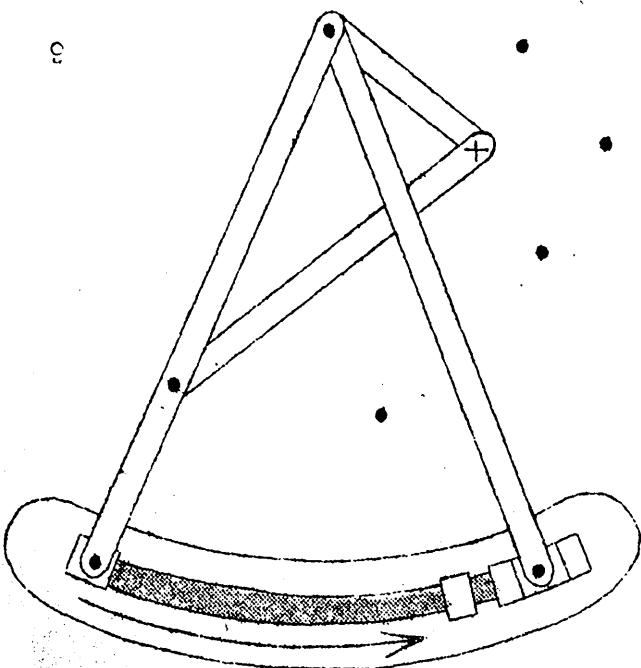
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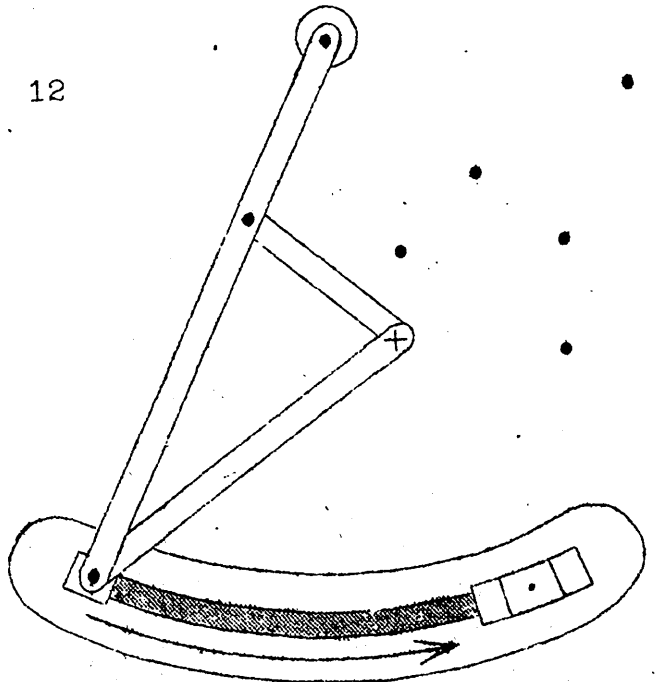
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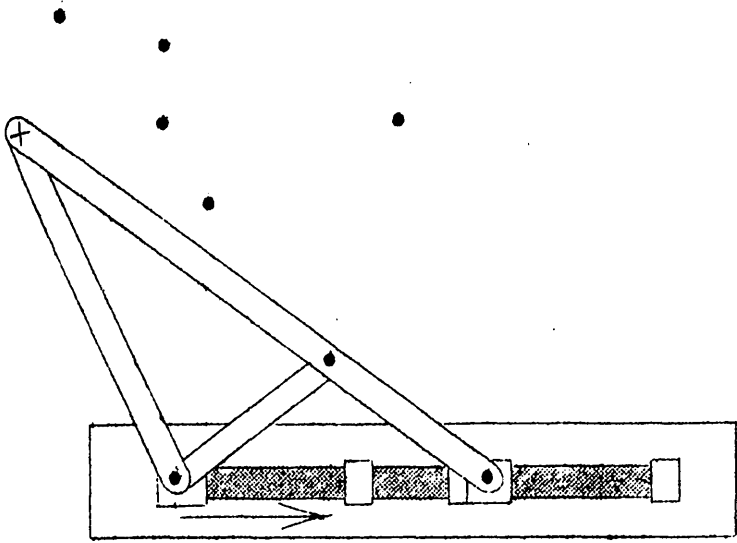
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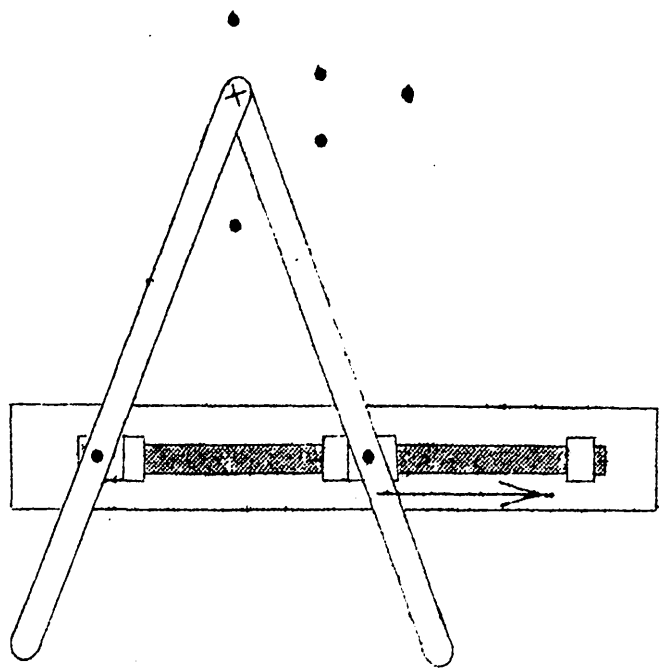
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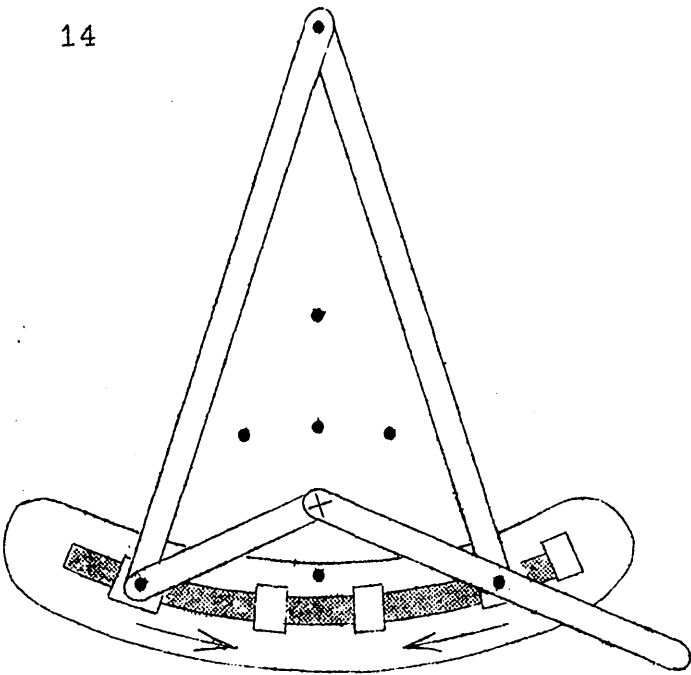
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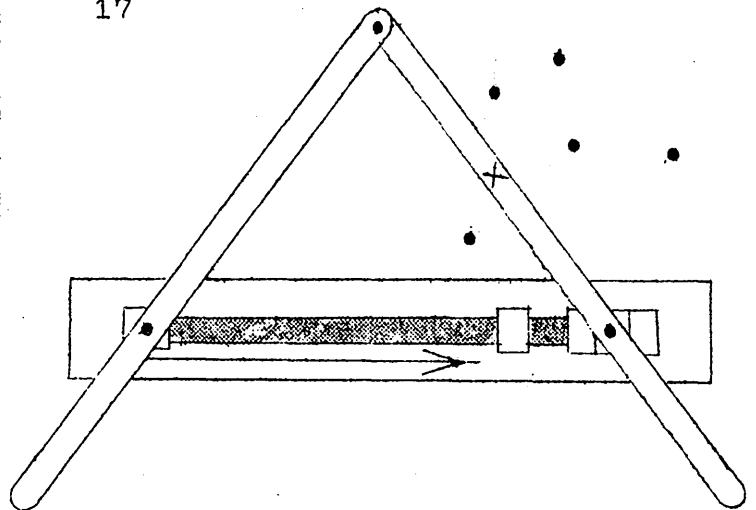
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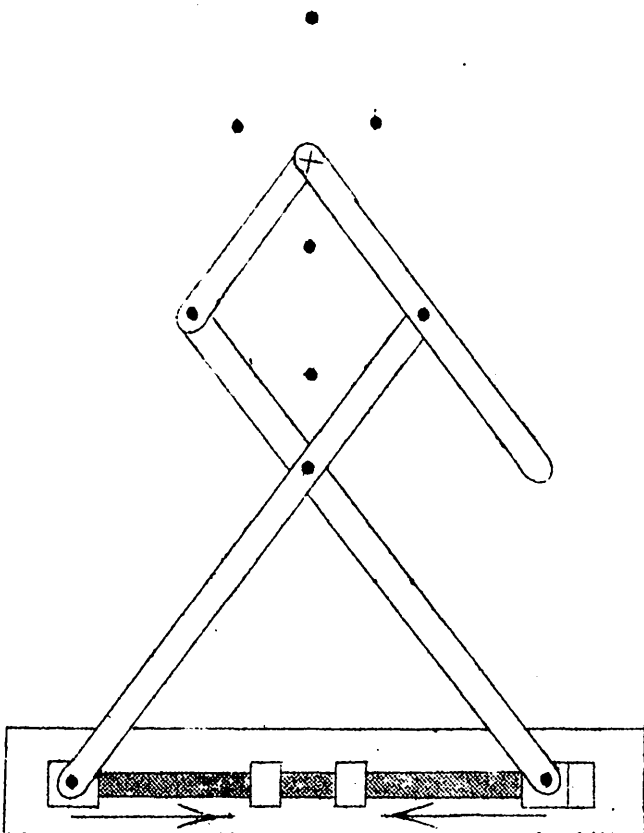
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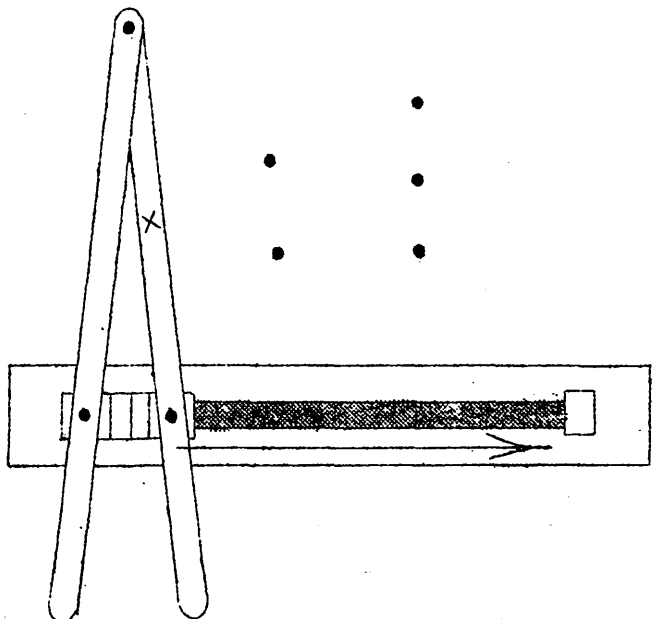
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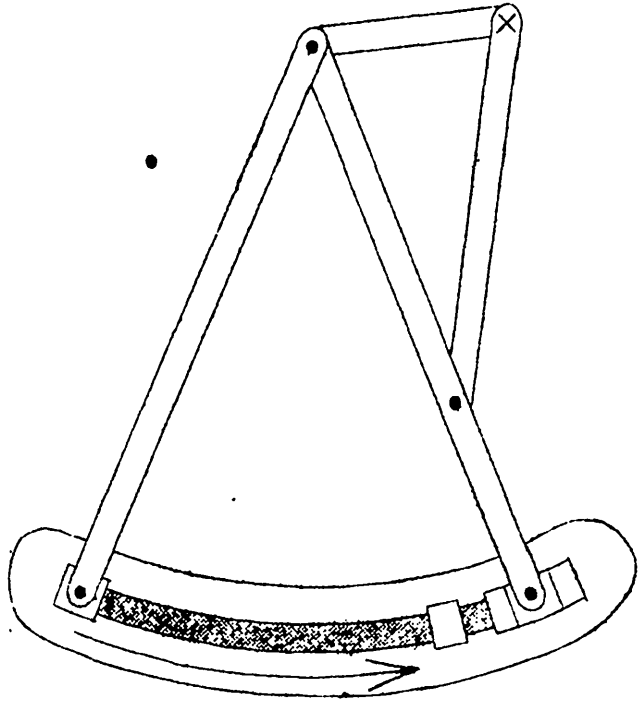
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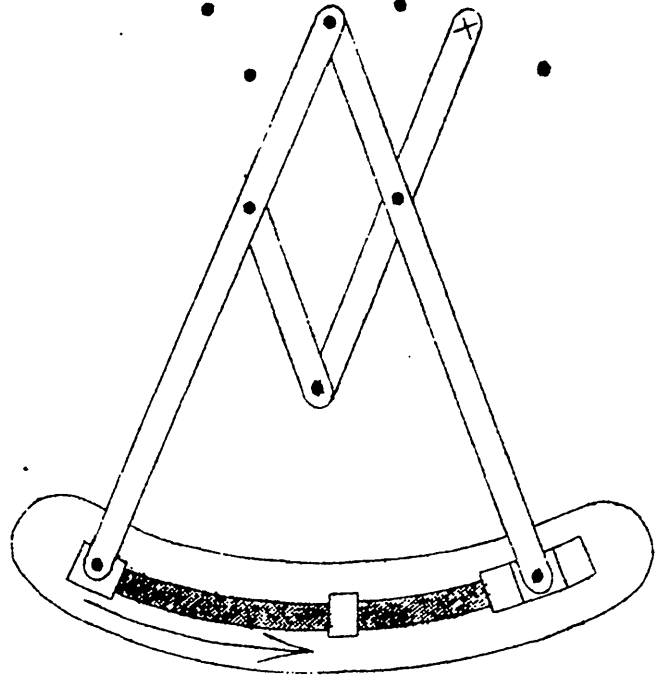
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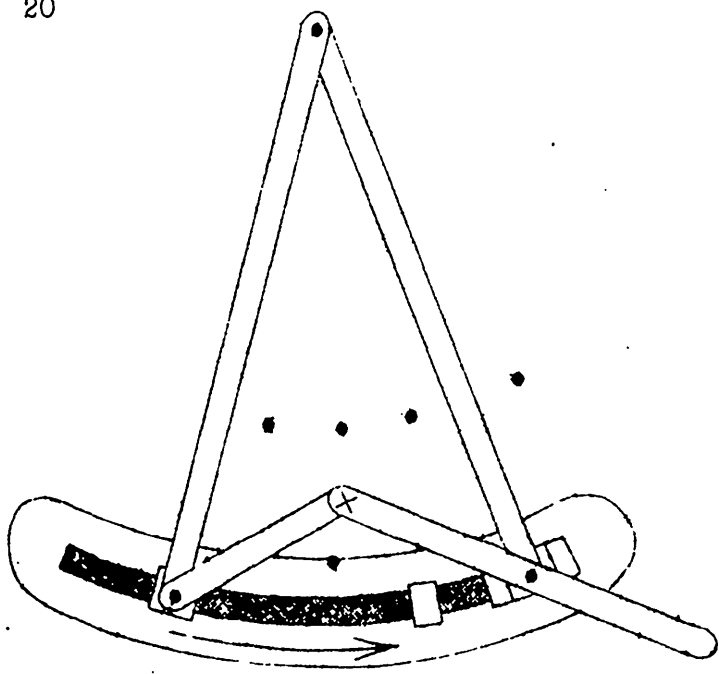
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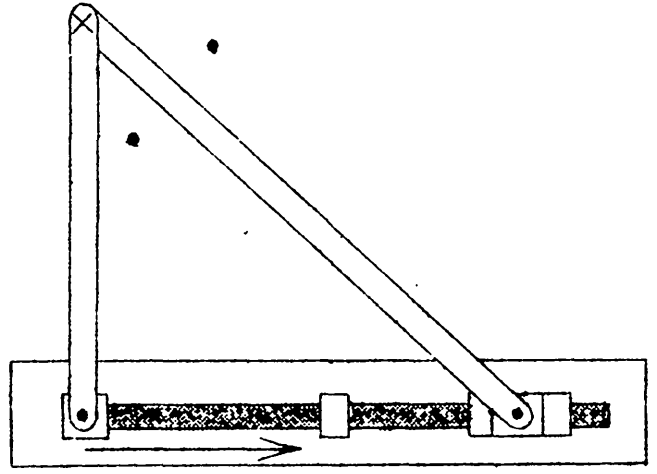
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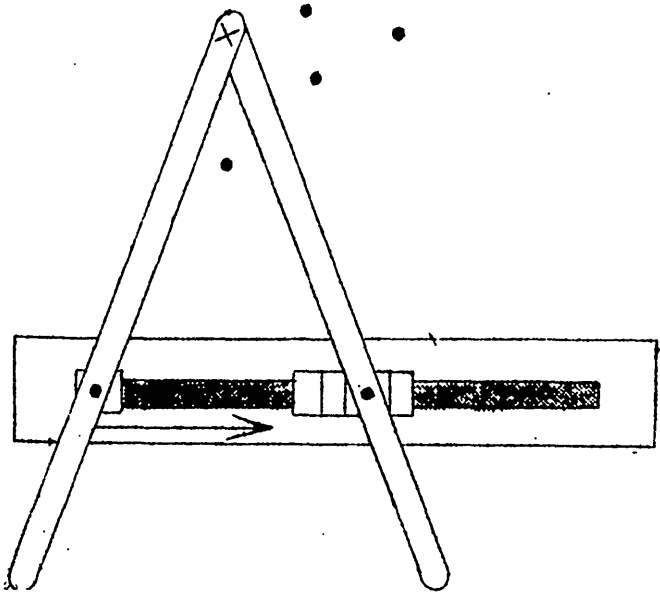
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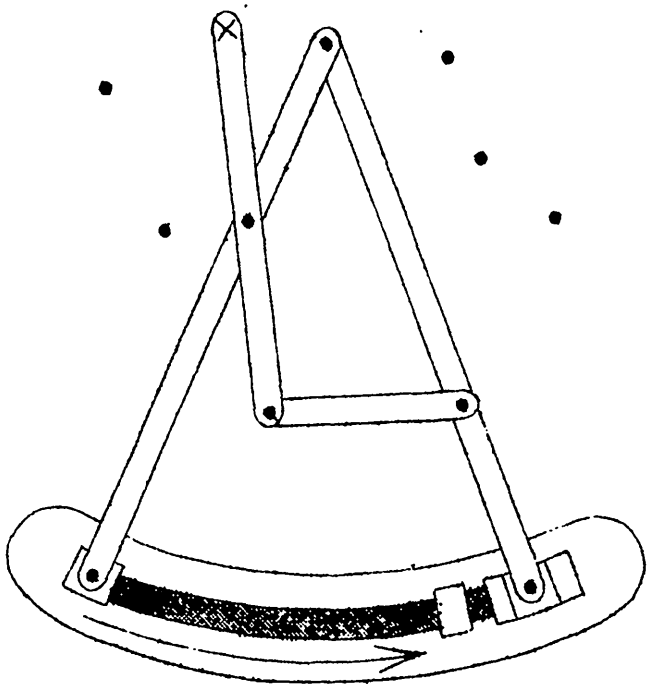
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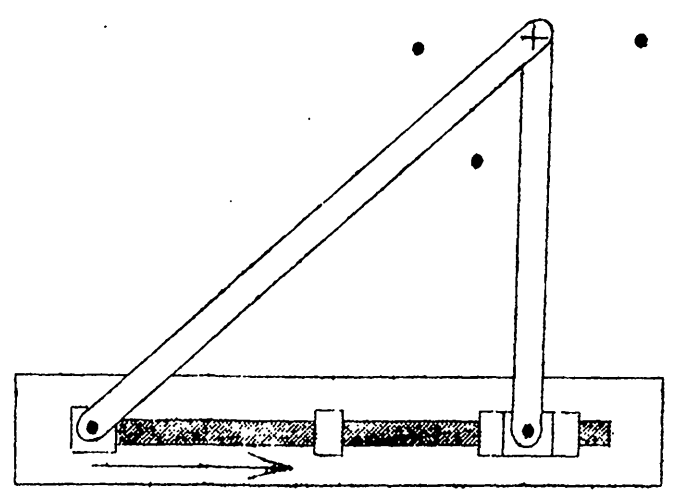
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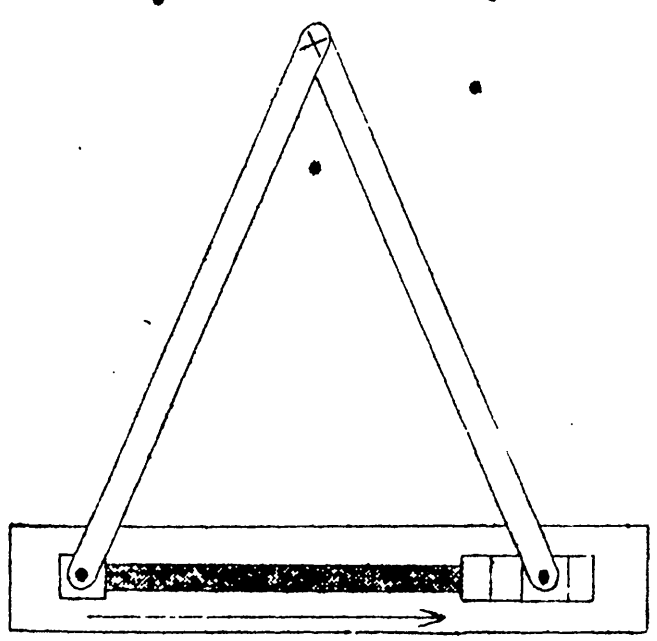
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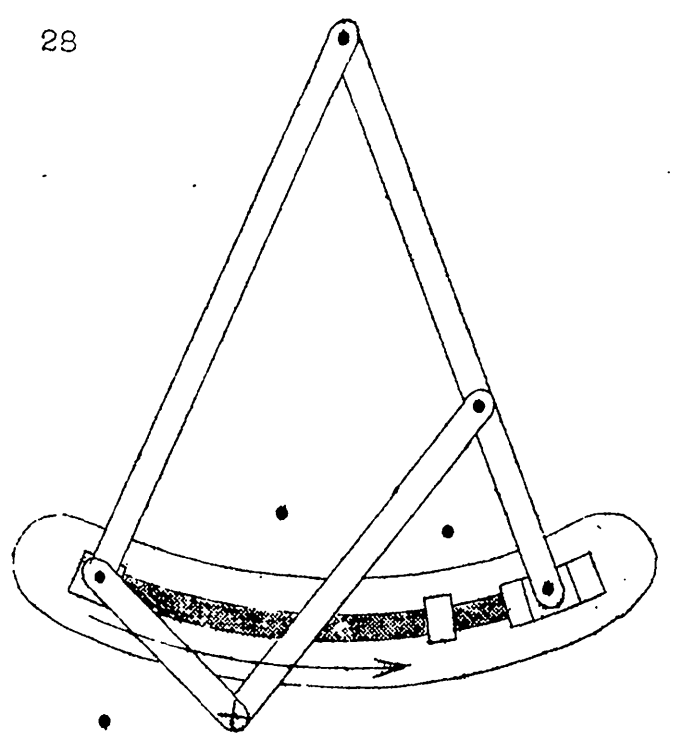
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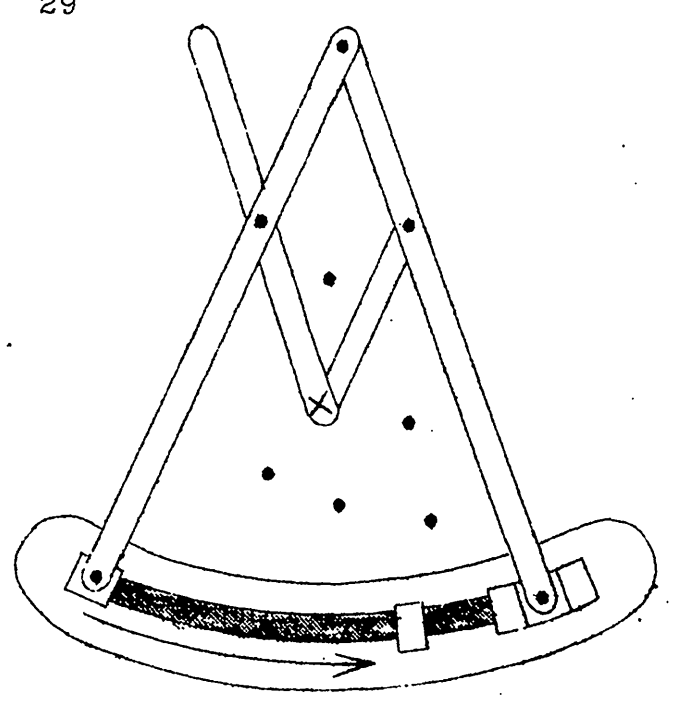
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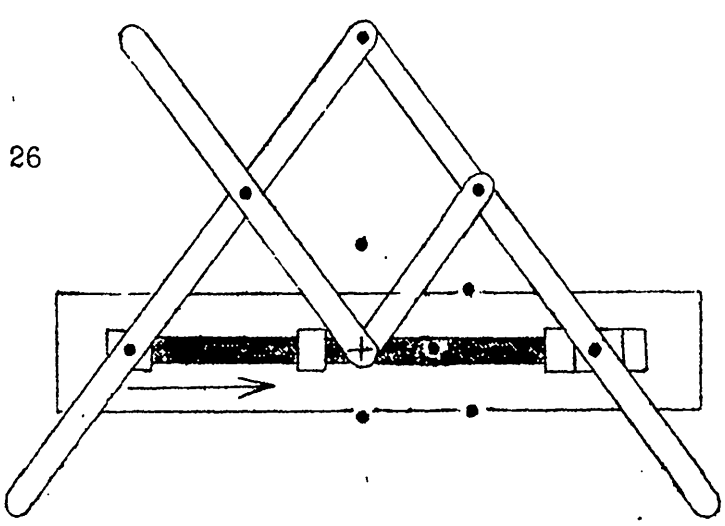
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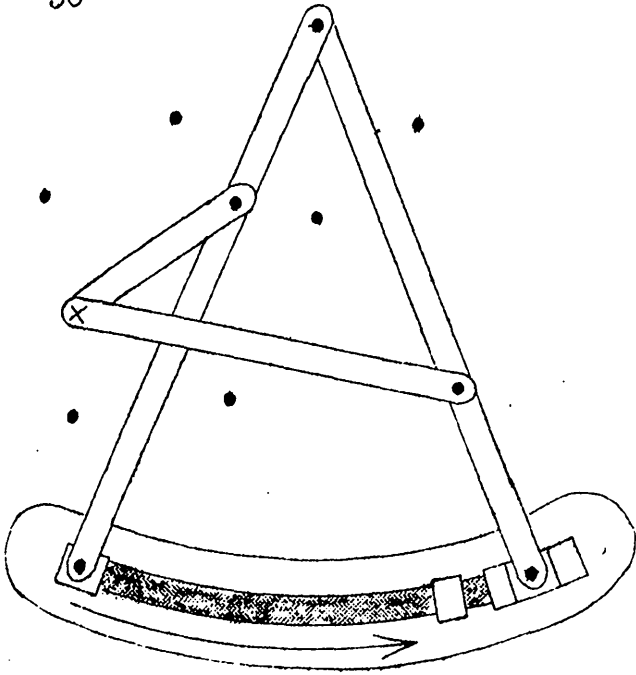
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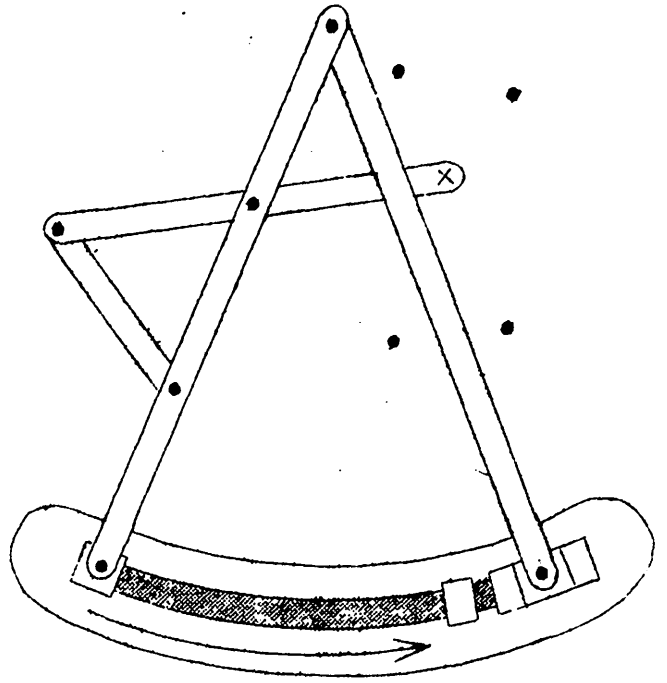
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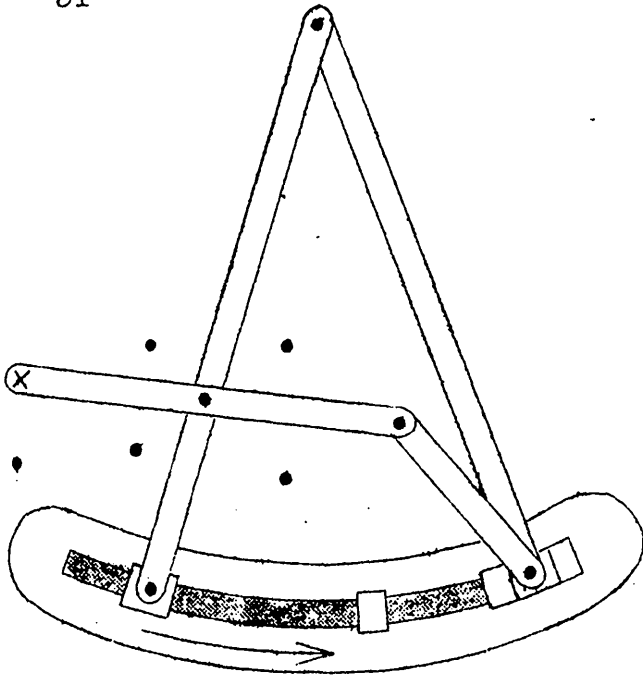
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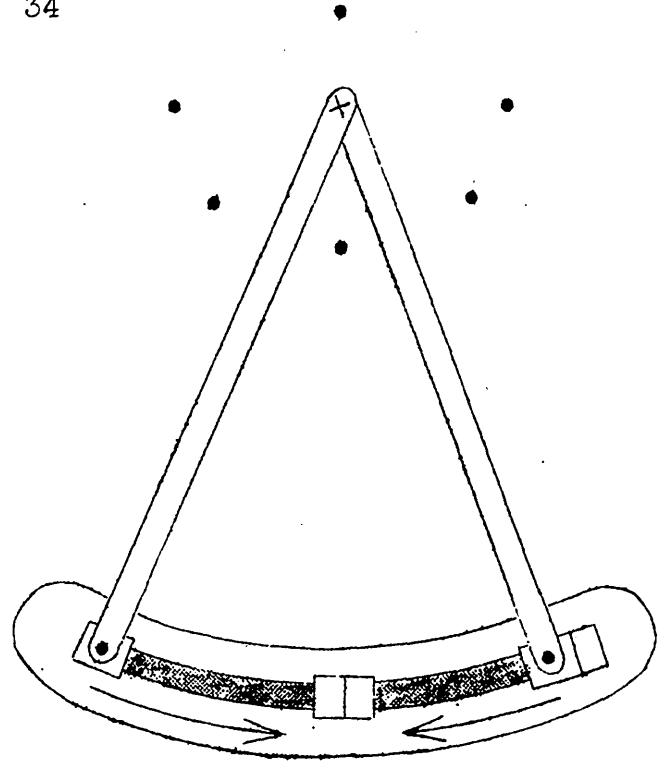
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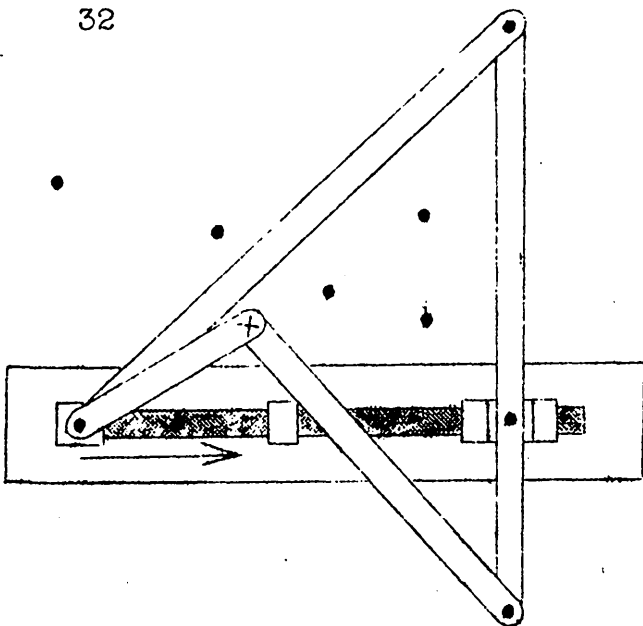
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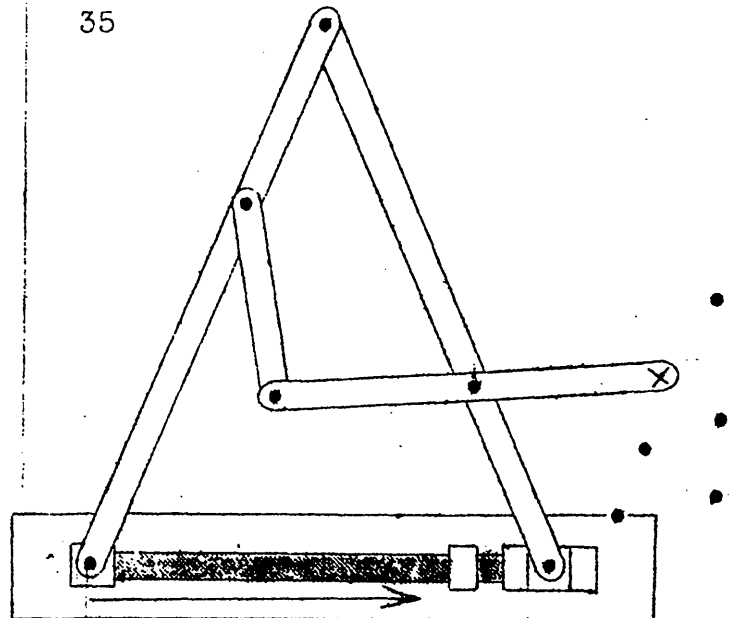
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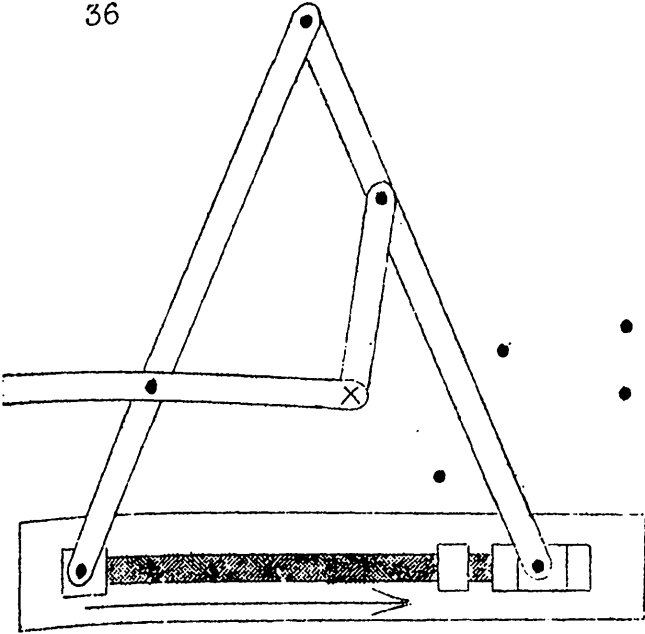
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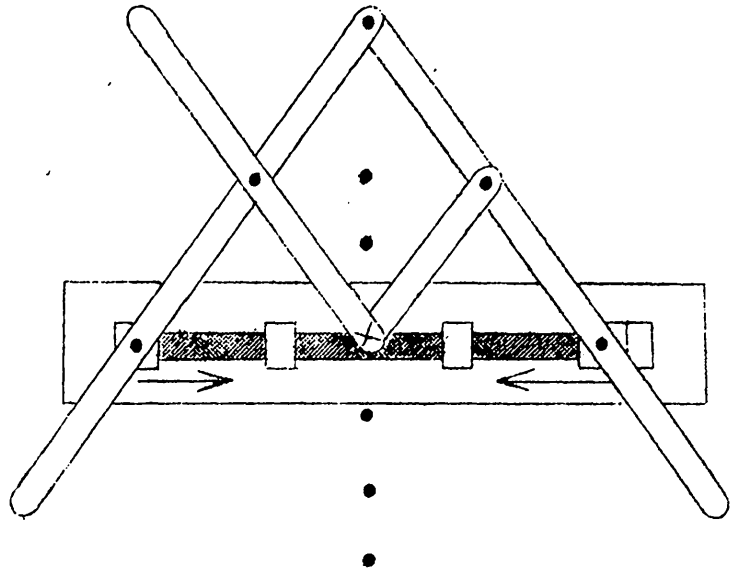
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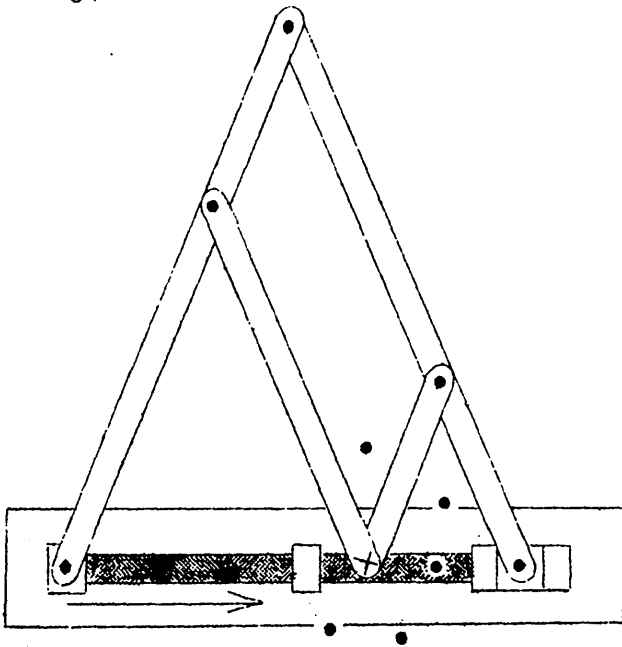
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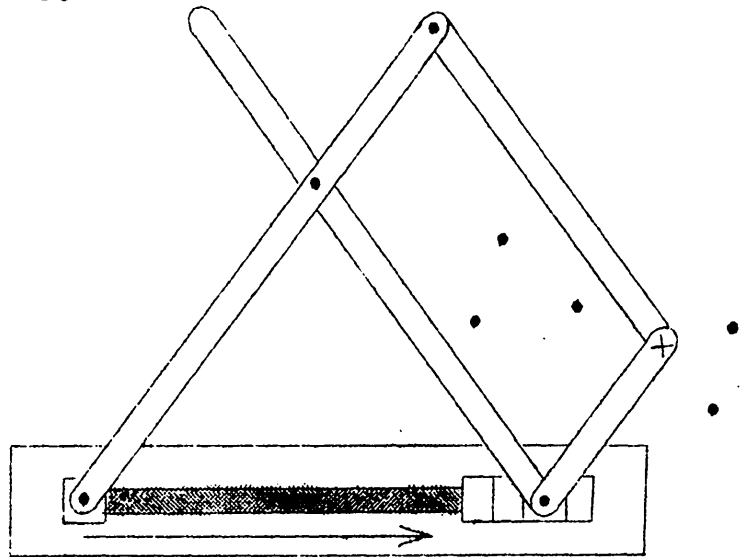
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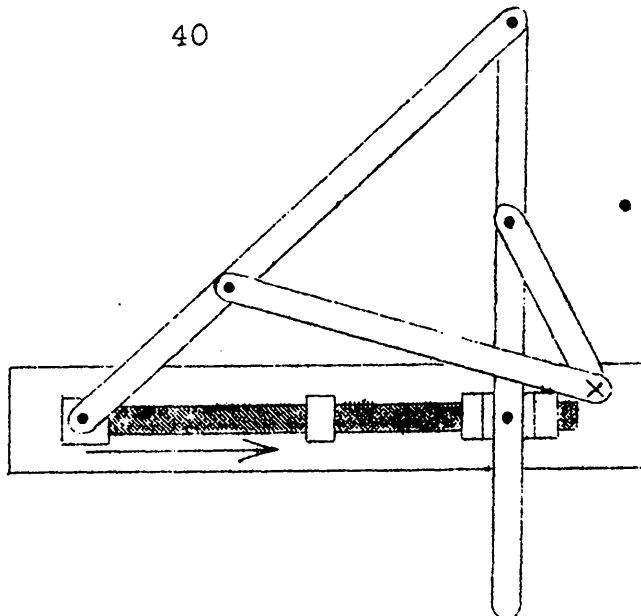
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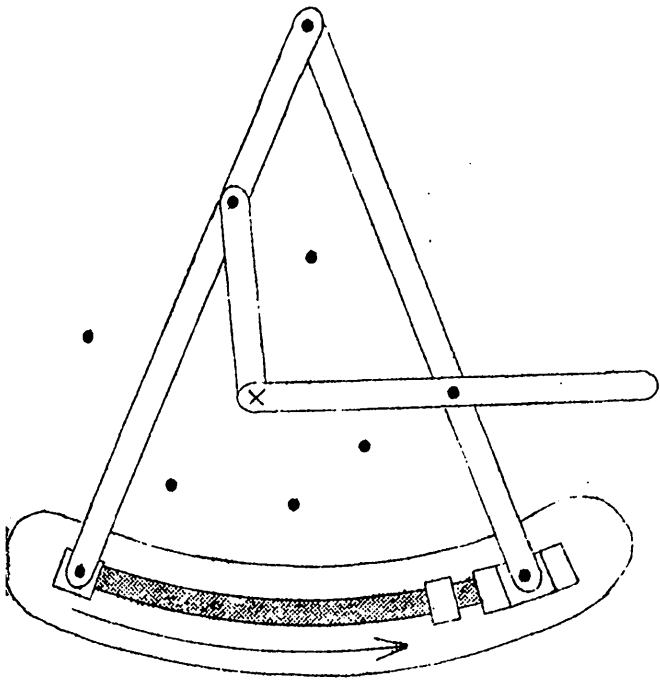
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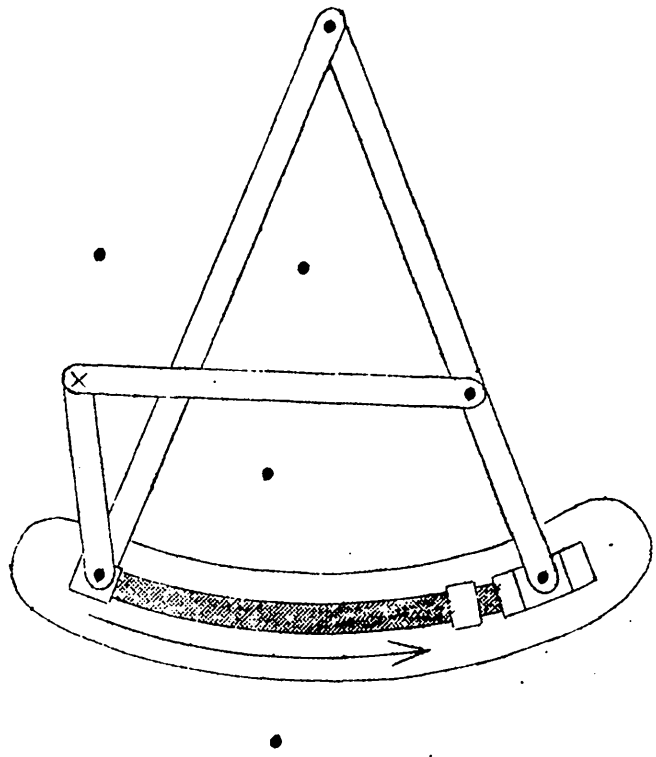
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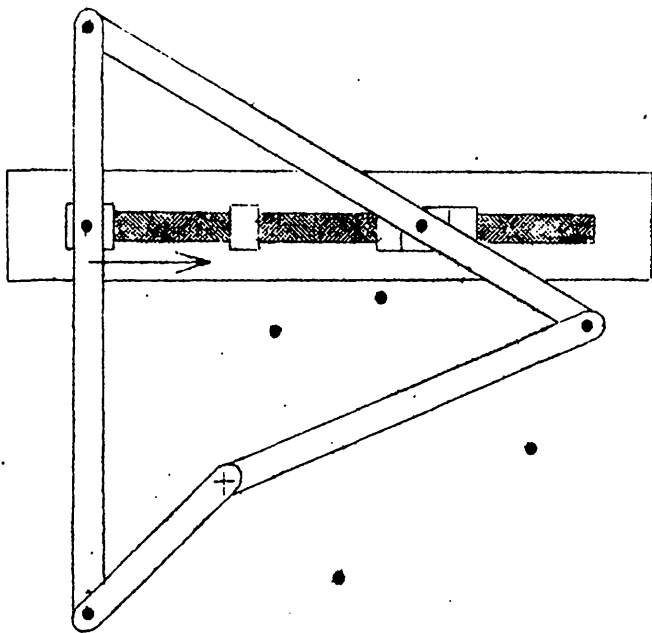
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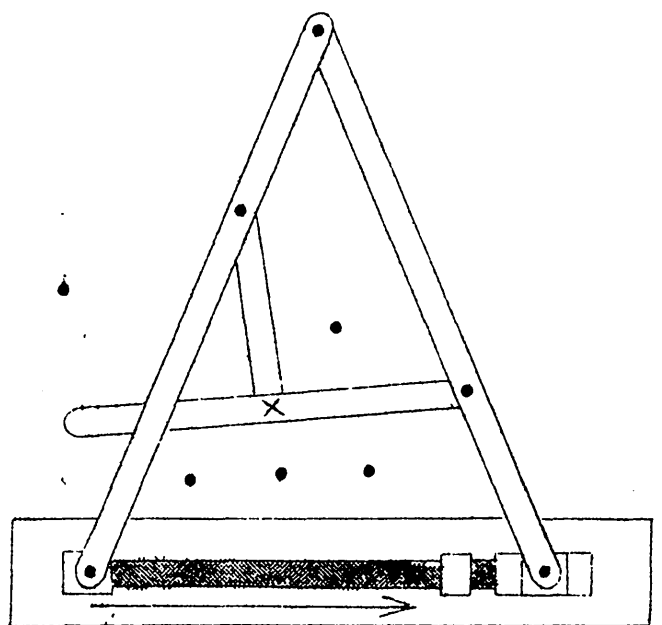
43



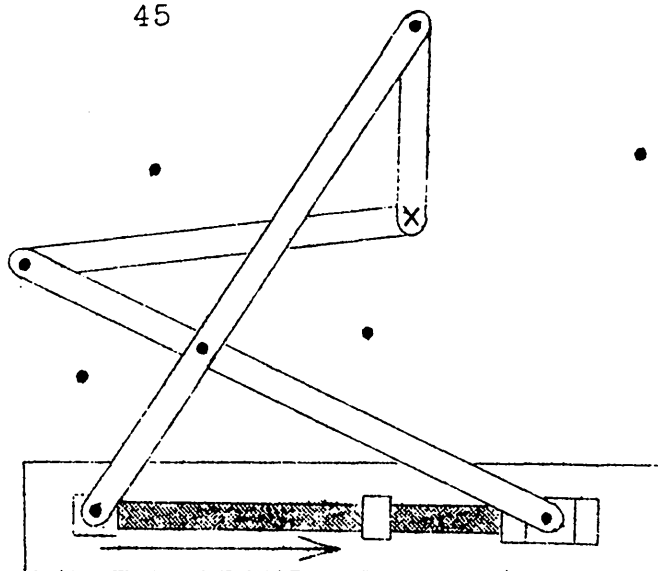
42



44



45



TEST 9. Links (23 Items) "11 Schools Exp."

After obtaining the order of difficulty of the items from the Q.R.C results a battery with about half the number was tried out on the Central Island Schools and from this, after further a-nalysis, the battery given here was made. For the 6 Practice Examples the apparatus was demonstrated on the blackboard^{or} (the standing parts having been stained black). It was found possible to make these demonstrations to as many as 100 children at one time.

VERBAL INSTRUCTIONS TO SUPERVISORS (When the apparatus is available)

Have a blackboard available. Have short sighted children in front. See that no geometrical instruments are in use during the test, only pencils or pens are allowed. Say to class, "Your teacher has not shown you this. You must put away any geometrical instruments - compasses, rulers, protractors - you may have, as you will not be allowed to use these. Is there anyone who has not got a sharp pencil or pen? (if there is anyone lend him one). These are puzzles about this simple piece of machinery which is made of wood (exhibiting the four strips and the two slotted pieces). You see here are four strips of wood with holes in them. These two are long (exhibiting). This one is medium (exhibiting), and this one is short (exhibiting). Here is a curved piece of wood with (exhibiting) with a slot in it. These two small blocks of wood with screws sticking up in the middle can move easily along the slot (demonstrating). But these three other small blocks are difficult to move (demonstrating that they move with difficulty). Now look carefully at what I am doing.

Set up apparatus as in P1. Say to class, "~~Now open your books at the first page.~~ Do you see that P1 (pointing) is a picture of what I have on the blackboard? Now where will the "X" go when I move the bottom end of the strip as far as I can to the right? Let us see (moving it). It goes here (making a mark under it on the blackboard). Swing back the strip). Now look again at the picture P1. You see that the "X" would go to the middle dot (pointing) if the strip were moved as shown by the arrow. So we make a ring round this dot. Will you all draw a ring round this dot in your books like this (illustrating in booklet. See that the class does this). The tip of the arrow (pointing) shows how far the screw in the small moving block of wood will get before it is stopped by one of the blocks which are hard to move. Each question will be, "Which dot does the "X" go to when the moving block, or sometimes both blocks move, is pushed as shown by the arrows.

"Now look at what I am doing again (set up P2). Notice that this strip (pointing to strip on right) is held at its lower end by these two small blocks (pointing). This other block (pointing) will stop this strip (pointing to strip on left) from moving too far to the right. When I swing this strip round (pointing to strip on left) where will the "X" go? (swing the strip round). You see the "X" does not move. (Swing strip several times and leave in left hand position). (Cont'd overleaf).

So in your book put a ring round the "X" like this (illustrating in booklet). I want you to remember this: At all times in the test, when the curved strip is used, the top point will stay still. This does not mean that the "X" would stay still, because the "X" may not be at the top point.

"Now look at this (setting up P3). When both strips are moved together as the arrows show where will the "X" go? (pause). Well I said it would stay still and you see it does (swinging both strips together. Swing several times and leave as in P3). So the answer is again "X" and you must draw a ring round "X" for P3.

"Now look at what I am doing again. I am now going to use the straight slot (setting up P4). ^{What turn over to P4} Where will the "X" go when I move both strips in the direction of the arrows in P4? (pause. Move strips). It does not stay still because the straight slot is being used, but it moves evenly to the right, neither up nor down. (Move strips back). You see the dot to put a ring round is this one on the right (illustrating in booklet).

"Now look at this (setting up P5.) When the strips are (both) pushed to the middle ^{the → show} where will the "X" go? (pause. Move strips). The "X" goes ~~straight up~~ ^{here}. (do this several times). So this is the dot to put a ring round (illustrating in booklet).

"Some of the questions are very easy and some are very difficult. I am now going to show you a difficult one (setting up P6). ^{while we are putting this one up you may look at once to find where the X will go} I doubt if any of you could tell me where the "X" will go this time. (Put dots on the black-board in the approximate positions shown in P6, and receive answers pointing to dots ^{including them} as children answer). Well let us see who was right (making movement).

"Remember while doing the test that in each question you must draw a ring round the dot where you think the "X" will go when the blocks have been moved in the slots as shown by the arrows. If the "X" does not move draw a ring round it. Also remember that the top point will never move when the curved slot is used. If you wish to change your mind about a ring you have made, clearly ^{like this} cross it out and make another one. (When first twenty-four items only are used say,) "You will have 20 minutes for the test. If you finish before this, I do not want to know, but go on trying. Are you all ready? START".

At 18 minutes, say, "2 minutes more", at 20 minutes say "time up" and see that no more work is done. Collect booklets.

TEST, 9

S.S.R. LINKS TEST (TRINIDAD)

NAME KEN RICK BENN
Christian names in block letters Surname (Title)

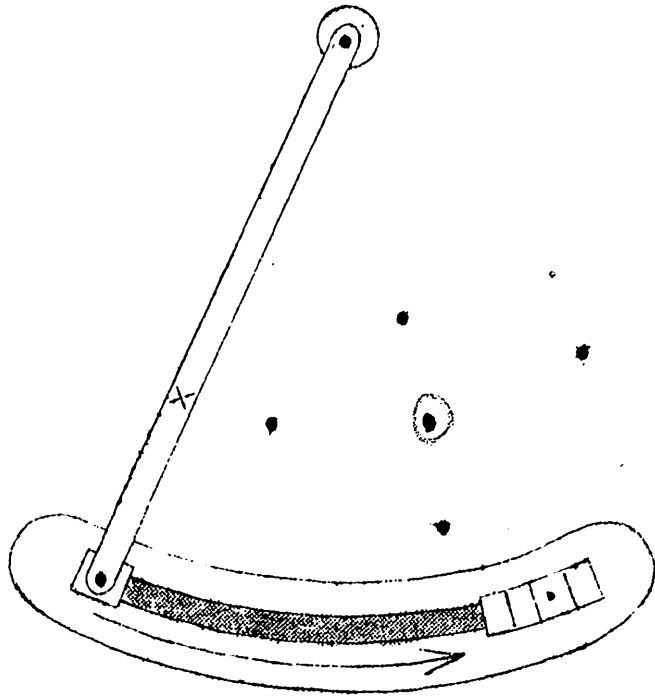
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DATE OF BIRTHDAY 24 February 1936
Date Month

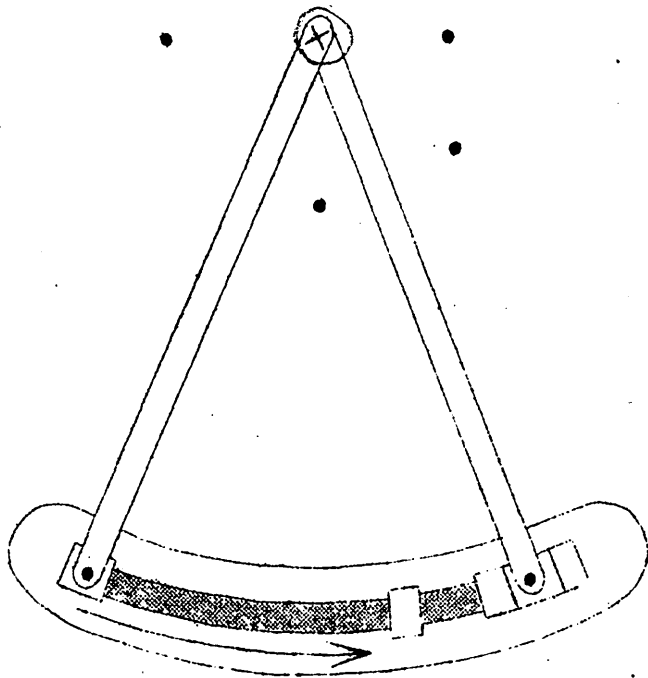
STANDARD VI NAME OF SCHOOL Longdenville Govt Sch

13
✓

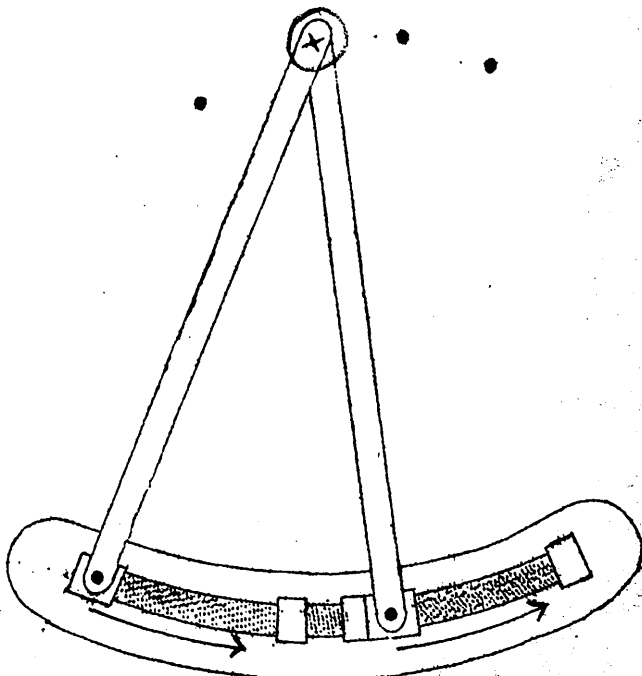
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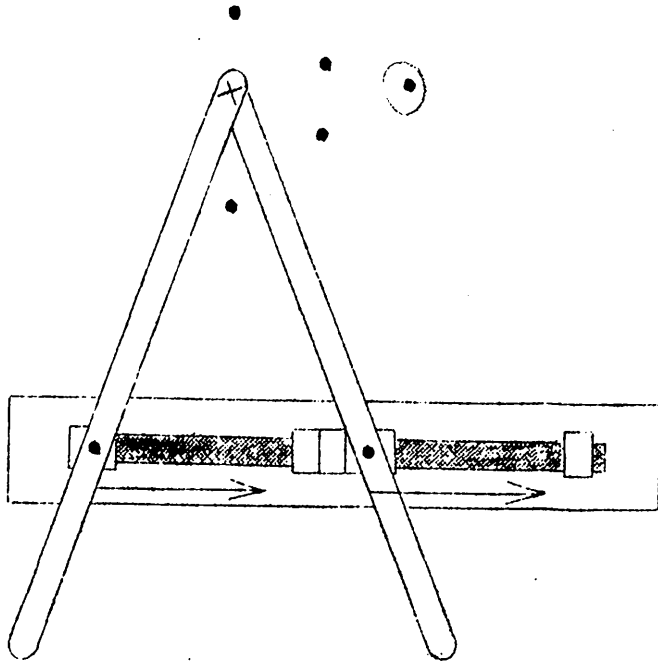
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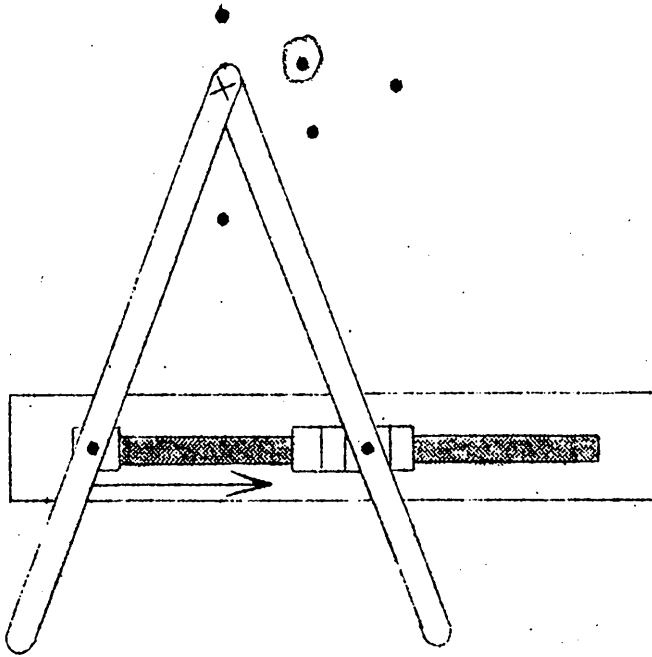
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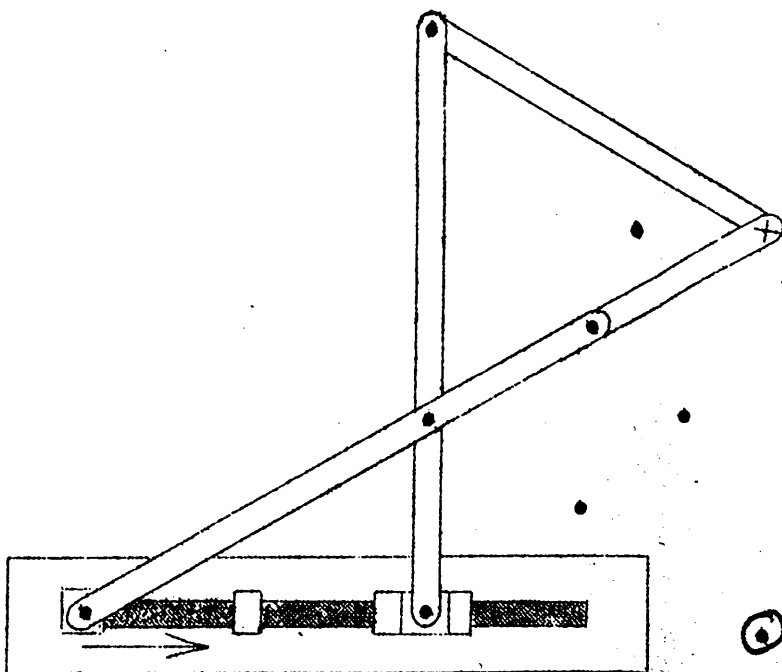
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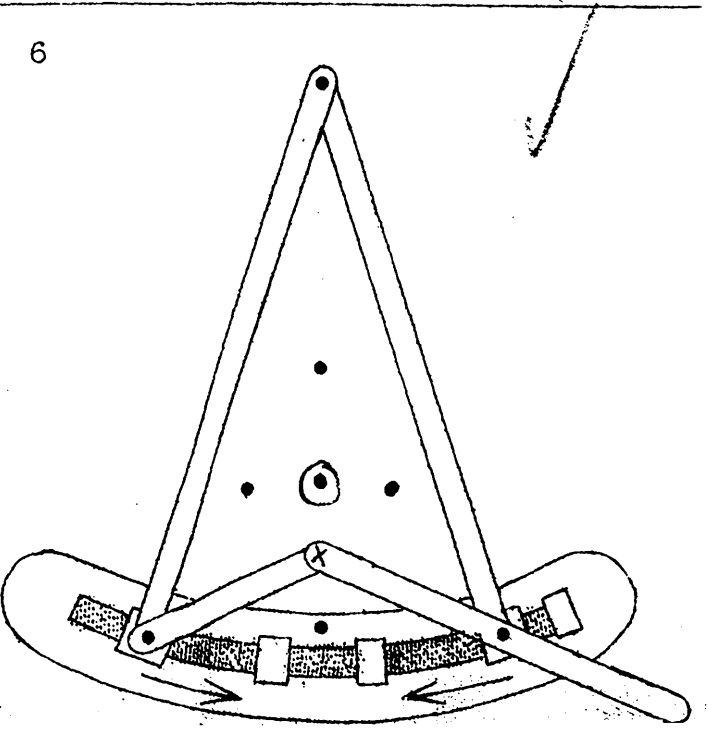
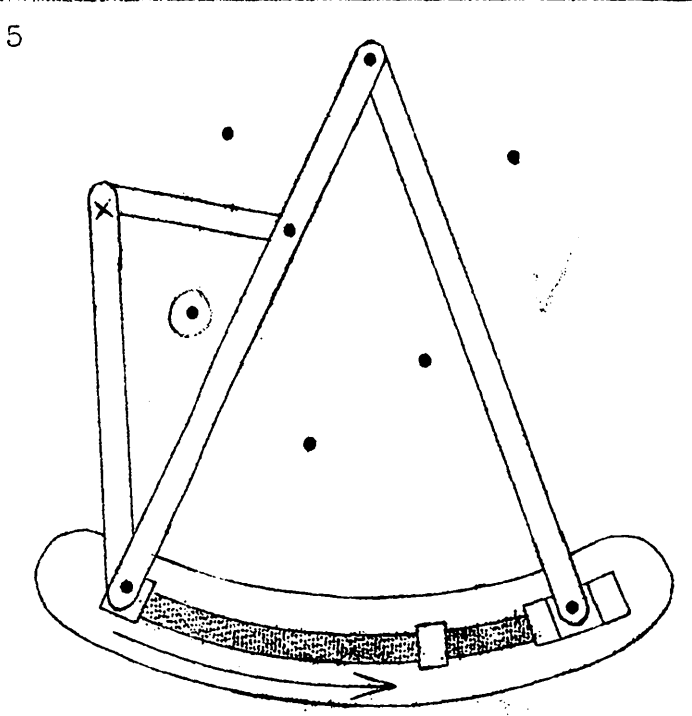
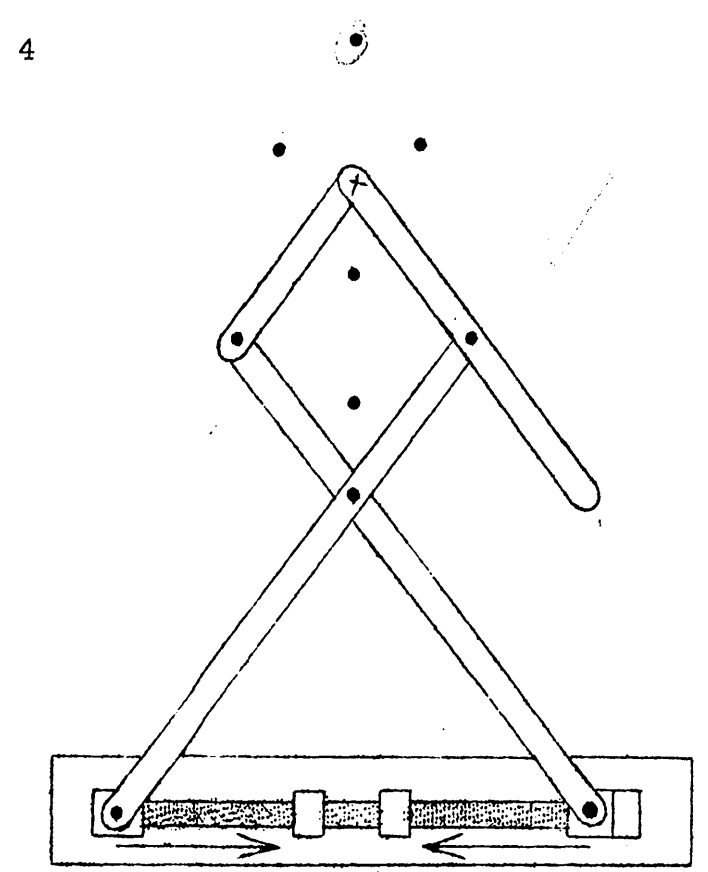
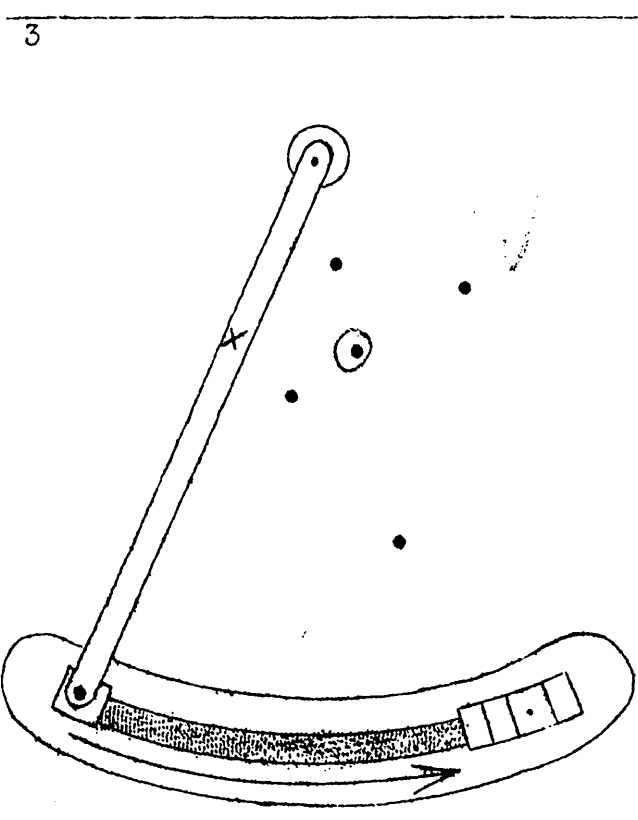
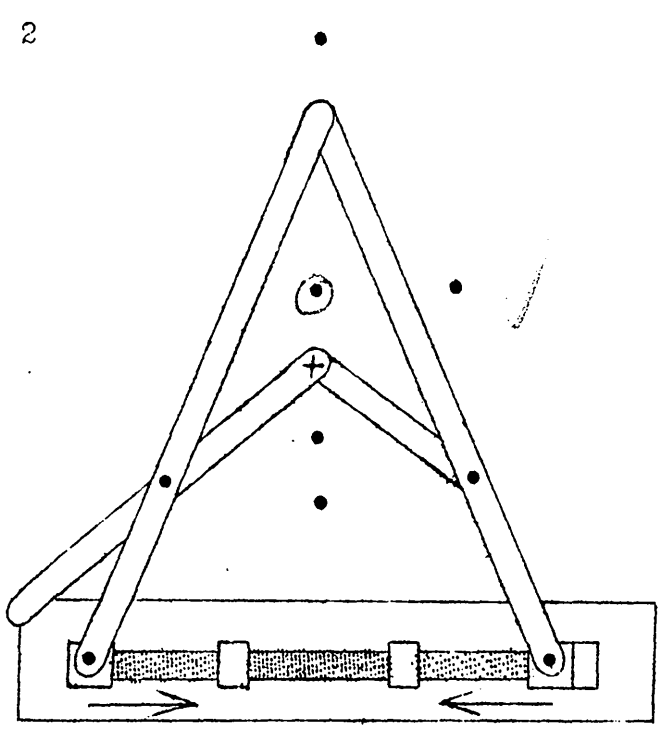
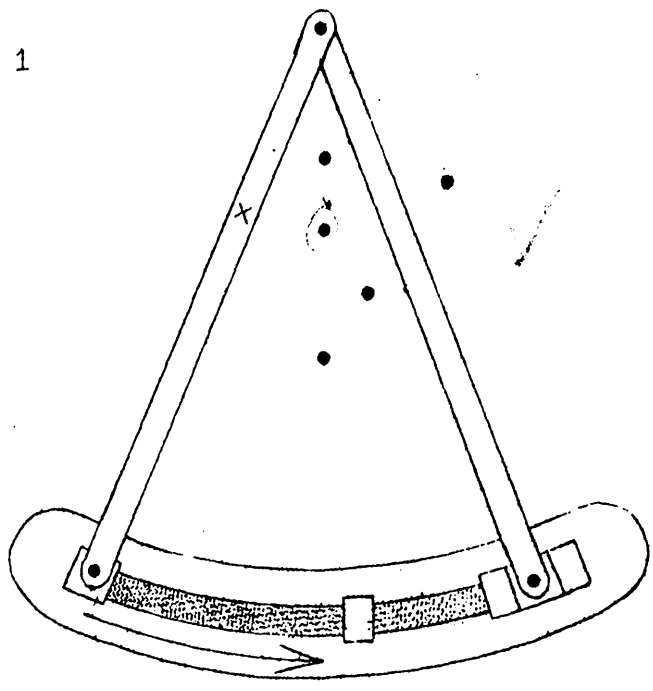


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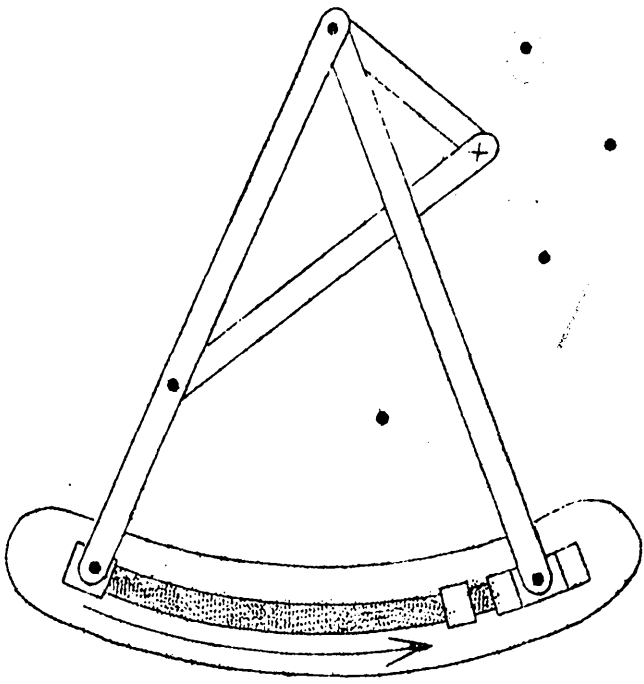


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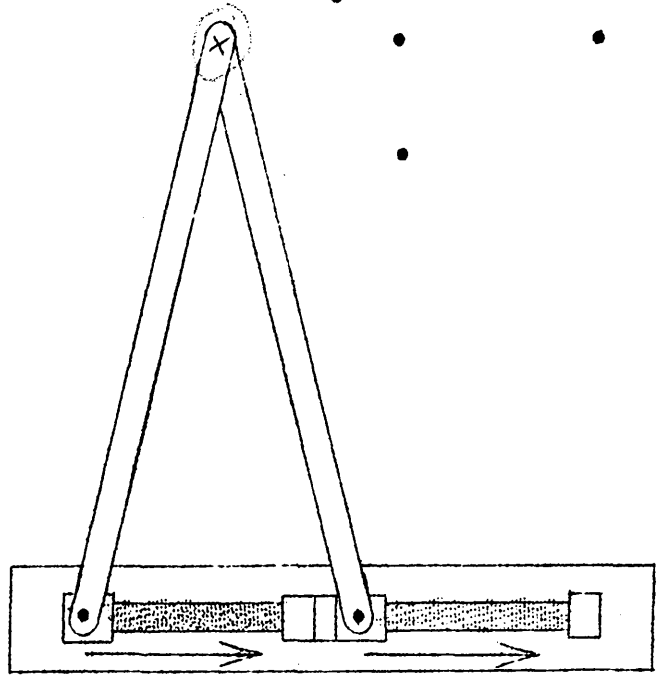




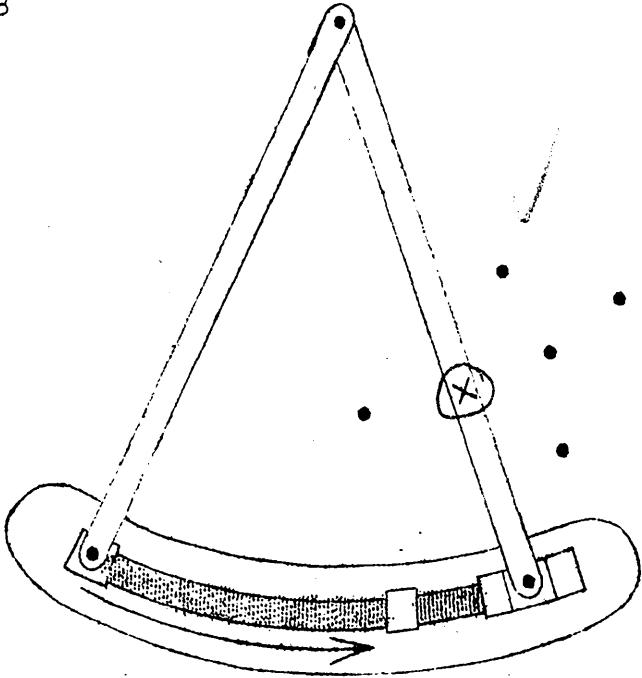
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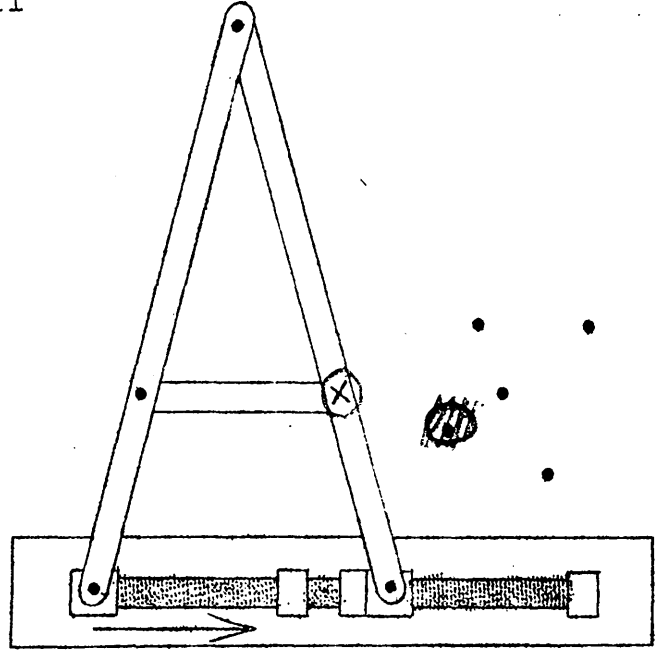
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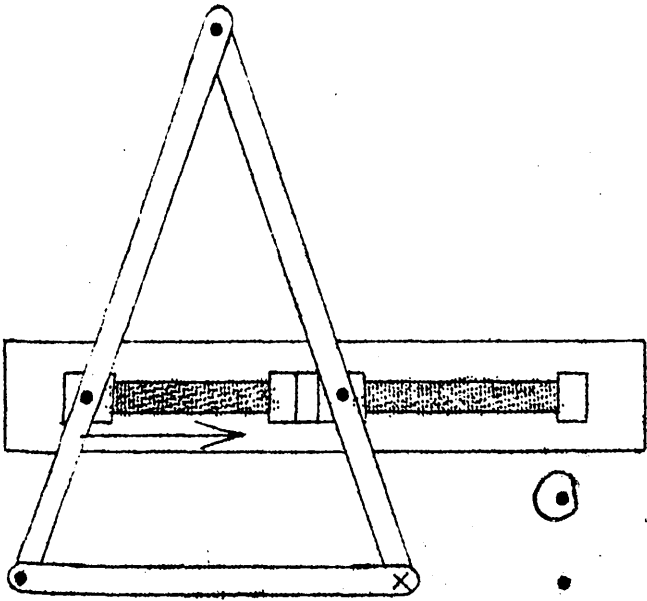
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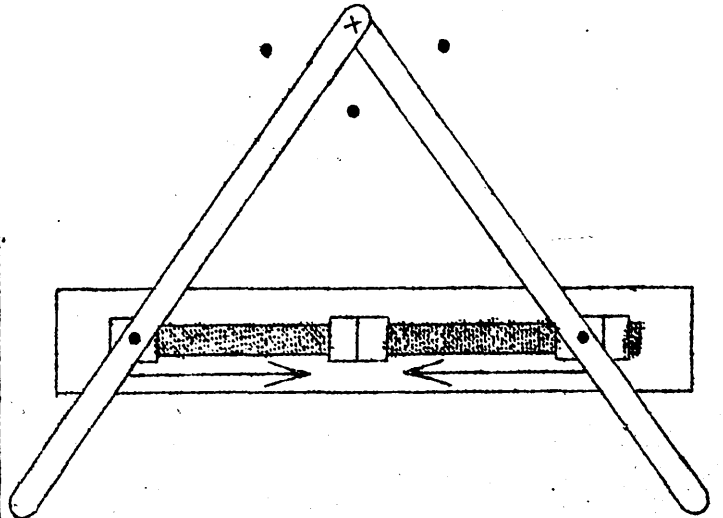
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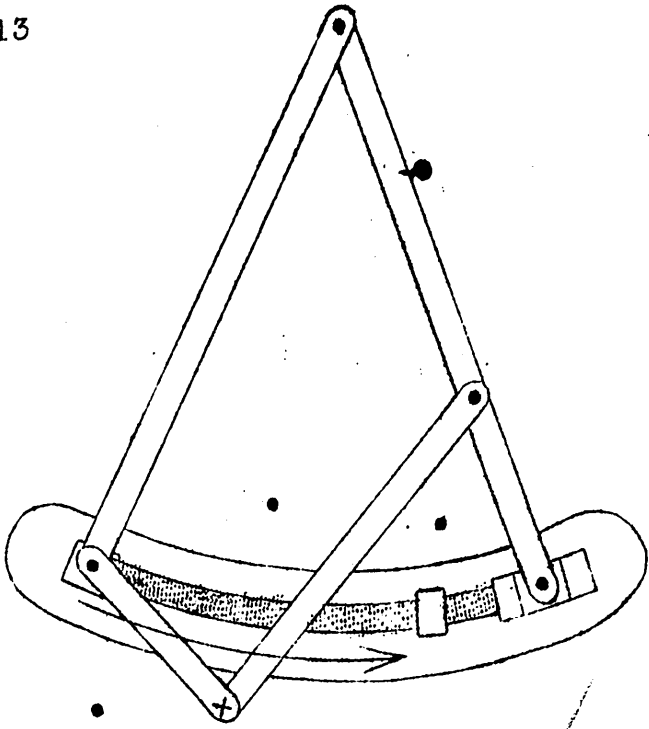
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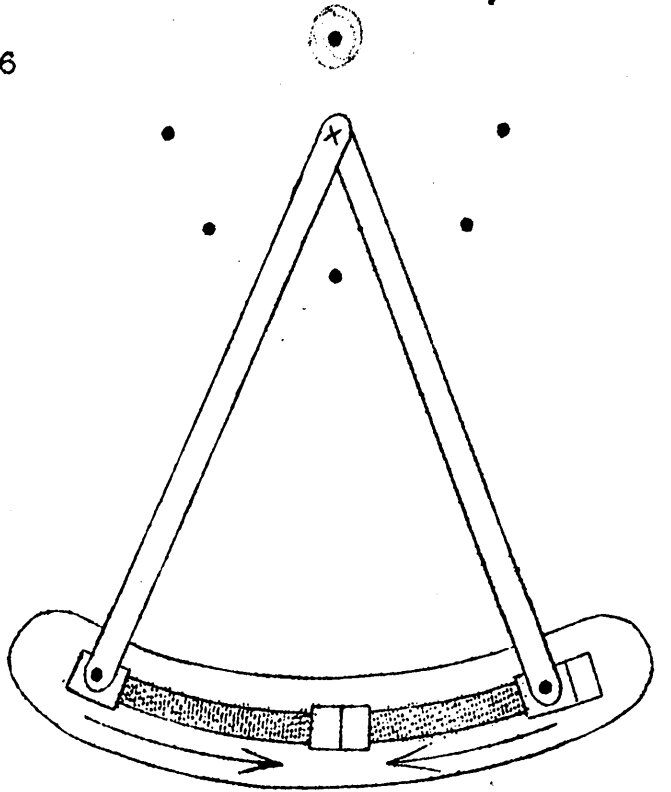


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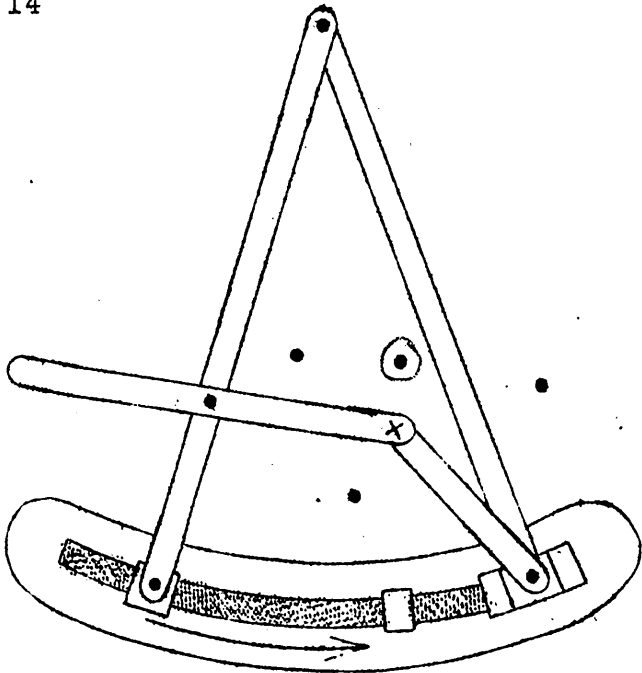


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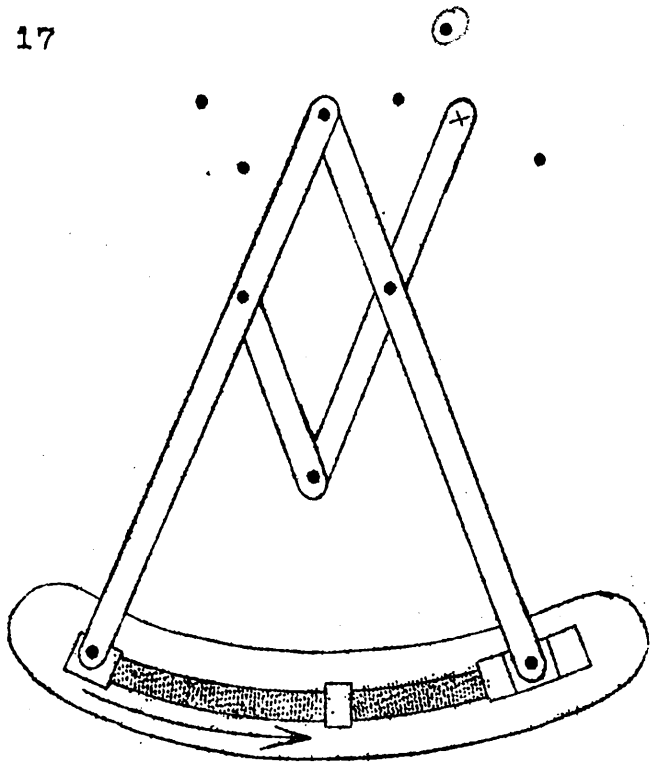
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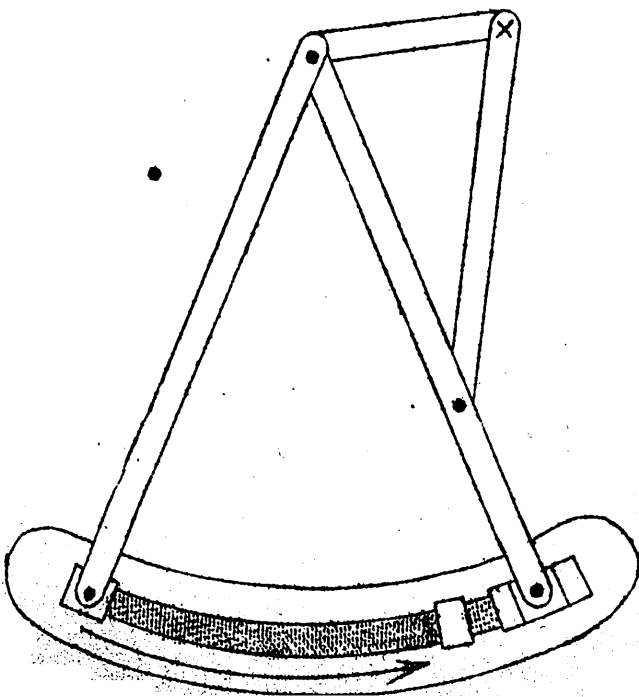
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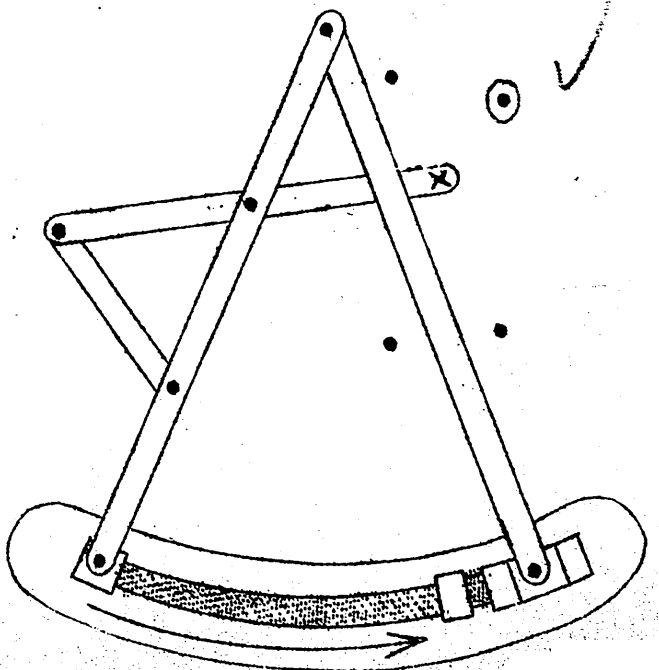
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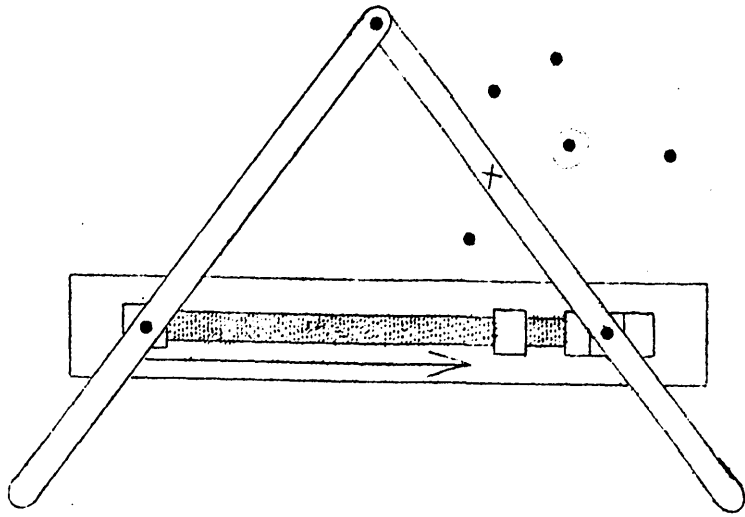
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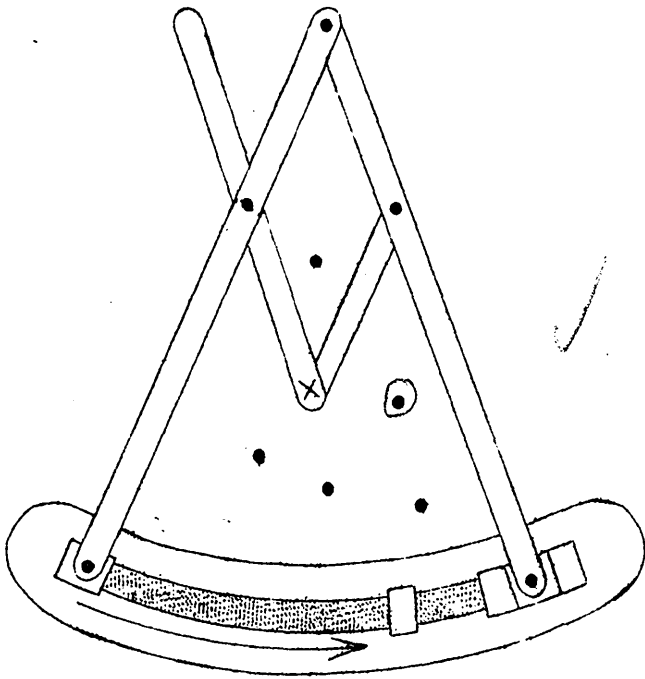
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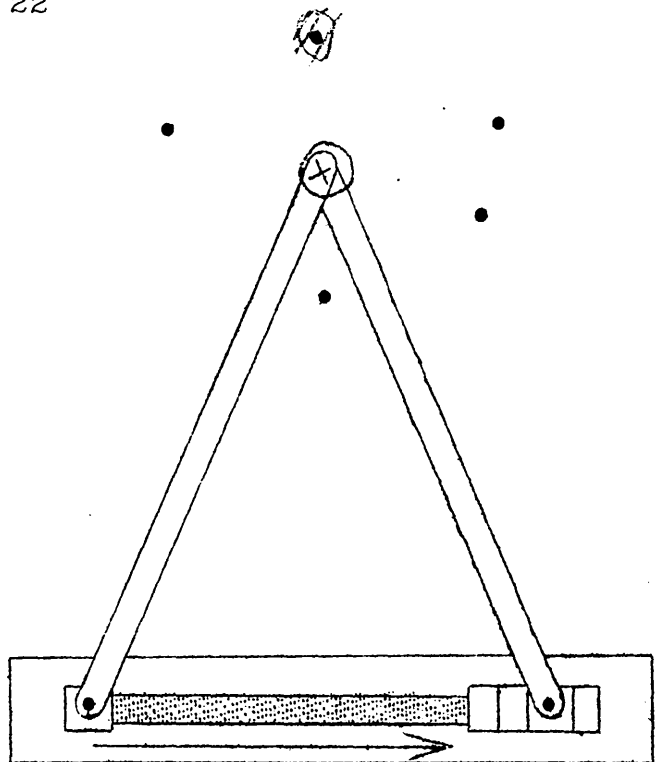
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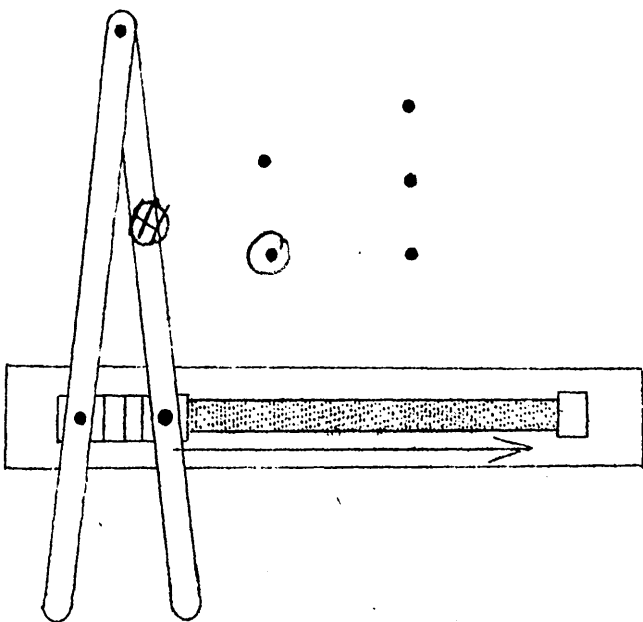
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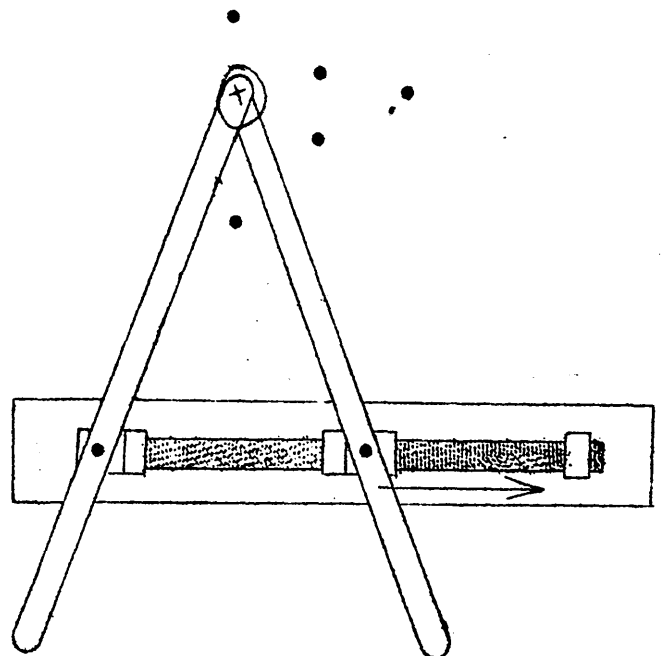
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21



23



PICTURE TESTS, TESTS 10, 11 & 12

The drawings were made in black and white on paper or "scraperboard" and taken to the Trinidad Government Printing Office, Lithographic Section, to be reproduced. An "offset" lithographic process was used which was not so satisfactory as the line block process would have been for my drawings, as white lines tended to fill in. I was present at the printing and on many occasions I had to have it stopped because the copies were not good enough. Fresh "printing off" on the plates had to be done a number of times. It took altogether about three months to get the booklets out after the drawings had been made.

The tests were set to Q.R.C. and to the elementary schools, but for the latter, to make the test easier, part of Picture Test 2 (TEST 11) was filled in as shown here (I regret that I have no unfilled in copies left). The Verbal Instructions to the Q.R.C. supervisors are given on page 148. The following are the Q.R.C. Norms:

Q. R. C. NORMS

| Age | Test 10 | Test 11* | Test 12 |
|-------------------------------|---------|----------|---------|
| 11.0 | 12.5 | 8.5 | 8.8 |
| 12.0 | 13.0 | 10.0 | 9.7 |
| 13.0 | 13.5 | 11.2 | 10.3 |
| 14.0 | 14.0 | 12.5 | 11.0 |
| 15.0 | 14.5 | 13.6 | 11.9 |
| 16.0 | 14.75 | 14.5 | 12.4 |
| 17.0 | 15.0 | 15.0 | 12.7 |
| 18.0 | 15.0 | 15.2 | 12.9 |
| S.D. based on 13-year-olds | 2.4 | 3.5 | 2.9 |

Test 10 was evidently too easy for all but 10 and 11 year-olds.

in Test 11

* For Q.R.C., only each item quite correct scored 2, from Item 7 the alternative, 2, 4, 1, 3, 5 scored 1.
for

S. S. R. PICTURE TESTS

INSTRUCTIONS TO SUPERVISORS.

Have short-sighted boys in front. See that you have 35 copies of booklets. Say to class, "Is there anyone who has not got a sharp pencil or a fountain pen containing ink?" If there is anyone lend him a lead pencil. Say to class, "You will each be given a little book of Picture Tests." Give out booklets then say, "Write your age in years after the word 'Age' at the top of the front page, and after the word 'Form' write down the form you are in at school. Next, write your full name (I mean all your names) after the word 'Name'; write your surname last and write in block letters (these are capital letters) so that they may be easily read."

S.S.R. PICTURE TEST 1. Say to class, "This is an Analogies Test. The first two pictures go together in some way and the third picture must go with one of the five pictures on the right in the same way as the first two pictures go together. The chosen picture on the right is to be underlined."

"Looking at the first row, a cat is a kitten after it is grown up so we must look for what becomes a cock after it is grown up. The answer is a chick and a line should be drawn under the square containing the picture of the chick for we can say: 'cat is to kitten as cock is to chick'. In the second row we can say: 'pencil is to note-book as chalk is to blackboard'. Be careful to look at the first two pictures very closely because the third picture by itself could not possibly give us the correct answer. Do the next three items by yourselves but do not look past the thick line drawn across the page." After the class has just had time to do this say, "These are the answers you should have got:-

Standing top is to top lying down, as standing boy is to boy lying down.
Sheep is to grass as boy is to bread.
'5 to 8' is to '5 to 9' as '10 to 3' is to '10 to 4'.

"More than one picture underlined will be counted as wrong. If you make a mistake and wish to change your mind, clearly cross out the line you have drawn like this :- ~~//////////~~ (Demonstrate on Blackboard).

"You need not hurry as you will be given 12 minutes to do the test which is plenty of time. Nevertheless, do not waste a long time over any one row but get on with the next. When I tell you to start do the next 16 items by yourselves. They start easy and get more difficult. I want to tell you again be careful to study the first two pictures well, before you draw a line under the picture you think is the correct one.

"If you have finished the 3 pages of this test before the time is up do not turn over to the next page but look over the answers you have already given. No talking - to yourselves, neighbour nor me - will be allowed during the test. Are you all ready? START!"

At 15 minutes say "2 minutes more". At 12 minutes say "time up".

"Turn over to PICTURE TEST 2. This is a Sequence Test. You see four pictures which tell a story the same as you might find in a comic strip in the newspapers but the pictures are not in the right order. The puzzle is to find out what the story is about and to put numbers in the little squares beneath the pictures, to show in what order the pictures should be put. The four pictures above the thick line tell the story of a motor car accident. The car is going along the road in the last picture; it is just going over the edge of a cliff in the second picture; it hits the ground below the cliff in the third picture and the ambulance comes along in the fourth picture. A 1 should therefore be put in the little square beneath the fourth picture, a 2 beneath the second, a 3 beneath the third and a 4 beneath the first picture."

"As you will see most of the items of the test have more than four pictures. An item will be counted as right only if all the numbers are put into the little squares correctly.

"If you make a mistake and wish to change your mind, clearly cross out the number you have written and write the number you now wish to write outside, to the right of the little square. If you wish to change, say, a 3 to a 4, do this :-

| |
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 4 (Demonstrate on blackboard).

"You will be given ~~10~~² minutes do this test and if you have finished the two pages before you are told to do so, you may look over your answers but do not turn back to Test 1 nor turn over to Test 3. Are you all ready? START!"
 At ~~10~~¹⁰ minutes say "~~10~~¹² minutes more". At ~~10~~¹² minutes say "Time up".

"Turn over to PICTURE TEST 3. This is a 'Two Alike' Test which means that two of the objects pictured in each row are alike in what they do or in what they are used for. You are required to underline these two pictures. Draw your line just under the frame containing the pictures.

"Look at the first row. A cow and a goat are both used for giving us milk, and in the second row a cup and a teapot do the same thing - they both hold tea. You will be given 12 minutes to do this test and if you have finished before you are told to do so you may look over your answers, but do not turn back to Tests 1 and 2. Are you all ready? START!"

At 10 minutes say "2 minutes more". At 12 minutes say "time up" and see that no more writing is done. Collect booklets putting blanks (if any) on top and see that you return **35** copies.

TEST 10. Picture Analogies. (16 Items)**"11 Schools Experiment"**

The children had received instructions from their teachers before the test proper and had worked on 5 practice examples.

This test was constructed by me before I left Edinburgh in 1947. The items are new except for some of the practice examples which were borrowed from Moray House. Care had to be taken in all these picture tests that none of the drawings would contain articles unfamiliar to West Indian children.

The test possessed the same feature as in the Geometrical Analogies namely the third picture did not offer a clue to the correct answer but the relationship between the first two pictures had to be grasped before this could be given. This restriction makes it much harder to think of satisfactory items.

Verbal Instructions

Give out booklets. Say to class "fill in the cover of your book as you have been doing. Now open the book at the first page. Your teacher has already shown you how to do the five rows of pictures above the thick line (p). He has told you that the first two pictures go together in some way and you have to underline the one of the five pictures on the right which goes together with the third picture (p) in the same way as the first two pictures go together. In the first row the first two pictures go together because a cat is a kitten after it is grown up; so you must ask yourselves what becomes a cock after it is grown up. The answer is a chick so underline the picture with the chick in it. We can say: 'Cat is to kitten as cock is to chick'. In the next row

pencil writes in notebook and chalk writes on blackboard or pencil is to notebook as chalk^k is to blackboard, so the picture of the blackboard is the one to underline. In the next row sheep eats grass and boy eats bread, or sheep is to grass as boy is to bread, so underline the picture of the bread. In the next row standing top is to top lying down as standing boy is to boy lying down. In the next row 5 to 8 is to 5 to 9 as 10 to 3 is to 10 to 4. I want to remind you when you are doing this test how important it is to study the first two pictures because unless you do this you could not possibly know which of the other five pictures to underline. When I tell you to start do the rows numbered 1 - 16. When you have done No. 16 do not turn over the page until you are told to do so. You will have 12 minutes to do this test. Are you all ready ? START! " At 10 minutes say "2 minutes more" at 12 minutes say, "Time up, now turn over the page to the next test".

TEST 11. Picture Sequences. (10 Items)

"11 Schools Experiment"

The children had received instructions from their teachers before the test proper and had worked on 1 practice example.

The practice example and the first 2 items of the test were borrowed from Moray House, the others are all new. An artist friend of mine, Mrs. E. R. Pashley, made rough sketches for item nos. 6, 7, 8 and 10 which I made suitable for reproduction. For these elementary schools certain of the squares had numbers put in, so as to make the test easier. Some of the items are very difficult without this help. For instance most adults to whom I have shown the test have been floored by Item 9, though they all agreed when shown the intended answer that that was the correct one. This test took me more time to make than any of the others. The drawings are not of simple articles, but depict action. And since I fancy myself as a student of mathematical perspective, I had to take a week over making the drawing of the classroom in item 5 (which is very badly reproduced here). My second Assistant Mr. George was my model for Item 4, though he does not smoke.

Verbal Instructions

"As your teacher has told you these rows each tell a story the same as you might find in a comic strip in the newspaper but the pictures are not in the right order. The puzzle is to find out what the story is about and to put numbers in the little squares beneath the picture to show in what order the pictures should go. You have done the one with the motor car accident with your teacher. A 1 has already been put in the

fourth picture to help you; the car next reaches the side of a cliff so put a 2 into this square (p); it then hits the ground so put a 3 into this square (p); the ambulance comes for the injured so put a 4 into this square (p). When you are doing this test you will see that some of the numbers have been put into the little squares in order to help you. These numbers which have already been put in you must think of as part of your answer, that is, as though you had put them in yourself. When I tell you to start do the rows number-ed 1 - 10 and if you have finished before time is up do not turn over until I tell you.

You will have 12 minutes to do this test. Are you all ready? START!" At 10 minutes say "2 minutes more", at 12 minutes say, "Time up, now turn over the page to the next test".

TEST 12. Picture, Two Alike. (18 Items)

"11 Schools Experiment"

All the articles depicted in this test are quite familiar to all the children. This was confirmed by the head teachers. Functional relationship must be apprehended, "DO" or "USED FOR" are stressed.

Verbal Instructions

"As your teacher has told you, in each row there are five pictures two of which are alike in what they do or in what they are used for. The puzzle is to find out which are the two alike in what they do or in what they are used for and to underline these two. In the first row underline the cow and the goat because they are both used for giving us milk. In the second row underline the cup and the teapot because they both

do the same thing - they both hold tea. When I tell you to start do the rest of the rows in the little book numbered from 1 - 18. Remember! Some of the pictures are put there to try and catch you, so you'll have to think well before underlining the two pictures. You will be given 12 minutes to do this test. Are you all ready ? **START!** At 10 minutes say, "2 minutes more", at 12 minutes say, "Time up", and see that no more writing is done. Collect booklets.

S. S. R. PICTURE TESTS

NAME.....
Christian names in block letters *Surname (Title)*

AGE LAST BIRTHDAY.....YEARS

DATE OF BIRTHDAY.....
Date *Month*

STANDARD..... **SCHOOL** _____

Time Allowed 36 minutes

INSTRUCTIONS

PICTURE TEST 1

The first two pictures in each row go together in some way. The next picture goes with one of the five pictures on the right, in the same way as the first picture goes with the second picture. The puzzle is to find which is the picture on the right that the third picture goes with, and to underline it. In each of these puzzles we can always say when we have the correct answer: "The first picture is to the second picture as the third picture is to.....the picture you have underlined." In the first row we can say, "A cat is to a kitten as a cock is to a ?....." Chick is the right answer because a cat is a kitten after it is grown up and a cock is a chick after it is grown up. So the picture of the chick is the one to underline; draw the line just outside the bottom of the picture. In the next row we can say, "Pencil is to notebook as chalk is to ?....." Blackboard, because a pencil writes in a notebook and chalk writes on a blackboard. In the next row, "A sheep is to grass as a boy is to bread." In the next, "Standing top is to top lying down as standing boy is to boy lying down." And in the next, "5 to 8 is to 5 to 9, as 10 to 3 is to 10 to 4". Be careful not to underline two pictures in any one row as this row will then be counted as wrong. If you make a mistake and wish to change your mind, clearly cross the line you have drawn like this: ///////////////

Time allowed—12 minutes.

PICTURE TEST 2

These rows of pictures each tell a story the same as you might find in a comic strip in the newspapers, but the pictures are not in the right order. The puzzle is to find out what the story is about and to put numbers in the little squares beneath the pictures to show in what order the pictures should be put. Some of the numbers are already put into the little squares in order to help you; these numbers which have already been put in, you must think of as part of your answer, that is as though you had put them in yourself. Look at the row above the thick line; it is the story of a motor-car accident. The fourth picture which has already had '1' placed in the little square beneath it shows the car being driven along; it then reaches the edge of a cliff, so a '2' should be put in the little square beneath the third picture; it falls over and is about to hit the ground so a '3' should be put in the little square beneath the second picture; lastly, the ambulance is there to take the injured, so '4' is put beneath the first picture. All the numbers in any row must be correct for that row to be counted as right. Suppose you have put a '3' but want to change it to a '4', clearly cross out the '3' that you have written and write the '4' beside the square like

this

| |
|---|
| 3 |
|---|

 4.

Time allowed—12 minutes.

PICTURE TEST 3

In each row there are five pictures; two of these are alike in what they *do* or in what they are *used for*. The puzzle is to find which of the two are alike in what they *do* or in what they are *used for* and to underline these two pictures. The lines should be drawn just beneath the line framing the pictures. In the first row the pictures of cow and goat should each be underlined as they both do the same thing—that is they both give milk which is drunk by us. In the second row the pictures of the tea-cup and tea-pot should be underlined because they both *do* the same thing—they both hold tea. You must underline two and not more than two pictures in each row before your answer can be counted as right.

Time allowed—12 minutes.

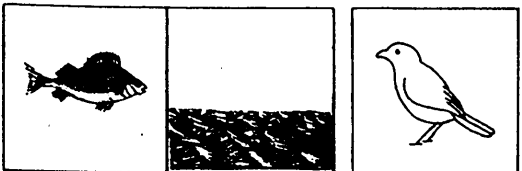
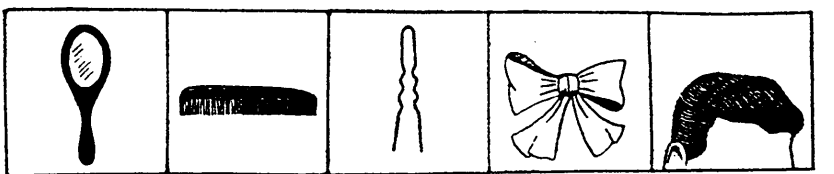
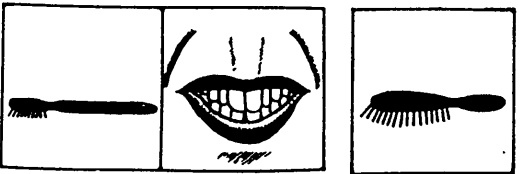
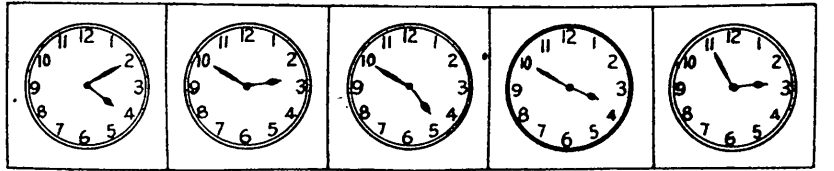
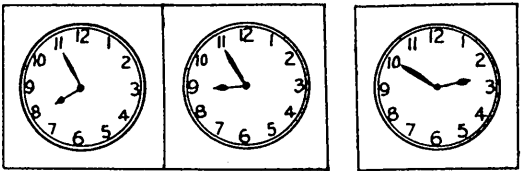
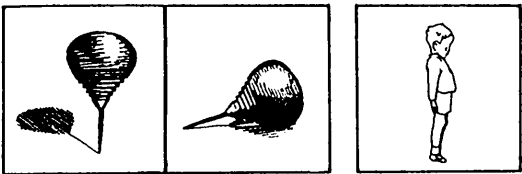
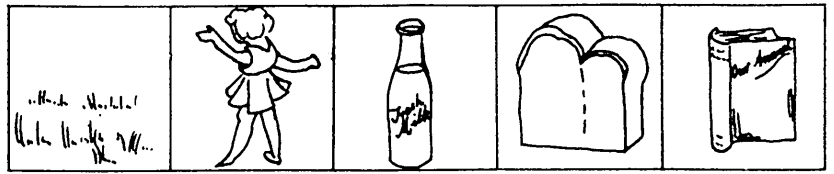
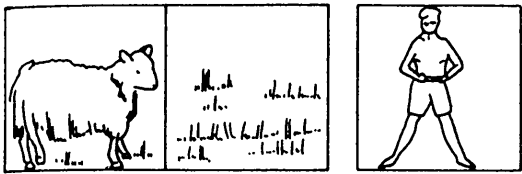
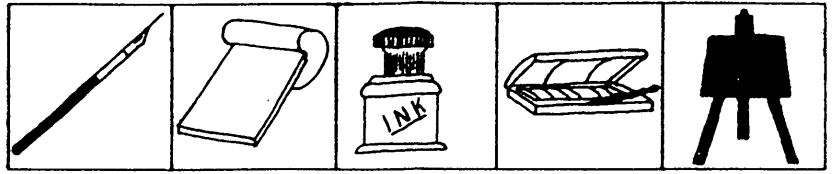
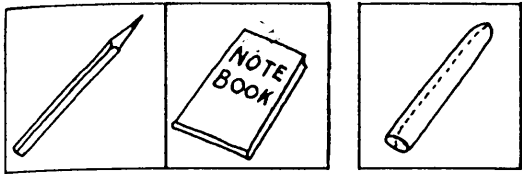
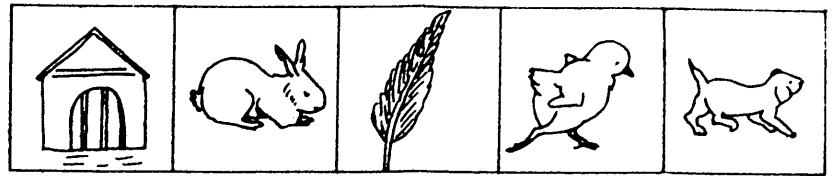
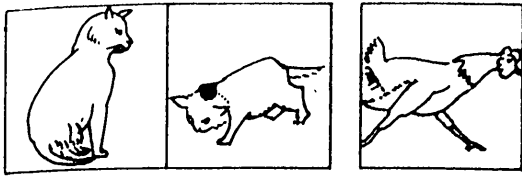
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Score on Picture Test 2, *TEST, 11*

Score on Picture Test 3, *TEST, 12*

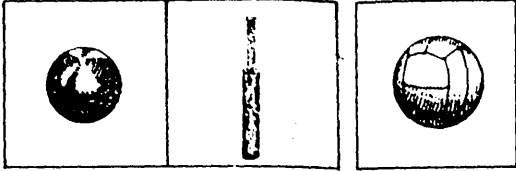
TEST, 10

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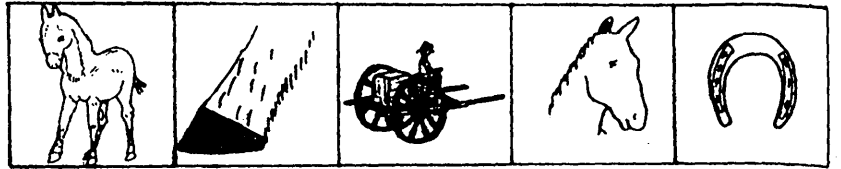


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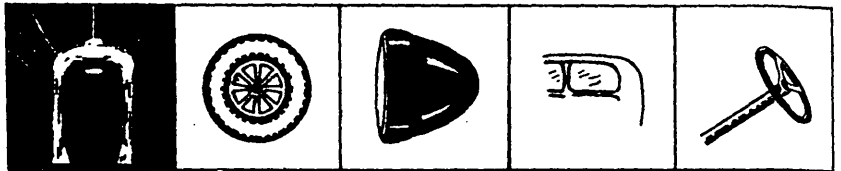
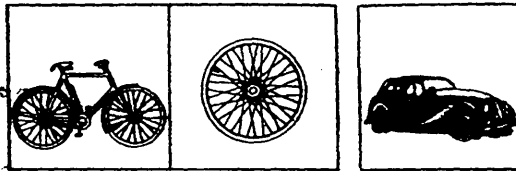
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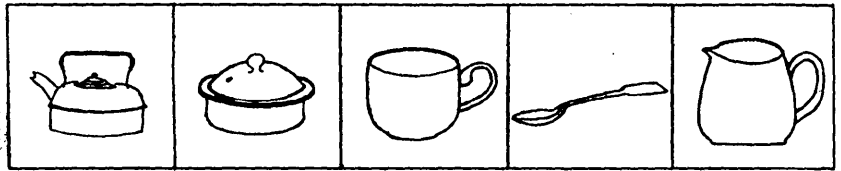
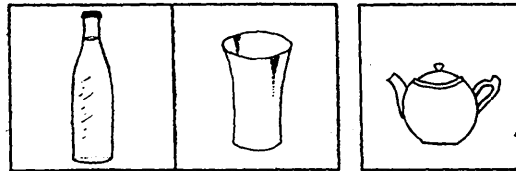
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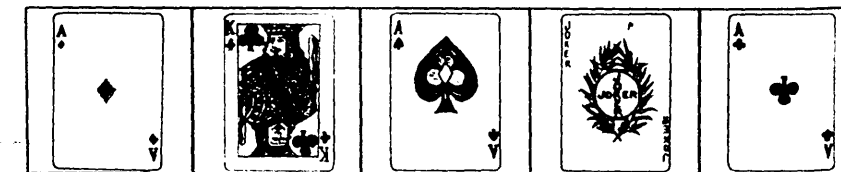
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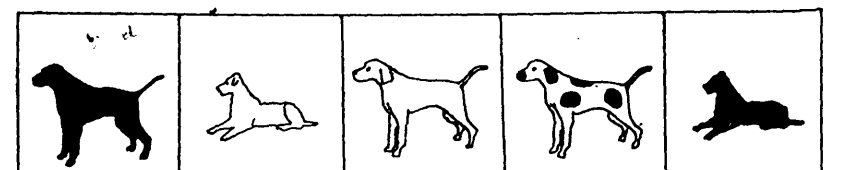
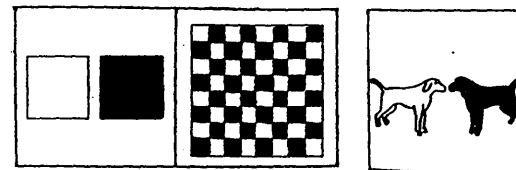
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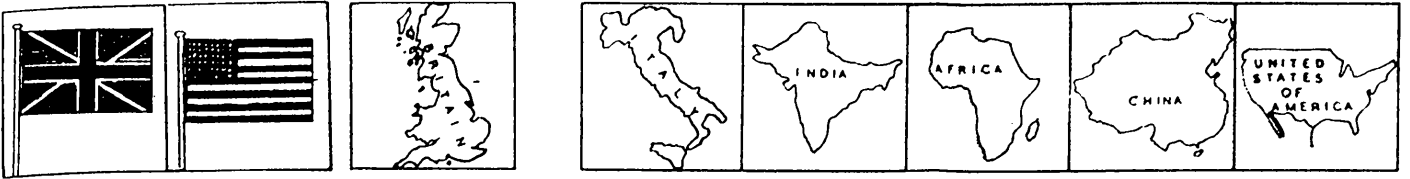
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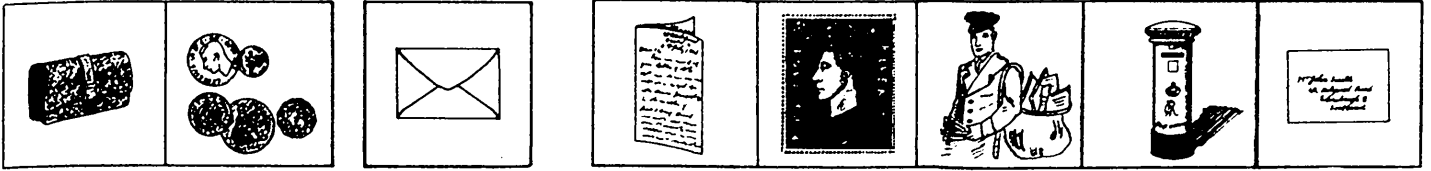
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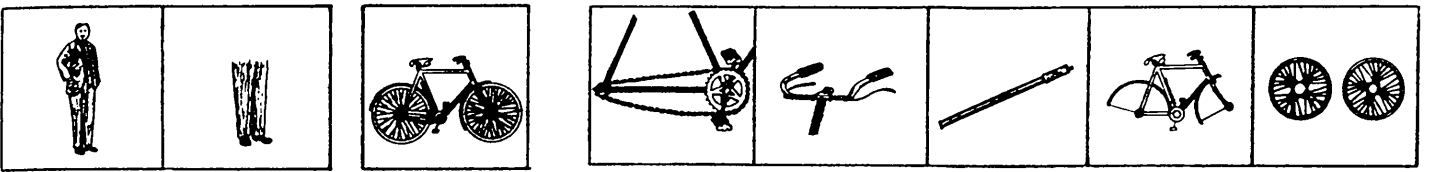
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11



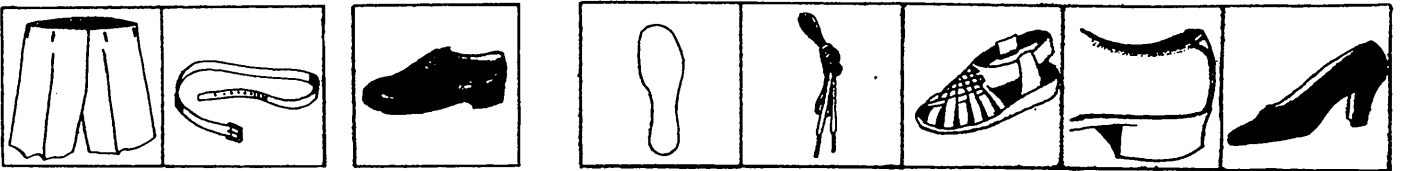
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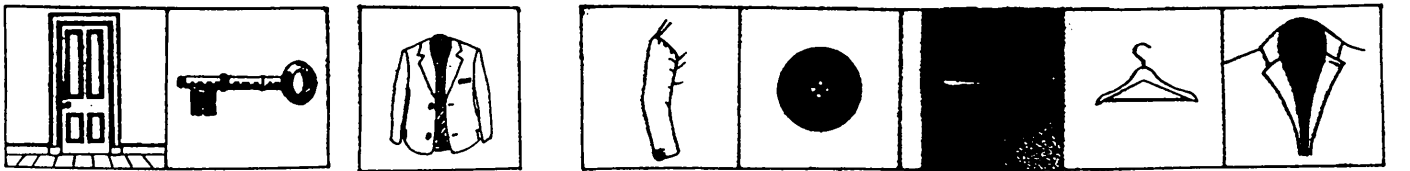
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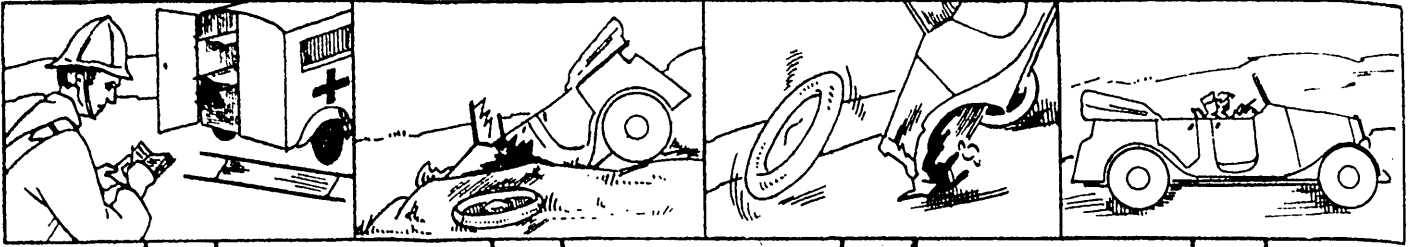
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16



DO NOT TURN OVER



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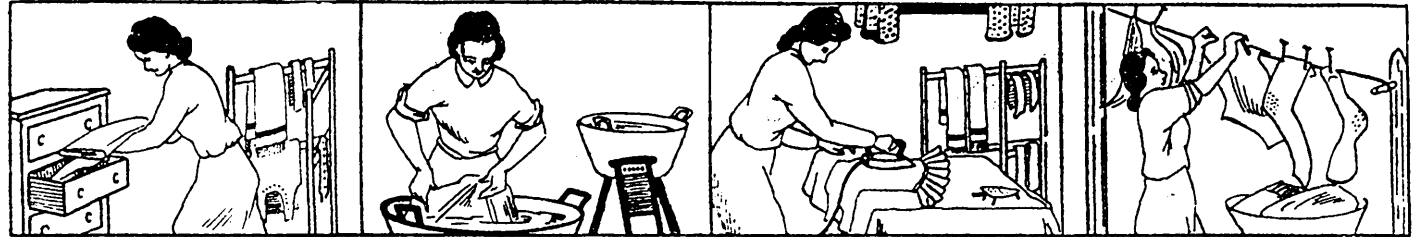


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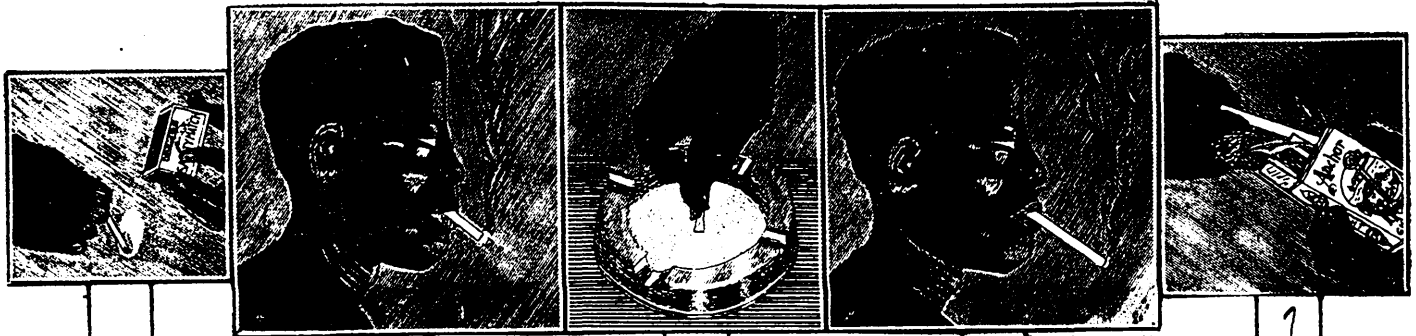
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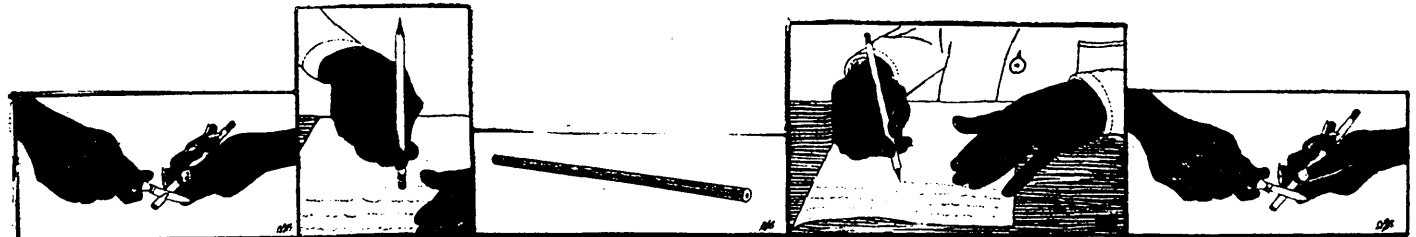
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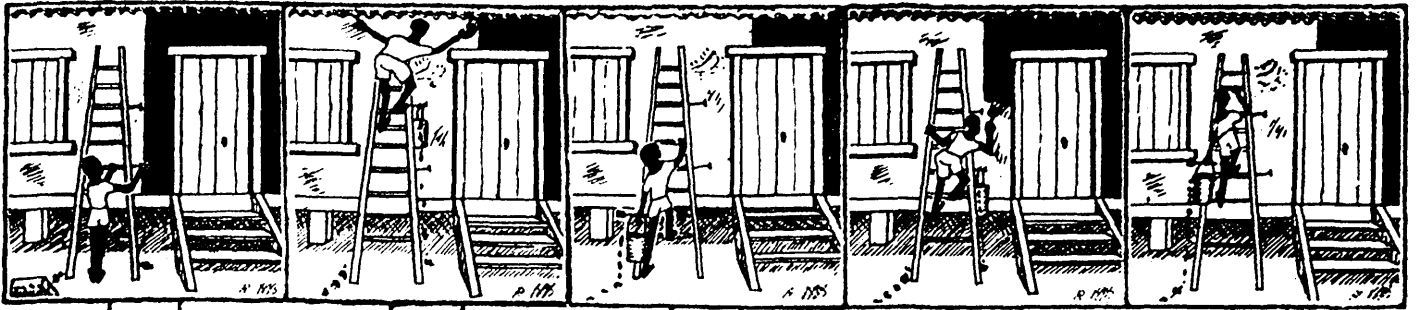
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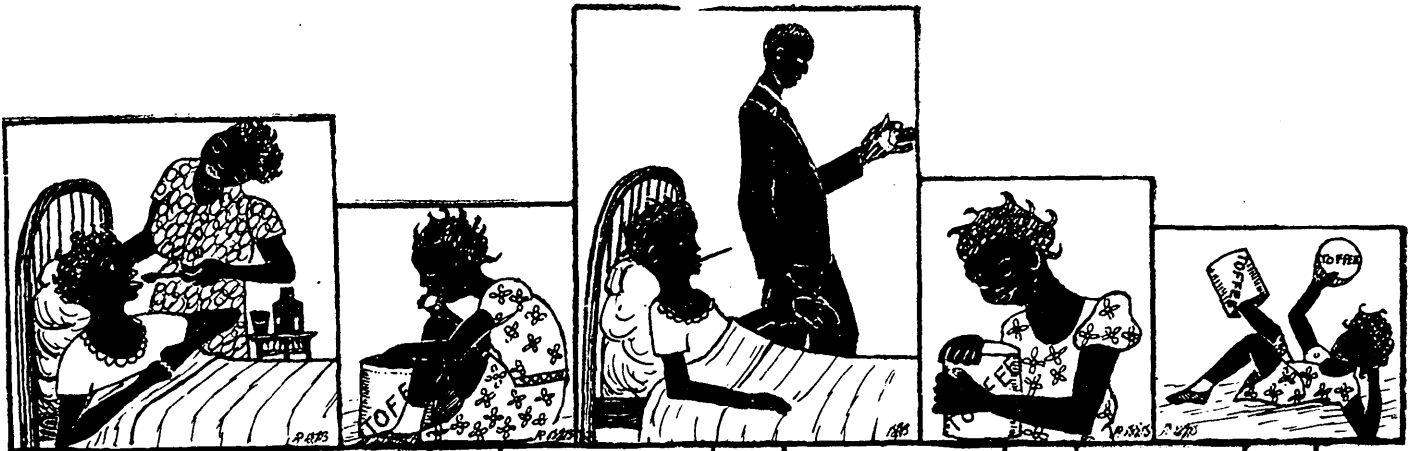
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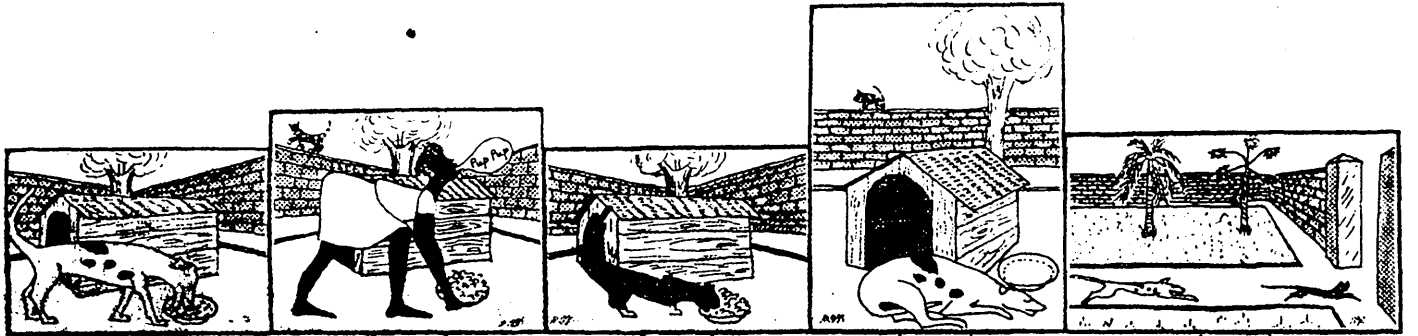
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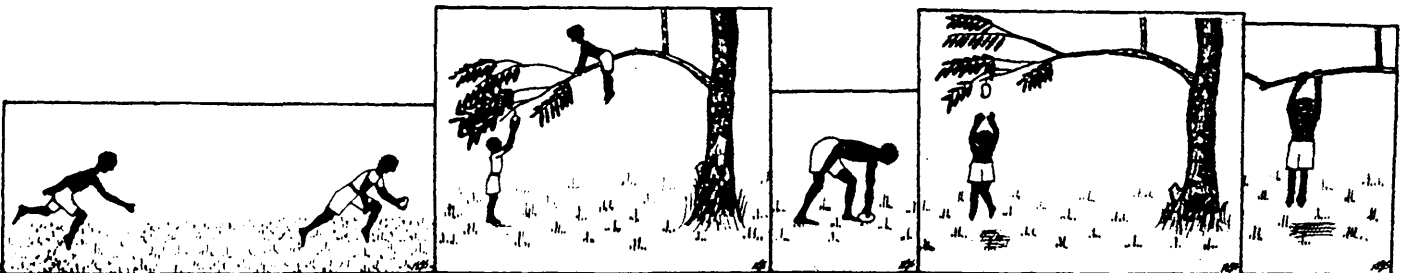
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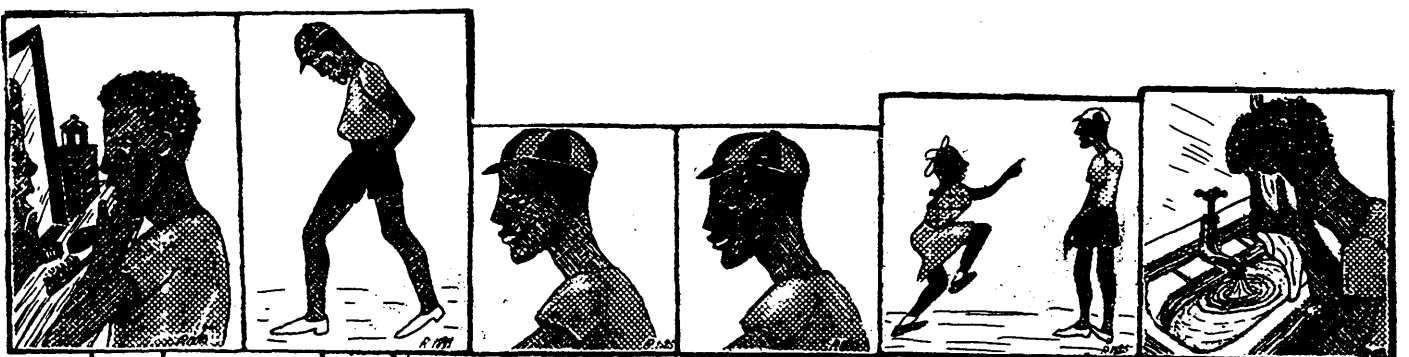
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3

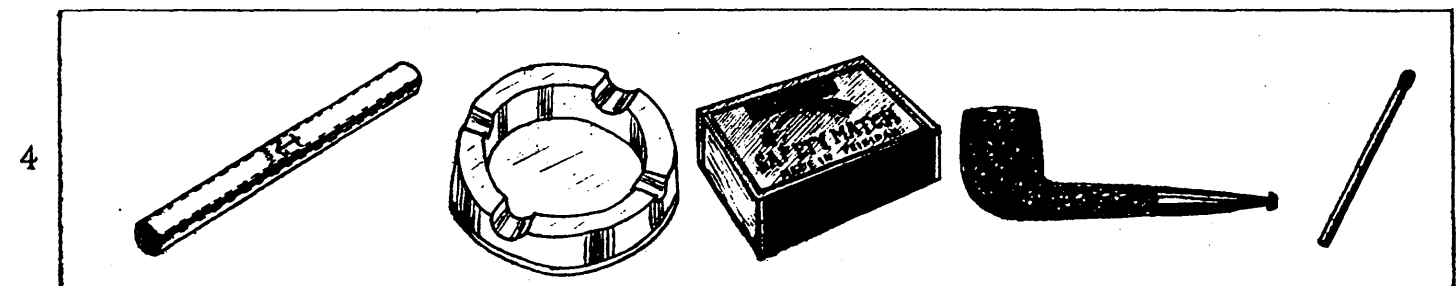
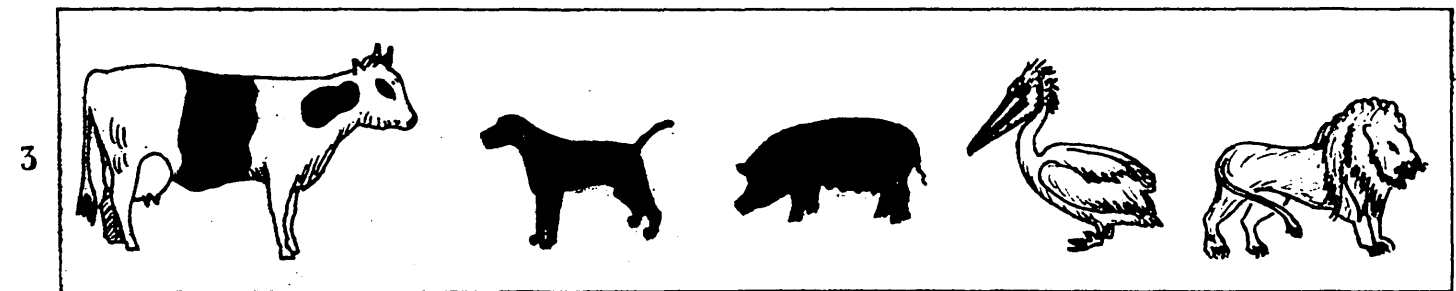
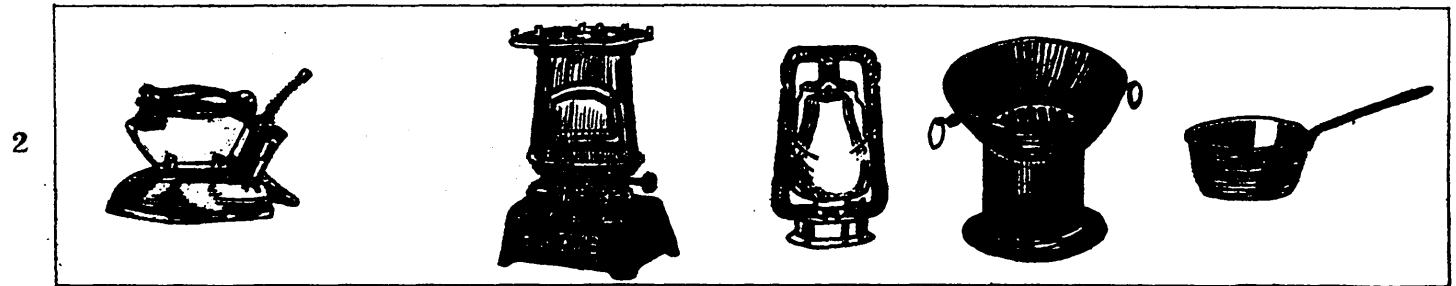
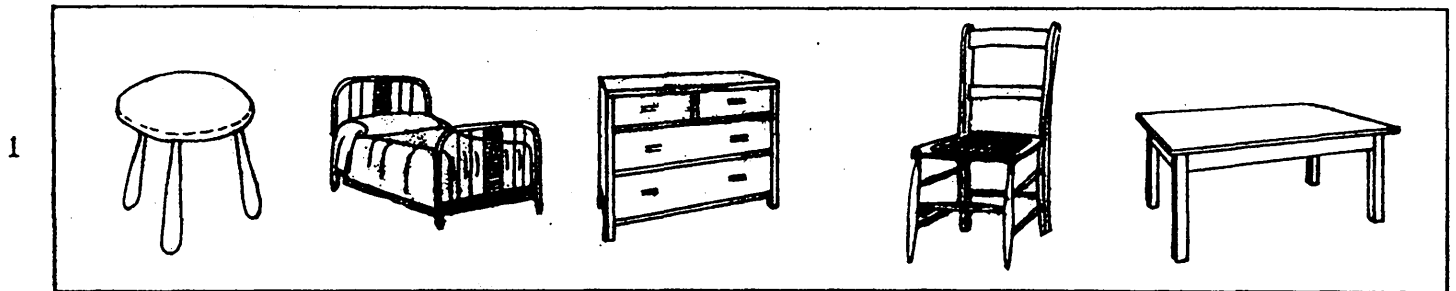
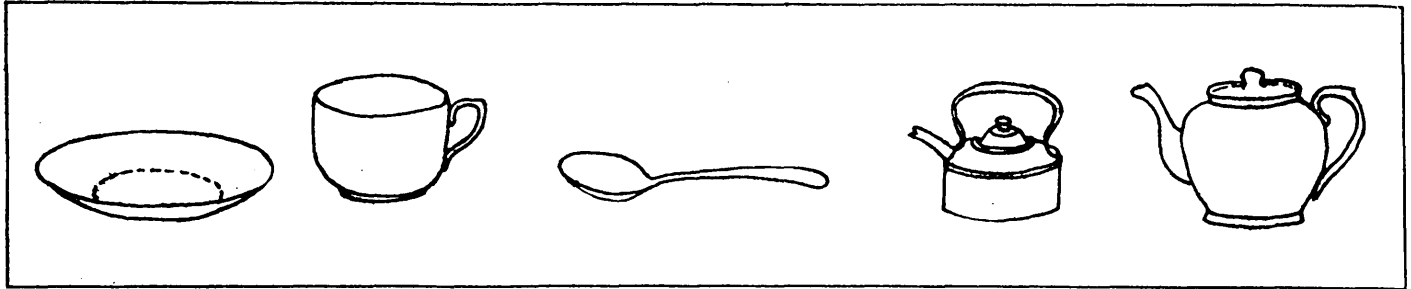
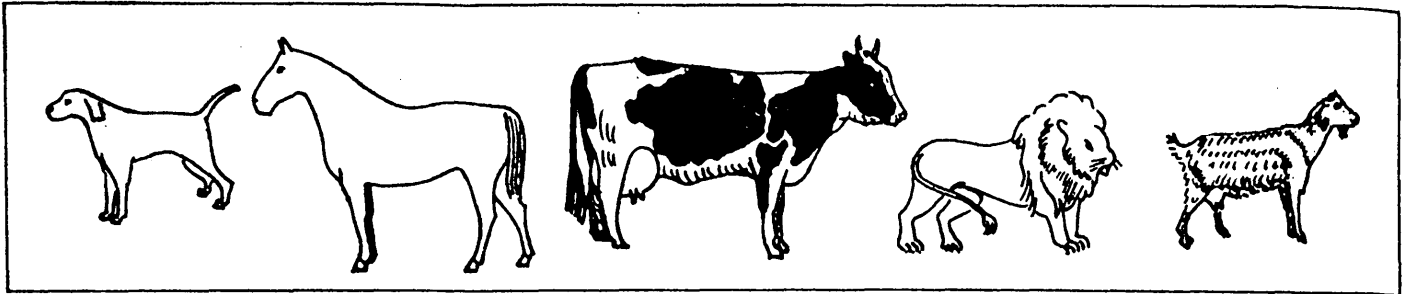
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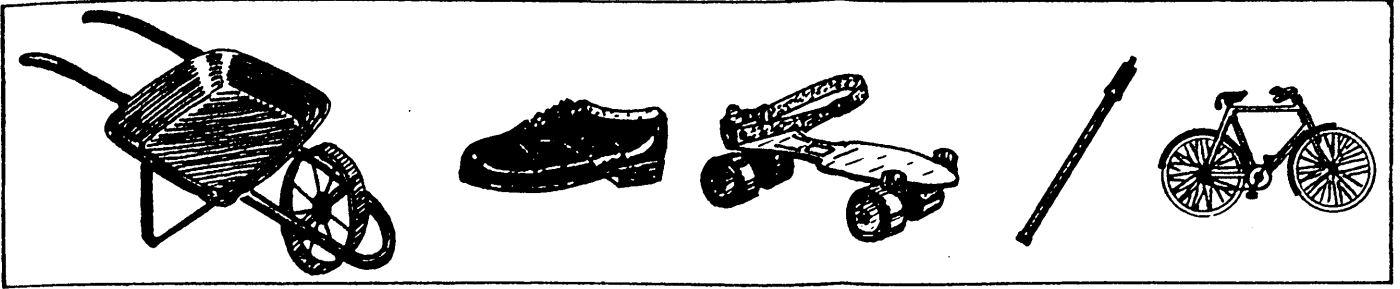
DO NOT TURN OVER

TEST, 12

TEST 3



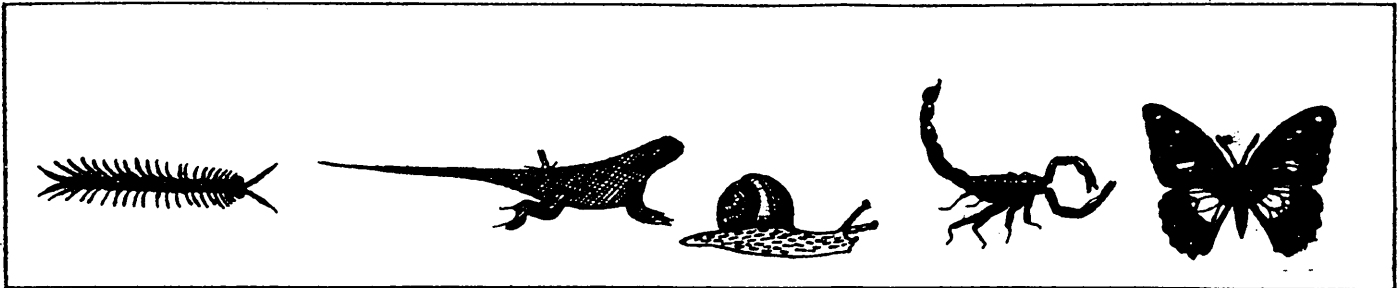
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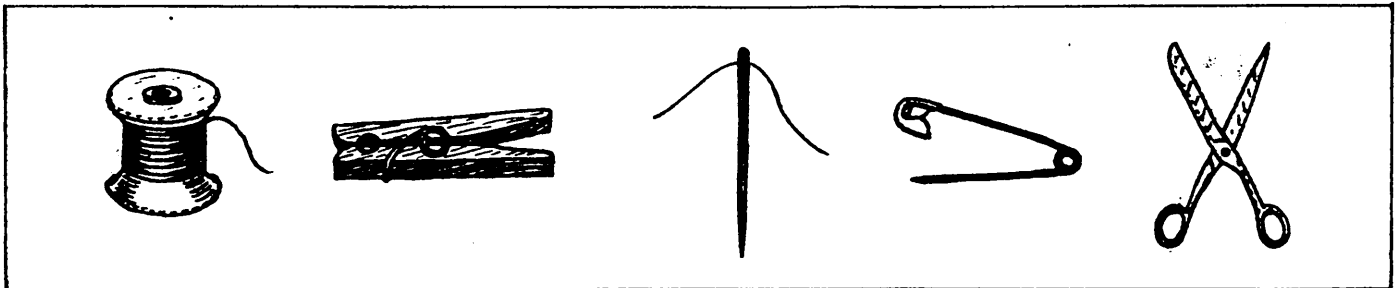
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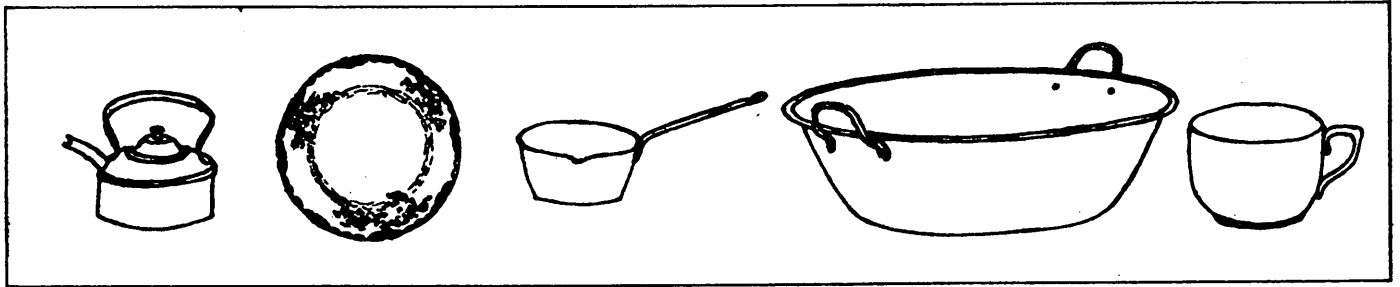
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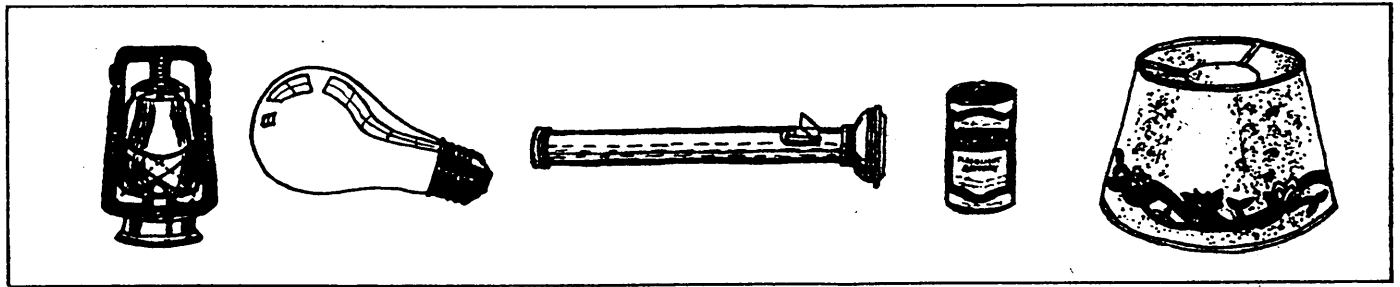
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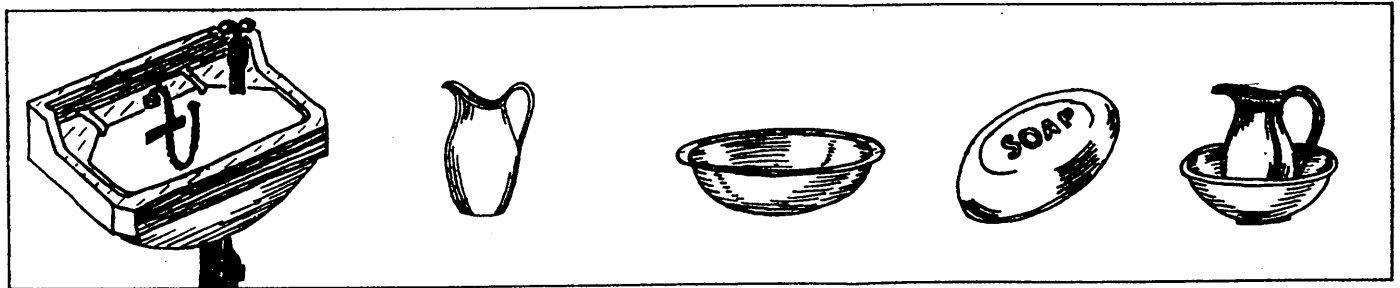
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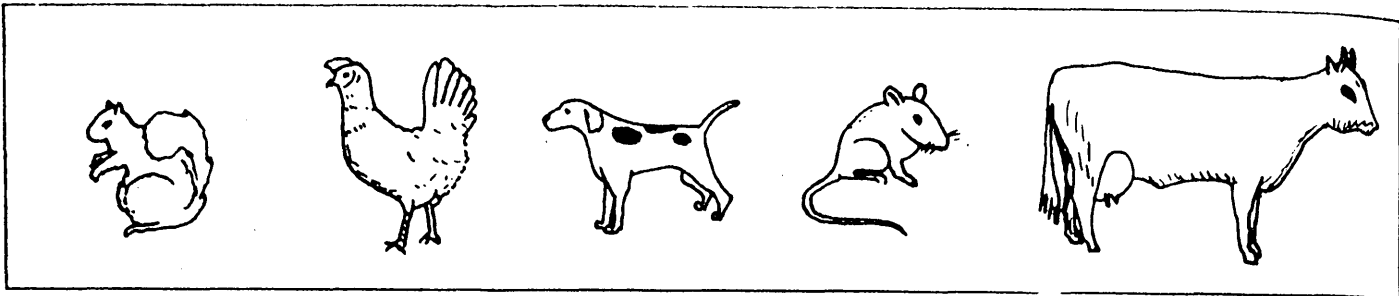


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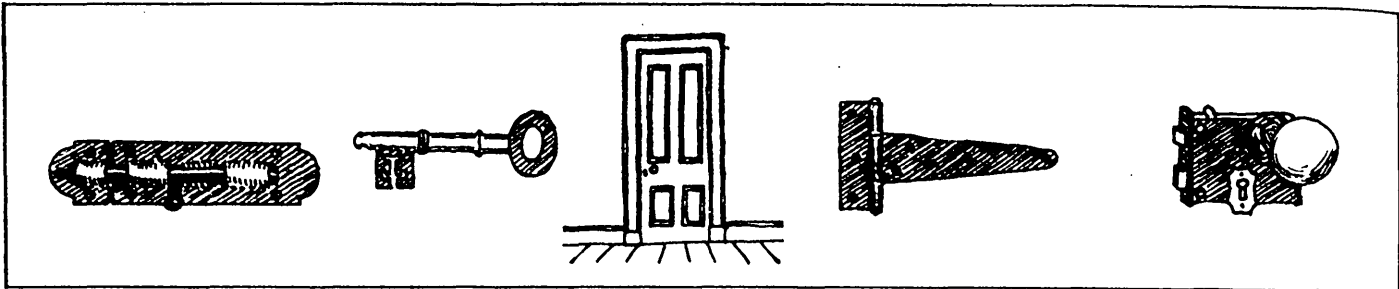


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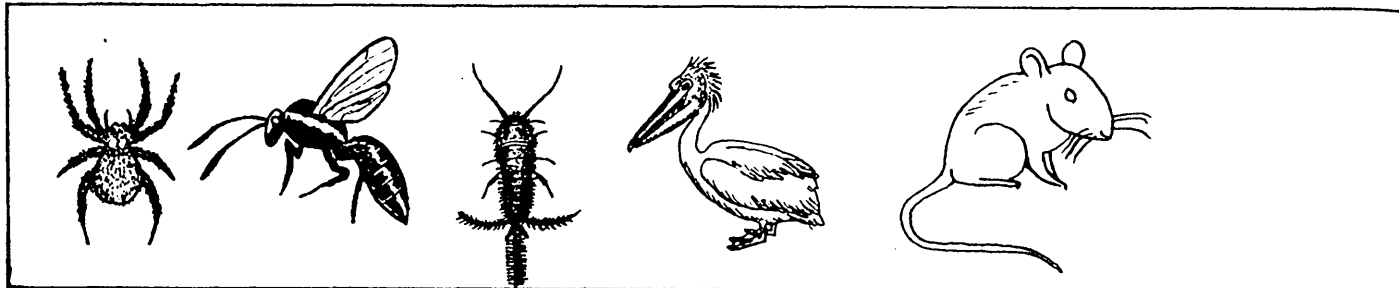
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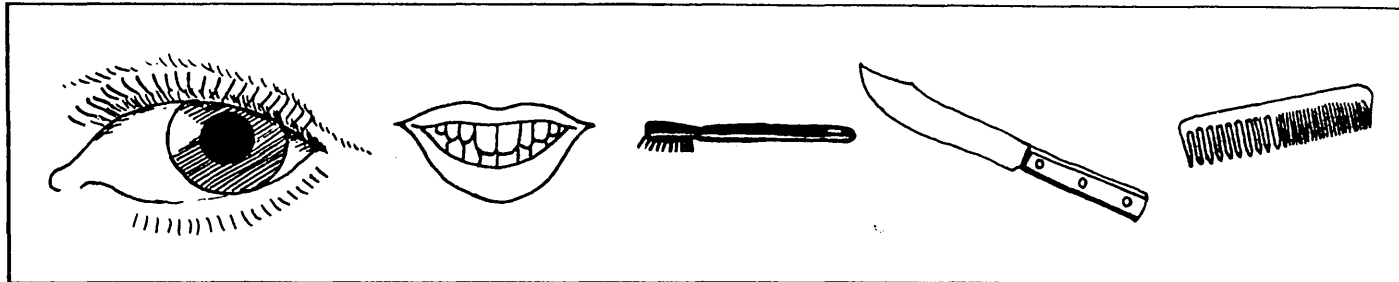
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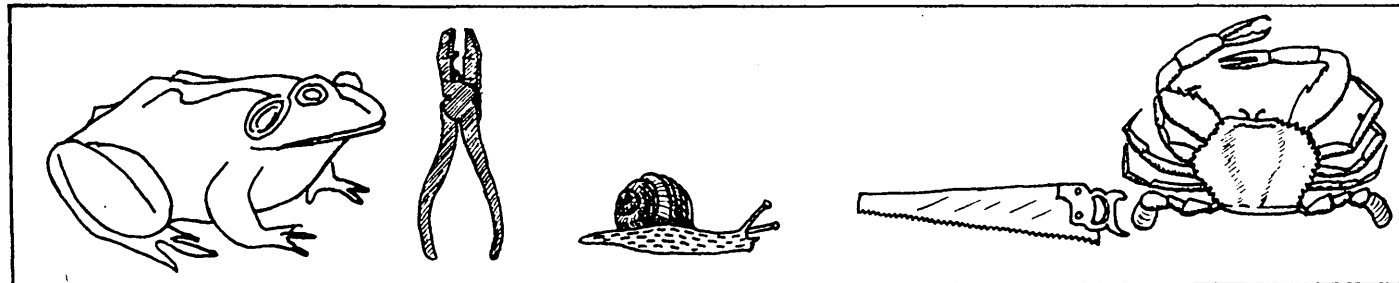
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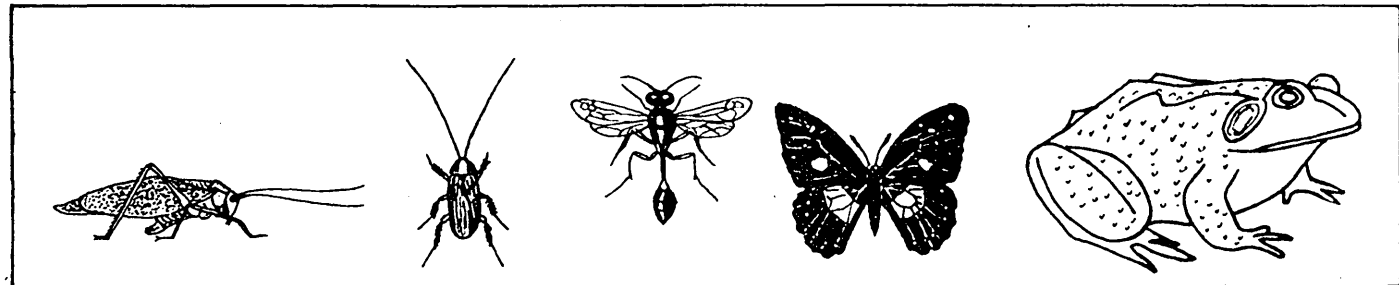
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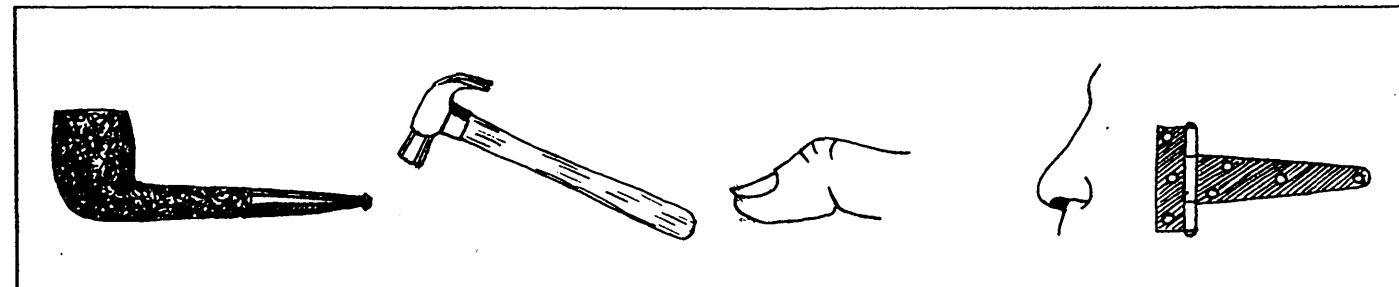
16



17



18



TEST 13. Numerical II. Continuation of Number Series
(37 Items)

and

TEST 14. Numerical I. Arithmetical Restorations
(43 Items)

These two tests were so designed that the attainment in arithmetic required for answering an item correctly should be far less than the ability to do so. In this way it was hoped to test Numerical Ability without its depending on "Schooling".

TEST 13.

The Verbal Instructions were the same as the Instructions on the Test Sheet, but the first item was explained as a practice example.

The test was given to the boys of Q.R.C., and as some of the boys learn Higher Certificate mathematics, the range was from very easy to very difficult indeed. I did not expect any of these boys to obtain full marks, and none did. Though most of the items on the second page were beyond the capabilities of elementary school children, still I saw no point in printing an abridged copy and gave them the whole test, as the probability of guessing a difficult answer correctly is very small. It would be of interest to anyone who doubts whether children guess when they do not know the answer, to see the scripts of this test. A very large proportion of the children went past those items they got right and finished the whole paper giving ridiculous answers, numbers at random and without discernible reason being put in the brackets, none of which happened to be right by guesswork.

Q. R. C. NORMS for Test 13.

Mean Standard Deviation per year group = 6.84

| Age | Score on 37 Items |
|------|-------------------|
| 11.0 | 12.2 |
| 12.0 | 15.5 |
| 13.0 | 18.6 |
| 14.0 | 21.4 |
| 15.0 | 23.2 |
| 16.0 | 24.2 |
| 17.0 | 24.6 |
| 18.0 | 24.6 |

TEST 14. Numerical I. Arithmetical Restorations
(43 Items)

"11 Schools Experiment"

This test was not given to the boys of Q.R.C

The Verbal Instructions were the same as the
Instructions on the Test Sheet.

Quite good scores we-re made in this test and
practically all the children understood what they
had to do. A few of these elementary school children
obtained full marks.

S.S.R. (TRINIDAD) NUMERICAL TEST II

CONTINUATION OF NUMBER SERIES

NAME _____
 Christian names in BLOCK LETTERS _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
 Date _____ Month _____

STANDARD (or FORM) _____ SCHOOL _____

You have to find out what should be the next number in the line and then write it in the brackets at the end of each line.
 Time allowed 40 minutes.

| | | | | | | | | |
|--|---|----|----|----|----|----|----|--------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | () |
| | | 10 | 9 | 8 | 7 | 6 | 5 | () |
| | | | | 1 | 2 | 4 | 8 | () |
| | | 2 | 4 | 6 | 8 | 10 | 12 | () |
| | | | | 3 | 6 | 12 | 24 | 48 () |
| | | 20 | 18 | 16 | 14 | 12 | 10 | () |
| | | | | | 80 | 40 | 20 | 10 () |
| | 0 | 1 | 3 | 6 | 10 | 15 | 21 | 28 () |
| | | | 1 | 4 | 6 | 9 | 11 | 14 () |
| | | | | 20 | 19 | 17 | 14 | 10 () |
| | 1 | 2 | 3 | 6 | 7 | 14 | 15 | 30 () |
| | | | 10 | 18 | 25 | 31 | 36 | 40 () |
| | | | | 1 | 3 | 7 | 15 | 31 () |
| | | | | 40 | 32 | 25 | 19 | 14 () |
| | | | | 2 | 3 | 5 | 9 | 17 () |

| | | | | | | | | | | | |
|----|----|-----|-----|----|----|----|--------|---|----|----|-----|
| 1 | 2 | 5 | 10 | 17 | 26 | 37 | () | | | | |
| | 1 | 2 | 3 | 5 | 8 | 13 | () | | | | |
| | | 50 | 49 | 46 | 41 | 34 | () | | | | |
| | | | 127 | 63 | 31 | 15 | () | | | | |
| 1 | 1 | 2 | 5 | 12 | 27 | 58 | () | | | | |
| | | 1 | 12 | 21 | 28 | 33 | () | | | | |
| | | 0 | 32 | 48 | 56 | 60 | () | | | | |
| | | 50 | 39 | 30 | 23 | 18 | () | | | | |
| | | 2 | 3 | 7 | 16 | 32 | () | | | | |
| | | 1 | 4 | 10 | 22 | 46 | () | | | | |
| 2 | 1 | 1 | 3 | 9 | 23 | 53 | () | | | | |
| | | 100 | 68 | 52 | 44 | 40 | () | | | | |
| | 3 | 4 | 6 | 10 | 18 | 34 | () | | | | |
| 1 | 0 | 0 | 2 | 8 | 22 | 52 | () | | | | |
| | 1 | 2 | 2 | 4 | 8 | 32 | () | | | | |
| | | 1 | 2 | 5 | 14 | 41 | () | | | | |
| | 7 | 13 | 22 | 35 | 54 | 83 | () | | | | |
| | | 2 | 6 | 10 | 18 | 32 | () | | | | |
| | 2 | 4 | 7 | 12 | 21 | 38 | () | | | | |
| 1 | 4 | 8 | 16 | 16 | 32 | 16 | 64 () | | | | |
| | | 16 | 23 | 30 | 35 | 34 | () | | | | |
| 70 | 72 | 75 | 78 | 79 | 74 | 55 | () | | | | |
| 0 | 2 | 1 | 2 | 2 | 3 | 4 | 6 | 9 | 14 | 22 | () |

S.S.R. (TRINIDAD) NUMERICAL TEST I

ARITHMETICAL RESTORATIONS

NAME Christian names in BLOCK LETTERS Surname (Title)

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
Date Month

STANDARD _____
(FORM)

SCHOOL

In these sums some of the figures are missed out. Beneath each figure missed out there is a short line, . On each short line write ONE of the figures (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) to make the sums correct. Work down each column before going on to the next.

Time allowed ~~45~~ ³⁵ minutes.

A D D I T I O N

$$\begin{array}{r} 2483 \\ 5213 \\ \hline 769 \end{array}$$

$$\begin{array}{r} 6 \quad 47 \\ \quad \underline{9} \quad 3 \\ \hline 910 \end{array}$$

$$\begin{array}{r} 3142 \\ 26 \quad 7 \\ \hline 5776 \end{array}$$

$$\begin{array}{r} 23 \quad 4 \\ 3 \quad \underline{1} \quad \underline{\quad} \\ \hline \quad 000 \end{array}$$

$$\begin{array}{r} 4 \quad 23 \\ 3162 \\ \hline 7685 \end{array}$$

$$\begin{array}{r} 3708 \\ 42 \quad \underline{\quad} \quad \underline{\quad} \\ \hline 8 \quad \quad 0 \end{array}$$

$$\begin{array}{r} 2 \quad \quad 7 \\ \quad \underline{361} \\ \hline 689 \end{array}$$

$$\begin{array}{r} \quad 3 \quad 2 \\ \underline{258} \\ \hline 68 \quad 1 \end{array}$$

$$\begin{array}{r} 3482 \\ 1364 \\ \hline 4 \quad 46 \end{array}$$

$$\begin{array}{r} 1001 \\ 3 \quad \underline{\quad} \quad \underline{\quad} \quad \underline{\quad} \\ \hline 5 \quad \quad \quad \end{array}$$

$$\begin{array}{r} 5327 \\ 32 \quad 8 \\ \hline 8585 \end{array}$$

$$\begin{array}{r} 4999 \\ 1 \quad \underline{\quad} \quad \underline{\quad} \quad \underline{\quad} \\ \hline 5 \quad \quad \quad \end{array}$$

$$\begin{array}{r} 648 \quad \underline{\quad} \\ 3 \quad 17 \\ \hline 9702 \end{array}$$

$$\begin{array}{r} 4 \quad \quad 2 \\ 30 \quad 5 \\ \hline 808 \end{array}$$

$$\begin{array}{r} 7 \quad 48 \\ \quad 43 \\ \hline 99 \quad 0 \end{array}$$

$$\begin{array}{r} 4 \quad \quad \underline{\quad} \\ 3 \quad \quad 2 \\ \hline 8988 \end{array}$$

$$\begin{array}{r} 4321 \\ 257 \\ \hline 69 \quad \quad \end{array}$$

S U B T R A C T I O N

$$\begin{array}{r} 7 \quad 84 \\ \quad \underline{36} \\ \hline 52 \quad 3 \end{array}$$

$$\begin{array}{r} 7 \quad 60 \\ \quad \underline{24} \\ \hline 46 \quad 3 \end{array}$$

$$\begin{array}{r} 820 \quad \underline{\quad} \\ 3 \quad 36 \\ \hline \quad 7 \quad 4 \end{array}$$

$$\begin{array}{r} \quad 000 \\ 45 \quad 7 \\ \hline 3 \quad 2 \quad \underline{\quad} \end{array}$$

$$\begin{array}{r} 7 \quad \quad 0 \\ 46 \quad \underline{\quad} \quad \underline{\quad} \\ \hline 2306 \end{array}$$

$$\begin{array}{r} 86 \quad 2 \\ 348 \quad \underline{\quad} \\ \hline \quad 2 \quad 7 \end{array}$$

$$\begin{array}{r} 9 \quad \quad \underline{\quad} \\ 300 \quad \underline{\quad} \quad \underline{\quad} \\ \hline 5 \quad \quad 1 \end{array}$$

$$\begin{array}{r} 398 \quad \underline{\quad} \\ 1 \quad \quad 1 \\ \hline 1 \quad \quad 4 \end{array}$$

$$\begin{array}{r} 8988 \\ 4 \quad \underline{\quad} \quad \underline{\quad} \quad \underline{\quad} \\ \hline 3 \quad \quad 2 \end{array}$$

$$\begin{array}{r} 6 \quad \quad \underline{\quad} \\ 4999 \\ \hline 2 \quad \quad \quad \end{array}$$

M U L T I P L I C A T I O N

$$\begin{array}{r} 3 \quad 14 \\ \quad \underline{\quad} \quad 2 \\ \hline 64 \quad \underline{\quad} \end{array}$$

$$\begin{array}{r} \quad 32 \quad \underline{\quad} \\ \quad \quad 2 \\ \hline 8 \quad 54 \end{array}$$

$$\begin{array}{r} 673 \quad \underline{\quad} \\ \quad \quad 2 \\ \hline 1 \quad 4 \quad 4 \end{array}$$

$$\begin{array}{r} 28 \quad \underline{\quad} \\ \quad \quad 2 \\ \hline \quad 792 \end{array}$$

$$\begin{array}{r} 4 \quad 2 \quad \underline{\quad} \\ \quad \quad 2 \\ \hline 86 \quad 6 \end{array}$$

$$\begin{array}{r} 2 \quad 8 \quad \underline{\quad} \\ \quad \quad 4 \\ \hline 1 \quad 748 \end{array}$$

$$\begin{array}{r} 33 \quad 4 \\ \quad \quad 3 \\ \hline 1 \quad \quad 0 \end{array}$$

$$\begin{array}{r} \quad 77 \quad \underline{\quad} \\ \quad \quad 6 \\ \hline 28 \quad 68 \end{array}$$

$$\begin{array}{r} 6 \quad 3 \quad \underline{\quad} \\ \quad \quad 6 \\ \hline 4 \quad 022 \end{array}$$

$$\begin{array}{r} 5 \quad 5 \quad \underline{5} \\ \quad \quad 8 \\ \hline 404 \quad 0 \end{array}$$

$$\begin{array}{r} 8 \quad 7 \quad \underline{\quad} \\ \quad \quad \underline{\quad} \\ \hline 6 \quad 0 \quad 3 \end{array}$$

$$\begin{array}{r} 7 \quad \quad 6 \\ \quad \quad \underline{\quad} \\ \hline 710 \quad \underline{\quad} \end{array}$$

$$\begin{array}{r} 1 \quad 1 \quad 2 \\ \quad \quad \underline{\quad} \\ \hline 1 \quad 0 \quad 0 \end{array}$$

$$\begin{array}{r} \quad 10 \quad \underline{\quad} \\ \quad \quad \underline{\quad} \\ \hline 2 \quad 65 \quad \underline{\quad} \end{array}$$

$$\begin{array}{r} 7 \quad \quad 6 \\ \quad \quad \underline{\quad} \\ \hline 4 \quad \quad 2 \end{array}$$

$$\begin{array}{r} 184 \quad \underline{\quad} \\ \quad \quad \underline{\quad} \\ \hline 1 \quad 9 \quad 9 \end{array}$$

TEST 15. Arithmetic Test (Mechanical)
 (21 Items) "11 Schools Experiment"
 and

TEST 16. Arithmetic Test (Problems)
 (19 Items) "11 Schools Experiment"

The Verbal Instructions were the same as the
 Instructions on the Test Sheets.

The children were provided with paper for working
 but blank spaces were also in many cases left in the
 question sheet for this. Their papers for working
 were collected, the principal reason for this being
 to discover cheating.

TEST 15

After studying the children's textbooks and talk-
 ing the matter over with one or two experienced tea-
 chers I arranged the series of items in order of diff-
 iculty, so that every child could be expected to
 score something and no child would score full marks.
 In this I was very nearly successful: 5 children
 out of the 575 scored 0 and no child scored full
 marks. The test was not set to the boys of Q.R.C.

TEST 16

My problem here was more difficult. The
 teachers' advice was useless. They seemed to have
 quite exalted ideas about the children's abilities
 in arithmetic, a-nd, from the results obtained here,
 I should say that few would have scored any marks
 on an arithmetic paper one of the teachers prepared
 for me. Nor would this paper have graded the ^{few} chil-
 dren who did succeed in getting marks satisfactorily
 as a child who scored on one question might be expect-
 ed to score on all the rest, given enough time.

The teacher too was hopelessly out in the times to be allotted to the questions. I do not regard tests of attainment as set in Trinidad as good measures of ability. And from my long experience with exam papers set by secondary school teachers and the School Certificate and Higher Certificate examinations, I may say that I have not much regard for them either.

In setting a paper on problems in arithmetic one is up against a problem oneself. A problem, to be a problem, should not have been done before. Nor should its like have been done. This means that one should not go to one of the children's textbooks at all unless it is to see what to avoid.

In the paper given here I have not been able to obey these restrictions, and the results show that the test was too hard.

S.S.R. (TRINIDAD) ARITHMETIC TEST (Mechanical)

NAME Christian names in BLOCK LETTERS Surname (Title) _____
 AGE LAST BIRTHDAY _____ years DATE OF BIRTHDAY _____
 STANDARD _____ SCHOOL _____
 Date _____ Month _____

You will be allowed 40 minutes for this test, including filling in the above. Save time and do not copy out those questions, for example Question 1., which are marked with an asterisk *, where spaces are left blank on this sheet for working. Do the working for the other questions on the blank sheet given you, but write all answers down on this sheet where it says "Ans." One mark for each answer quite correct and written in the proper place on this sheet. No marks for a wrong answer or one not written in the proper place. When you have finished look over your work.

1* Multiplication
$$\begin{array}{r} 843 \\ \times 79 \\ \hline \end{array}$$

Ans = _____

2* Division
$$\begin{array}{r} 41 \overline{)1476} \\ \underline{164} \\ 226 \\ \underline{226} \\ 0 \end{array}$$

3* $5\frac{3}{4} + 2\frac{1}{3} =$ _____ Ans

4* Addition
$$\begin{array}{r} 475.09 \\ + 264.22 \\ \hline \end{array}$$

Ans = _____

5* Express as a decimal fraction $\frac{63}{90} =$ _____ Ans

6* Express as a vulgar fraction $2\frac{2}{3} \div 4\frac{4}{5}$

Ans = _____

7. Find the average of 27, 35, 40 Ans = _____

8. Multiply 23.4 by 12.11
Ans = _____

9. Divide .3003 by 4.2
Ans = _____

10* 23% of \$30.00 = \$ _____ Ans

11. Twelve men earn \$360. What will 21 men earn?
Ans = \$ _____

12. Simplify $6 \times 5 - 4 \times (3 + 2)$
Ans = _____

13. Find the simple interest on \$120 for 4 years at $4\frac{1}{2}\%$
Ans = \$ _____

14. Find the L.C.M. of 28, 30, 35
Ans = _____

15. Simplify $\frac{3}{4} - \frac{1}{8} \div \frac{7}{13}$ of $\frac{5}{12}$
 $\frac{2}{5} + \frac{5}{7} \div \frac{2}{3} - \frac{2}{5}$ of $\frac{5}{6}$
Ans = _____

16. If 4 men can reap 10 acres in 30 days, working 6 hours per day, how many days will it take 7 men to reap 28 acres, working 8 hours per day?
Ans = _____

17. Find by factorizing the square root of 1764
Ans = _____

18* Find the square root of 76 correct to one decimal place

$$\begin{array}{r} \underline{)76} \\ \underline{76} \\ 0 \end{array}$$
 Ans = _____

19. Solve $x + \frac{x}{5} = 18$
Ans = _____

20. What yearly income would be derived from investing \$2610 in 3% stock at 87?
Ans = £ _____

21. Find the compound interest on \$300 at 10% for 3 years, the interest being compounded annually.
Ans = \$ _____

S.S.R. (TRINIDAD) ARITHMETIC TEST (Problems)

NAME _____
 Christian names in BLOCK LETTERS _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
 Date _____ Month _____

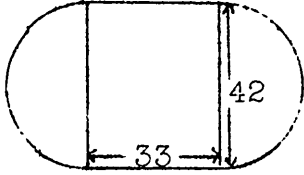
STANDARD _____ SCHOOL _____

TIME ALLOWED : 40 Minutes including filling up this cover and reading these instructions.

INSTRUCTIONS.

Do not waste time over any one question if you find it difficult but go on with the next. Do the working on the blank sheet given you, but write all answers down on this sheet where it says "Ans." One mark for each answer quite correct and written in the proper place on this sheet. No marks for a wrong answer or one not written in the proper place. If you have finished all you can do before time is up, look over your work to see that you have made no careless mistakes.

1. How many pencils at 3¢ can I buy for a shilling? Ans _____
2. Jane had twice as much money as Dick. Dick had 10¢ more than Harry. Harry had 50¢. How much did they have altogether? Ans \$ _____ ¢
3. Butter is 74¢ per pound. If I bought 4 pounds how much change should I get from a \$5.00 note? Ans \$ _____
4. In a class of 50 children 14% were boys. How many girls were there? Ans _____
5. I had 26 oranges. I gave 6 to Mary and divided what remained equally between John, Dick, Harry and George. How many oranges did I give to George? Ans _____
6. A room is twice as long as it is wide. It measures 24 yards all round. What is its area? Ans _____ sq. yds
7. How many tiles 5" x 3" are required for a square court each side of which measures 20 feet? Ans _____
8. If a man gains 20% by selling eggs at \$1.08 per dozen, how much % would he gain by selling them at \$9.75 per hundred? Ans _____ ¹⁰
9. My father is 36 years old and my age is 12. In how many years time will my father's age be twice mine? Ans _____ yrs

10. A cistern can be filled from 2 taps connected to different water supplies. The water from one tap can fill the empty cistern in 10 minutes. The water from the other tap can fill the empty cistern in 15 minutes. How long will it take both taps turned on together to fill the empty cistern? Ans mins.
11. If \$44 is paid for 3 goats and 2 pigs and \$41 is paid for 2 goats and 3 pigs, what is the price of a pig? Ans \$
12. A bottle and a cork cost $2\frac{1}{2}$ d. The bottle costs 2d more than the cork. How much does the cork cost? Ans d.
13. In a school $\frac{2}{3}$ of the scholars are girls and the rest are boys. If $\frac{2}{9}$ of the girls and $\frac{1}{4}$ of the boys are absent, what fraction of the whole number of scholars is present? Ans
14. The diagram shows the ground plan of a circus tent, dimensions being given in yards. What area does the tent cover?
(Take $\pi = \frac{22}{7}$)
- 
- Ans sq.yds
15. The average of nineteen results is 16 that of the first nine is 18, and of the last nine is 13. Find the tenth result. Ans
16. Two cyclists each cycling at the rate of 10 m.p.h. are approaching each other. When they are a mile apart a fly which has settled on the nose of one of them flies off at the rate of 20 m.p.h. and settles on the nose of the other cyclist. It immediately flies off again at the same rate and settles on the nose of the first cyclist again. It keeps on doing this, always flying at the rate of 20 m.p.h. and settling for an instant on the noses of each cyclist in turn. How far does the fly travel before the cyclists meet? Ans
17. A bottle contains a 32% solution of sugar. Half is thrown away and the bottle filled with water. This is done three more times. After the fourth time what is the percentage of sugar in the bottle? Ans %
18. If I walk from A to B at 5 m.p.h. and back again to A at 3 m.p.h., what has been my average speed? Ans m.p.h.
19. At what time between 3 o'clock and 4 o'clock are the hands of a clock exactly over one another? Ans mins.
 past 3 o'clock

TEST 17. Verbal Test I. Synonyms. (49 Items)

This test was designed for Q.R.C but I have not had an opportunity of setting it to them yet.

As the chance of guessing right was small the unabridged test was given to the elementary schools.

No Verbal Instructions were given.

A dictionary and Roget's Thesaurus were largely used for constructing this test which is mostly a vocabulary test. It is to be noted that the words in a line are none of them very different and considerable judgment must be used to underline the correct two words. A draft was made and copies circulated to, Mr. J. A. Wharton, a barrister; Mr. R. M. Hamer, Principal of Q.R.C., and Dr. B. Hamilton, a novelist and English master at Harrison's College, Barbados. They were requested to do the test. I discarded those items where there was not agreement between the four of us.

S.S.R. (TRINIDAD) V E R B A L T E S T I. (SYNONYMS)

NAME _____
 Christian names in BLOCK LETTERS _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTH _____
 Date _____ Month _____

STANDARD _____ SCHOOL _____

TIME ALLOWED : 45 MINUTES

INSTRUCTIONS.

You are to underline the TWO words in each line which have nearly the same meaning as each other. The first two are given as examples.

Young, Little, Pretty, Good, Soft, Small.

Large, Square, Tall, Round, Great, Long.

1. Truthful, Good, Polite, Pretty, Hard-working, Beautiful.
2. Polite, Pretty, Tidy, Clean, Neat, Smart.
3. Loud, Bad, Noisy, Mad, Playful, Strong.
4. Good, Rich, Wealthy, Large, Important, Strong.
5. Pleasant, Funny, Merry, Cheerful, Comic, Smart.
6. Right, Humble, Good, Handsome, Good-Looking, Polite.
7. Brave, Strong, Adventurous, Courageous, Severe, Rash.
8. Poor, Begging, Owing, Ragged, Miserable, Penniless.
9. Swampy, Soft, Moist, Slippery, Rainy, Damp.
10. Dishonest, Cruel, Bad, Wicked, Selfish, Cross.
11. Lazy, Stupid, Tired, Foolish, Dishonest, Bad.
12. Interesting, Peaceful, Humorous, Courteous, Intelligent, Brainy.
13. Ragged, Black, Dirty, Greasy, Soiled, Crumpled.
14. Idle, Drowsy, Lazy, Stupid, Still, Thoughtless.
15. Hard-working, Good, Clever, Truthful, Brave, Skilful.
16. Real, Good, Likely, Right, Correct, Certain.
17. Low, Short, Small, Shallow, Brief, Minute.
18. High, Long, Deep, Large, Broad, Tall.
19. Soft, Tired, Weak, Feeble, Lame, Ill.

TURN OVER.

20. Oval, Wavy, Spiral, Round, Hollow, Circular.
21. Active, Agile, Fast, Alert, Keen, Swift.
22. Good, Courteous, Polite, Mild, Fair, Friendly.
23. Probable, Hopeful, Reasonable, Possible, Likely, Certain.
24. Grumpy, Angry, Indignant, Glum, Unforgiving, Hasty.
25. Difficult, Laborious, Annoying, Complicated, Impossible, Hard.
26. Dishonest, Untruthful, Cunning, Sly, Untrustworthy, Criminal.
27. Determined, Obstinate, Unyielding, Persevering, Hard, Stubborn.
28. Steep, Vertical, Curved, Sloping, Slant, Crooked.
29. Careful, Tidy, Thoughtful, Alert, Cautious, Slow.
30. Quick, Strong, Energetic, Keen, Active, Industrious.
31. Wet, Tender, Juicy, Slimy, Soft, Pulpy.
32. Hideous, Plain, Frightful, Foul, Coarse, Awkward.
33. Impatient, Mad, Upset, Fierce, Dangerous, Perilous.
34. Bright, Smooth, Shiny, Polished, Clear, Glossy.
35. Impossible, Absurd, Ridiculous, Unlikely, Wrong, Uncertain.
36. False, Dishonest, Insincere, Untruthful, Faithless, Unfair.
37. Loyal, Truthful, Friendly, Patriotic, Faithful, Trustworthy.
38. Joyful, Triumphant, Fortunate, Prosperous, Successful, Lucky.
39. Kindly, Charitable, Generous, Wasteful, Extravagant, Hospitable.
40. Gaudy, Dowdy, Tawdry, Vulgar, Odd, Uncouth.
41. Conventional, Continual, Occasional, Usual, Frequent, Ordinary.
42. Proud, Insolent, Boastful, Vain, Pompous, Haughty.
43. Exemplary, Creditable, Laudable, Commendable, Dutiful, Admirable.
44. Clever, Wise, Intellectual, Erudite, Sagacious, Studious.
45. Ambiguous, Mysterious, Circuitous, Illogical, Inconceivable, Indirect.
46. Distinctive, Evident, Definite, Obvious, Distinct, Recognisable.
47. Restive, Disobedient, Lawless, Insurgent, Mutinous, Insubordinate.
48. Paradoxical, Enigmatic, Unauthentic, Conjectural, Disputable, Hypothetical.
49. Contemptuous, Humptious, Cynical, Critical, Ironical, Disdainful.

TEST 18. Verbal Test II. Proverbs (Story) (38 Items)

"11 Schools Experiment"

This was designed to test Reading Comprehension.

Though the use of proverbs in mental tests is not new, I believe this way of using them is.

First of all I constructed a Multiple Choice Proverbs test of 62 items in each of which a proverb is given, followed by 5 sentences one of which expresses the meaning of the proverb, but none of which, to a child, would be ruled out as absurd at first glance. This is an example:

25. BETWEEN THE DEVIL AND THE DEEP SEA

Out of the frying pan into the fire - - - - - ()
 Dont fall between two stools - - - - - ()
 Of two evils choose the less - - - - - ()
 Every choice is bad - - - - - ()
 Where bad's the best naughty must be the choice - - ()

The child was to put an (R) into the brackets to indicate his choice.

But having made a long list of proverbs the neater and more interesting way of using them given here occurred to me. It also has the advantage of offering so many choices that guessing is greatly reduced, but perhaps the greatest advantage is that a situation is built up to which a proverb will apply. Reading comprehension is required for this as well as for the selection of the applicable proverb.

A simple 3 page story was written about a boy who bought a bicycle, had it stolen from him at school, recovered it, and his doings at school. Opposite each page of the story were printed about 17 numbered proverbs (the meaning of the word is explained in the story). During the course of the story there are blanks for the filling in of the number of the proverb appropriate to the situation built up. Scarcely any of the proverbs would be familiar to the children.

S. S. R. (TRINIDAD) VERBAL TEST II
 PROVERBS (Story)

NAME Christian names in BLOCK LETTERS Surname (Title)

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
 Date Month

STANDARD _____ SCHOOL _____

TIME ALLOWED : 50 Minutes including
 filling up this cover and reading
 the following :-

A proverb is a wise saying. Its real meaning need not only have to do with the things said in it, but if its real meaning is understood it can be used for many of the things which happen to us every day. For example, the Proverb "Kill not the goose that lays the golden eggs." need have nothing to do with a goose or eggs at all. it means "Do not destroy what brings you good." Again, the proverb "New brooms sweep clean." need have nothing to do with brooms. It means that just as a new broom does its sweeping well, so a new servant works well at first.

When you have filled in the details asked for and read the above carefully, open the book and go on with the test.

RAW SCORE ON 39 ITEMS _____

" " " " _____

LIST OF PROVERBS FOR THE OPPOSITE PAGE ONLY

You will not need to use all the proverbs on this page. If you wish to use the same proverb twice you may do so.

1. A fool and his money are soon parted.
2. Do not count your chickens before they are hatched.
3. Half a loaf is better than no bread.
4. A friend in need is a friend indeed.
5. All is not gold that glisters.
6. Look after the pence and the pounds will look after themselves.
7. Its no use locking the stable door when the horse is stolen.
8. A bird in the hand is worth two in the bush.
9. The early bird catches the worm.
10. Honesty is the best policy.
11. He knows which side his bread is buttered.
12. A sorrow shared is half a trouble,
A joy shared is a joy made double.
13. Kill not the goose that lays the golden eggs.
14. A young idler, an old beggar.
15. Cheapest is dearest.

TELLING TALES OUT OF SCHOOL

My father borrowed a book from the library with many proverbs in it. Proverbs are wise sayings, and he gave it me to read. I like them a lot and tried to learn a number of them by heart. Some of them are printed on the opposite page. After reading the proverbs one night I became rather sleepy and went to bed and began thinking of the bicycle I wanted to buy, which I had seen at the shop. It was a nice bicycle and I felt that another boy might buy it before me if I did not get up early. I was thinking, I expect, of the proverb 9 which you see on the page opposite. (Look there and you see "9. The early bird catches the worm"). I had saved up some money, small change at a time, just as the proverb ___ says one should do. (Find the most suitable proverb on the page opposite and put its number on the line. Write the correct number on all the little lines in this story. The proverbs for each page are on the opposite page to the one you are reading). I got up early and when I reached the shop I saw another bicycle as well as the one I had seen before. This one was much better, but more expensive. But after thinking some time I remembered the proverb ___ and bought the better one. I didn't pay for the bike before getting the man in the shop to let me try it out, because it might have had something the matter with it, and I should have lost my money, as in proverb ___. The shop-keeper allowed me to do this and knew I should not make away with the bicycle because he knows my father well and gets a lot of business from him and knows who he can look to for help when he needs it, just as with the proverb ___. Well I paid the man and joyfully made off on my new bike.

When I got to school on my bike I left it in the school yard and went into the classroom deciding to work a bit harder than usual as I didn't wish to end my days living on charity. (Proverb ___). When I came out of school, to my horror, I found the bike was not where I had left it, and I bitterly regretted not buying a chain for it. It was no use buying a chain now. (Proverb ___). I told my best friend about what had happened, for Proverb ___. He didn't just say he was sorry but at once offered to help. (Proverb ___). He lent me

LIST OF PROVERBS FOR PAGE 2 ONLY

You will not need to use all the proverbs on this page. If you wish to use the same proverb twice you may do so.

16. More haste less speed.
17. He that will steal an egg will steal an ox.
18. Little sense in the head makes much work for the feet.
19. Better late than never.
20. It takes two to make a quarrel.
21. His bark is worse than his bite.
22. Never put off till tomorrow what you can do today.
23. Might is right.
24. If a donkey brays at you dont bray at him.
25. Once bitten twice shy.
26. Learn wisdom from other's follies.
27. Everybody is wise after the event.
28. Out of sight out of mind.
29. Neither a lender nor a borrower be, for loan both loses itself and friend.
30. He that does you an ill never forgives you.

his racing bicycle. We were such close friends that we had no need to pay attention to the proverb ____.

The school is at the end of a road, so that I thought If I cycled fast I might catch up with the thief. And, sure enough, I did after going about half a mile. I knew the boy. He had stolen things before, but only small things, still Proverb ____ . The boy stopped and at first tried to frighten me by shouting loudly that he wanted to fight me. But I knew that he was no good at fighting. (Proverb ____), and I was not afraid. As I had got the bike back everything seemed to be all right, for Proverb ____ .

I then had to wheel both bicycles back home. I thought of riding mine and wheeling the other to be quicker, but decided that as this might make me fall off and hinder me more, I would wheel both along, walking. (Proverb ____). As I started off the boy shouted things at me but I didn't shout back as (Proverb ____). When I got home my father said I had been very stupid not to buy a chain. This advice was easy to give, but I was too polite to remind him of the proverb ____ . My mother said I was very late and I am afraid I did tell her proverb ____.

After lunch I rode my friend's bicycle round to him and, after thanking him for lending it I told him how I had got my bike back. He said that he would go and buy a chain for his bike seeing what had happened to mine. He was doing what proverb ____ says. The cycle shop was a little out of my way but I thought I would walk round to it and buy the lock and chain at once, and not put off doing this until some other time, as the proverb ____ tells one. Yet it would have saved me time and trouble if I had only thought a moment and gone home first and cycled to the shop. This was just like the proverb ____ . When I got home I had to hurry to get to school in time, and this time I locked the bike up. I had had it stolen once, but never again. (Proverb ____).

When I got to the classroom and settled down to my lessons I forgot all about my bicycle and what had happened, just like proverb ____ , until I found the very boy who had stolen the bike hitting me from behind. He could have nothing against me, but I remembered the proverb ____ .

LIST OF PROVERBS FOR PAGE 3 ONLY

You will not need to use all the proverbs on this page. If you wish to use the same proverb twice you may do so.

31. His heart was in his boots.
32. You can take a horse to the water but you cant make it drink.
33. Spare the rod and spoil the child.
34. To give a dog a bad name and hang him.
35. You must not expect old heads on young shoulders.
36. What is sauce for the goose is sauce for the gander.
37. Two heads are better than one.
38. Early to bed and early to rise makes a man healthy wealthy and wise.
39. That is well spoken is well taken.
40. You cant make a silk purse out of a sow's ear.
41. Many bring the rake but few the shovel.
42. Give a fool enough rope and he will hang himself.
43. Do not wear out your welcome.
44. One is not so soon healed as hurt.
45. To cry out before you are hurt.
46. No one knows where the shoe pinches but he who wears it.
47. Between the devil and the deep sea.
48. Little is done when everyone is master.
49. Never hit a man when he is down.
50. A drowning man will clutch at a straw.

If I turned round to hit him back I might be seen by the teacher and if I didn't I should go on getting hit. I was like the proverb ___. I thought of the proverb ___ and made up my mind to take no notice of the boy and let the teacher catch him. It was not long before the teacher did see him. When the teacher called him out to cane him I could see by the boy's face that he had lost his courage, or, as the proverb says ___. He started making excuses to the teacher for, (Proverb ___). But in spite of the teacher seeming not to like what he was saying and, not heeding the proverb ___, he went on talking. But when he saw it was no further use he started to bawl, like proverb ___. But the teacher is a very fair man and treats us all alike. (Proverb___). He believes in using the cane where necessary and when he thinks it is good for us. (Proverb ___). A caning takes such a short time to give but you feel it a long time after, as the proverb ___ says. I was sorry for the boy, though he knew best how he felt, as the proverb ___ says. I like the teacher for not giving the boy a talking to, after he had caned him. He knows the proverb ___ I expect. On the whole the teacher does fairly well with most of us. There are some, though, who are too bad for much to be done with them. (Proverb ___). And some are given a lot of extra teaching but won't learn. (Proverb ___).

After school we had to get the classroom ready for a concert which some people were giving that night. The chief difficulty was to get boys to move the heavy desks and benches, plenty offered to carry the light things. This was just as in proverb ___. We started by ourselves, but some thought the desks should go here and others there until our head-teacher arrived. (Proverb ___). However, later he called in the Assistant Teacher to discuss where the desks should go, for he realised that Proverb ___.

I had a good tea and my friend and I went out for a ride. I invited him back to dinner with us, and showed him the book of proverbs. When he read proverb ___ he said he must be going. I was sorry he went, but I got to bed early and got up early the next day all the fresher. (Proverb ___). Proverbs are always true.

TEST 19. English

(76 Items)

"11 Schools Experiment"

This was designed as a test of attainment.

I was misled in setting the second question on Naming Clauses, for very few indeed of the children could score appreciably in this.

The third question which consists of a letter written in the local dialect was composed with the assistance of my staff. Any alternative which made good or even colloquial English was accepted. I did all the marking for this myself. The "Rights" for this question were divided by 3.

I intend to try and get this third question 'translated' into other West Indian dialects and into African dialects as well if I can.

TEST, 19

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S. S. R. (TRINIDAD) ENGLISH TEST

NAME _____
Christian names in BLOCK LETTERS _____ Surname (Title) _____

AGE LAST BIRTHDAY _____ years

DATE OF BIRTHDAY _____
Date _____ Month _____

Standard _____ SCHOOL _____

TIME ALLOWED : ONE HOUR : 15 MINS.
including filling up this cover.

| | |
|-------------------------------------|-------|
| RAW SCORE ON NAMING PARTS OF SPEECH | _____ |
| " " " " CLAUSES | _____ |
| " " " CORRECTING MISTAKES ÷ 3= | _____ |
| " " " TOTAL | _____ |

NAMING PARTS OF SPEECH

Put into the brackets at the ends of the sentences the names of the Parts of Speech of the words underlined. Do not write the whole of the name of the Part of Speech but:

| | | | |
|------------|----------------|-------|----------|
| Instead of | noun | write | (n) |
| " | " verb | " | (v) |
| " | " pronoun | " | (pron) |
| " | " adjective | " | (adj) |
| " | " adverb | " | (adv) |
| " | " preposition | " | (prep) |
| " | " conjunction | " | (conj) |
| " | " interjection | " | (int) |

- | | | | |
|---|-----|--|-----|
| <u>Close</u> the door. | () | <u>That</u> man is good. | () |
| He has <u>enough</u> bread. | () | He did it <u>only</u> for me | () |
| He learns quickly <u>for</u> he is clever. | () | I want to <u>better</u> myself | () |
| He went <u>past</u> me. | () | He fell on his <u>back</u> . | () |
| I should like to have stayed <u>only</u> I had to go. | () | I have had <u>enough</u> . | () |
| He is a <u>close</u> friend. | () | I took the <u>only</u> choice. | () |
| He knew it all the <u>while</u> . | () | The sea is <u>calm</u> . | () |
| The procession went <u>past</u> . | () | You can do it <u>better</u> than I. | () |
| I know <u>that</u> he is clever. | () | <u>They</u> say it will be fine tomorrow. | () |
| This is the man <u>whom</u> I saw yesterday. | () | The day is <u>past</u> . | () |
| Stand <u>close</u> to me. | () | <u>What</u> did you say? | () |
| The cake is cooked <u>enough</u> . | () | He is <u>better</u> than you. | () |
| He did it <u>for</u> me. | () | That is <u>what</u> I meant. | () |
| Give that <u>back</u> to me. | () | <u>Calm</u> yourself. | () |
| He did it <u>while</u> I waited. | () | <u>Who</u> did this? | () |
| A <u>calm</u> comes before a storm | () | The gambler wants to <u>back</u> a horse in the race. | () |
| <u>What</u> a steep hill! | () | The man <u>that</u> went up the ladder will come down. | () |

NAMING CLAUSES

Here is a list of the names of 14 clauses, each with a number:

| <u>Noun Clauses</u> | | <u>Adverbial Clauses</u> |
|--------------------------|----------------------|--------------------------|
| 1. Subject to verb | 6. Adjectival clause | 7. Reason or cause |
| 2. Object to verb | | 8. Result or effect |
| 3. Object to preposition | | 9. Purpose |
| 4. Complement to verb | | 10. Condition |
| 5. In apposition to noun | | 11. Contrast |
| | | 12. Comparison |
| | | 13. Time |
| | | 14. Place |

The clauses underlined in the following sentences are of the kinds given in the above list. In each sentence you are to find out the kind of the clause which is underlined and to find its name on the list. Put the number corresponding to the clause into the brackets at the end of each sentence. For example :

This is the book which I read. (6)

"which I read" is an Adjectival Clause. Find Adjectival Clause on the list, its number is 6, so a 6 is put into the brackets in this case.

He will be clever if he works hard. ()

He worked hard so that he became clever. ()

We know that he is clever. ()

The statement that he is clever is true. ()

He is clever because he works hard. ()

He works as well as he can. ()

He works where he can. ()

That he is clever is well known. ()

They can do well if they try. ()

He is clever in what he does. ()

The man who works hard is clever. ()

They know that he works well. ()

He is clever although he does not work hard. ()

He worked hard so that he might be clever. ()

He can do it because he is clever. ()

He works well when he tries. ()

He is what is called clever. ()

He knows what to do. ()

CORRECTING MISTAKES

Here is a letter written by Carlton to John. It has many mistakes of spelling and grammar in it. Each mistake is underlined, and there are brackets above the wrong words. You are to correct the English by writing in the brackets the words Carlton should have written. You need not always write the same number of words as those underlined. For instance look at the first line of the second paragraph; "did go" should be "went", so "went" has been printed in the brackets as an example to show you what you are required to do.

() () ()
149, st. vincent ST.
()
belmont.

10th., Sept., 1948.

() ()
dear john,

()
I did studying you all the time, but I din't have time to
()
drop you a line quicker.

(went) ()
The other day we did go up Manzanilla and I had to go barefoot
() () ()
for they sack me father where he did working, and we dont have plenty
()
money again.

() () ()
When we did meet up there a fellow did get drunk and take
() () () ()
he own knife and give heself a big cut like as if he did mad, and the
() () () () ()
balance of the people run out of the bus, and a mister go and bring
() () () () ()
a police as he was the onliest body to cool him down. When the police
() () () ()
did come he hold George pretty shirt and tug him out of the bus, but
() () () () ()
George brother start to say, "Let go him. And too besides, is the
()
next man that is drunk".

() () () ()
When you see Clyde tell he that I lend his belt from he and
() () () ()
I go bring it for he on sunday for I does be feeling tired during the
week.

() () ()
 I has a big crab I did get there and my mother tell me she
 () ()
go cook it for we next Sunday.

() () ()
 I did get the message that you did give me brother to
 () ()
bring come give me, so I did fix up everything for I knew you would
 () () () ()
 be vex if I din't done as you did tell me. If you could come in
 () () () ()
 town Satooday we would finish talk about the thing we did talk about
 when you did come by me, for I am still studying it plenty.

()
Yours truly friend,

()
carlton

ANALYSIS OF RESULTS OF THE "11 SCHOOLS EXPERIMENT"

Before this analysis is presented it should be strongly emphasized that no attempt has been made in this investigation to determine superiority in mental ability between the sexes or races. It is not claimed that the samples of children chosen are representative of the World's Negroes and Indians, and I do not believe it would be possible to select such samples. I have been concerned with the problem of determining the factors involved in the mental processes used in the performance of the tests. Where sex or race differences are mentioned these are qualitative differences in mental form. A Negro boy, a Negro girl or an Indian boy may all three score the same in a test but it does not follow that each adopts the same methods of reasoning. It is these differences which are investigated here.

It should be noted also that the possession of a "factor" does not imply necessarily superiority or inferiority to those not possessing it. A factor indicates variability in one performance linked with variability in another. If one group possessed a disability (ability) varying from individual to individual manifesting itself in some of the tests, a factor might emerge which would not be found in the group without this disability (ability)

THE TESTS CORES

After correcting the scripts of the children of a school the following information was entered in the mark book: Reference Number of the School (I - XI), Name of School, Standards tested, Dates of testing, Surname of each child, Initials, Age at time of test as given by the child on his script and as entered in the school register, Standard, Racial

composition, Sex, Raw Scores in Moray House Junior Intelligence Test and in the 19 tests of the battery (a "c" indicating that cheating had taken place).

Also to each child was assigned a reference number.

For each test frequency distributions of the Raw Scores were made, without grouping, for each school separately, and, by adding these, grand frequency distributions were obtained for each test. Table I gives some idea of the distributions of Raw Scores:

TABLE I

| Test No. | Maximum score obtainable | Mode |
|------------|--------------------------|----------------------|
| M.H.J.I.T. | 100 | Roughly Rectangular |
| 1 | 14 | 12 & 2 $\frac{1}{2}$ |
| 2 | 29 | 13 |
| 3 | 25 | 17 |
| 4 | 15 | 11 |
| 5 | 42 | 23 |
| 6 | 100 | 65 |
| 7 | 100 | 60 |
| 8 | 100 | 7 |
| 9 | 23 | 9 |
| 10 | 16 | 10 |
| 11 | 10 | 4 |
| 12 | 18 | 6 |
| 13 | 38 | 6 |
| 14 | 43 | 20 |
| 15 | 21 | 9 |
| 16 | 19 | 4 |
| 17 | 49 | 12 |
| 18 | 38 | 7 |
| 19 | 76 | 28 |

The distribution for Test 8 was very skewed.

From the mode at 7, up, there was a gradual trailing off of scores, one child obtaining 87 and 30 over 59.

It seems as if even with the instructions modified, most of the children did not grasp what the test was

about, but that when they did they could give an adequate performance. The assumption is made in

all Mental Tests that the ability concerned is

distributed normally, that the Raw Scores them-

selves simply serve to place the children in order

of merit (See Multiple Factor Analysis, Thurstone,

pp. 367 - 368). Indeed this is tacitly assumed

whenever linear correlation coefficients are calculated. A bivariate normal distribution has linear regression lines, so has a bivariate Poissonian distribution (See Statistical Mathematics, A. C. Aitken, pg. 95), but two unlike distributions would in general lead to curved regression lines and no linear correlation coefficients are possible. In the case of Test 8 the raw scores seem to indicate two things: The ability to understand what the test is about and the ability to do the test. If the Raw Scores could be resolved into two independent components each might serve to place the children in order of merit in these abilities. But this is not possible without further experiment, nor are the abilities independent; for to do the test depends on understanding what one has to do. This dependence I think accounts for the skewness. By forcing all the scores into a normal distribution one is making one distribution do for two abilities, and we cannot say that the Normalized Scores represent any single order of merit. This may account for the peculiar results obtained from this test which will be pointed out later. In Test 13 the top score was 26 and this score more correctly than 38 represents the maximum score obtainable. The same shortening of the range occurs in Test 16 where the top score was 15 but only 5 children scored more than 11, in Test 17 where the top score was 32, in Test 18 where also the top score was 32 and in Test 19 where the top score was 59. The distributions in these tests are far less skewed than that for Test 8.

Cumulative distributions were then found and by the usual procedure scores which are called here "normalized scores" with $M = 100$ and $S.D. = 15$ were obtained. No account was taken of age since this was such an immeasurable quantity, so that these are not

TABLE II

CONVERSION TABLE

Test 0. Moray House Junior Intelligence Test

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-----|-----|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | - | - | - | - | - | - | - | - | - | 54 |
| 10 | 57 | 59 | 60 | 60 | 61 | 62 | 63 | 64 | 65 | 67 |
| 20 | 69 | 70 | 71 | 71 | 72 | 72 | 73 | 74 | 74 | 75 |
| 30 | 76 | 77 | 78 | 79 | 79 | 80 | 81 | 81 | 82 | 83 |
| 40 | 84 | 84 ⁵ | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 92 |
| 50 | 93 | 93 | 94 | 94 | 95 | 95 | 96 | 97 | 97 | 98 |
| 60 | 98 | 99 | 99 | 100 | 101 | 101 | 102 | 102 | 103 | 103 |
| 70 | 104 | 105 | 105 | 106 | 106 | 106 | 107 | 108 | 108 | 109 |
| 80 | 110 | 111 | 112 | 113 | 114 | 114 | 115 | 116 | 117 | 118 |
| 90 | 119 | 121 | 123 | 125 | 126 | 127 | 129 | 133 | 134 | 137 |
| 100 | 143 | | | | | | | | | |

Test 1. Geometrical Analogies

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|----|----|----|----|-----|
| 0 | 69 | 78 | 85 | 89 | 92 | 94 | 95 | 97 | 98 | 100 |
| 10 | 102 | 105 | 110 | 115 | 125 | | | | | |

Test 2. Doesn't Belong

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | - | 54 | 57 | 57 | 59 | 65 | 69 | 73 | 76 | 79 |
| 10 | 83 | 87 | 89 | 94 | 98 | 101 | 106 | 110 | 115 | 118 |
| 20 | 122 | 126 | 131 | 135 | 138 | 143 | | | | |

Test 3. Rows and Columns

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|
| 0 | - | 57 | 62 | 66 | 71 | 74 | 77 | 79 | 81 | 83 |
| 10 | 84 | 86 | 89 | 93 | 96 | 101 | 105 | 110 | 116 | 121 |
| 20 | 127 | 132 | 140 | | | | | | | |

Test 4. Pattern Completion

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|----|-----|-----|-----|-----|-----|----|----|----|----|
| 0 | 54 | 61 | 66 | 71 | 75 | 78 | 81 | 86 | 90 | 94 |
| 10 | 99 | 104 | 109 | 116 | 123 | 134 | | | | |

Test 8. Moray House Space Test 4

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | - | 59 | 68 | 74 | 78 | 82 | 86 | 89 | 92 | 95 |
| 10 | 96 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 104 | 105 |
| 20 | 105 | 105 | 106 | 107 | 107 | 108 | 108 | 109 | 109 | 110 |
| 30 | 110 | 111 | 111 | 111 | 111 | 111 | 111 | 112 | 112 | 112 |
| 40 | 112 | 112 | 112 | 113 | 113 | 114 | 114 | 115 | 115 | 115 |
| 50 | 115 | 116 | 116 | 117 | 118 | 119 | 119 | 120 | 120 | 121 |
| 60 | 122 | 123 | 123 | 124 | 125 | 126 | 126 | 127 | 127 | 128 |
| 70 | 128 | 128 | 129 | 131 | 132 | 133 | 133 | 134 | 135 | 135 |
| 80 | 135 | 135 | 135 | 138 | 139 | 139 | 140 | 146 | | |

Test 9. Links

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 54 | 61 | 68 | 74 | 79 | 84 | 88 | 91 | 94 | 98 |
| 10 | 102 | 107 | 111 | 115 | 119 | 122 | 125 | 129 | 133 | 140 |

Test 10. Picture Analogies

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|----|----|----|
| 0 | - | 57 | 63 | 69 | 75 | 79 | 84 | 89 | 93 | 97 |
| 10 | 101 | 105 | 110 | 115 | 121 | 127 | 140 | | | |

Test 11. Picture Sequences

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|----|----|----|----|-----|-----|-----|-----|-----|
| 0 | 66 | 73 | 80 | 87 | 94 | 102 | 109 | 116 | 125 | 134 |
| 10 | 141 | | | | | | | | | |

Test 12. Picture Two Alike

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 60 | 69 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 109 |
| 10 | 114 | 118 | 123 | 130 | 135 | 141 | 146 | | | |

Test 13. Numerical II (Series continuation)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 63 | 73 | 81 | 86 | 88 | 91 | 94 | 97 | 100 | 102 |
| 10 | 103 | 105 | 107 | 109 | 111 | 112 | 114 | 116 | 118 | 120 |
| 20 | 123 | 127 | 130 | 133 | 139 | 143 | 146 | | | |

Test 14. Numerical I (Restorations)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 57 | 60 | 60 | 61 | 62 | 64 | 66 | 67 | 70 | 74 |
| 10 | 76 | 78 | 80 | 81 | 83 | 85 | 87 | 89 | 90 | 92 |
| 20 | 94 | 96 | 98 | 100 | 101 | 102 | 104 | 106 | 108 | 110 |
| 30 | 112 | 114 | 116 | 118 | 121 | 124 | 127 | 130 | 131 | 133 |
| 40 | 135 | 141 | 143 | 146 | | | | | | |

Test 15. Arithmetic (Mechanical)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 61 | 69 | 75 | 81 | 87 | 91 | 95 | 99 | 102 | 106 |
| 10 | 109 | 113 | 117 | 120 | 123 | 129 | 134 | 139 | 146 | |

Test 16. Arithmetic (Problems)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 59 | 73 | 83 | 92 | 101 | 108 | 115 | 119 | 123 | 127 |
| 10 | 130 | 133 | 138 | 141 | 143 | 146 | | | | |

Test 17. Synonyms

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 57 | 62 | 65 | 68 | 72 | 75 | 79 | 83 | 87 | 90 |
| 10 | 93 | 96 | 99 | 103 | 105 | 109 | 112 | 114 | 117 | 120 |
| 20 | 123 | 126 | 128 | 131 | 134 | 139 | 140 | 141 | 143 | 143 |
| 30 | 143 | 143 | 146 | | | | | | | |

Test 18. Proverbs (Story)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 69 | 75 | 78 | 81 | 83 | 85 | 88 | 91 | 94 | 96 |
| 10 | 98 | 100 | 103 | 105 | 107 | 109 | 111 | 113 | 116 | 118 |
| 20 | 120 | 122 | 124 | 126 | 128 | 130 | 131 | 132 | 133 | 135 |
| 30 | 135 | 137 | 141 | | | | | | | |

Test 19. English

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|-----|-----|-----|-----|-----|-----|------------------|-----|-----|-----|
| 0 | 54 | 57 | 57 | 57 | 57 | 57 | 57 | 61 | 65 | 67 |
| 10 | 67 | 69 | 71 | 74 | 76 | 78 | 80 | 82 | 83 | 85 |
| 20 | 86 | 88 | 90 | 92 | 93 | 95 | 97 | 98 | 100 | 101 |
| 30 | 103 | 104 | 106 | 107 | 108 | 109 | 110 | 112 | 113 | 114 |
| 40 | 116 | 116 | 117 | 119 | 120 | 121 | 122 | 123 | 124 | 125 |
| 50 | 126 | 127 | 129 | 131 | 133 | 135 | 135 ⁵ | 137 | 141 | 146 |

to be thought of as I.Q.'s. The conversion from Raw Scores to "Normalized Scores" is given in Table II. From this table the Normalized Scores for each child in each test were determined and entered on the opposite page of the mark book in different coloured inks for the different racial groups to make it easier to prepare Tables III, IV & V. The blank spaces indicate absences or that the scores were disallowed on account of cheating. The many blanks for Test 8 are due to cancellation of scores in this test in schools I - IV on account of the instructions being modified after these schools had been tested.

From the scores in the mark book also two copies of the normalized scores (minus 50)* were made school by school and standard by standard with the children's names entered in alphabetical order. One copy was sent to the head teachers of the schools concerned and the other to the Director of Education, with the following letter:

"Room 70, Moray House,
Holyrood Road,
Edinburgh, 8.
Scotland.

16th., November 1949.

Dear Mr. Hogben,

Enclosed are the standardized scores of the 575 children in the 11 schools in the Mental Tests which I set a few months ago.

By "standardized scores" is meant this: The average, or mean, scores of the children of V, VI, VII Standards of the 11 schools in the experiment is 50 in each test. The dispersion of the scores about this mean is also standardized (the Standard Deviation being 15). Thus if a child scores, say, 62 in one test and 62 in another he has done equally well in both. This could not be said of ordinary school marking where the means are different and also the dispersions. Thus in school marking 62 might be good if the mean were 45, and bad if it were 75; or, if in school the means happened to be the same, 62 would be very good if this were the score of the top child, but not very good if the top child scored 95.

* 50 was subtracted to make the scores range from 0 - 100 which made them appear to the teachers like the examination marks familiar to them.

TABLE V

I.B. Continued.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 372 | 81 | 89 | 89 | 89 | 116 | 86 | 92 | 115 | 106 | 84 | 110 | 109 | 100 | 94 | 74 | 95 | 101 | 96 | 105 | 85 |
| 373 | 103 | 92 | 87 | 86 | 94 | 103 | 110 | 96 | 104 | 102 | 97 | 94 | 105 | 114 | 98 | 113 | 108 | 93 | 109 | 106 |
| 374 | 112 | 110 | 106 | 105 | 134 | 125 | 107 | 107 | 110 | 119 | 101 | 102 | 114 | 103 | 127 | 106 | 123 | 114 | 111 | 114 |
| 377 | 86 | 69 | 89 | 110 | 99 | 102 | 86 | 107 | 96 | 122 | 79 | 94 | 69 | 97 | 98 | 113 | 101 | 79 | 88 | 74 |
| 379 | 88 | 94 | 65 | 77 | 99 | 103 | 95 | 100 | 112 | 79 | 97 | 116 | 85 | 105 | 78 | 91 | 108 | 90 | 91 | 78 |
| 380 | 92 | 100 | 89 | 86 | 109 | 97 | 74 | 81 | 68 | 122 | 93 | 94 | 95 | 105 | 100 | 91 | 108 | 75 | 81 | 78 |
| 382 | 89 | 69 | 101 | 96 | 104 | 103 | 91 | 93 | 106 | 79 | 84 | 94 | 109 | 88 | 104 | 91 | 92 | 68 | 94 | 80 |
| 384 | 104 | 102 | 110 | 105 | 104 | 110 | 92 | 97 | 112 | 94 | 105 | 94 | 109 | 118 | 102 | 106 | 108 | 90 | 94 | 101 |
| 385 | 92 | 85 | 122 | 89 | 104 | 99 | 101 | 115 | 101 | 79 | 79 | 80 | 95 | 102 | 100 | 117 | 101 | 93 | 98 | 88 |
| 388 | 89 | 69 | 69 | 71 | 71 | 79 | 106 | 90 | 86 | 84 | 84 | 73 | 90 | 94 | 106 | 99 | 92 | 93 | 83 | 92 |
| 405 | 123 | 125 | 118 | 132 | 134 | 114 | 119 | 123 | 134 | 140 | 127 | 125 | 109 | 133 | 135 | 129 | 127 | 117 | 109 | 119 |
| 407 | 106 | 89 | 101 | 89 | 99 | 97 | 107 | 80 | 89 | 94 | 115 | 94 | 118 | 73 | 116 | 106 | 101 | 90 | 81 | 95 |
| 410 | 121 | 115 | 115 | 121 | 123 | 132 | 115 | 94 | 82 | 133 | 115 | 125 | 114 | 114 | 114 | 113 | 119 | | 120 | 122 |
| 421 | 114 | 100 | 106 | 121 | 123 | 97 | 97 | 111 | 78 | 133 | 110 | 102 | 100 | 91 | 121 | | | 96 | 105 | |
| 424 | 100 | 110 | 89 | 93 | 116 | 95 | 108 | 103 | 86 | 107 | 101 | 109 | 85 | 91 | 87 | | | 87 | 88 | |
| 425 | 94 | 69 | 101 | 89 | 90 | 81 | 78 | 86 | 115 | 98 | 97 | 109 | 95 | 91 | 102 | 109 | 101 | 109 | 98 | 95 |
| 426 | 79 | 97 | 106 | 83 | 99 | 77 | 90 | 112 | 96 | 115 | 84 | 80 | 90 | 91 | 89 | 81 | 101 | 90 | 69 | 80 |
| 427 | 103 | 110 | 101 | 116 | 99 | 123 | 125 | 107 | 100 | 115 | 105 | 116 | 123 | 86 | 94 | 87 | 92 | 105 | 103 | 85 |
| 441 | 87 | 97 | 76 | 71 | 75 | 108 | 107 | 83 | 100 | 107 | 93 | 94 | 75 | 103 | 92 | 87 | 83 | 87 | 69 | 80 |
| 478 | 74 | 78 | 76 | 89 | 99 | 81 | 84 | 111 | 100 | 74 | 79 | 87 | 95 | 81 | 94 | 99 | 92 | 83 | 81 | 71 |
| 479 | 81 | 92 | 87 | 86 | 99 | 86 | 89 | 78 | 103 | 111 | 84 | 87 | 90 | 88 | 87 | 106 | 101 | 87 | 83 | 69 |
| 481 | 92 | 100 | 79 | 86 | 104 | 105 | 83 | 101 | 92 | | 115 | 94 | 95 | 114 | 112 | 102 | 108 | 103 | 91 | 78 |
| 482 | 99 | 102 | 98 | 96 | 104 | 108 | 80 | 86 | 92 | 98 | 115 | 102 | 109 | 94 | 101 | 99 | 101 | 99 | 98 | 83 |
| 483 | 101 | 110 | 122 | 101 | 104 | 108 | 77 | 93 | 99 | 91 | 121 | 109 | 114 | 97 | 112 | 113 | 108 | 103 | 107 | 103 |
| 490 | 114 | 105 | 89 | 105 | 116 | 103 | 71 | 111 | 107 | | 115 | 102 | 75 | 127 | 124 | 109 | 115 | 93 | 107 | 109 |
| 491 | 97 | 78 | 98 | 84 | 104 | 81 | 112 | 90 | 104 | | 97 | 102 | 85 | 91 | 98 | 91 | 83 | 87 | 88 | 80 |
| 492 | 110 | 115 | 98 | 116 | 109 | 112 | 103 | 86 | 115 | | 115 | 109 | 109 | 105 | 112 | 95 | 115 | 112 | 94 | 104 |
| 493 | 103 | 105 | 73 | 101 | 123 | 84 | 126 | 102 | 111 | 91 | 97 | 102 | 85 | 105 | 116 | 95 | 101 | 103 | 98 | 100 |
| 494 | 110 | 125 | 126 | 110 | 116 | 114 | 116 | 96 | 103 | 98 | 101 | 125 | 135 | 105 | 114 | 106 | 108 | 99 | 105 | 100 |
| 504 | | | | 116 | 104 | 99 | | | 74 | 111 | | | | | 110 | 117 | 115 | | 69 | 95 |
| 507 | | | | 105 | 104 | 101 | 89 | 111 | 95 | 111 | 79 | 125 | 105 | | 90 | 95 | 92 | 87 | 69 | 92 |
| 509 | 114 | 100 | 122 | 101 | 90 | 112 | 101 | 94 | 106 | 98 | 110 | 109 | 85 | 112 | 110 | 117 | 115 | 90 | 116 | 124 |
| 514 | 83 | 69 | 94 | 77 | 90 | 105 | 112 | 93 | 89 | 91 | 93 | 87 | 95 | 73 | 96 | | | 109 | 91 | |
| 516 | 109 | 125 | 101 | 110 | 109 | 105 | 105 | 86 | 92 | 107 | 140 | 109 | 105 | 118 | 121 | 95 | 108 | 112 | 103 | 120 |
| 520 | 113 | 115 | 110 | 110 | 94 | 114 | 117 | 112 | 117 | 115 | 110 | 134 | 114 | 100 | 112 | 106 | 108 | 72 | 88 | 103 |
| 525 | 98 | 105 | 87 | 93 | 90 | 91 | 79 | 83 | 107 | 94 | 79 | 94 | 95 | 81 | 110 | 99 | 108 | 79 | 85 | 103 |
| 527 | 105 | 115 | 118 | 110 | 109 | 99 | 117 | 97 | 82 | 125 | 101 | 109 | 114 | 116 | 130 | 106 | 108 | 109 | 94 | 90 |
| 529 | 103 | 110 | 94 | 110 | 99 | 75 | 94 | 88 | 103 | 98 | 105 | 94 | 75 | 100 | 96 | | | 99 | 96 | |
| 531 | 94 | 100 | 94 | 101 | 75 | 97 | 71 | 84 | 74 | 111 | 93 | 94 | 100 | 91 | 89 | 95 | 83 | 93 | 85 | 85 |
| 537 | 95 | 110 | 106 | 121 | 116 | 101 | 92 | 103 | 86 | 111 | 110 | 116 | 100 | 73 | 96 | 87 | 92 | 96 | 91 | 86 |
| 538 | 61 | 78 | 94 | 79 | 66 | 95 | 116 | 98 | 101 | 84 | 75 | 102 | 69 | 86 | 102 | 81 | 73 | 83 | 78 | 86 |

I.B. Continued.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 117 | | | | 121 | | 118 | | | | 111 | | | | | 83 | 106 | 101 | | 100 | 85 | |
| 118 | | | | 71 | 104 | 110 | | | | 115 | | | | | 85 | 81 | 73 | | 83 | 103 | |
| 121 | 97 | 69 | 87 | 89 | 71 | 110 | 80 | 83 | | | 97 | 94 | 95 | 105 | 87 | 95 | 92 | 87 | 78 | 100 | |
| 122 | 95 | 97 | 101 | 81 | 86 | 93 | 75 | 76 | | 119 | 79 | 116 | 109 | 103 | 94 | 99 | 92 | 83 | 91 | 106 | |
| 123 | 85 | 92 | 101 | 66 | 99 | 105 | 85 | 84 | | 88 | 75 | 94 | 85 | 97 | 87 | 75 | 92 | 93 | 88 | 82 | |
| 132 | 97 | 89 | 115 | 96 | 94 | 84 | 103 | 132 | | | 89 | | 69 | 103 | 94 | 102 | 101 | 90 | 94 | 103 | |
| 135 | 97 | 89 | 110 | 101 | 78 | 118 | 113 | 119 | | | 93 | 94 | 95 | 105 | 108 | 102 | 108 | 99 | 85 | 97 | |
| 138 | 98 | 89 | 94 | 121 | 104 | 108 | 119 | 122 | | | 97 | 102 | 114 | 116 | 98 | 99 | 115 | 105 | 91 | 95 | |
| 140 | 105 | 102 | 98 | 110 | 123 | 86 | 89 | 122 | | | 89 | 80 | 123 | 116 | 102 | 91 | 101 | 103 | 96 | 93 | |
| 141 | 92 | 78 | 87 | 89 | 90 | 97 | 92 | 105 | | | 97 | 80 | 100 | 81 | 94 | 109 | 101 | 103 | 94 | 100 | |
| 143 | | | | | 109 | | | | | | | | | | | 98 | 102 | 108 | | 96 | 101 |
| 147 | | | | 105 | 94 | 110 | | | | | | | | | 112 | 102 | 123 | | 100 | 119 | |
| 150 | 93 | 78 | 98 | 93 | 94 | 110 | 124 | 115 | | | 93 | 80 | 100 | 81 | 90 | 91 | 92 | 90 | 100 | 120 | |
| 153 | 101 | 102 | 98 | 105 | 90 | 91 | 112 | 103 | | | 84 | 80 | 85 | 94 | 116 | 95 | 108 | 87 | 83 | 97 | |
| 154 | 109 | 125 | 115 | 77 | 104 | 95 | 101 | 117 | | | 89 | 87 | 85 | 103 | 112 | 102 | 108 | 90 | 88 | 101 | |
| 155 | 88 | 85 | 87 | 79 | 86 | 89 | 75 | 108 | | | 97 | 80 | 114 | 100 | 96 | 95 | 101 | 83 | 85 | 83 | |
| 157 | 102 | 105 | 106 | 96 | 94 | 103 | 112 | 96 | | | 89 | 94 | 95 | 73 | 98 | 109 | 92 | 93 | 103 | 110 | |
| 165 | 96 | 89 | 69 | 101 | 104 | 105 | | | | | 89 | 73 | 85 | 105 | 90 | 87 | 92 | 83 | 81 | 100 | |
| 253 | | | | | | | | | 129 | | | | | | | 120 | 115 | | 113 | 109 | |
| 265 | 96 | 98 | 98 | 84 | 116 | 108 | 112 | 102 | 103 | 129 | 105 | 109 | 118 | 86 | 101 | 117 | 108 | 117 | 91 | 95 | |
| 267 | 107 | 110 | 115 | 105 | 94 | 91 | 88 | 100 | 95 | 107 | 110 | 94 | 114 | 97 | 103 | 102 | 101 | 105 | 96 | 101 | |
| 281 | 88 | 78 | 98 | 101 | 99 | 121 | 108 | 86 | 115 | 98 | 93 | 87 | 75 | 91 | 102 | | | 87 | | | |
| 285 | 88 | 78 | 94 | 71 | 78 | 89 | 81 | 101 | 101 | 107 | 69 | 87 | 69 | 86 | 96 | 91 | 83 | 99 | 85 | 95 | |
| 295 | 107 | 115 | 106 | 110 | 109 | 99 | 83 | 102 | 117 | 115 | 115 | 94 | 114 | 105 | 130 | 106 | 92 | 93 | 78 | 98 | |
| 303 | 117 | 115 | 106 | 105 | 109 | 132 | 117 | 88 | 78 | 115 | 127 | 102 | 105 | 111 | 118 | 123 | 130 | 123 | 107 | 112 | |
| 310 | 115 | 102 | 106 | 101 | 116 | 84 | 81 | 98 | 108 | 125 | 101 | 102 | 90 | 111 | 80 | 106 | 118 | 103 | 81 | 86 | |
| 317 | 116 | 115 | 110 | 121 | 123 | 95 | 100 | 111 | 101 | 115 | 115 | 116 | 100 | 118 | 112 | 139 | 123 | 120 | 118 | 131 | |
| 320 | 110 | 110 | 126 | 110 | 116 | 112 | 101 | 101 | 113 | 98 | 121 | 102 | 95 | 102 | 106 | 99 | 108 | 75 | 88 | 107 | |
| 321 | 115 | 125 | 143 | 121 | 123 | 130 | 113 | 113 | 123 | 122 | 110 | 116 | 114 | 120 | 114 | 113 | 123 | 99 | 109 | 93 | |
| 322 | 87 | 69 | 87 | 84 | 75 | 89 | 78 | 83 | 99 | 88 | 79 | 94 | 105 | 97 | 92 | 113 | 101 | 105 | 105 | 100 | |
| 327 | | | | 89 | 90 | 89 | 100 | 116 | 132 | 98 | 115 | 125 | 118 | | 89 | 109 | 101 | 90 | 96 | 108 | |
| 328 | | | | 71 | 78 | 91 | | | 95 | 98 | | | | | 101 | 99 | 92 | | 83 | 108 | |
| 336 | 99 | 95 | 94 | 101 | 104 | 93 | 86 | 105 | 98 | 122 | 97 | 94 | 85 | 73 | 106 | 99 | 83 | 96 | 78 | 103 | |
| 338 | 102 | 89 | 98 | 110 | 94 | 89 | 108 | 86 | 86 | 102 | 93 | 102 | 90 | 114 | 116 | 95 | 92 | 65 | 83 | 100 | |
| 341 | 108 | 105 | 98 | 116 | 104 | 95 | 74 | 98 | 125 | 102 | 110 | 94 | 85 | 81 | 94 | 117 | 101 | 87 | 91 | 110 | |
| 342 | 94 | 85 | 110 | 116 | 104 | 81 | 92 | 107 | 86 | 94 | 89 | 109 | 100 | 94 | 110 | 102 | 101 | 90 | 91 | 114 | |
| 350 | 129 | 125 | 110 | 77 | 116 | 108 | 113 | 90 | 128 | 115 | 105 | 94 | 95 | | 135 | 123 | 138 | 117 | 122 | 112 | |
| 352 | 105 | 105 | 98 | 96 | 123 | 108 | 117 | 83 | 108 | 111 | 110 | 116 | 109 | 111 | 101 | 123 | 119 | 83 | 113 | 114 | |
| 354 | 108 | 100 | 94 | 105 | 86 | 101 | 82 | 90 | 102 | 84 | 93 | 73 | 90 | 97 | 102 | 117 | 123 | 103 | 105 | 112 | |
| 355 | 133 | 115 | 118 | 110 | 116 | 110 | 112 | 83 | 104 | 88 | 105 | 87 | 90 | 127 | 118 | 139 | 141 | 103 | 122 | 125 | |
| 370 | 95 | 85 | 69 | 77 | 109 | 86 | 92 | 97 | 95 | 88 | 79 | 94 | 75 | 81 | 110 | 120 | 101 | 114 | 88 | 106 | |

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I.B Normalized Scores. (M = 100, S.D. = 15)

TABLE V

| CHILD # | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 11 | 101 | 105 | 69 | 110 | 116 | 114 | 119 | 110 | | 111 | 89 | 102 | 100 | 114 | 106 | 102 | 108 | 120 | 94 | 104 |
| 13 | 109 | 115 | 101 | 110 | 99 | 93 | 95 | 113 | | 102 | 97 | 94 | 100 | 123 | 131 | 113 | 115 | 90 | 103 | 97 |
| 19 | | | | 83 | 94 | 91 | 69 | 106 | | 102 | 97 | 87 | 90 | | 94 | 106 | 92 | 103 | 96 | 113 |
| 20 | | | | 93 | 116 | 114 | 79 | 117 | | 119 | 101 | 125 | 85 | | 116 | 102 | 101 | 93 | 91 | 85 |
| 22 | 106 | 110 | 106 | 116 | 99 | 95 | 99 | 96 | | 107 | 115 | 109 | 118 | 100 | 94 | 75 | 101 | 105 | 85 | 90 |
| 24 | 95 | 102 | 94 | 101 | 104 | 84 | 92 | 103 | | 107 | 79 | 66 | 80 | 105 | 118 | 95 | 83 | 79 | 69 | 74 |
| 25 | 91 | 89 | 98 | 101 | 94 | 86 | 113 | 120 | | 102 | 93 | 66 | 80 | 81 | 100 | 99 | 92 | 75 | 91 | 88 |
| 28 | 99 | 100 | 98 | 84 | 86 | 93 | 111 | 86 | | 98 | 89 | 94 | 85 | 103 | 106 | 99 | 101 | 103 | 105 | 101 |
| 29 | 72 | 78 | 65 | 93 | 90 | 95 | 108 | 88 | | 111 | 89 | 66 | 100 | 94 | 92 | 87 | 73 | 90 | 103 | 65 |
| 37 | 88 | 97 | 89 | 86 | 86 | 89 | 76 | 110 | | 107 | 105 | 94 | 100 | 81 | 118 | 87 | 101 | 87 | 88 | 82 |
| 42 | 119 | 125 | 126 | 127 | 116 | 121 | 110 | 112 | | 122 | 121 | 134 | 105 | 120 | 141 | 120 | 127 | 117 | 122 | 123 |
| 43 | 116 | 105 | 101 | 105 | 109 | 105 | 128 | 131 | | 125 | 110 | 116 | 109 | 94 | 124 | 102 | 108 | 109 | 107 | 109 |
| 44 | 77 | 85 | 54 | 77 | 90 | 84 | 91 | 106 | | 79 | 79 | 109 | 95 | 81 | 100 | 99 | 83 | 79 | 98 | 85 |
| 45 | 89 | 102 | 83 | 89 | 90 | 81 | 121 | 88 | | 111 | 101 | 87 | 90 | 107 | 108 | 99 | 108 | 96 | 83 | 80 |
| 46 | 100 | 115 | 87 | 101 | 104 | 121 | 130 | 116 | | 98 | 101 | 116 | 85 | 97 | 92 | 87 | 83 | 89 | 94 | 85 |
| 48 | | | | 93 | 81 | 72 | 108 | 83 | | 91 | 93 | 109 | 95 | | 80 | 81 | 92 | 83 | 69 | 86 |
| 49 | 90 | 97 | 69 | 96 | 99 | 99 | 103 | 103 | | 111 | 101 | 94 | 100 | 94 | 87 | 87 | 101 | 90 | 88 | 83 |
| 50 | 74 | 85 | 94 | 86 | 90 | 95 | 54 | 81 | | 102 | 89 | 87 | 114 | 73 | 106 | 95 | 83 | 83 | 88 | 83 |
| 54 | 102 | 110 | 101 | 110 | 134 | 108 | 107 | 86 | | 107 | 101 | 116 | 100 | 86 | 102 | 81 | 92 | 109 | 85 | 68 |
| 55 | 99 | 97 | 101 | 96 | 123 | 112 | 89 | 98 | | 107 | 110 | 116 | 90 | 97 | 101 | 91 | 73 | 117 | 91 | 90 |
| 57 | 96 | 102 | 106 | 105 | 99 | 101 | 113 | 124 | | 84 | 101 | 116 | 90 | 102 | 112 | 99 | 101 | 79 | 88 | 88 |
| 58 | 123 | 115 | 94 | 110 | 116 | 110 | 101 | 106 | | 94 | 101 | 102 | 109 | 88 | 127 | 120 | 115 | 105 | 111 | 114 |
| 60 | 103 | 94 | 110 | 110 | 109 | 108 | 99 | 100 | | 119 | 75 | 102 | 95 | 114 | 102 | 95 | 92 | 90 | 69 | 78 |
| 61 | 91 | 95 | 110 | 96 | 94 | 105 | 113 | 116 | | 122 | 93 | 80 | 69 | 81 | 94 | 95 | 92 | 72 | 94 | 33 |
| 62 | 79 | 85 | 76 | 96 | 90 | 99 | 108 | 119 | | 74 | 97 | 109 | 109 | 73 | 102 | 87 | 101 | 83 | 94 | 88 |
| 63 | 78 | 89 | 106 | 96 | 94 | 116 | 119 | 100 | | 102 | 89 | 102 | 60 | 73 | 67 | 69 | 73 | 87 | 91 | 80 |
| 64 | 74 | 85 | 79 | 101 | 90 | 112 | 106 | 110 | | 94 | 79 | 102 | 100 | 91 | 83 | 87 | 73 | 96 | 81 | 83 |
| 65 | 75 | 85 | 122 | 89 | 75 | 108 | 132 | 101 | | 94 | 97 | 80 | 90 | 81 | 78 | 75 | 73 | 105 | 88 | 93 |
| 66 | 92 | 78 | 101 | 101 | 116 | 121 | 90 | 84 | | 79 | 79 | 102 | 85 | 73 | 96 | 99 | 108 | 87 | 91 | 65 |
| 67 | 99 | 110 | 94 | 93 | 116 | 116 | 119 | 115 | | 102 | 110 | 116 | 90 | 81 | 96 | 81 | 101 | 87 | 94 | 92 |
| 70 | 106 | 115 | 126 | 101 | 99 | 121 | 122 | 120 | | 91 | 93 | 87 | 130 | 97 | 121 | 106 | 92 | 103 | 94 | 106 |
| 75 | 114 | 110 | 101 | 116 | 99 | 101 | 106 | 101 | | 79 | 110 | 109 | 95 | 123 | 112 | 117 | 115 | 120 | 109 | 112 |
| 76 | 85 | 95 | 126 | 105 | 104 | 72 | 116 | 98 | | 102 | 89 | 80 | 118 | 109 | 100 | 81 | 83 | 112 | 83 | 93 |
| 91 | 96 | 85 | 101 | 89 | 61 | 105 | 88 | 78 | | 107 | 75 | 94 | 85 | 107 | 74 | 91 | 92 | 96 | 81 | 104 |
| 93 | 101 | 98 | 110 | 96 | 90 | 99 | 92 | 90 | | 102 | 97 | 87 | 100 | 86 | 92 | 106 | 101 | 114 | 107 | 109 |
| 94 | 119 | 89 | 131 | 132 | 104 | 121 | 119 | 126 | | 98 | 127 | 102 | 118 | 133 | 114 | 123 | 119 | 120 | 122 | 129 |
| 99 | | | | 110 | 109 | 91 | | | | 129 | | | | | 94 | 91 | 101 | | 91 | 88 |
| 107 | | | | 105 | 86 | | 112 | 107 | | 91 | 101 | 87 | 85 | | 94 | | 101 | 93 | 88 | 108 |
| 115 | 83 | 85 | 83 | 79 | 90 | 84 | 95 | 88 | | 102 | 69 | 80 | 100 | 102 | 96 | 91 | 101 | 105 | 102 | 97 |

TABLE V

TABLE IV

N.G. Continued.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 449 | 104 | 98 | 101 | 121 | 116 | 91 | 117 | 71 | 110 | 98 | 105 | 109 | 109 | 73 | 114 | 117 | 108 | 103 | 107 | 121 |
| 450 | 92 | 89 | 98 | 93 | 90 | 101 | 93 | 93 | 68 | 107 | 79 | 94 | 75 | 97 | 101 | 106 | 83 | 93 | 88 | 97 |
| 451 | 101 | 105 | 115 | 116 | 81 | 95 | 92 | 97 | 92 | 91 | 101 | 109 | 118 | 91 | 101 | 113 | 108 | 109 | 120 | 109 |
| 454 | 87 | 85 | 101 | 74 | 81 | 89 | 103 | 90 | 106 | 84 | 84 | 87 | 95 | 81 | 81 | 87 | 83 | 112 | 116 | 92 |
| 455 | 88 | 85 | 89 | 96 | 104 | 89 | 97 | 90 | 86 | 98 | 69 | 80 | 69 | 88 | 102 | 81 | 73 | 99 | 69 | 69 |
| 456 | 73 | 89 | 101 | 93 | 86 | 81 | 108 | 90 | 99 | 98 | 79 | 94 | 105 | 88 | 66 | 75 | 73 | 109 | 91 | 88 |
| 461 | 81 | 69 | 110 | 81 | 90 | 72 | 115 | 80 | 102 | 84 | 79 | 102 | 90 | 91 | 92 | 81 | 83 | 83 | 103 | 90 |
| 462 | 82 | 69 | 89 | 74 | 81 | 54 | 85 | 96 | 59 | 79 | 84 | 87 | 75 | 81 | 82 | 81 | 92 | 90 | 83 | 82 |
| 468 | 87 | 85 | 69 | 93 | 94 | 72 | 97 | 84 | 104 | 91 | 75 | 94 | 85 | 100 | 83 | 91 | 92 | 105 | 107 | 88 |
| 870 | 103 | 105 | 110 | 105 | 94 | 108 | 101 | 122 | 82 | 102 | 63 | 87 | 60 | 97 | 94 | 109 | 108 | 99 | 111 | 100 |
| 471 | 95 | 89 | 98 | 86 | 104 | 81 | 88 | 94 | 95 | 88 | 97 | 109 | 100 | 100 | 94 | 106 | 92 | 109 | 107 | 101 |
| 473 | 93 | 89 | 83 | 96 | 99 | 101 | 82 | 94 | 86 | 61 | 93 | 94 | 109 | 94 | 102 | 95 | 92 | 96 | 96 | 103 |
| 496 | 72 | 69 | 79 | 71 | 71 | 81 | 101 | 93 | 104 | 79 | 75 | 87 | 75 | 88 | 92 | 91 | 92 | 112 | 81 | 82 |
| 497 | 80 | 92 | 79 | 101 | 86 | 93 | 83 | 78 | 104 | 84 | 69 | 87 | 100 | 94 | 83 | 109 | 73 | 112 | 103 | 103 |
| 498 | 92 | 97 | 110 | 105 | 99 | 110 | 108 | 88 | 68 | 98 | 93 | 94 | 85 | 103 | 90 | | | 109 | 109 | |
| 500 | 70 | 89 | 89 | 89 | 78 | 81 | 86 | 83 | 78 | 68 | 63 | 109 | 85 | 73 | 94 | 91 | 101 | 96 | 100 | 92 |
| 502 | 78 | 95 | 79 | 77 | 90 | 91 | 59 | 73 | 86 | 91 | 89 | 102 | 100 | 73 | 94 | 91 | 101 | 109 | 100 | 88 |
| 506 | | | | 101 | 94 | 91 | | | 86 | 84 | | | | | 83 | 87 | 83 | | 105 | 107 |
| 541 | 121 | 105 | 110 | 110 | 99 | 108 | 101 | 98 | 99 | 115 | 105 | 116 | 100 | 123 | 106 | 99 | 115 | 114 | 130 | 117 |
| 542 | 137 | 125 | 118 | 116 | 109 | 123 | 120 | 122 | 124 | 115 | 121 | 116 | 109 | 120 | 116 | 117 | 123 | 128 | 128 | 131 |
| 543 | 110 | 105 | 106 | 110 | 99 | 114 | 103 | 73 | 116 | 125 | 105 | 125 | 114 | 102 | 106 | 109 | 108 | 123 | 113 | 112 |
| 545 | 114 | 105 | 126 | 116 | 104 | 121 | 86 | 118 | 123 | 111 | 110 | 116 | 105 | 107 | 121 | 120 | 101 | 114 | 130 | 113 |
| 547 | 111 | 105 | 101 | 101 | 116 | 105 | 97 | 100 | 92 | 102 | 121 | 116 | 95 | 103 | 100 | 102 | 92 | 123 | 120 | 101 |
| 555 | 102 | 100 | 101 | 110 | 109 | 95 | 95 | 93 | 89 | 94 | 101 | 94 | 95 | 111 | 121 | 102 | 108 | 83 | 105 | 110 |
| 558 | 106 | 115 | 122 | 110 | 86 | | 78 | 71 | 96 | 98 | 121 | 141 | 114 | 103 | | 91 | 101 | 105 | | 110 |
| 559 | 93 | 73 | 79 | 86 | 78 | 108 | 101 | 81 | 95 | 119 | 93 | 94 | 105 | 94 | 85 | 106 | 83 | 105 | 94 | 106 |
| 561 | 100 | 110 | 115 | 105 | 99 | 93 | 117 | 103 | 118 | 88 | 97 | 94 | 100 | 114 | 108 | 81 | 101 | 87 | | 106 |
| 562 | 99 | 102 | 122 | 110 | 104 | 99 | 105 | 93 | 115 | 98 | 101 | 102 | 105 | 97 | 104 | 87 | 101 | 83 | 100 | 95 |
| 563 | 90 | 78 | 65 | 110 | 94 | 108 | 86 | 76 | 101 | 98 | 84 | 94 | 80 | 94 | 108 | 106 | 101 | 105 | 113 | 100 |
| 566 | 108 | 110 | 101 | 116 | 116 | 97 | 116 | 93 | 92 | 102 | 101 | 94 | 90 | 94 | 100 | 117 | 109 | 109 | 113 | 93 |
| 568 | 94 | 89 | 98 | 89 | 94 | 93 | 78 | 106 | 101 | 98 | 89 | 80 | 75 | 88 | 98 | 95 | 92 | 79 | 98 | 98 |
| 569 | 89 | 98 | 83 | 101 | 104 | 112 | 99 | 86 | 89 | 102 | 105 | 87 | 80 | 91 | 94 | 91 | 83 | 87 | 85 | 97 |
| 570 | 85 | 85 | 79 | 89 | 90 | 91 | 103 | 90 | 68 | 88 | 79 | 80 | 85 | 88 | 94 | 87 | 92 | 87 | 103 | 92 |
| 571 | 95 | 102 | 106 | 121 | 86 | 84 | 106 | 110 | 116 | 102 | 93 | 102 | 118 | 88 | 98 | 87 | 83 | 103 | 109 | 104 |
| 572 | 98 | 92 | 94 | 89 | 94 | 101 | 111 | 103 | 92 | 91 | 97 | 109 | 109 | 86 | 98 | 91 | 83 | 109 | 100 | 95 |
| 573 | 90 | 94 | 101 | 93 | 90 | 84 | 95 | 97 | 104 | 88 | 89 | 87 | 114 | 81 | 90 | 61 | 92 | 93 | 98 | 98 |
| 575 | | | | 96 | 94 | 110 | | | 96 | 98 | | | | | 92 | 69 | 92 | | 105 | 95 |
| 84 | | | | | | | | | | 125 | | | | | | | 101 | | | 92 |
| 202 | | | | | | | | | | | | | | | | 87 | 92 | | | 100 |
| 239 | 79 | 95 | 73 | 96 | 90 | 86 | 78 | 98 | 106 | 88 | 93 | 94 | 95 | 94 | 78 | 75 | 101 | 79 | | 80 |

N.G. Continued.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 190 | 126 | 125 | 106 | 127 | 104 | 103 | 106 | 105 | 78 | 98 | 115 | 125 | 109 | 123 | 135 | 113 | 108 | 99 | 111 | 106 |
| 191 | 90 | 85 | 101 | 89 | 75 | 97 | 91 | 75 | 89 | 74 | 93 | 87 | 90 | 97 | 98 | 99 | 83 | 79 | 103 | 98 |
| 192 | 127 | 115 | 106 | 105 | 104 | 116 | 100 | 113 | 89 | 107 | 127 | 94 | 109 | 130 | 124 | 117 | 108 | 131 | 128 | 122 |
| 195 | 81 | 94 | 115 | 86 | 71 | 89 | 99 | 98 | 96 | 91 | 93 | 94 | 114 | 102 | 94 | 94 | 92 | 90 | 91 | 97 |
| 201 | 86 | 69 | 115 | 105 | 99 | 103 | 105 | 106 | 92 | 84 | 115 | 102 | 95 | 94 | 85 | 87 | 92 | 99 | 109 | 95 |
| 203 | | | | 96 | 99 | 77 | | | 78 | | 89 | | | | 62 | 87 | 73 | | 103 | 95 |
| 204 | 67 | 89 | 89 | 89 | 86 | 68 | 69 | 93 | | 88 | 69 | 94 | 95 | 81 | 83 | 81 | 101 | 87 | 103 | 80 |
| 207 | 67 | 78 | 89 | 83 | 104 | 79 | 88 | 105 | 99 | 79 | 89 | 94 | 95 | 86 | 81 | 75 | 83 | 103 | 88 | 88 |
| 208 | 83 | 85 | 106 | 66 | 75 | 54 | 74 | 103 | 82 | 68 | 93 | 102 | 109 | 102 | 106 | 87 | 108 | 99 | 98 | 78 |
| 213 | 109 | 115 | 110 | 127 | 116 | 84 | 97 | 119 | 112 | 84 | 115 | 125 | 123 | 105 | 106 | 95 | 101 | 117 | 113 | 119 |
| 216 | 107 | 102 | 94 | 101 | 123 | 86 | 94 | 111 | 111 | 88 | 101 | 116 | 105 | 105 | 94 | 102 | 92 | 99 | 109 | 106 |
| 218 | 101 | 110 | 106 | 116 | 109 | 81 | 107 | 113 | 123 | 107 | 93 | 116 | 118 | 97 | 100 | 87 | 108 | 102 | 96 | 92 |
| 219 | 100 | 110 | 94 | 101 | 90 | 72 | 103 | 106 | 101 | 88 | 97 | 102 | 105 | 100 | 80 | 87 | 92 | 99 | 113 | 104 |
| 220 | 65 | 85 | 79 | 93 | 81 | 62 | 86 | 86 | 86 | 79 | 79 | 73 | 75 | 81 | 74 | 69 | 73 | 83 | 69 | 67 |
| 221 | 98 | 110 | 101 | 89 | 104 | 79 | 91 | 71 | 89 | 84 | 97 | 94 | 100 | 107 | 85 | 99 | 92 | 103 | 88 | 92 |
| 222 | 103 | 110 | 98 | 100 | 90 | 72 | 82 | 90 | 74 | 74 | 57 | 80 | 75 | 88 | 78 | 95 | 108 | 87 | 111 | 93 |
| 223 | 103 | 100 | 94 | 105 | 116 | 84 | 76 | 71 | 82 | 91 | 110 | 125 | 109 | 97 | 92 | 87 | 83 | 120 | 118 | 104 |
| 225 | 82 | 92 | 73 | 81 | 86 | 68 | 92 | 88 | 92 | 72 | 79 | 94 | 90 | 63 | 70 | 75 | 92 | 103 | 91 | 97 |
| 226 | 115 | 110 | 94 | 93 | 123 | 86 | 91 | 100 | 101 | 91 | 121 | 102 | 105 | 109 | 100 | 81 | 83 | 117 | 105 | 109 |
| 230 | 84 | 89 | 98 | 96 | 104 | 95 | 73 | 98 | 78 | 79 | 97 | 109 | 80 | 91 | 78 | 75 | 83 | 96 | 96 | 78 |
| 231 | 81 | 85 | 89 | 101 | 104 | 77 | 81 | 98 | 89 | | 89 | 87 | 90 | 91 | 76 | 87 | 92 | 103 | 94 | 92 |
| 234 | 97 | 100 | 110 | 89 | 104 | 86 | 94 | 94 | 99 | 84 | 89 | 87 | 90 | 111 | 98 | 95 | 92 | 99 | 105 | 101 |
| 238 | 108 | 98 | 106 | 105 | 90 | 108 | 93 | 81 | 107 | 88 | 93 | 80 | 100 | 97 | 94 | 91 | 115 | 114 | 118 | 113 |
| 241 | 88 | 98 | 94 | 86 | 90 | 99 | 84 | 106 | 98 | 84 | 84 | 102 | 85 | 86 | 87 | | | 90 | 91 | |
| 245 | 74 | 85 | 94 | 84 | 94 | 86 | 110 | 81 | 106 | 74 | 89 | 66 | 80 | 73 | 70 | | | 83 | | |
| 246 | 84 | 105 | 79 | 121 | 99 | 101 | 97 | 108 | 105 | 91 | 84 | 102 | 95 | 105 | 85 | | | 103 | 69 | |
| 248 | 112 | 125 | 76 | 105 | 99 | 116 | 99 | 114 | 68 | 74 | 115 | 125 | 95 | 103 | 106 | | | 128 | 133 | |
| 349 | | | | | | | | | | | | | | | | 123 | 115 | | | 127 |
| 392 | 137 | 125 | 135 | 121 | 134 | 121 | 125 | 137 | 119 | 119 | 115 | 125 | 135 | 139 | 135 | 129 | 138 | 112 | 137 | 127 |
| 394 | 65 | 78 | 76 | 71 | | 78 | 71 | 84 | 82 | 79 | 63 | 73 | 95 | 81 | 66 | 87 | 101 | 96 | 103 | 85 |
| 397 | 95 | 92 | 83 | 79 | 71 | 72 | 99 | 98 | 96 | 88 | 93 | 116 | 80 | 94 | 104 | 102 | 101 | 114 | 107 | 106 |
| 398 | 105 | 105 | 98 | 116 | 94 | 108 | 97 | 106 | 78 | 98 | 93 | 94 | 95 | 91 | 98 | 102 | 73 | 105 | 105 | 110 |
| 406 | 94 | 89 | 94 | 101 | 104 | 105 | 99 | 67 | 99 | 98 | 101 | 80 | 105 | 91 | 96 | 113 | 101 | 83 | 105 | 112 |
| 411 | 133 | 125 | 118 | 121 | 123 | 125 | 95 | 123 | 82 | 133 | 127 | 125 | 130 | 139 | 133 | 117 | 127 | 128 | 128 | 126 |
| 412 | 143 | 125 | 131 | 110 | 134 | 143 | 94 | 131 | 111 | 133 | 121 | 125 | 130 | 118 | 121 | 139 | 133 | 139 | 137 | 124 |
| 416 | 129 | 125 | 122 | 127 | 104 | 127 | 103 | 97 | 89 | 119 | 101 | 102 | 102 | 127 | 124 | 117 | 119 | 123 | 103 | 116 |
| 436 | 123 | 115 | 110 | 101 | 116 | 112 | 115 | 90 | 82 | 102 | 101 | 116 | 123 | 118 | 118 | 102 | 101 | 109 | 98 | 108 |
| 443 | 105 | 98 | 118 | 121 | 123 | 127 | 110 | 123 | 99 | 102 | 110 | 116 | 114 | 130 | 112 | 117 | 115 | 123 | 120 | 121 |
| 445 | 84 | 85 | 101 | 105 | 81 | 101 | 86 | 96 | 92 | 79 | 97 | 116 | 85 | 81 | 94 | 113 | 92 | 99 | 109 | 88 |
| 447 | 110 | 125 | 83 | 105 | 104 | 97 | 101 | 81 | 92 | 111 | 115 | 87 | 109 | 109 | 108 | 109 | 101 | 105 | 116 | 108 |

TABLE IV

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 5 | 108 | 105 | 126 | 110 | 109 | 110 | 71 | 102 | | 107 | 105 | 94 | 114 | 116 | 118 | 99 | 101 | 96 | 113 | 101 |
| 9 | 126 | 115 | 122 | 127 | 123 | 127 | 89 | 115 | | 140 | 121 | 141 | 123 | 111 | 127 | 113 | 108 | 117 | 128 | 131 |
| 15 | 109 | 102 | 118 | 116 | 99 | 108 | 116 | 103 | | 107 | 105 | 116 | 95 | 100 | 110 | 102 | 115 | 128 | 107 | 113 |
| 30 | 99 | 115 | 98 | 105 | 116 | 121 | 76 | 112 | | 115 | 115 | 109 | 95 | 100 | 81 | 91 | 92 | 87 | 94 | 93 |
| 31 | 93 | 100 | 94 | 105 | 104 | 89 | 91 | 96 | | 102 | 101 | 94 | 85 | 91 | 96 | 91 | 108 | 90 | 94 | 95 |
| 39 | 63 | 85 | 79 | 81 | 81 | 77 | 101 | 86 | | 68 | 57 | 80 | 80 | 63 | 78 | 81 | 92 | 72 | 78 | 80 |
| 40 | 93 | 102 | 110 | 93 | 104 | 93 | 63 | 107 | | 91 | 97 | 94 | 95 | 88 | 94 | 87 | 92 | 99 | 78 | 93 |
| 56 | 114 | 125 | 126 | 110 | 123 | 114 | 120 | 123 | | 111 | 110 | 116 | 95 | 112 | 124 | 120 | 92 | 109 | 130 | 104 |
| 71 | 91 | 95 | 94 | 93 | 86 | 72 | 116 | 108 | | 98 | 101 | 80 | 85 | 118 | 89 | 87 | 73 | 109 | 107 | 116 |
| 73 | 99 | 105 | 89 | 84 | 94 | 84 | 100 | 110 | | 94 | 93 | 102 | 85 | 100 | 83 | 75 | 83 | 90 | 94 | 82 |
| 78 | 110 | 105 | 87 | 101 | 116 | 103 | 100 | 80 | | 107 | | | | 102 | 104 | 91 | 101 | 120 | 118 | 104 |
| 79 | 106 | 110 | 87 | 105 | 109 | 62 | 106 | 78 | | 88 | 101 | 94 | 95 | 100 | 92 | 99 | 108 | 112 | 116 | 110 |
| 88 | 112 | 110 | 98 | 121 | 116 | 97 | 97 | 108 | | 102 | 121 | 87 | 109 | 109 | 104 | 106 | 127 | 120 | 122 | 120 |
| 105 | | | 57 | 71 | 62 | | | | | 79 | | | | | 78 | 75 | 92 | 103 | 103 | 97 |
| 106 | | | 105 | 90 | 93 | | | | | 98 | | | | | 94 | 91 | 83 | 100 | 100 | 109 |
| 109 | 89 | 94 | 94 | 71 | 90 | 89 | 79 | 107 | | 102 | 84 | 94 | 114 | 97 | 70 | 61 | 92 | 109 | 113 | 93 |
| 112 | | | 105 | 81 | 77 | | | | | 84 | | | | | 94 | 102 | 101 | | 103 | 109 |
| 113 | 102 | 100 | 89 | 96 | 94 | 91 | 101 | 86 | | 79 | 101 | 80 | 109 | 107 | 98 | 109 | 73 | | 100 | 109 |
| 125 | 77 | 85 | 115 | 83 | 90 | 95 | 73 | 105 | | 107 | 69 | 87 | 80 | 86 | 80 | 81 | 73 | 79 | 83 | 97 |
| 126 | 94 | 94 | 106 | 62 | 66 | 99 | 81 | 106 | | 74 | 75 | 66 | 100 | 100 | 85 | 95 | 92 | 90 | 94 | 103 |
| 130 | 110 | 102 | 131 | 105 | 109 | 108 | 129 | 131 | | | 101 | 109 | 100 | 133 | 114 | 113 | 101 | 105 | 124 | 103 |
| 131 | 93 | 94 | 98 | 86 | 86 | 108 | 112 | 111 | | | 93 | 94 | 109 | | 87 | 95 | 83 | 123 | 111 | 112 |
| 149 | 90 | 78 | 94 | 93 | 99 | 91 | 112 | 103 | | | 97 | 87 | 114 | 91 | 94 | | | 103 | 88 | |
| 160 | 106 | 98 | 83 | 101 | 81 | 91 | 95 | 86 | | | 93 | 94 | 95 | 100 | 85 | 91 | 108 | 90 | 100 | 109 |
| 161 | 97 | 98 | 106 | 89 | 90 | 97 | 99 | 88 | | | 97 | 109 | 123 | 105 | 106 | 91 | 101 | 75 | 94 | 103 |
| 163 | 82 | 69 | 94 | 89 | 90 | 79 | 93 | 90 | | | 75 | 80 | 105 | 73 | 90 | 87 | 83 | 96 | 85 | 93 |
| 167 | 85 | 92 | 87 | 110 | 104 | 101 | 92 | 115 | 78 | 102 | 89 | 102 | 100 | 86 | 89 | 81 | 83 | 114 | 103 | 95 |
| 170 | 107 | 110 | 98 | 110 | 90 | 105 | 112 | 126 | 78 | 98 | 97 | 102 | 95 | 109 | 102 | 106 | 108 | 96 | 100 | 98 |
| 172 | 104 | 105 | 131 | 96 | 90 | 81 | 125 | 128 | 86 | 102 | 110 | 94 | 95 | 86 | 83 | 106 | 115 | 114 | 118 | 108 |
| 175 | | | 71 | 71 | 81 | | | | 89 | 79 | | | | | 74 | 113 | 108 | | 105 | 103 |
| 179 | 118 | 110 | 122 | 116 | 123 | 114 | 137 | 137 | 129 | 115 | 121 | 116 | 114 | 105 | 100 | 117 | 108 | 109 | 107 | 123 |
| 180 | 112 | 110 | 115 | 96 | 99 | 118 | 107 | 103 | 105 | 94 | 121 | 94 | 123 | 94 | 124 | 129 | 119 | 117 | 141 | 117 |
| 181 | 100 | 105 | 94 | | | | 107 | 100 | | | 127 | 94 | 109 | 91 | | 106 | 101 | 109 | | 109 |
| 183 | 106 | 102 | 118 | 110 | 81 | 108 | 105 | 107 | 108 | 115 | 101 | 109 | 109 | 123 | 121 | 106 | 123 | 126 | 141 | 113 |
| 185 | 104 | 102 | 89 | 93 | 90 | 95 | 92 | 105 | 103 | 88 | 89 | 109 | 114 | 102 | 90 | 102 | 101 | 114 | 105 | 106 |
| 186 | 111 | 100 | 106 | 101 | 86 | 84 | 92 | 101 | 95 | 84 | 97 | 109 | 105 | 102 | 127 | 113 | 101 | 126 | 96 | 106 |
| 188 | 112 | 110 | 94 | 110 | 109 | 105 | 93 | 116 | 68 | 94 | 93 | 109 | 114 | 118 | 118 | 117 | 115 | 134 | 111 | 116 |
| 189 | 126 | 115 | 118 | 121 | 123 | 130 | 95 | 93 | 89 | 111 | 121 | 116 | 105 | 127 | 121 | 129 | 130 | 109 | 124 | 127 |

TABLE III

N. B. Continued.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 433 | 88 | 85 | 110 | 96 | 123 | 118 | 107 | 88 | 122 | 98 | 93 | 94 | 95 | 94 | 74 | 95 | 101 | 99 | 69 | 76 |
| 434 | 99 | 102 | 83 | 96 | 99 | 84 | 87 | 78 | 86 | 98 | 97 | 94 | 105 | 94 | 83 | 81 | 92 | 99 | 83 | 82 |
| 435 | 98 | 105 | 65 | 93 | 116 | 99 | 100 | 93 | 115 | 115 | 110 | 109 | 85 | 111 | 87 | 95 | 92 | 99 | 75 | 80 |
| 439 | 101 | 92 | 101 | 110 | 104 | 95 | 119 | 90 | 96 | 107 | 89 | 102 | 80 | 120 | 108 | 81 | 83 | 96 | 83 | 85 |
| 440 | 83 | 100 | 110 | 105 | 90 | 105 | 112 | 102 | 98 | 115 | 105 | 87 | 95 | 81 | 106 | 81 | 92 | 87 | 69 | 61 |
| 442 | 86 | 89 | 87 | 81 | 116 | 84 | 107 | 90 | 101 | 129 | 105 | 109 | 118 | 94 | 101 | | | 93 | 107 | |
| 446 | 104 | 110 | 106 | 110 | 109 | 103 | 128 | 116 | 100 | 107 | 121 | 125 | 75 | 81 | 96 | 99 | 92 | 99 | 107 | 82 |
| 458 | 91 | 105 | 89 | 84 | 78 | 105 | 88 | 100 | 98 | 79 | 93 | 87 | 95 | 103 | 90 | 95 | 92 | 99 | 81 | 85 |
| 459 | 111 | 125 | 110 | 96 | 94 | 108 | 106 | 90 | 92 | 107 | 84 | 94 | 118 | 102 | 101 | 109 | 101 | 105 | 96 | 106 |
| 467 | 83 | 89 | 106 | | 116 | 89 | 105 | 103 | 102 | 88 | 79 | 94 | 100 | 86 | 104 | 99 | 83 | 75 | 88 | 88 |
| 477 | 73 | 78 | 83 | 86 | 71 | 75 | 78 | 115 | 101 | 91 | | 80 | 100 | 73 | 67 | | | 75 | 69 | |
| 484 | 98 | 102 | 94 | 96 | | 91 | 76 | 103 | 105 | 102 | | 94 | 95 | 97 | 94 | | | 93 | 85 | |
| 485 | 98 | 102 | 89 | 101 | | 95 | 106 | 98 | 96 | 88 | | 94 | 95 | 97 | 110 | 109 | 73 | 93 | 81 | 78 |
| 486 | 99 | 98 | 83 | 101 | 90 | 105 | 97 | 117 | 104 | 119 | 93 | 109 | 100 | 97 | 90 | 81 | 83 | 105 | 100 | 103 |
| 487 | 81 | 94 | 106 | 101 | 90 | 110 | 89 | 101 | 86 | 98 | 79 | 66 | 85 | 105 | 96 | 81 | 92 | 96 | 94 | 88 |
| 488 | 112 | 105 | 89 | 96 | 104 | 105 | 90 | 90 | 100 | 98 | 121 | 102 | 95 | 100 | 94 | 106 | 108 | 109 | 107 | 100 |
| 489 | 111 | 125 | 115 | 96 | 90 | 97 | 92 | 98 | 107 | | 110 | 102 | 118 | 100 | 100 | 95 | 101 | 112 | 113 | 107 |
| 495 | 80 | 92 | 98 | 74 | 81 | 89 | 90 | 115 | 92 | 94 | 93 | 73 | 80 | 94 | 74 | 87 | 83 | 87 | 69 | 76 |
| 499 | 91 | 98 | 87 | 105 | 99 | 103 | 99 | 73 | 74 | 74 | 115 | 94 | 80 | 91 | 90 | 81 | 92 | 62 | 96 | 93 |
| 511 | 113 | 115 | 118 | 110 | 116 | 114 | 112 | 88 | 133 | 102 | 105 | 125 | 114 | 105 | 96 | 106 | 108 | 112 | 118 | 116 |
| 512 | 123 | 102 | 110 | 96 | 109 | 93 | 101 | 73 | 86 | 125 | 105 | 109 | 90 | 123 | 118 | 123 | 115 | 93 | 120 | 120 |
| 515 | 94 | 78 | 83 | 83 | 81 | 84 | 106 | 80 | 114 | 98 | 75 | 94 | 105 | 86 | 100 | 102 | 92 | 93 | 96 | 92 |
| 519 | 92 | 92 | 83 | 79 | 99 | 68 | 90 | 88 | 110 | 98 | 84 | 66 | 80 | 94 | 94 | 106 | 101 | 112 | 100 | 98 |
| 522 | 95 | 89 | 79 | 96 | 78 | 72 | 89 | 93 | 107 | 94 | 75 | 102 | 105 | 97 | 85 | 102 | 92 | 103 | 120 | 104 |
| 523 | 69 | 78 | 78 | 93 | 99 | 103 | 120 | 81 | 110 | 94 | 93 | 109 | 114 | 63 | 78 | 75 | 83 | 93 | 69 | 76 |
| 524 | 67 | 89 | 83 | 96 | 81 | 97 | 100 | 98 | 82 | 98 | 84 | 94 | 85 | 88 | 74 | 69 | 73 | 83 | 78 | 65 |
| 526 | 92 | 102 | 110 | 96 | 86 | 93 | 65 | 65 | 95 | 79 | 101 | 89 | 95 | 94 | 85 | 91 | 83 | 99 | 100 | 97 |
| 528 | 79 | 89 | 106 | 81 | 104 | 86 | 108 | 65 | 105 | 91 | 79 | 80 | 90 | 94 | 85 | 87 | 73 | 99 | 78 | 76 |
| 530 | 87 | 98 | 94 | 105 | 116 | 103 | 122 | 88 | 107 | 98 | 93 | 109 | 105 | 97 | 94 | 87 | 108 | 68 | 78 | 71 |
| 532 | 97 | 105 | 110 | 96 | 78 | 81 | 83 | 107 | 74 | 102 | 93 | 94 | 100 | 86 | 116 | 99 | 92 | 103 | 85 | 100 |
| 533 | 91 | 105 | 94 | 79 | 90 | 95 | 105 | 101 | 103 | 94 | 75 | 87 | 105 | 94 | 74 | 75 | 101 | 68 | 78 | 83 |
| 534 | 77 | 94 | 89 | | | | 69 | 59 | | | 97 | 94 | 135 | 73 | | 91 | 83 | 72 | | 83 |
| 536 | 83 | 92 | 110 | 84 | 81 | 77 | 92 | 76 | 74 | 84 | 75 | 80 | 90 | 81 | 80 | 87 | 92 | 72 | 103 | 97 |
| 539 | | | | 105 | 86 | 101 | | | 92 | 82 | | | | | 101 | 99 | 92 | | 91 | 98 |
| 359 | | | | 116 | 116 | 116 | | | 119 | 111 | | | | | 108 | 99 | 130 | | 113 | 101 |

N. B. Continued.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 331 | 113 | 95 | 94 | 96 | 90 | 97 | 100 | 103 | 119 | 88 | 97 | 80 | 90 | 111 | 106 | 109 | 101 | 87 | 98 | 98 |
| 334 | 110 | 125 | 110 | 105 | 116 | 95 | 103 | 113 | 100 | 115 | 110 | 102 | 109 | 107 | 116 | 129 | 115 | 123 | 105 | 116 |
| 335 | 110 | 115 | 122 | 116 | 116 | 114 | 103 | 103 | 78 | 107 | 101 | 94 | 123 | 94 | 121 | 123 | 108 | 134 | 120 | 137 |
| 337 | 95 | 102 | 94 | 93 | 81 | 91 | 84 | 96 | 103 | 94 | 84 | 109 | 95 | 103 | 87 | 102 | 115 | 93 | 85 | 103 |
| 340 | | | | 101 | 109 | 112 | | | 92 | 98 | | | | 104 | 102 | 101 | | | 81 | 103 |
| 343 | 113 | 105 | 94 | 105 | 81 | 95 | 85 | 115 | 89 | 84 | 101 | 94 | 114 | 120 | 106 | 109 | 101 | 103 | 96 | 119 |
| 344 | 119 | 102 | 118 | 89 | | 81 | 88 | 100 | 82 | 102 | | | | 100 | 110 | 123 | 119 | 75 | 98 | 95 |
| 345 | 85 | 85 | 79 | 81 | 75 | 79 | 67 | 90 | 105 | 115 | 93 | 87 | 95 | 63 | 85 | 106 | 92 | 90 | 81 | 93 |
| 346 | 108 | 110 | 110 | 110 | 109 | 103 | 93 | 75 | 86 | 79 | 110 | 94 | 114 | 73 | 102 | 109 | 92 | 90 | 91 | 100 |
| 351 | 123 | 125 | 131 | 110 | 109 | 123 | 113 | 107 | 117 | 107 | 121 | 125 | 123 | 109 | 114 | 123 | 138 | 146 | 133 | 141 |
| 357 | 107 | 115 | 118 | 121 | 104 | 103 | 117 | 118 | 113 | 94 | 110 | 125 | 114 | 103 | 110 | 102 | 115 | 93 | 100 | 108 |
| 358 | 111 | 115 | 110 | 116 | 109 | 121 | 90 | 90 | 112 | 102 | 101 | 109 | 114 | 112 | 104 | 106 | 108 | 93 | 91 | 107 |
| 361 | 85 | 89 | 87 | 132 | 109 | 84 | 111 | 80 | 124 | 107 | 97 | 109 | 123 | 103 | 81 | 102 | 108 | 103 | 109 | 112 |
| 363 | 100 | 102 | 106 | 96 | 109 | 116 | 90 | 114 | 111 | 111 | 97 | 109 | 109 | 105 | 98 | 109 | 92 | 96 | 107 | 100 |
| 364 | 123 | 110 | 135 | 121 | 109 | 93 | 86 | 114 | 86 | 125 | 110 | 102 | 100 | 107 | 114 | 113 | 115 | 120 | 111 | 112 |
| 366 | 121 | 115 | 98 | 121 | 109 | 118 | 110 | 127 | 119 | 125 | 115 | 116 | 95 | 114 | 96 | 117 | 123 | 112 | 113 | 119 |
| 368 | 102 | 105 | 94 | 93 | 90 | 105 | 91 | 105 | 123 | 107 | 115 | 119 | 118 | 94 | 108 | 91 | 92 | 99 | 98 | 93 |
| 369 | 100 | 105 | 106 | 116 | 109 | 110 | 101 | 101 | 95 | 115 | 84 | 80 | 100 | 109 | 101 | 113 | 108 | 99 | 98 | 93 |
| 371 | 83 | 78 | 101 | 79 | 94 | 110 | 97 | 100 | 103 | 74 | 89 | 102 | 95 | 94 | 85 | | | 99 | 91 | |
| 375 | 87 | 69 | 101 | 71 | 66 | 86 | 93 | 78 | 92 | 102 | 79 | 87 | 100 | 97 | 85 | 106 | 83 | 114 | 96 | 97 |
| 376 | 89 | 85 | 83 | 89 | 116 | 91 | 95 | 107 | 89 | 102 | 79 | 87 | 69 | 100 | 101 | 113 | 92 | 83 | 94 | 92 |
| 381 | 96 | 92 | 89 | 84 | 71 | 97 | 105 | 93 | 78 | 91 | 97 | 87 | 105 | 81 | 106 | 102 | 115 | 99 | 105 | 100 |
| 383 | 99 | 110 | 106 | 105 | 134 | 99 | 83 | 98 | 114 | 88 | 110 | 116 | 109 | 116 | 90 | 106 | 92 | 105 | 116 | 92 |
| 386 | 105 | 110 | 110 | 110 | 99 | 97 | 91 | 83 | 121 | 94 | 110 | 102 | 123 | 103 | 106 | 95 | 108 | 103 | 111 | 95 |
| 387 | 110 | 94 | 83 | 62 | 71 | 84 | 88 | 100 | 109 | 68 | 84 | 109 | 95 | | 98 | 91 | 108 | 79 | 100 | 92 |
| 389 | 92 | 95 | 89 | 93 | 109 | | 86 | 94 | | | 89 | 102 | 85 | 105 | 90 | 102 | 108 | 90 | 88 | 82 |
| 390 | | | | | | | | | | | | | | | | 99 | 108 | | | 90 |
| 403 | 101 | 97 | 94 | 89 | 109 | 118 | 115 | 97 | 112 | 94 | 97 | 109 | 130 | 81 | 100 | 113 | 101 | 128 | 122 | 137 |
| 404 | 125 | 115 | 101 | 127 | 109 | 125 | 132 | 118 | 115 | 133 | 121 | 102 | 114 | 133 | 110 | 123 | 123 | 103 | 109 | 113 |
| 408 | 118 | 125 | 126 | 110 | 99 | 110 | 120 | 123 | 98 | 94 | 115 | 87 | 114 | 109 | 110 | 106 | 119 | 112 | 103 | 109 |
| 409 | 121 | 115 | 122 | 116 | 116 | 134 | 124 | 125 | 101 | 107 | 115 | 94 | 130 | 127 | 127 | 123 | 123 | | 91 | 126 |
| 417 | 115 | 98 | 83 | 71 | 66 | 95 | 88 | 111 | 92 | 98 | 115 | 80 | 100 | 133 | 112 | 109 | 108 | 99 | 107 | 116 |
| 418 | 121 | 125 | 101 | 110 | 104 | 118 | 108 | 115 | 124 | 129 | 127 | 116 | 141 | 112 | 106 | 113 | 123 | 120 | 132 | 122 |
| 419 | 99 | 97 | 94 | 101 | 123 | 105 | 124 | 102 | 116 | 115 | 105 | 116 | 109 | 81 | 108 | 99 | 73 | 83 | 96 | 97 |
| 420 | 115 | 110 | 122 | 124 | 123 | 123 | 111 | 94 | 92 | 102 | 127 | 102 | 130 | 120 | 135 | 134 | 133 | 117 | 124 | 124 |
| 423 | 82 | 85 | 94 | 89 | 90 | 91 | 101 | 86 | 102 | 107 | 140 | 80 | 95 | 109 | 76 | 75 | 92 | 83 | 91 | 71 |
| 428 | 79 | 89 | 83 | 93 | 54 | 99 | 101 | 108 | 120 | 107 | 89 | 94 | 80 | 73 | 76 | 81 | 59 | 79 | 69 | 61 |
| 429 | 78 | 69 | 59 | 79 | 90 | 72 | 85 | 75 | 105 | 98 | | | | | 96 | 61 | 92 | 90 | 69 | 69 |
| 431 | 67 | 89 | 94 | 77 | 94 | 99 | 97 | 98 | 111 | 54 | 79 | 87 | 75 | 86 | 64 | 61 | 59 | 57 | 69 | 54 |
| 432 | 94 | 94 | 110 | 93 | 99 | 81 | 94 | 98 | 86 | 94 | 84 | 102 | 90 | 97 | 94 | 106 | 101 | 93 | 91 | 95 |

N. R. Continued.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 264 | 126 | 125 | 126 | 84 | 123 | 118 | 116 | 80 | 123 | 119 | 115 | 102 | 109 | 114 | 114 | 102 | 108 | 93 | 94 | 109 |
| 266 | 108 | 115 | 101 | 127 | 99 | 125 | 110 | 83 | 111 | 115 | 110 | 116 | 95 | 120 | 124 | 106 | 101 | 109 | 116 | 108 |
| 268 | 125 | 125 | 110 | 101 | 123 | 112 | 107 | 101 | 138 | 115 | 140 | 125 | 100 | 116 | 116 | 113 | 123 | 105 | 131 | 113 |
| 269 | 88 | 78 | 122 | 121 | 104 | 108 | 113 | 102 | 78 | 84 | 105 | 80 | 100 | 91 | 100 | 99 | 101 | 99 | 109 | 98 |
| 270 | 88 | 102 | 106 | 105 | 99 | 103 | 106 | 102 | 92 | 74 | 121 | 80 | 90 | 86 | 118 | 99 | 92 | 123 | 113 | 71 |
| 278 | 71 | 89 | 89 | 79 | 81 | 68 | 99 | 86 | 110 | 102 | 69 | 66 | 95 | 86 | 70 | 99 | 73 | 83 | 83 | 76 |
| 279 | 96 | 102 | 118 | 105 | 99 | 93 | 85 | 107 | 99 | 111 | 110 | 87 | 109 | 97 | 90 | 81 | 92 | 120 | 109 | 100 |
| 280 | 114 | 115 | 106 | 101 | 109 | 121 | 97 | 124 | 126 | 107 | 105 | 102 | 95 | 114 | 118 | 113 | 115 | 99 | 103 | 106 |
| 286 | 103 | 92 | 101 | 86 | 94 | 93 | 97 | 98 | 106 | 94 | 97 | 94 | 105 | 94 | 110 | 99 | 101 | 90 | 98 | 86 |
| 287 | 98 | 97 | 106 | 110 | 99 | 127 | 129 | 120 | 106 | 111 | 101 | 116 | 90 | 107 | 102 | 106 | 101 | 83 | 91 | 85 |
| 288 | 101 | 115 | 94 | 96 | 71 | 89 | 111 | 97 | 98 | 111 | 105 | 109 | 100 | 81 | 104 | 109 | 101 | 96 | 105 | 93 |
| 289 | 114 | 125 | | | 109 | 134 | 103 | 84 | | 98 | 110 | 116 | 114 | 114 | 118 | 129 | 127 | 117 | | |
| 290 | 117 | 125 | | | 109 | 139 | 95 | 67 | | 115 | 115 | 109 | 114 | 130 | 121 | 134 | 133 | 123 | | |
| 291 | 126 | 110 | 110 | 101 | 109 | 130 | 116 | 106 | 122 | 102 | 101 | 109 | 123 | 111 | 130 | 123 | 115 | 112 | 118 | |
| 293 | 107 | 110 | 110 | 96 | 104 | 99 | 107 | 88 | 127 | 107 | 105 | 134 | 69 | 105 | 96 | 134 | 115 | 103 | 107 | 106 |
| 294 | 103 | 100 | 110 | 116 | 99 | 101 | 89 | 105 | 107 | 91 | 89 | 102 | 95 | 120 | 104 | 123 | 108 | 120 | 107 | 126 |
| 296 | 76 | 89 | 110 | 86 | 109 | 89 | 100 | 93 | 114 | 102 | 97 | 109 | 130 | 91 | 83 | 87 | 73 | 109 | 100 | 95 |
| 297 | | | | 116 | 123 | 105 | 107 | 101 | 113 | 111 | 101 | 125 | 123 | | 92 | 99 | 101 | 75 | 113 | 90 |
| 298 | | | | 79 | 86 | 86 | 115 | 94 | 105 | 68 | 89 | 94 | 85 | | 85 | 91 | 92 | 87 | 111 | 86 |
| 299 | | | | 110 | 104 | 114 | | | 115 | 98 | | | | | 121 | 129 | 123 | | 111 | 122 |
| 300 | | | | 101 | 104 | 101 | | | 118 | 111 | | | | | 102 | 117 | 108 | | 78 | 124 |
| 301 | 101 | 100 | 89 | 93 | 109 | 86 | 66 | 84 | 78 | 107 | 105 | 116 | 114 | 100 | 102 | 106 | 92 | 96 | 116 | 101 |
| 302 | 78 | 89 | 89 | 96 | 109 | 84 | 95 | 114 | 96 | 119 | 97 | 102 | 80 | 86 | 75 | 75 | 83 | 75 | 75 | 80 |
| 304 | 104 | 115 | 101 | 110 | 104 | 93 | 100 | 94 | 68 | 79 | 110 | 94 | 85 | 97 | 81 | 109 | 101 | 105 | 94 | 98 |
| 305 | 102 | 92 | 110 | 83 | 99 | 93 | 75 | 100 | 98 | 98 | 89 | 94 | 95 | 127 | 108 | 129 | 119 | 103 | | 98 |
| 306 | 109 | 85 | 94 | 110 | 109 | 105 | 124 | 88 | 92 | 98 | 97 | 102 | 90 | 127 | 110 | 117 | 108 | 99 | 109 | 100 |
| 307 | 101 | 89 | 79 | 101 | 109 | 84 | 90 | 81 | 98 | 91 | 105 | 109 | 90 | 111 | 116 | 99 | 92 | 75 | 75 | 80 |
| 308 | 85 | 78 | 106 | | | | 85 | 96 | | | | 94 | 85 | 88 | | | | 99 | | |
| 309 | 106 | 125 | 118 | 105 | 94 | 77 | 116 | 113 | 96 | 84 | 110 | 109 | 85 | 116 | 116 | 99 | 108 | 126 | 109 | 104 |
| 311 | 92 | 69 | 106 | 89 | 90 | 81 | 106 | 105 | 107 | 98 | 89 | 109 | 100 | 105 | 98 | 99 | 115 | 99 | 91 | 107 |
| 312 | 105 | 110 | 110 | 116 | 104 | 97 | 113 | 118 | 114 | 107 | 115 | 109 | 105 | 112 | 116 | 109 | 115 | 120 | 120 | 123 |
| 313 | 82 | 85 | 83 | 81 | 99 | 79 | 84 | 76 | 92 | 79 | 75 | 94 | 114 | 81 | 85 | 95 | 108 | 87 | 81 | 100 |
| 314 | 143 | 125 | 131 | 127 | 123 | 134 | 111 | 119 | 126 | 102 | 115 | 125 | 123 | 123 | 118 | 123 | 123 | 105 | 118 | 107 |
| 316 | 105 | 115 | 115 | 93 | 104 | 59 | 79 | 114 | 119 | 111 | 121 | 94 | 114 | 109 | 98 | 106 | 108 | 96 | 83 | 88 |
| 318 | 129 | 115 | 118 | 116 | 86 | 112 | 88 | 102 | 107 | 107 | 140 | | 130 | 105 | 96 | 117 | 130 | 123 | 116 | 121 |
| 323 | 94 | 115 | 126 | 110 | 104 | 105 | 101 | 106 | 78 | 115 | 84 | 102 | 118 | 94 | 106 | 113 | 101 | 93 | 88 | 116 |
| 324 | 108 | 78 | 106 | 116 | 90 | 116 | 101 | 102 | 89 | 94 | 105 | 102 | 105 | 116 | 98 | 129 | 101 | 105 | 126 | 125 |
| 325 | 93 | 78 | 89 | 84 | 94 | 93 | 94 | 94 | 59 | 79 | 84 | 102 | 95 | 94 | 90 | | | 117 | 105 | |
| 326 | 114 | 125 | 115 | 105 | 116 | 101 | 111 | 103 | 112 | 102 | 115 | 102 | 100 | 107 | 104 | 113 | 108 | 90 | 94 | 110 |
| 330 | 100 | 105 | 115 | 93 | 104 | 132 | 92 | 125 | 110 | 119 | 121 | 116 | 118 | 94 | 85 | 106 | 101 | 112 | 98 | 119 |

N.B Normalized Scores. (M = 100, S.D. = 15)

TABLE III

| CHILD NO | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 10 | 108 | 105 | 101 | 116 | 104 | 114 | 97 | 108 | | 98 | 101 | 87 | 109 | 116 | 124 | 117 | 123 | 123 | 107 | 113 |
| 14 | 117 | 110 | 115 | 96 | 109 | 118 | 81 | 103 | | 119 | 105 | 134 | 123 | 118 | 118 | 113 | 119 | 93 | 94 | 100 |
| 16 | 96 | 78 | 101 | 101 | 86 | 99 | 84 | 108 | | 98 | 93 | 109 | 118 | 97 | 104 | | | 109 | 98 | |
| 17 | 123 | 105 | 106 | 110 | 123 | 127 | 125 | 128 | | 119 | 105 | 116 | | 109 | 116 | 113 | 119 | 114 | 100 | 114 |
| 18 | 108 | 98 | 83 | 62 | 75 | 89 | 95 | 103 | | 111 | 89 | 87 | 146 | 123 | 100 | 95 | 108 | 105 | 100 | 97 |
| 23 | 77 | 95 | 73 | 93 | 81 | 91 | 97 | 122 | | 111 | 84 | 73 | 80 | 63 | 67 | 61 | 73 | 87 | 69 | 71 |
| 34 | 100 | 115 | 115 | 105 | 109 | 123 | 122 | 110 | | 122 | 110 | 102 | 118 | 97 | 101 | 95 | 83 | 87 | 91 | 106 |
| 36 | 93 | 100 | 110 | 89 | 94 | 91 | 121 | 93 | | 115 | 115 | 94 | 90 | 81 | 108 | 95 | 92 | 93 | 85 | 85 |
| 74 | 100 | 92 | 115 | 101 | 104 | 114 | 121 | 113 | | 115 | 84 | 102 | 118 | 109 | 102 | 87 | 92 | 93 | 98 | 90 |
| 77 | 112 | 115 | 118 | 116 | 104 | 110 | 101 | 115 | | 98 | 110 | 102 | 109 | 118 | 116 | 99 | 115 | 109 | 116 | 113 |
| 81 | 82 | 85 | 76 | 74 | 75 | 79 | 76 | 110 | | 74 | 79 | 80 | 100 | 91 | 83 | 95 | 92 | 93 | 113 | 88 |
| 85 | 107 | 115 | 110 | 101 | 104 | 110 | 127 | 100 | | 84 | 97 | 94 | 109 | 116 | 92 | 109 | 108 | 105 | 111 | 98 |
| 89 | 113 | 110 | 115 | 96 | 116 | 93 | 100 | 107 | | 125 | 115 | 94 | 123 | 130 | 110 | 95 | 108 | 109 | 126 | 112 |
| 92 | 117 | 100 | 118 | 96 | 99 | | 122 | 119 | | | 110 | 87 | 114 | 127 | 110 | | 92 | 93 | 96 | 95 |
| 97 | 99 | 94 | 76 | 71 | 90 | 95 | 105 | 93 | | 129 | 79 | 80 | 105 | 91 | 83 | 106 | 92 | 87 | 120 | 109 |
| 103 | 79 | 69 | 94 | 77 | 94 | 103 | 124 | 88 | | 88 | 84 | 102 | 90 | 88 | 76 | 81 | 83 | 75 | 98 | 92 |
| 108 | | | | 105 | 99 | 99 | | | | 98 | | | | | 90 | 102 | 92 | | 98 | 103 |
| 111 | | | | 110 | 116 | 112 | | | | 133 | | | | | 92 | 109 | 101 | | 81 | 93 |
| 124 | | | | 93 | 99 | 95 | | | | 107 | | | | | 90 | 102 | 92 | | 81 | 88 |
| 137 | 106 | 105 | 101 | 105 | 116 | 105 | 140 | 122 | | | 110 | 116 | 114 | 102 | 100 | 95 | 115 | 126 | 85 | 100 |
| 139 | 79 | 89 | 65 | 81 | 78 | 86 | 92 | 98 | | | 93 | 73 | 75 | 88 | 57 | 99 | 92 | 83 | 75 | 71 |
| 144 | 86 | 78 | 101 | 96 | 109 | 95 | 110 | 118 | | | 69 | 94 | 75 | 100 | 87 | 97 | 115 | 65 | 75 | 82 |
| 148 | | | | 140 | 123 | 139 | | | | | | | | | 96 | 87 | 101 | | 81 | 97 |
| 156 | 106 | 105 | 110 | 105 | 116 | 116 | 122 | 134 | | | 115 | 87 | 118 | 103 | 98 | 91 | 101 | 109 | 113 | 110 |
| 158 | 90 | 102 | 106 | 116 | 104 | 121 | 100 | 120 | | | 101 | 116 | 109 | 114 | 83 | 95 | 101 | 83 | 78 | 90 |
| 159 | 70 | 98 | 89 | 86 | 86 | 72 | 95 | 97 | | | 79 | 80 | 69 | 63 | 89 | 87 | 83 | 79 | 69 | 76 |
| 164 | | | | 77 | 78 | 84 | | | | | | | | | 70 | 69 | 92 | | 78 | 100 |
| 249 | 93 | 92 | 106 | 89 | 90 | 101 | 97 | 94 | 102 | 91 | 93 | 80 | 85 | 81 | 90 | 113 | 101 | 87 | 78 | 95 |
| 250 | 125 | 110 | 122 | 110 | 116 | 121 | 120 | 81 | 119 | 107 | 110 | 116 | 123 | 130 | 116 | 109 | 123 | 114 | 111 | 117 |
| 251 | 121 | 105 | 101 | 74 | 99 | 101 | 119 | 105 | 107 | 91 | 115 | 87 | 90 | 120 | 124 | 117 | 127 | 112 | 118 | 116 |
| 252 | 121 | 115 | 106 | 132 | 109 | 121 | 115 | 93 | 122 | 125 | 110 | 102 | 118 | 127 | 127 | 123 | 130 | 93 | 118 | 113 |
| 254 | 105 | 110 | 110 | 93 | 116 | 103 | 92 | 54 | 110 | 125 | 101 | 94 | 118 | 94 | 98 | 99 | 101 | 75 | 116 | 85 |
| 255 | 108 | 115 | 69 | 127 | 104 | | 99 | 61 | | | 101 | 109 | 85 | 91 | 104 | | | 83 | 111 | |
| 256 | 97 | 78 | 76 | 93 | 99 | 105 | 106 | 101 | 110 | 107 | 89 | 102 | 95 | 107 | 106 | 99 | 83 | 68 | 85 | 100 |
| 258 | 102 | 95 | 83 | 101 | 86 | 84 | 88 | 93 | 111 | 79 | 89 | 87 | 100 | 91 | 102 | 91 | 101 | 96 | 96 | 95 |
| 259 | 90 | 89 | 115 | 84 | 86 | 93 | 88 | 111 | 86 | 122 | 105 | 102 | 60 | 73 | 112 | 106 | 101 | 87 | | 106 |
| 263 | 112 | 125 | 87 | 116 | 104 | 110 | 105 | 88 | 115 | 119 | 115 | 141 | 80 | 107 | 83 | 106 | 101 | 112 | | 109 |

TABLE III

Notes on the nature of the Tests.

- Test 0. Moray House Junior Intelligence Test.
A general test. It was the first set.
- Test 1. Geometrical Analogies. Analogies in which geometrical figures are presented.
- Test 2. Doesn't Belong. 5 geometrical figures have something alike, the 6th., has not got this likeness.
- Test 3. Rows and Columns. One of 5 squares containing geometrical figures has to be chosen to complete a larger square.
- Test 4. Pattern Completion. Similar to the above but the large square contains a pattern to be completed.
- Test 5. Recognition of Figures. A geometrical figure such as the letter, A, is to be recognised the same way up in more complicated figures.
- Test 6. Triangles (Form). Triangles are to be recognised when turned round.
- Test 7. Triangles (Orientation). Another marking of the same test measures ability to distinguish between mirror images of triangles.
- Test 8. Moray House Space Test 4. In 3-dimensional drawings of blocks the number of blocks which lettered blocks touch is to be determined.
- Test 9. Links. The wooden apparatus attached to the blackboard. To determine ability in visualising change of shape.
- Test 10. Picture Analogies.
- Test 11. Picture Sequences.
- Test 12. Picture, 2 Alike. In what they do or are used for.
- Test 13. Numerical II. Series Continuation.
A series of numbers is to be extended to see whether the pattern of the series is grasped.
- Test 14. Numerical I. Arithmetical Restorations.
Sums with blanks left are to be completed.
- Test 15. Arithmetic (Mechanical). An arithmetic paper of attainment in arithmetic processes.
- Test 16. Arithmetic (Problems). Similar but with problems.
- Test 17. Synonyms. Words with the same meanings are to be underlined. This is largely a vocabulary test.
- Test 18. Proverbs (Story). This is to test reading comprehension.
- Test 19. English. This is a paper on English attainment consisting of questions on parsing, clauses and correction of local dialect.

At the time of test construction it was intended that they should fall into groups, each measuring a mental ability. Thus, roughly speaking, Tests 15, 16, 17, 18, 19 were to measure school attainment. Tests 13 & 14, native number ability. Tests 10, 11, 12 to see whether certain children excelled when the material was presented in the form of pictures. Tests 5, 6, 7, 8, 9 to measure Spatial Ability or the power to visualise shapes - possibly connected with Mechanical Ability. Tests 1, 2, 3, 4 to test pure native ability to reason, divorced from the above special abilities.

Whether this a priori grouping will hold or what is the actual grouping obtaining is my present research problem for which a recently devised

statistical technique, called Factorial Analysis is being used. One of the practical uses of this analysis is the construction of a short battery taking about $2\frac{1}{2}$ hours instead of $2\frac{1}{2}$ days to give, which might be used for various purposes. With a population unexplored by previous mental testing this preliminary analysis seems necessary.

I have sent copies of the scores to the head teachers concerned, with suggestions about how they may help them, and a warning about telling the children of their results.

Yours sincerely,

NOTE

"a" stands for absent

"c" is when one child has copied from another.

When it has been impossible to decide which has cheated a "c" is entered for both.

The Director of Education,
Trinidad".

Unfortunately I have mislaid my copy of the letters sent to the head teachers. They were very similar to the above but in addition they contained suggestions about how the scores might help in the teaching. The head teachers were asked to express their views on the testing and stamped addressed air letter forms were enclosed for this purpose.

The following are extracts from their replies:

"Tests 5, 6, 7, 8, 9 proved to be almost true to those who scored high - good at handwork - some with aptitude to become motor mechanics."

"The greater number of those who scored low, apart from those naturally backward, were irregular at school, mal-nourished, and from poor environment - sugar cane estates."

"I think this type of work is likely to be valuable".

"Children who were selected as the best pupils of the upper division before arrival of your results proved to be the very ones who have excelled in the tests."

"The tests are useful in that they help in the classification of pupils according to intelligence. The results will be quite useful to us in determining the general ability of each child and in what direction special training can be given."

"Your results are true to the abilities of all the boys tested except in the case of ----- whose scores in 4, 6, 7, 9, 10, 11, 12 & 13 are baffling."

"Your work seems tremendous."

"Your research must prove of inestimable value to

educationists generally."

"This type of mental tests is inevitably valuable, but there should be an aim in view. My humble opinion is that these tests should be conducted on a large scale in the West Indies in general but at Trinidad Barbadoes and Jamaica in particular . . . These are my humble observations. If I have erred I beg to be excused."

THE CORRELATIONS

Each computer was supplied with a copy of each of Tables III, IV and V. All the data possible were used. That is to say a child did not have to do all the tests for his scores to be used. If with two tests being correlated a score on one came opposite a blank on the other naturally this score could not be used, but it was used when it came opposite a score for another correlation. It was felt that a great deal of data would be wasted and less reliable coefficients obtained if this procedure was not adopted, but it meant that the N's varied from one correlation to another and the S.D's had to be worked with each.

The diagonal method was used. Forms, an example of which is put in here, were duplicated. f_x , f_y , N , ΣX , ΣY , $\Sigma (Y - X)$, ΣX^2 , ΣY^2 , $\Sigma (Y - X)^2$ were all subjected to independent checks. The subsequent working out by 4-figure logarithms was checked by Mr. Murrell. The 171 correlations for each of these populations N.B., N.G., I.B., are given in the upper right hand halves in Tables VI, VII & VIII. In the lower left hand halves are entered the N's used. Some idea of the Sampling Errors to be expected is shown in Table IX worked out from Table VII of Statistical Tables, Fisher and Yates.

TABLE IX

| P | 000 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 |
|-----|------|------|-----|-----|-----|-----|-----|-----|-----|
| 50 | +185 | 279 | 371 | 460 | 545 | 627 | 706 | 783 | 858 |
| | -185 | -087 | 016 | 122 | 233 | 348 | 467 | 592 | 722 |
| 70 | +155 | 251 | 345 | 435 | 523 | 608 | 691 | 771 | 849 |
| | -155 | -056 | 046 | 143 | 262 | 375 | 491 | 611 | 736 |
| 90 | +136 | 233 | 328 | 419 | 509 | 597 | 681 | 763 | 844 |
| | -136 | -037 | 056 | 171 | 280 | 391 | 505 | 623 | 745 |
| 110 | +123 | 220 | 316 | 409 | 499 | 588 | 673 | 758 | 840 |
| | -123 | -024 | 079 | 184 | 291 | 402 | 515 | 631 | 750 |
| 130 | +114 | 211 | 307 | 400 | 491 | 581 | 668 | 754 | 837 |
| | -114 | -014 | 089 | 194 | 300 | 410 | 522 | 637 | 755 |
| 150 | +106 | 203 | 299 | 393 | 485 | 576 | 664 | 750 | 835 |
| | -106 | -006 | 097 | 201 | 308 | 417 | 528 | 642 | 758 |

P is the population correlation coefficient.

N is the number in the sample.

.1 is the probability of a sample correlation exceeding the upper of the pair of numbers in the table. .1 is also the probability of a sample correlation being less than the lower of the pair of numbers.

* A table giving checked values for f_x for all columns of Tables III, IV & V were prepared. The f_x 's and the f_y 's were checked against these, deductions being made for unpaired scores, so that with the N's checking it was possible to make sure that a tally had not been put into the wrong square.

TEST No.

TEST NAME

TEST No.
TEST NAME

| | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | |
|------------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 140 | | | | | | | | | | | | | | | | | | | 140 |
| 135 | | | | | | | | | | | | | | | | | | | 135 |
| 130 | | | | | | | | | | | | | | | | | | | 130 |
| 125 | | | | | | | | | | | | | | | | | | | 125 |
| 120 | | | | | | | | | | | | | | | | | | | 120 |
| 115 | | | | | | | | | | | | | | | | | | | 115 |
| 110 | | | | | | | | | | | | | | | | | | | 110 |
| 105 | | | | | | | | | | | | | | | | | | | 105 |
| 100 | | | | | | | | | | | | | | | | | | | 100 |
| 95 | | | | | | | | | | | | | | | | | | | 95 |
| 90 | | | | | | | | | | | | | | | | | | | 90 |
| 85 | | | | | | | | | | | | | | | | | | | 85 |
| 80 | | | | | | | | | | | | | | | | | | | 80 |
| 75 | | | | | | | | | | | | | | | | | | | 75 |
| 70 | | | | | | | | | | | | | | | | | | | 70 |
| 65 | | | | | | | | | | | | | | | | | | | 65 |
| 60 | | | | | | | | | | | | | | | | | | | 60 |
| 55 | | | | | | | | | | | | | | | | | | | 55 |
| f_x | | | | | | | | | | | | | | | | | | | |
| d_x | -8 | -7 | -6 | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| $\sum X$ | | | | | | | | | | | | | | | | | | | |
| $\sum X^2$ | | | | | | | | | | | | | | | | | | | |

| f_y | Y | Y^2 | f_{x-y} | $X-Y$ | $(X-Y)^2$ | f_{x+y} | $X+Y$ | $(X+Y)^2$ |
|-------|-----|-------|-----------|-------|-----------|-----------|-------|-----------|
| | 18 | | | | | | | |
| | 17 | | | | | | | |
| | 16 | | | | | | | |
| | 15 | | | | | | | |
| | 14 | | | | | | | |
| | 13 | | | | | | | |
| | 12 | | | | | | | |
| | 11 | | | | | | | |
| | 10 | | | | | | | |
| | 9 | | | | | | | |
| | 8 | | | | | | | |
| | 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 | | | | | | | |

Checks:

- (1) Check each N
- (2) $\sum(X-Y) = \sum X - \sum Y$
 $\sum X - \sum Y =$ _____
- (3) $\sum(X+Y) = \sum X + \sum Y$
 $\sum X + \sum Y =$ _____
- (4) $\sum(X-Y)^2 + \sum(X+Y)^2 = 2(\sum X^2 + \sum Y^2)$
 $\sum(X-Y)^2 + \sum(X+Y)^2 =$ _____
 $\sum X^2 + \sum Y^2 =$ _____ $2(\sum X^2 + \sum Y^2) =$ _____

$r = \frac{A + B - C}{\sqrt{4AB}}$
 $A = N \sum X^2 - (\sum X)^2$
 $B = N \sum Y^2 - (\sum Y)^2$
 $C = N \sum(X-Y)^2 - \sum(X-Y)$

N
 $\sum X$
 $\sum X^2$

N $\sum Y$ $\sum Y^2$ $N \sum(X-Y)(X-Y)$ $N \sum(X+Y)(X+Y)$

Signature of Computer

$r =$

TABLES VI, VII, and VIII

TABLE VIII

INDIAN BOYS

Correlations and Sample Sizes

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
|----|-----|-----|-----|-----|-----|-----|-----|-----|------|-----|-----|------|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | | 408 | 508 | 552 | 327 | 236 | 137 | 160 | 430 | 594 | 452 | 327 | 418 | 524 | 244 | 502 | 318 | 360 | 407 | 1 |
| 2 | 107 | | 464 | 244 | 353 | 217 | 167 | 169 | 263 | 366 | 285 | 292 | 280 | 277 | 291 | 297 | 226 | 321 | 384 | 2 |
| 3 | 107 | 107 | | 402 | 389 | 233 | 343 | 025 | 332 | 500 | 371 | 412 | 426 | 386 | 329 | 411 | 250 | 306 | 321 | 3 |
| 4 | 107 | 107 | 118 | | 307 | 130 | 220 | 165 | 362 | 456 | 446 | 266 | 261 | 413 | 328 | 448 | 318 | 382 | 167 | 4 |
| 5 | 107 | 107 | 118 | 117 | | 346 | 097 | 102 | 203 | 385 | 373 | 196 | 174 | 169 | 198 | 268 | 224 | 376 | 270 | 5 |
| 6 | 106 | 106 | 112 | 112 | 111 | | 269 | 104 | 073 | 185 | 194 | 090 | 140 | 141 | 018 | 096 | 200 | 387 | 213 | 6 |
| 7 | 106 | 106 | 112 | 112 | 111 | 112 | | 082 | 091 | 128 | 174 | 056 | 085 | 157 | 057 | 072 | 059 | 101 | 095 | 7 |
| 8 | 59 | 59 | 63 | 63 | 63 | 61 | 61 | | -097 | 147 | 202 | -078 | 230 | 040 | 220 | 221 | 055 | 259 | 209 | 8 |
| 9 | 91 | 91 | 102 | 101 | 101 | 97 | 97 | 59 | | 300 | 247 | 131 | 266 | 215 | 124 | 221 | 266 | 042 | 100 | 9 |
| 10 | 107 | 107 | 113 | 113 | 112 | 112 | 112 | 61 | 97 | | 467 | 372 | 355 | 388 | 350 | 489 | 384 | 470 | 444 | 10 |
| 11 | 106 | 106 | 112 | 112 | 111 | 111 | 111 | 61 | 97 | 112 | | 290 | 227 | 174 | 145 | 240 | 160 | 259 | 219 | 11 |
| 12 | 107 | 107 | 113 | 113 | 112 | 112 | 112 | 61 | 97 | 113 | 112 | | 199 | 277 | 203 | 261 | 336 | 278 | 232 | 12 |
| 13 | 106 | 106 | 106 | 106 | 106 | 105 | 105 | 58 | 90 | 106 | 105 | 106 | | 389 | 419 | 559 | 313 | 337 | 381 | 13 |
| 14 | 107 | 107 | 119 | 119 | 118 | 112 | 112 | 63 | 102 | 113 | 112 | 113 | 106 | | 540 | 523 | 264 | 343 | 411 | 14 |
| 15 | 102 | 102 | 113 | 113 | 113 | 106 | 106 | 59 | 96 | 107 | 106 | 107 | 101 | 114 | | 723 | 368 | 588 | 588 | 15 |
| 16 | 102 | 102 | 114 | 114 | 113 | 107 | 107 | 59 | 97 | 108 | 107 | 108 | 101 | 115 | 115 | | 387 | 591 | 512 | 16 |
| 17 | 106 | 106 | 112 | 112 | 111 | 111 | 111 | 60 | 96 | 112 | 111 | 112 | 105 | 112 | 106 | 107 | | 496 | 479 | 17 |
| 18 | 106 | 106 | 118 | 118 | 117 | 111 | 111 | 63 | 101 | 112 | 111 | 112 | 105 | 119 | 115 | 116 | 111 | | 594 | 18 |
| 19 | 102 | 102 | 114 | 114 | 113 | 107 | 107 | 59 | 97 | 108 | 107 | 108 | 102 | 115 | 115 | 116 | 107 | 116 | | 19 |

Correlations upper right, Sample Sizes lower left.

TABLE VII

NEGRO GIRLS

Correlations and Sample Sizes

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | | 455 | 654 | 572 | 407 | 252 | 388 | 140 | 528 | 633 | 530 | 456 | 641 | 586 | 518 | 505 | 546 | 550 | 601 | 1 |
| 2 | 108 | | 437 | 352 | 486 | 226 | 466 | 291 | 492 | 488 | 438 | 445 | 547 | 580 | 468 | 461 | 278 | 483 | 501 | 2 |
| 3 | 107 | 107 | | 625 | 576 | 343 | 308 | 226 | 585 | 595 | 547 | 380 | 528 | 603 | 536 | 464 | 383 | 444 | 582 | 3 |
| 4 | 106 | 106 | 113 | | 508 | 221 | 374 | 202 | 554 | 624 | 483 | 416 | 496 | 499 | 336 | 366 | 325 | 356 | 428 | 4 |
| 5 | 106 | 106 | 113 | 112 | | 228 | 252 | 133 | 697 | 557 | 457 | 342 | 565 | 561 | 623 | 474 | 406 | 598 | 611 | 5 |
| 6 | 108 | 108 | 107 | 106 | 106 | | 311 | 328 | 282 | 324 | 144 | 178 | 314 | 327 | 360 | 221 | 240 | 306 | 473 | 6 |
| 7 | 110 | 108 | 107 | 106 | 106 | 108 | | 155 | 365 | 335 | 338 | 266 | 454 | 338 | 295 | 285 | 293 | 316 | 314 | 7 |
| 8 | 83 | 83 | 87 | 86 | 86 | 83 | 83 | | 293 | 263 | 204 | 406 | 108 | 159 | 141 | 216 | 090 | 226 | 332 | 8 |
| 9 | 100 | 100 | 106 | 105 | 105 | 100 | 100 | 85 | | 537 | 462 | 412 | 557 | 547 | 462 | 407 | 434 | 409 | 532 | 9 |
| 10 | 107 | 107 | 107 | 106 | 106 | 107 | 107 | 84 | 99 | | 589 | 582 | 602 | 635 | 536 | 465 | 501 | 598 | 670 | 10 |
| 11 | 107 | 107 | 106 | 105 | 105 | 107 | 107 | 83 | 99 | 107 | | 510 | 468 | 595 | 419 | 420 | 495 | 530 | 476 | 11 |
| 12 | 107 | 107 | 106 | 105 | 105 | 107 | 107 | 83 | 99 | 107 | 107 | | 423 | 466 | 366 | 431 | 450 | 476 | 595 | 12 |
| 13 | 107 | 107 | 106 | 105 | 105 | 107 | 101 | 83 | 100 | 106 | 106 | 106 | | 683 | 537 | 498 | 462 | 534 | 633 | 13 |
| 14 | 106 | 106 | 113 | 112 | 113 | 106 | 106 | 86 | 105 | 106 | 105 | 105 | 105 | | 691 | 603 | 457 | 539 | 620 | 14 |
| 15 | 101 | 102 | 108 | 107 | 107 | 102 | 102 | 82 | 101 | 102 | 101 | 101 | 101 | 107 | | 605 | 469 | 616 | 692 | 15 |
| 16 | 102 | 102 | 108 | 106 | 107 | 102 | 102 | 82 | 102 | 102 | 101 | 101 | 101 | 107 | 111 | | 449 | 606 | 569 | 16 |
| 17 | 103 | 107 | 108 | 106 | 107 | 107 | 107 | 83 | 101 | 106 | 106 | 106 | 106 | 107 | 103 | 103 | | 606 | 577 | 17 |
| 18 | 103 | 103 | 110 | 109 | 110 | 103 | 103 | 83 | 102 | 103 | 102 | 102 | 102 | 110 | 105 | 105 | 104 | | 708 | 18 |
| 19 | 102 | 102 | 108 | 107 | 107 | 102 | 102 | 82 | 102 | 102 | 101 | 101 | 101 | 107 | 111 | 112 | 103 | 105 | | 19 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |

Correlations upper right, Sample Sizes lower left.

TABLE VI

NEGRO BOYS

Correlations and Sample Sizes

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
|----|------------|------------|------------|------------|------------|------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | | 503 | 561 | 408 | 494 | 218 | 167 | 327 | 330 | 625 | 422 | 318 | 435 | 490 | 480 | 534 | 456 | 427 | 481 | 1 |
| 2 | 137 | | 436 | 570 | 455 | 255 | 274 | 020 | 198 | 410 | 245 | 319 | 319 | 488 | 441 | 457 | 387 | 366 | 483 | 2 |
| 3 | 134 | 134 | | 544 | 594 | 336 | 189 | 133 | 274 | 480 | 488 | 257 | 376 | 422 | 343 | 401 | 346 | 312 | 390 | 3 |
| 4 | 134 | 132 | 143 | | 484 | 395 | 031 | 292 | 381 | 394 | 463 | 268 | 384 | 370 | 324 | 346 | 203 | 256 | 278 | 4 |
| 5 | 134 | 132 | 143 | 143 | | 470 | 270 | 330 | 331 | 438 | 438 | 360 | 426 | 425 | 385 | 426 | 312 | 283 | 409 | 5 |
| 6 | 139 | 137 | 136 | 136 | 136 | | 250 | 338 | 208 | 219 | 267 | 079 | 226 | 253 | 072 | 170 | 121 | 137 | 133 | 6 |
| 7 | 139 | 137 | 136 | 136 | 136 | 141 | | 381 | 177 | 175 | 085 | 040 | 178 | 142 | 106 | 202 | 206 | 030 | 243 | 7 |
| 8 | 111 | 111 | 117 | 115 | 118 | 113 | 113 | | 309 | 246 | 418 | 218 | 219 | 051 | 116 | 188 | 074 | 122 | 094 | 8 |
| 9 | 127 | 125 | 134 | 134 | 137 | 129 | 129 | 117 | | 338 | 318 | 230 | 215 | 253 | 258 | 239 | 158 | 161 | 208 | 9 |
| 10 | 133 | 131 | 131 | 134 | 131 | 135 | 135 | 108 | 124 | | 435 | 308 | 386 | 476 | 328 | 477 | 437 | 446 | 404 | 10 |
| 11 | 136 | 134 | 133 | 134 | 133 | 138 | 138 | 110 | 126 | 134 | | 244 | 302 | 306 | 351 | 373 | 262 | 333 | 376 | 11 |
| 12 | 136 | 134 | 133 | 134 | 133 | 138 | 138 | 111 | 126 | 134 | 137 | | 275 | 349 | 270 | 357 | 382 | 483 | 474 | 12 |
| 13 | 137 | 135 | 132 | 132 | 132 | 137 | 137 | 109 | 125 | 132 | 135 | 135 | | 561 | 536 | 600 | 383 | 464 | 490 | 13 |
| 14 | 137 | 135 | 146 | 146 | 146 | 137 | 139 | 118 | 137 | 134 | 136 | 136 | 135 | | 628 | 606 | 457 | 530 | 566 | 14 |
| 15 | 130 | 128 | 138 | 139 | 140 | 132 | 132 | 113 | 131 | 129 | 129 | 129 | 128 | 141 | | 690 | 514 | 565 | 706 | 15 |
| 16 | 131 | 129 | 139 | 140 | 140 | 133 | 133 | 113 | 131 | 130 | 130 | 130 | 129 | 142 | 143 | | 514 | 537 | 657 | 16 |
| 17 | 138 | 136 | 135 | 135 | 135 | 140 | 140 | 112 | 128 | 134 | 137 | 137 | 137 | 138 | 131 | 132 | | 590 | 671 | 17 |
| 18 | 132 | 132 | 143 | 141 | 141 | 134 | 134 | 115 | 132 | 129 | 131 | 131 | 130 | 144 | 136 | 137 | 133 | | 692 | 18 |
| 19 | 128 | 128 | 138 | 137 | 137 | 130 | 130 | 112 | 128 | 127 | 127 | 127 | 126 | 139 | 140 | 141 | 129 | 136 | | 19 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |

Correlations upper right, Sample Sizes lower left.

Thurstone's "Complete centroid method" was used and five factors were extracted in each of the samples of the populations of Negro Boys (N.B.), Negro Girls (N.G.), and Indian Boys (I.B.). The loadings on these, together with the communalities obtained and the original guessed communalities (in brackets), are shown in Tables X, XI and XII. The guessed communalities. For the Negro Boys the communalities for the first factor which were used were estimated by Medland's method, using 4-test grouping, as described in The Factorial Analysis of Human Ability, Godfrey H. Thomson. For the other factors the communalities were adjusted by taking the highest coefficient in each column. Communalities were also estimated from the same 4-test groupings by the formula, $h_1^2 = \sqrt{(r_{12}^2 r_{13}^2 r_{14}^2 / r_{23} r_{24} r_{34})}$, a modification of Spearman's 3-test formula given in Thurstone's Multiple-Factor Analysis. Since it was found that the communalities estimated by these methods were no nearer the communalities actually obtained than were the highest coefficients in the columns, it was decided, for the sake of expediency, to use these highest coefficients for the other centroid analyses. It is to be noted that the greatest discrepancy between the guessed and found communalities occurs with Test 8 for the N.B.'s .617, .355 was estimated by Medford's method. The estimation by the method of Spearman, modified by Thurstone was found to be .340, and the highest correlation coefficient in the column was .418. The communality of Test 8 will be dealt with at length later.

Determination of the number of factors to extract.

In all cases Guilford's, Burt's and McNemar's criteria were used as recommended by P. E. Veron in "How Many Factors?" With Guilford the product of the 2 highest loadings should not fall much below the S.E. of zero r. The formula of Burt's used was $S.E. = (1 - r_{j_s}^2)$

NEGRO BOYS

FACTOR MATRIX F₀ (Unrotated)

| TEST | Centroid Factors | | | | | h ² | (h ²) |
|---------------------------------------|------------------|------|------|------|------|----------------|-------------------|
| | I | II | III | IV | V | | |
| 1. Geometrical Analogies | 731 | +106 | -078 | -119 | -197 | 605 | (630) |
| 2. Doesn't Belong | 635 | +045 | +230 | -232 | -222 | 560 | (585) |
| 3. Rows and Columns | 660 | +251 | +171 | -246 | -046 | 591 | (620) |
| 4. Pattern Completion | 610 | +324 | +297 | -217 | +290 | 696 | (538) |
| 5. Recognition of Figures | 692 | +284 | +144 | +061 | +057 | 588 | (538) |
| 6. Triangles (Form) | 396 | +365 | +140 | +165 | +135 | 355 | (357) |
| 7. Triangles (Orientation) | 302 | +196 | -097 | +323 | -301 | 334 | (287) |
| 8. M. H. Space 4 (Blocks) | 372 | +368 | -364 | +370 | +272 | 617 | (355) |
| 9. Links (Wooden Apparatus) | 433 | +227 | -106 | +087 | +081 | 264 | (318) |
| 10. Picture Analogies | 668 | +111 | -166 | -152 | -108 | 521 | (572) |
| 11. Picture Sequences | 577 | +224 | -104 | -064 | +162 | 424 | (430) |
| 12. Picture, 2 Alike | 493 | -149 | -193 | -116 | +218 | 364 | (365) |
| 13. Numerical II. Series continuation | 644 | -179 | +169 | +215 | +061 | 525 | (537) |
| 14. Numerical I. Arith Restorations | 699 | -256 | +232 | +046 | -054 | 613 | (564) |
| 15. Arithmetic (Mechanical) | 689 | -388 | +143 | +110 | -081 | 664 | (712) |
| 16. Arithmetic (Problems) | 743 | -297 | +086 | +115 | -088 | 668 | (668) |
| 17. Synonyms | 621 | -329 | -188 | -140 | -165 | 576 | (585) |
| 18. Proverbs (Story) | 648 | -430 | -169 | -170 | +170 | 691 | (630) |
| 19. English | 749 | -427 | -124 | -063 | -085 | 769 | (750) |

Sums of Squares (or relative contributions of Factors to sum of communalities) 7.116 1.517 .635 .622 .536 9.890

II 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

IV 5 6 7 8 9 1 2 3 4 10 11 13 14 15 16 12 17 18 19

II Geometrical + 10 + 11 Non-geometrical + 12

IV Space Non-space Arithmetic English + 12

A number underlined indicates a loading greater than .200; that is it lies in the upper third of all the loadings.
A circumflex accent indicates a loading less than .114; that is it lies in the lower third of all the loadings.

TABLE XI

FACTOR MATRIX F₀ (Unrotated)

| TEST | Centroid Factors | | | | | h ² | (h ²) |
|---------------------------------------|------------------|------|------|------|------|----------------|-------------------|
| | I | II | III | IV | V | | |
| 1. Geometrical Analogies | 752 | +152 | +180 | +129 | -103 | 648 | (654) |
| 2. Doesn't Belong | 663 | -063 | -134 | -261 | -211 | 569 | (580) |
| 3. Rows and Columns | 740 | +293 | -095 | +126 | +186 | 693 | (654) |
| 4. Pattern Completion | 651 | +391 | -124 | +194 | +032 | 630 | (625) |
| 5. Recognition of Figures | 710 | +196 | -080 | -258 | +197 | 654 | (697) |
| 6. Triangles (Form) | 434 | -228 | -246 | +098 | +210 | 355 | (473) |
| 7. Triangles (Orientation) | 491 | -054 | -196 | -067 | -261 | 355 | (466) |
| 8. M.H.Space 4 (Blocks) | 338 | -271 | -322 | +300 | -036 | 383 | (406) |
| 9. Links (Wooden Apparatus) | 723 | +232 | -282 | -083 | -095 | 672 | (697) |
| 10. Picture Analogies | 798 | +122 | +096 | +195 | +040 | 700 | (671) |
| 11. Picture Sequences | 680 | +142 | +139 | +092 | -148 | 533 | (595) |
| 12. Picture, 2 Alike | 641 | -151 | +082 | +279 | -236 | 573 | (595) |
| 13. Numerical II. Series continuation | 761 | +128 | +072 | -188 | -084 | 643 | (683) |
| 14. Numerical I. Arith Restorations | 796 | +099 | +155 | -177 | +051 | 701 | (691) |
| 15. Arithmetic (Mechanical) | 732 | -104 | +131 | -250 | +309 | 721 | (692) |
| 16. Arithmetic (Problems) | 676 | -149 | +157 | -175 | +066 | 539 | (606) |
| 17. Synonyms | 631 | -076 | +309 | +075 | -094 | 513 | (606) |
| 18. Proverbs (Story) | 744 | -268 | +254 | -026 | +047 | 692 | (708) |
| 19. English | 831 | -230 | +094 | +084 | +181 | 791 | (708) |

Contributions 8.903 ~~.230~~ .638 .608 .484 11.366
 .733

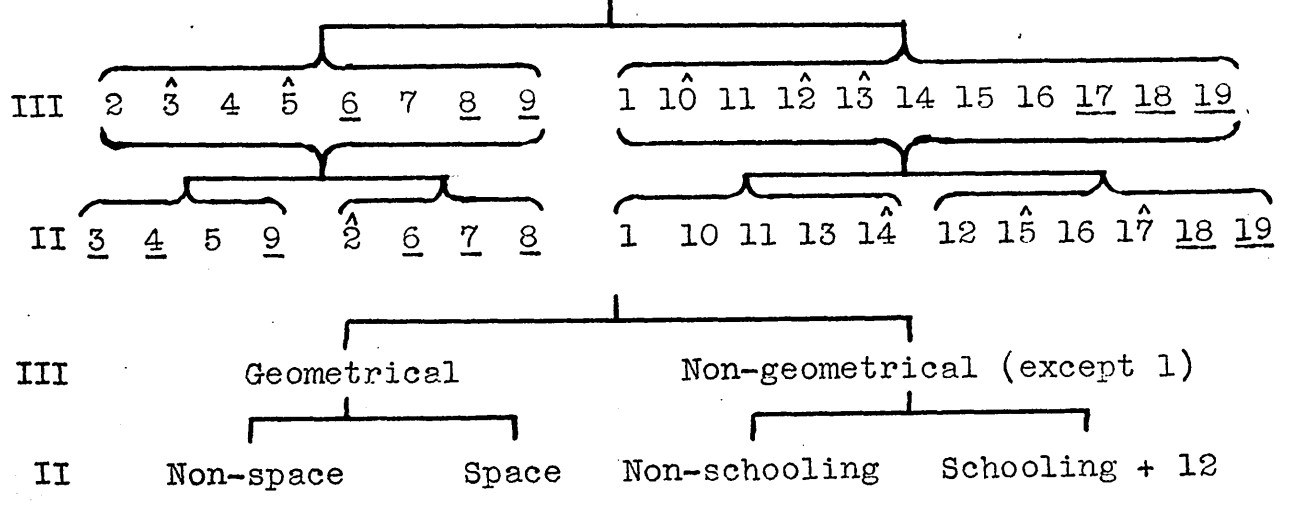


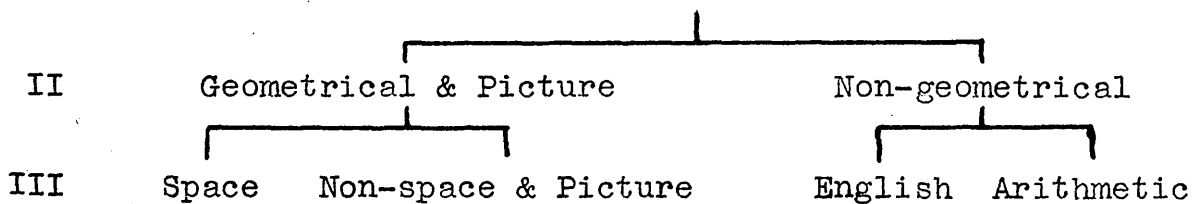
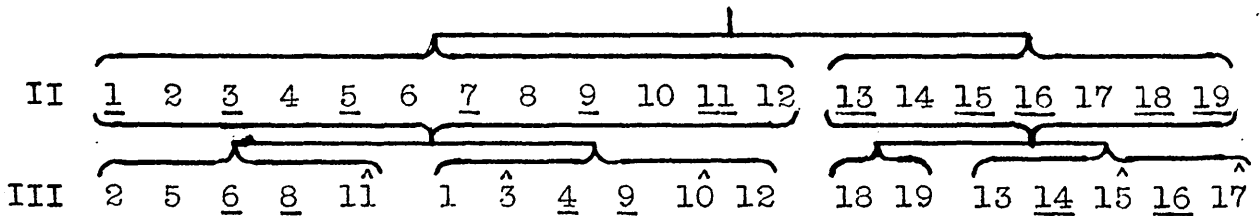
TABLE XII

INDIAN BOYS

FACTOR MATRIX F₀ (Unrotated)

| | Centroid Factors | | | | | h ² | (h ²) |
|--|------------------|------|------|------|------|----------------|-------------------|
| | I | II | III | IV | V | | |
| 1. Geometrical Analogies | 725 | +205 | -178 | -051 | +156 | 627 | (594) |
| 2. Doesn't Belong | 558 | +140 | +133 | -069 | -102 | 364 | (464) |
| 3. Rows and Columns | 667 | +303 | -106 | +151 | -112 | 583 | (508) |
| 4. Pattern Completion | 628 | +181 | -203 | +195 | +099 | 517 | (552) |
| 5. Recognition of Figures | 497 | +237 | +235 | -108 | -172 | 400 | (389) |
| 6. Triangles (Form) | 346 | +138 | +418 | -111 | +243 | 385 | (346) |
| 7. Triangles (Orientation) | 264 | +204 | +141 | +255 | +148 | 218 | (343) |
| 8. M.H.Space 4 (Blocks) | 240 | -171 | +294 | +266 | +063 | 248 | (259) |
| 9. Links (Wooden Apparatus) | 386 | +269 | -314 | -106 | +190 | 367 | (430) |
| 10. Picture Analogies | 712 | +121 | -064 | -107 | -134 | 555 | (594) |
| 11. Picture Sequences | 521 | +343 | +096 | +095 | -084 | 414 | (467) |
| 12. Picture, 2 Alike | 423 | +114 | -148 | -199 | -213 | 299 | (336) |
| 13. Numerical II. Series continuation | 582 | -204 | -136 | +113 | +121 | 426 | (559) |
| 14. Numerical I. Arithmetic Restorations | 596 | -125 | -266 | +058 | +046 | 447 | (540) |
| 15. Arithmetic (Mechanical) | 620 | -560 | -106 | +165 | -263 | 805 | (723) |
| 16. Arithmetic (Problems) | 728 | -401 | -212 | +109 | -082 | 755 | (723) |
| 17. Synonyms | 541 | -142 | -036 | -343 | +088 | 439 | (496) |
| 18. Proverbs (Story) | 684 | -289 | +265 | -141 | -070 | 647 | (594) |
| 19. English | 639 | -369 | +186 | -222 | -083 | 635 | (594) |

Contributions 5.931 1.322 .814 .541 .391 9.009



$n/(N - s + 1)$, where r_{js}^2 is the sum of squares of the loadings for factor/s, n is the number of tests in the battery and N is the size of the sample. "When half the loadings fall below 2 S.E. the significance of the factor as a whole should be suspect." With McNemar, $\sigma_I = \sigma / \sqrt{(1 - h_s^2)}$, where σ is the S.D. of residuals (not including diagonal entries) after s factors have been extracted and h_s^2 is the mean communality for the s factors extracted. σ_I should not fall below $1/\sqrt{N}$ which is the S.E. of zero r . For Factor V and the 4th., residual matrix, the following are the results of applying these criteria:

TABLE XIII

| Name of population | $1/\sqrt{N}$ | Guilford Product | Burt 2 S.E. | No. of loadings greater than 2 S.E. | McNemar σ_I |
|--------------------|--------------|------------------|-------------|-------------------------------------|--------------------|
| Negro Boys | .086 | .082 | .090 | 11 | .097 |
| Negro Girls | .098 | .081 | .113 | 9 | .111 |
| Indian Boys | .098 | .064 | .134 | 8 | * |

It should be noted that the N 's used were approximations, as they varied within each matrix on account of some children having been absent from some of the tests.

It seemed necessary to extract as many factors as are warranted, for should the levels of significance of the same factor appearing in m of the 3 populations be $p_{1, \dots, m}$ its level of significance would become $\prod^m p$. Also for the purposes of comparison of the populations a factor might be very significantly present in one, but it would be of interest to see if it appeared at all in another.

Before rotation was carried out a rough analysis of the results so far obtained was made by a method due to Burt. In this the tests are grouped according to the signs of their loadings in all but the first

* σ_I for the 3rd., residual matrix was .097 so that it was unnecessary to determine σ_I for the 4th., and with all the criteria for the Indian Boys the 5th., factor would seem suspect.

factor, each group determined by one factor is similarly subdivided according to the next and so on. The natural order to take is II, III, IV. This was tried out, but with the Negro Boys and the Negro Girls no meaningful classification was found to emerge. So that the order of the dichotomies was modified to give the results shown below Tables X, XI and XII. With the N.B's, III & IV were reversed with contributions of .635 and .622 respectively to the sum of the communalities, and with the N.G's II & III were reversed with contributions of .733 and .638, to give meaningful results. If the contributions to the sum of communalities of factors II, III & IV had been the same, the order would be optional. Small loadings were transferred as indicated to the other branch of a dichotomy if this made the meaning clearer. Only in one case was it found necessary to transfer a loading of moderate size: Test 8 with the I.B's with a loading of $-.171$ in Factor II. It does not follow that this loading must be regarded as insignificant, but in the 5-dimensional space it would not be impossible, one would think, for this test to be associated with some of those of opposite sign; only rotation would solve this.

This analysis reveals a first dichotomy into Geometrical and Non-geometrical, with Picture tests associated more with the Geometrical with the boys and with the non-geometrical with the girls. Generally it would seem that perhaps tests containing geometrical figures present something more novel to the children than the other tests. The Geometrical in all three populations become subdivided into Space and Non-space. The Non-geometrical naturally divide into Arithmetic and English with the boys, and little distinction is to be found between the Numerical Tests, 13 & 14 and the Arithmetic Attainment Tests, 15 & 16. However, with the girls this distinction is found and

Non-geometrical divides into Non-schooling, including Tests 13 & 14 and Schooling including Tests 15 & 16 with English.

ROTATION OF AXES

To determine what are the abilities possessed by the populations studied was the main object of the research. In order that the analysis should have meaningful psychological interpretation, rotation of axes was next carried out. By this time, I think the reader will know the tests by their reference numbers. The tests are arranged in an orderly sequence so that I do not think that it will cause him any bother if from now on I omit the names of the tests. For the rest of the analysis Thurstone's symbols are used as given in his Multiple Factor Analysis (M.F.A.): The Centroid Factors are, I, II, III, IV, V. When the subscript m is used it refers to these. r is the rank of the Reduced Correlation matrix (in this case = 5). F_0 is the matrix giving the loadings, a_{jm} , referred to these axes, where j (=1,2 19) refers to the tests. Λ is a matrix which postmultiplies F_0 to rotate the axes to the oblique axes (Reference Vectors) normal to the hyperplanes through groups of the tests, A, B, C, D, E of the oblique factor matrix V ; thus $V = F_0\Lambda$. Or after c rotations $V_c = F_0\Lambda$. (However, my subscripts to A .. E, unlike Thurstone's refer to the number of times an axis has been rotated). The subscript p (=1,2 . . . 5) refers to these Reference Vectors, v_{jp} being the loading of test j on the p th., Reference Vector.

The Primary Vectors which are the oblique axes formed by the intersections of the hyperplanes are symbolized by T_t (= 1,2, 3 . . 5) and T is the matrix of the Primary Vectors referred to the Centroid axes, t_{tm} being an element of this matrix. The loadings of the tests referred to the Primary Vectors are not given symbols in

M.F.A., but t_{jp} seems the obvious symbol to employ. $TA = D$ where D is the diagonal matrix which normalizes the rows of Λ^{-1} when it premultiplies it. D also is the matrix of cosines of angles between the Reference Vectors and the Primary Vectors.

The first method tried was, "A successive approximation method of rotation" (M.F.A. pg. 378 ff.) which Thurstone describes as "simple as to the numerical work, which can be easily done by a clerk without instruction in factorial theory". It was not the advertised simplicity which appealed to me, however, as much as, having followed the theory of the method very closely, and not having found that very simple, I felt I should like to see how it worked in practice. Besides I thought that here must be a purely mechanical way of rotating the axes without regard to the nature of the tests. I was disappointed, however, to find that I quickly lost two dimensions in spite of my having used Guilford's, Burt's and McNemar's tests which showed that there should be 5.

I, thereupon, decided to use the Method of Extended Vectors as fully described in M.F.A. on the first attempt after carrying out 5 sets of rotations and obtaining the following Λ matrix for the N.B's:

TABLE XIV

| | Λ (N.B's) | | | | |
|-----|-------------------|-------|-------|-------|-------|
| | A_5 | B_5 | C_5 | D_5 | E_5 |
| I | 294 | 311 | 316 | 346 | 640 |
| II | -096 | 737 | 077 | -752 | -753 |
| III | 009 | 271 | -932 | 264 | . |
| IV | 951 | -535 | -162 | 494 | . |
| V | -009 | -003 | 017 | -001 | 151 |

I arrived at a Simple Structure in that each/row of V had at least one zero and each column had several zeros, and there were no significantly negative load-

ings. But the correlations between the Primaries showed that they were all either very close to one another or nearly opposite; the positive cosines ranging from .878 to .964 and the negative cosines ranging from -.805 to -.988, with none in between. These results were quite useless from the point of view of interpretation. I realised then that I should have to take care in future that, before I rotated each axis, the angles between them would not be far off right angles. I had previously paid no attention to this but had been guided solely by attractive "streaks" of points in the plots. After proceeding for a time it became possible, I found, to restrict myself to positive cosines between axes not greater than .30 and negative cosines not less than -.40. The greater tolerance for negative cosines between the Reference Vectors was allowed because they lead to positive cosines between the Primaries with less chance of Bi-polarity occurring.

In order to start with a clean slate, as it were with the N.B's I post-multiplied the extended factor matrix **E** by the following Landhal Matrix:

TABLE XV
Landhal Matrix

| | I | A. | B. | C. | D. | E. |
|-----|---|-----|------|------|------|------|
| I | 1 | 447 | 447 | 447 | 447 | 447 |
| II | . | 894 | -224 | -224 | -224 | -224 |
| III | . | . | 866 | -289 | -289 | -289 |
| IV | . | . | . | 816 | -408 | -408 |
| V | . | . | . | . | 707 | -707 |

It would be impossible to give here the plots made for the 7 subsequent sets of rotations. Each set required 10 plots and sometimes when it was found that the axes were getting close or separating too much alternative sets were made, so that altogether for the N.B's there were over 100 plots. These plots themselves

yielded some interesting information; it was evident that the points for tests 13, 14, 15, 16 were close together in all the plane sections, so were the points for 17, 18, 19 and these two clusters were not far from each other. Points for Tests 1 and 10, the two Analogies Tests, were also always close together. Points for 6, 7, 8 in some sections were fairly far apart but fitted to a straight line remarkably well. Eventually the following Λ matrix was evolved for the N.B.'s which was at first found to 3 places of decimals and then accurately normalized by columns to give the 5 places shown here:

TABLE XVI

 Λ (N.B.)

| | A_7 | B_8^* | C_7 | D_7 | E_7 |
|-----|--------|---------|--------|--------|--------|
| I | 48313 | 26594 | 34176 | 40292 | 62233 |
| II | 36810 | 51687 | -78545 | 67587 | -18210 |
| III | 20406 | -67784 | 17088 | 35493 | -32817 |
| IV | -10003 | 44989 | 41671 | -35093 | -67836 |
| V | -76121 | -01600 | 25182 | 36293 | -10806 |

The matrix, $V = E_0\Lambda$, of Test loadings on these Reference Vectors is given here, and from it we see that a moderately good Simple Structure has been obtained. It is to be noted that the planes through the test vectors in this particular s-structure could not have been determined straight away from the 6 plots made from the original Extended Factor Matrix.

* The B axis was given a small/e-xtra rotation on its own.

TABLE XVII

$$V = F_0 \Lambda \quad (\text{N.B.})$$

| | A_7 | B_8 | C_7 | D_7 | E_7 |
|----|-------|-------|-------|-------|-------|
| 1 | 538 | 252 | 054 | 309 | 563 |
| 2 | 562 | -064 | 069 | 368 | 493 |
| 3 | 506 | 079 | -056 | 566 | 481 |
| 4 | 276 | 026 | -013 | 751 | 339 |
| 5 | 419 | 260 | 078 | 522 | 284 |
| 6 | 235 | 271 | -025 | 447 | 008 |
| 7 | 395 | 398 | -008 | -003 | -003 |
| 8 | -003 | 698 | -002 | 238 | 004 |
| 9 | 200 | 342 | 008 | 289 | 195 |
| 10 | 427 | 281 | 022 | 300 | 565 |
| 11 | 223 | 308 | 018 | 428 | 378 |
| 12 | -010 | 129 | 259 | 150 | 453 |
| 13 | 212 | 060 | 494 | 145 | 225 |
| 14 | 327 | -083 | 485 | 155 | 380 |
| 15 | 269 | -064 | 590 | -002 | 387 |
| 16 | 323 | 039 | 527 | 057 | 419 |
| 17 | 280 | 062 | 339 | -050 | 621 |
| 18 | 008 | -015 | 502 | 032 | 634 |
| 19 | 250 | 035 | 523 | -040 | 636 |

The cosines of the angles between the Reference Vectors are shown in the following $\Lambda' \Lambda$ matrix, where it will be seen that the cosines range from $-.38735$ to $+.31989$:

TABLE XVIII

$$\Lambda' \Lambda \quad (\text{N.B.})$$

| | A_7 | B_8 | C_7 | D_7 | E_7 |
|-------|---------|---------|--------|--------|---------|
| A_7 | 1.00000 | 14760 | -32250 | 27472 | 31989 |
| B_8 | 14760 | 1.00000 | -24747 | 05222 | -00963 |
| C_7 | -32250 | -24747 | 99999 | -38735 | -01025 |
| D_7 | 27472 | 05222 | -38735 | 99999 | 21003 |
| E_7 | 31989 | -00963 | -01025 | 21003 | 1.00000 |

By Aitken's method of Pivotal Condensation Λ^{-1} was found to be:

TABLE XIX

$$\Lambda^{-1} \quad (\text{N.B.})$$

| | | | | |
|-------|--------|--------|--------|--------|
| 41340 | 13213 | 45972 | 26465 | -89900 |
| 37100 | 35353 | -69358 | 55753 | 14723 |
| 75641 | -46013 | 34336 | 60837 | 26968 |
| 47853 | 51281 | 53106 | -06221 | 69958 |
| 40218 | -33297 | -58642 | -73752 | 03396 |

The normalizing constants for the rows of Λ^{-1} constitute the elements of the diagonal matrix D , which are also the cosines of the angles between the Reference Vectors and the Primary Factors.

TABLE XX

$$D = T\Lambda \quad (\text{N.B.})$$

| | A_1 | B_2 | C_3 | D_4 | E_5 |
|-------|-------|-------|-------|-------|-------|
| T_A | 88459 | . | . | . | . |
| T_B | . | 96395 | . | . | . |
| T_C | . | . | 86239 | . | . |
| T_D | . | . | . | 89202 | . |
| T_E | . | . | . | . | 92784 |

And Λ^{-1} normalized by premultiplication with D gives the matrix T , the direction cosines of the Primary Factors referred to the Centroid Axes:

TABLE XXI

$$T = D\Lambda^{-1} \quad (\text{N.B.})$$

| | I | II | III | IV | V |
|-------|-------|--------|--------|--------|--------|
| T_A | 36569 | 11688 | 40667 | 23411 | -79525 |
| T_B | 35763 | 34079 | -66858 | 53743 | 14197 |
| T_C | 65232 | -39681 | 29611 | 52465 | 23257 |
| T_D | 42686 | 45744 | 46480 | -05549 | 62404 |
| T_E | 37316 | -30894 | -54410 | -68430 | 03151 |

The cosines of the angles between these Primary Factors are shown in the matrix TT' , where it will be noted that the cosines range from $-.30618$ to $+.35058$

TABLE XXII

$$TT' \quad (\text{N.B.})$$

| | T_A | T_B | T_C | T_D | T_E |
|-------|---------|---------|---------|---------|---------|
| T_A | 1.00000 | -.08832 | .25046 | -.11067 | -.30618 |
| T_B | -.08832 | 1.00001 | .21506 | .05653 | .02865 |
| T_C | .25046 | .21506 | 1.00001 | .35058 | -.14679 |
| T_D | -.11067 | .05653 | .35058 | 1.00000 | -.17730 |
| T_E | -.30618 | .02865 | -.14679 | -.17730 | 1.00000 |

The loadings of tests on the Primary Factors T_A, T_B, T_C, T_D, T_E are given by the matrix $F_0 T'$. For the purpose of comparing the different populations this matrix is put with similar matrices for the N.G's and I.B's in Table LXII, page 252, where also, for the sake of making comparison easy, the order of putting down the Primary Factors has been changed; for it would be incorrect to equate a factor found in one population to one found in another. So that each set of Primaries will be made to retain the symbols used in finding them.

It was thought that it would be interesting to determine the correlations, that is the cosines of the angles between not only the whole test vectors, in their 19-dimensional space, and the Primaries (this is already done by $F_0 T'$), but also the cosines of the angles between the projections of the Test Vectors on to the 5-dimensional common factor space and the Primaries. If θ is this angle between the projection of a test and a primary, then the cosine of the angle between the whole unprojected test and the primary is given by, $t_{jt} = h \cos \theta$, where h is the length of the projection, since the Primary is of unit length. Hence $\cos \theta = t_{jt} / h$. Or if H is a diagonal matrix the elements of which are the reciprocals of the square roots of the communalities, $H^T F_0 T'$ gives the degree of closeness of the communal part of a test to the Primaries. This matrix brings into greater prominence those tests whose communal parts are nearest the Primaries and, if one were to know the psychological ability represented by this communal component of a test one would be able to translate the Primary Factor into psychological terms. With those tests, however, whose communalities are low, the danger arises of assuming an aspect of the test to be its communal component when in reality it may be specific. Still, I believe that with this in mind some useful information is to be gained for psychological interpretation of the Primaries from this type of matrix when studied

along with the matrix before its pre-multiplication with H^{-1} ; it is not intended, of course, for the purpose of estimation. So that matrices of this type are also given in Table LXIV, for what they are worth.

During the process of rotation of the axes for the N.G's and the I.B's an attempt was made to reduce the number of sets of rotations and at the same time to ensure that the cosines of the angles between the new axes chosen should be within the limits I set myself of $-.4$ to $+.3$ and that all the points should, in at least one section, lie near the trace of a plane. The method was this: on the 10 plots for a rotation to draw as many possible (or even impossible) lines through streaks of points. It was better to have all the test points which were not near the line on one side only of it, though in some cases if there was a very good streak leaving one test on the opposite side from the rest it was found possible by subsequent rotation in another dimension to bring this point on to the line. The 3-dimensional Vector equations of all the Reference Vectors to the planes of which these lines are the traces were written down as described in M.F.A. in the form of Thurstone's "S" matrix. Pre-multiplication by the last rotating matrix ("M" of Thurstone) and normalizing the columns gave the direction cosines of all the axes normal to the trial planes. Pre-multiplying this matrix by its transpose yielded the cosines of all the angles between these axes. The method is the ordinary one used for finding the next axes but here many trial axes are found at the same time. It was used with as many axes as 21 and is not so laborious as it would appear if working is carried to only 2 places of decimals. Table XXIII, taken from the working done after one rotation with the I.B's illustrates the method. The first row of the Table gives the symbols a, \dots, q , of the 17 lines drawn on the 10 plots. Beneath these are the test points through

which these lines pass. Brackets indicate that these points are not as close to the lines as the unbracketed points. Beneath comes the matrix "S" of coefficients of the vector equations referred to the axes I (the First Centroid axis) and A . . . E, the last rotated axes. This is multiplied by the following M_{oi} matrix:

TABLE XXIV

| | M_{oi} (I.B.) | | | | | |
|-----|-----------------|----------------|----------------|----------------|----------------|----------------|
| | I | A ₁ | B ₁ | C ₁ | D ₁ | E ₁ |
| I | 1.00 | 49 | 45 | 44 | 42 | 26 |
| II | . | 64 | -33 | -52 | . | . |
| III | . | -59 | . | . | 82 | 36 |
| IV | . | . | 83 | -73 | . | . |
| V | . | . | . | . | 39 | -90 |

to give the next matrix of direction numbers of the new axes referred to the Centroid Axes. Normalizing the columns of this gives the next matrix of direction cosines which when pre-multiplied by its transpose gives the matrix of cosines of the angles between the new trial axes. Cosines greater than $+0.30$ or less than -0.60 are crossed out and those greater than $+0.20$ and less than -0.50 are ringed. From this matrix one attempts to make the best selection of a set of 5 new axes such that the cosines of the angles between them shall be not outside the prescribed limits and such that the points shall lie on at least one plane trace. The axes corresponding to the traces a, e, g, m, q, were the ones chosen, and constituted the axes A₂, D₂, E₂, C₂, B₂ respectively for the next rotation. It was hoped that the points (9;12-), both on the wrong side of the q, (B₂) trace could be brought round by subsequent rotation in another dimension, as had been done with a point in the rotation for the N.B's. This, however, proved not to be possible here without causing the test points for 1 and 10 to fall away from their planes. So that after repeated efforts it was found impossible

to obtain a completely Simple Structure for the I.B's.

The plots for the N.G's and I.B's showed very much the same clusters as with the N.B's, but with the N.G's the test points 1 and 11 instead of 1 and 10 held together very closely. Tables XXV - XXXI give the matrices found for the N.G's and Tables XXXII - XXXVIII those for the I.B's. The $F_0 T'$ matrices are to be found in Table LXII page 252.

TABLE XXV

| | | Λ (N.G.) | | | | |
|-----|--|------------------|--------------------------------------|--------|--------|--------|
| | | A_5 | B_3 | C_3 | D_4 | E_4 |
| I | | 26887 | 28908 | 19959 | 33005 | 31979 |
| II | | -35850 | ⁸⁴⁷³⁰ 84730 | -17963 | -13002 | -44971 |
| III | | -56762 | -02990 | -56883 | 79012 | -03997 |
| IV | | 68712 | 41866 | -37922 | 47007 | -41973 |
| V | | 06971 | 14952 | -67861 | -17003 | 71953 |

TABLE XXVI

| | | $V = F_0 \Lambda$ (N.G.) | | | | |
|----|--|--------------------------|-------|-------|-------|-------|
| | | A_5 | B_3 | C_3 | D_4 | E_4 |
| 1 | | 127 | 379 | 042 | 449 | 037 |
| 2 | | 090 | 005 | 459 | 038 | 199 |
| 3 | | 247 | 546 | -025 | 159 | 190 |
| 4 | | 241 | 609 | 035 | 152 | -021 |
| 5 | | 003 | 295 | 116 | -009 | 392 |
| 6 | | 420 | 012 | 088 | -011 | 361 |
| 7 | | 198 | 035 | 422 | 027 | 029 |
| 8 | | 575 | -002 | 210 | 040 | 091 |
| 9 | | 208 | 365 | 359 | -037 | 105 |
| 10 | | 253 | 419 | -018 | 408 | 144 |
| 11 | | 106 | 329 | 097 | 384 | 003 |
| 12 | | 355 | 136 | 163 | 467 | -017 |
| 13 | | -017 | 235 | 216 | 217 | 202 |
| 14 | | -027 | 243 | 086 | 280 | 315 |
| 15 | | 010 | 061 | -024 | 189 | 603 |
| 16 | | 031 | 001 | 094 | 273 | 398 |
| 17 | | 066 | 126 | -001 | 513 | 125 |
| 18 | | 138 | -023 | 030 | 461 | 393 |
| 19 | | 323 | 105 | -001 | 387 | 461 |

TABLE XXVII

| | | $\Lambda' \Lambda$ (N.G.) | | | | |
|-------|--|---------------------------|---------|--------|---------|---------|
| | | A_5 | B_3 | C_3 | D_4 | E_4 |
| A_5 | | 1.00000 | 08903 | 13306 | -00199 | 03164 |
| B_3 | | 08903 | 1.00001 | -33773 | 13300 | -35554 |
| C_3 | | 13306 | -33773 | 99999 | -42309 | -16177 |
| D_4 | | -00199 | 13300 | -42309 | 1.00000 | -18721 |
| E_4 | | 03164 | -35554 | -16177 | -18721 | 1.00000 |

TABLE XXVIII

$$\Lambda^{-1} \quad (\text{N.G.})$$

| | | | | |
|-------|--------|--------|--------|--------|
| 03954 | -43578 | -51862 | 77081 | 13094 |
| 83072 | 87216 | -15932 | -01754 | 15682 |
| 96132 | 03352 | -25362 | -49618 | -70985 |
| 79840 | -26452 | 70499 | 17065 | -38147 |
| 91886 | -16993 | 01074 | -49867 | 58490 |

TABLE XXIX

$$D = T\Lambda \quad (\text{N.G.})$$

| | A ₅ | B ₃ | C ₃ | D ₄ | E ₄ |
|----------------|----------------|----------------|----------------|----------------|----------------|
| T _A | 96596 | . | . | . | . |
| T _B | . | 81621 | . | . | . |
| T _C | . | . | 75817 | . | . |
| T _D | . | . | . | 85155 | . |
| T _E | . | . | . | . | 82645 |

TABLE XXX

$$T = D\Lambda^{-1} \quad (\text{N.G.})$$

| | I | II | III | IV | V |
|----------------|-------|--------|--------|--------|--------|
| T _A | 03819 | -42095 | -50097 | 74457 | 12648 |
| T _B | 67804 | 71187 | -13004 | -01432 | 12800 |
| T _C | 72884 | 02541 | -19229 | -37619 | -53819 |
| T _D | 67988 | -22525 | 60033 | 14532 | -32484 |
| T _E | 75937 | -14044 | 00888 | -11213 | 48339 |

TABLE XXXI

$$TT^{-1} \quad (\text{N.G.})$$

| | T _A | T _B | T _C | T _D | T _E |
|----------------|----------------|----------------|----------------|----------------|----------------|
| T _A | 1.00001 | -20305 | -23470 | -11285 | -16205 |
| T _B | -20305 | 1.00000 | 47378 | 17891 | 48154 |
| T _C | -23470 | 47378 | 1.00000 | 49452 | 44308 |
| T _D | -11285 | 17891 | 49452 | 1.00001 | 33630 |
| T _E | -16205 | 48154 | 44308 | 33630 | 99999 |

TABLE XXXII

 Λ (I.B.)

| | A_6 | B_7 | C_5 | D_5 | E_5 |
|-----|--------|--------|--------|--------|--------|
| I | 46096 | 36779 | 45763 | 78337 | 38288 |
| II | -65559 | 22476 | 19897 | -17849 | 20101 |
| III | 31755 | 52103 | 09948 | -49581 | -45946 |
| IV | -12292 | -69471 | 47752 | -23799 | 12444 |
| V | 49169 | -24519 | -71628 | -22807 | 76577 |

TABLE XXXIII

 $V = F_0 \Lambda$ (I.B.)

| | A_6 | B_7 | C_5 | D_5 | E_5 |
|----|-------|-------|-------|-------|-------------------|
| 1 | 226 | 217 | 219 | 596 | 514 |
| 2 | 166 | 379 | 337 | 386 | 094 |
| 3 | 001 | 181 | 508 | 511 | 298 |
| 4 | 131 | 006 | 326 | 491 | 470 |
| 5 | 077 | 476 | 370 | 295 | -015 |
| 6 | 335 | 394 | 000 | 010 | 141 |
| 7 | 074 | 003 | 191 | 006 | 222 |
| 8 | 315 | 003 | 187 | -005 | 004 |
| 9 | 008 | 066 | 013 | 392 | 478 |
| 10 | 176 | 363 | 389 | 624 | 210 |
| 11 | -007 | 273 | 422 | 296 | 172 |
| 12 | -007 | 295 | 259 | 480 | 065 |
| 13 | 405 | -011 | 180 | 505 | ³⁵ 315 |
| 14 | 288 | 001 | 217 | 597 | 368 |
| 15 | 470 | -003 | 429 | 658 | -007 |
| 16 | 477 | 012 | 343 | 739 | 246 |
| 17 | 417 | 365 | -011 | 528 | 220 |
| 18 | 572 | 440 | 265 | 505 | 011 |
| 19 | 582 | 424 | 191 | 546 | -006 |

TABLE XXXIV

 $\Lambda' \Lambda$ (I.B.)

| | A_6 | B_7 | C_5 | D_5 | E_5 |
|-------|-------|-------|-------|-------|-------|
| A_6 | 1.001 | 153 | -299 | 237 | 260 |
| B_7 | 153 | 1.001 | 108 | 211 | -327 |
| C_5 | -299 | 108 | 1.000 | 324 | -319 |
| D_5 | 237 | 211 | 324 | 999 | 288 |
| E_5 | 260 | -327 | -319 | 288 | 1.000 |

TABLE XXXV

 Λ' (I.B.)

| | | | | |
|-------|--------|--------|--------|--------|
| 39661 | -77000 | 59852 | 29775 | 31499 |
| 34543 | 70114 | 58526 | -62248 | 09459 |
| 62619 | 34263 | 49605 | 90029 | -25032 |
| 26129 | -51002 | -91422 | -54961 | -45680 |
| 51946 | 88748 | -00519 | 28792 | 76371 |

TABLE XXXVI

 $D = TA$ (I.B.)

| | A_6 | B_7 | C_5 | D_5 | E_5 |
|-------|-------|-------|-------|-------|-------|
| T_A | 87831 | . | . | . | . |
| T_B | . | 86070 | . | . | . |
| T_C | . | . | 78356 | . | . |
| T_D | . | . | . | 77268 | . |
| T_E | . | . | . | . | 76169 |

TABLE XXXVII

 $T = D\Lambda'$ (I.B.)

| | I | II | III | IV | V |
|-------|-------|--------|--------|--------|--------|
| T_A | 34835 | -67630 | 52569 | 26152 | 27666 |
| T_B | 29731 | 60347 | 50373 | -53577 | 08141 |
| T_C | 49066 | 26847 | 38868 | 70543 | -19614 |
| T_D | 20189 | -39408 | -70640 | -42467 | -35296 |
| T_E | 39567 | 67598 | -00395 | 21931 | 58171 |

TABLE XXXVIII

 TT' (I.B.)

| | T_A | T_B | T_C | T_D | T_E |
|-------|---------|--------|---------|--------|---------|
| T_A | 1.00001 | -15734 | 32390 | -24321 | -10312 |
| T_B | -15734 | 99999 | 10977 | -33484 | 45344 |
| T_C | 32390 | 10977 | 1.00000 | -51165 | 41470 |
| T_D | -24321 | -33484 | -51165 | 99999 | -48217 |
| T_E | -10312 | 45344 | 41470 | -48217 | 1.00000 |

SECOND ORDER ANALYSIS

An attempt was made to "explain" the correlations between the Primary Factors given in the TT' matrices of Tables XXII, XXXI and XXXVIII by carrying out Centroid analyses ~~using~~ ^{using} the 5 Primary Factors for each population as the variables.

With the N.B's, for the first approximation the highest coefficients in the columns were used as the trial communalities, and extraction of two factors was carried out. The loadings obtained were then used as the trial loadings in Lawley's Maximum Likelihood Method for two factors.

8 iterations were made but when no convergence seemed likely I went back to the Centroid Method using the last communality obtained in the first approximation. I was intent upon obtaining exact agreement between the communalities used as trials and the s-ums of squares (S.Sq. in future) of the loadings obtained, so I proceeded to make futher approximations using the Centroid Method. If I found that the communality of a Primary Factor was, say, regularly increasing from approximation to approximation I would start the next with a slightly greater trial communality than that obtained from the previous

one, in order to speed up the process. Nevertheless convergence did not occur even after 12 approximations had been made. I then continued for 4 more approximations to extract 3 factors instead of 2 as I had been doing, though for the purposes of Factorial Analysis this number of factors should not be extracted from only 5 variables. In the case of the Primary Factor T, I had gone right up to a trial communality of 1,000 and obtained a S.Sq. of loadings for this factor of 1,04, and during the course of the approximations communalities which at one time seemed likely to settle down to convergence began to increase or decrease again. After the 16th. approximation and still failing to obtain equality between the S.Sq. of the loadings and the trial communalities used, I gave up. Reviewing the situation I concluded that here I had a case of the terminations of the Primary Vectors lying too evenly over the surface of a hypersphere for the methods of Centroid Analysis or Maximum Likelihood to apply. I think the factor matrix which I obtained by the method about to be described confirms this explanation.

It was evident that it should be possible, even if Centroid Analysis had failed, to refer the 5 Primary Factors to a 3-dimensional orthogonal framework. When describing the method I thought I had devised to meet this situation, to Mr. Murrell, my former assistant, he said he thought he remembered it to have been given in M.F.A. I find that he was right, that it is really the Diagonal Method of Factoring, a faint recollection of which must have remained with me. I give here the method as I used it with the N.B's. in Table XXXIX. The resulting

factor matrix Φ_0 is given in Table XL where F, G, H are the second order factors. This matrix reproduces the original TT' correlations very well, and if the small residual .0087 is taken into account, exactly.

TABLE XL (N.B.)

| | F | G | H | h^2 |
|-------|---------------|-------------|-------------|--------|
| T_A | 2505 | <u>9680</u> | 0 | 1.0000 |
| T_B | 2151 | -1469 | -0536 | 0707 |
| T_C | <u>1.0000</u> | 0 | 0 | 1.0000 |
| T_D | 3506 | -2051 | <u>9138</u> | 1.0000 |
| T_E | -1468 | -2783 | -2002 | 1391 |

This analysis into 3 second order factors with 3 of the communalities of the 5 Primaries = 1 works out to the 5 oblique Primary axes being replaced by 5 orthogonal axes very near to them. So that the original object of finding a General Second Order Factor has given way to finding the orthogonal framework best fitting the Primaries. The underlined entries in Table XL are the cosines of the angles between T_C , T_A and T_D and their nearest second order factors. The best orthogonal fit will be obtained by orthogonally rotating the orthogonal axes F, G, H so that these cosines shall be equal. Accordingly the loadings were plotted in the plane of O, F H and the axes F and H orthogonally rotated to F_1 and H_1 so as to make the loadings of T_C on F_1 and T_D on H_1 equal. Then a plot in the plane of O, F_1 G was made and F_1 and G orthogonally rotated to F_2 and G_1 so as to make the loadings of T_C on F_2 and T_A on G_1 equal. These orthogonal rotations were made graphically by the following geometrical construction:

TABLE XXXIX

(N.B.)

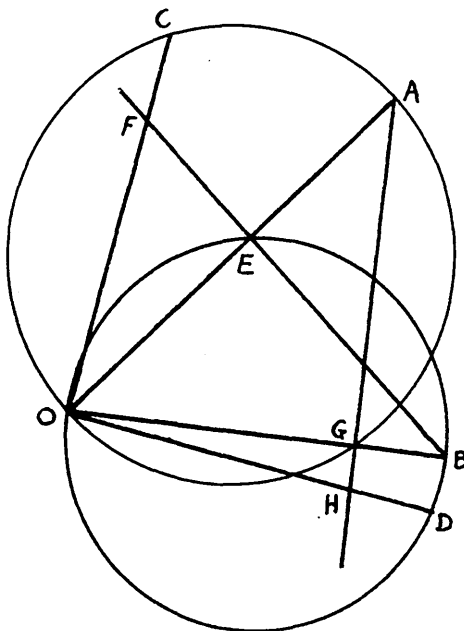
| | | | | | |
|---------|--------|----------|----------|--------|--------|
| (1.000) | -0883 | 2505 | -1107 | -3062 | |
| -0883 | (0707) | 2151 | 0565 | 0287 | |
| 2505 | 2151 | (1.0000) | 3506 | -1468 | |
| -1107 | 0565 | 3506 | (1.0000) | -1773 | |
| -3062 | 0287 | -1468 | -1773 | (1391) | |
| | | | | | |
| | 2505 | 2151 | (1.0000) | 3506 | -1468 |
| 2505 | (9372) | -1422 | 0 | -1985 | -2694 |
| 2151 | -1422 | (0244) | 0 | -0189 | 0603 |
| 1.0000 | 0 | 0 | 0 | 0 | 0 |
| 3506 | -1985 | -0189 | 0 | (8771) | -1258 |
| -1468 | -2694 | 0603 | 0 | -1258 | (1175) |
| | | | | | |
| | 9680 | -1469 | 0 | -2051 | -2783 |
| 9680 | 0 | 0 | 0 | 0 | 0 |
| -1469 | 0 | (0028) | 0 | -0490 | 0194 |
| 0 | 0 | 0 | 0 | 0 | 0 |
| -2051 | 0 | -0490 | 0 | (8350) | -1829 |
| -2783 | 0 | 0194 | 0 | -1829 | (0400) |
| | | | | | |
| | 0 | -0536 | 0 | 9138 | -2002 |
| 0 | 0 | 0 | 0 | 0 | 0 |
| -0536 | 0 | (0) | 0 | 0 | 0087 |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 9138 | 0 | 0 | 0 | 0 | 0 |
| -2002 | 0 | 0087 | 0 | 0 | (0) |

The first slab shows the correlation matrix of Primary Factors from Table XXII, the numbers in brackets are inserted as the work proceeds. The second slab shows first residuals using as loadings the correlations on the Primary with the numerically greatest values (T_c). Insert 1.0000 as the communality for this factor. Now take T_h as having the numerically greatest values. The portion of T_h resolved at right angles to T_c is $\sqrt{(1 - 2505^2)} = \sqrt{9372} = 9680 = 1/1.033$. The next loading of T_h is 9680 and the last residuals on T_h are extended by dividing by this to give the next loadings. The diagonal entry of T_h , 9372 is entered in the last residual matrix and its communality is entered as 1.0000 in the correlation matrix. In a similar way take T_b . $\sqrt{(1 - 3506^2 - 2051^2)} = \sqrt{8350} = 9138 = 1/1.096$ And the loadings for the last slab are obtained, which give the residuals as shown, only 2 remain and these are negligible.

Suppose A and B to be two points on the plot.

It is required to find two orthogonal axes so that the projection of OA on one of them shall be equal to the projection of OB on the other.

Construction. Construct circles with OA, OB as diameters. Join B to E, the intersection of the circle on OB and OA, and produce to F, making $BF = OA$. Join O to F and produce to cut the circle on OA at C. Join A to G, the intersection of the circle on OA and OB, and produce to H, making $AH = OB$. Join O to H and produce to cut the circle on OB at D. Then $OC = OD$ and they are at right angles, and they are the projections of OA and OB respectively.



Figure, 1.

Rotations in two planes were found sufficient and post-multiplication of the second order factor matrix ϕ_0 by the following orthogonal transformation e_1, e_2 ,

TABLE XLI

e_1, e_2

(N.B.)

| | F_2 | G_1 | H_1 |
|---|-------|-------|-------|
| F | 9742 | 0488 | 2200 |
| G | -0500 | 9987 | . |
| H | -2197 | -0110 | 9755 |

gives the Rotated orthogonal Second Order Factor Matrix ϕ_2 in which it can be seen that the underlined loadings are nearly equal.

TABLE XLII

 $\phi_2 \theta_1 \theta_2$ (N.B.)

| | F_2 | G_1 | H_1 |
|-------|-------------|-------------|-------------|
| T_A | 1956 | <u>9790</u> | 0551 |
| T_B | 2287 | -1356 | -0050 |
| T_C | <u>9742</u> | 0488 | 2200 |
| T_D | 1510 | -1978 | <u>9685</u> |
| T_E | -1139 | -2829 | -2276 |

From this matrix is constructed the U_t matrix in the usual way by inserting in the diagonal to the right of the F_2, G_1, H_1 columns $\sqrt{(1 - h^2)}$. It is unnecessary to make a complete square to the right to hold the zero diagonal entries. The Primaries T_C, T_A and T_D possessing unit communalities in the F_2, G_1, H_1 space they are completely represented in this space and leave no second order components, or "group factors" at right angles to it.

TABLE XLIII

 U_t (N.B.)

| | F_2 | G_1 | H_1 | b | e |
|-------|-------------|-------------|-------------|-------------|-------------|
| T_A | 1956 | <u>9790</u> | 0551 | . | . |
| T_B | 2287 | -1356 | -0050 | <u>9640</u> | . |
| T_C | <u>9742</u> | 0488 | 2200 | . | . |
| T_D | 1510 | -1978 | <u>9685</u> | . | . |
| T_E | -1139 | -2829 | -2276 | . | <u>9278</u> |

This matrix is to be pre-multiplied by D^{-1} obtained from Table XX:

TABLE XLIV

| D^{-1} | (N.B.) | | | |
|----------|--------|--------|--------|--------|
| 1.1305 | . | . | . | . |
| . | 1.0374 | . | . | . |
| . | . | 1.1596 | . | . |
| . | . | . | 1.1211 | . |
| . | . | . | . | 1.0778 |

to give the matrix $\bar{D}^{-1} U_t$,

TABLE XLV

| $\bar{D}^{-1} U_t$ | (N.B.) | | | |
|--------------------|--------|--------|--------|--------|
| 2211 | 1.1068 | 0623 | . | . |
| 2373 | -1407 | -0052 | 1.0001 | . |
| 1.1297 | 0566 | 2551 | . | . |
| 1693 | -2218 | 1.0858 | . | . |
| -1228 | -3049 | -2453 | . | 1.0000 |

It will be observed that there are unit entries in the last two columns. If this matrix were used to post-multiply V to give the loadings of the tests on this new set of orthogonal axes we should, therefore, retain the loadings on the Reference Vectors for the Axes B_8 and E_7 . So that the "b" and "e" of Table XLIII will be replaced by B_8 and E_7 . However, it was thought to be better to operate on the original F_0 matrix by post-multiplying it by Ψ_{mw} , where $\Psi_{mw} = \Lambda^{-1} \bar{D}^{-1} U_t$, because F_0 and $F_0 \Psi_{mw}$ each have orthogonal axes, hence Ψ_{mw} itself should be an orthogonal matrix. This can be tested to give a check.

TABLE XLVI

$$\Psi_{m\omega} = \Lambda D' U_t \quad (\text{N.B.})$$

| | F ₁ | G ₁ | H ₁ | B ₈ | E ₇ | S.Sq. |
|-------|----------------|----------------|----------------|----------------|----------------|--------|
| I | 5478 | 2375 | 4011 | 2659 | 6223 | 9753 |
| II | -5466 | 1957 | 5988 | 5169 | -1821 | 9960 |
| III | 1780 | 3521 | 5255 | -6778 | -3282 | 9989 |
| IV | 5798 | 1342 | -1172 | 4499 | -6784 | 1.0306 |
| V | 1874 | -8733 | 4378 | -0160 | -1081 | 1.0014 |
| S.Sq. | 1.0018 | 9993 | 1.0001 | 1.0000 | 1.0000 | |

The final F₀ $\Psi_{m\omega}$ matrix is given in Table LXIII page and represents the loadings of the tests on the set of orthogonal axes which best fit the oblique framework of the Primary Factors. This matrix pre-multiplied by its transpose should yield the original correlation coefficients of the battery and the communalities derived from F₀. The latter are given here for comparison with the S.Sq of the loadings in F₀ $\Psi_{m\omega}$ and we see close agreement.

TABLE XLVII

| | S.Sq. | h ² |
|----|-------|----------------|
| 1 | 5936 | 6048 |
| 2 | 5551 | 5603 |
| 3 | 5871 | 5910 |
| 4 | 6939 | 6960 |
| 5 | 5821 | 5878 |
| 6 | 3553 | 3553 |
| 7 | 3342 | 3340 |
| 8 | 6170 | 6171 |
| 9 | 2607 | 2640 |
| 10 | 5120 | 5212 |
| 11 | 4181 | 4243 |
| 12 | 3548 | 3637 |
| 13 | 5164 | 5247 |
| 14 | 5998 | 6125 |
| 15 | 6482 | 6639 |
| 16 | 6512 | 6683 |
| 17 | 5607 | 5763 |
| 18 | 6712 | 6908 |
| 19 | 7446 | 7692 |

Next follow tables of matrices similar to the above for the N.G's and I.B's.

TABLE XLVIII

Unrotated Second Order Factor Matrix ϕ_0 (N.G.)

| | F | G | H | h^2 |
|-------|--------|-------|-------|--------|
| T_A | -2347 | -0648 | -0875 | 0669 |
| T_B | 4738 | 3028 | 8269 | 1.0000 |
| T_C | 1.0000 | 0 | 0 | 1.0000 |
| T_D | 4945 | 1307 | -1150 | 2748 |
| T_E | 4431 | 8965 | 0 | 1.0000 |

TABLE XLIX

Orthogonal Rotating Matrix θ, θ_1 (N.G.)

| | F_1 | G_1 | H_1 |
|---|-------|-------|-------|
| F | 9383 | 0848 | 3350 |
| G | -0900 | 9959 | . |
| H | -3336 | -0302 | 9422 |

TABLE L

 U_2 (N.G.)

| | F_1 | G_1 | H_1 | a | d |
|-------|-------------|-------------|-------------|-------------|-------------|
| T_A | -1852 | -0818 | -1611 | <u>9660</u> | . |
| T_B | 1415 | 3168 | <u>9378</u> | . | . |
| T_C | <u>9383</u> | 0848 | 3350 | . | . |
| T_D | 4906 | 1756 | 0573 | . | <u>8516</u> |
| T_E | 3351 | <u>9304</u> | 1484 | . | . |

TABLE LI

 D^{-1} (N.G.)

| | | | | |
|--------|--------|--------|--------|--------|
| 1.0352 | . | . | . | . |
| . | 1.2252 | . | . | . |
| . | . | 1.3190 | . | . |
| . | . | . | 1.1743 | . |
| . | . | . | . | 1.2100 |

TABLE LII

| $D^{-1}U_t$ | | | (N.G.) | | |
|-------------|--------|--------|--------|--------|---|
| -1917 | -0847 | -1668 | 1.0000 | . | . |
| 1734 | 3881 | 1.1490 | . | . | . |
| 1.2376 | 1119 | 4419 | . | . | . |
| 5761 | 2062 | 0673 | . | 1.0000 | . |
| 4055 | 1.1258 | 1796 | . | . | . |

TABLE LIII

| $\Psi_{m\omega} = \Lambda D^{-1}U_t$ | | | | | | | (N.G.) |
|--------------------------------------|--------|--------|-------|----------|----------|--------|--------|
| | F_1 | G_1 | H_1 | A_{x5} | $D_{\#}$ | S.Sq. | |
| I | 5659 | 5400 | 4552 | 2689 | 3301 | 1.0003 | |
| II | -2650 | -1945 | 8639 | -3585 | -1300 | 9998 | |
| III | -1618 | 0906 | -1454 | -5676 | 7901 | 1.0020 | |
| IV | -4284 | -3144 | 1551 | 6871 | 4701 | 9995 | |
| V | -6337 | 7519 | -0212 | 0697 | -1700 | 1.0011 | |
| S.Sq. | 1.0017 | 1.0018 | 9992 | 1.0000 | 1.0000 | | |

TABLE LIV

| | S.Sq. | h | (N.G.) |
|----|-------|------|--------|
| 1 | 6483 | 6478 | |
| 2 | 5697 | 5685 | |
| 3 | 6920 | 6933 | |
| 4 | 6296 | 6304 | |
| 5 | 6543 | 6541 | |
| 6 | 3554 | 3549 | |
| 7 | 3551 | 3552 | |
| 8 | 3837 | 3827 | |
| 9 | 6713 | 6718 | |
| 10 | 7000 | 7000 | |
| 11 | 5313 | 5326 | |
| 12 | 5736 | 5732 | |
| 13 | 6428 | 6430 | |
| 14 | 7023 | 7010 | |
| 15 | 7227 | 7214 | |
| 16 | 5397 | 5390 | |
| 17 | 5132 | 5131 | |
| 18 | 6939 | 6922 | |
| 19 | 7925 | 7913 | |

TABLE LV

Unrotated Second Order Factor Matrix ϕ . (I.B.)

| | F | G | H | h^2 |
|---|--------|-------|-------|--------|
| T | 3239 | -2609 | -1922 | 2099 |
| T | 1098 | 4483 | -1807 | 2457 |
| T | 1.0000 | 0 | 0 | 1.0000 |
| T | -5117 | -2967 | 8063 | 1.0000 |
| T | 4147 | 9099 | 0 | 1.0000 |

TABLE LVI

Orthogonal Rotating Matrix θ, θ_2 (I.B.)

| | F_2 | G_1 | H_1 |
|---|-------|-------|-------|
| F | 9370 | 0752 | -3412 |
| G | -0800 | 9968 | . |
| H | 3401 | 0273 | 9400 |

TABLE LVII

 U_t (I.B.)

| | F_2 | G_1 | H_1 | a | b |
|---|-------------|-------------|-------------|-------------|-------------|
| T | 2590 | -2401 | -2912 | <u>8888</u> | . |
| T | 0056 | 4502 | -2073 | . | <u>8685</u> |
| T | <u>9370</u> | 0752 | -3412 | . | . |
| T | -1815 | -3122 | <u>9325</u> | . | . |
| T | 3158 | <u>9382</u> | -1415 | . | . |

TABLE LVIII

 D^{-1} (I.B.)

| | | | | |
|---------|---------|---------|---------|---------|
| 1.13855 | . | . | . | . |
| . | 1.16185 | . | . | . |
| . | . | 1.27623 | . | . |
| . | . | . | 1.29420 | . |
| . | . | . | . | 1.31287 |

TABLE LIX

| $D^{-1}U_t$ | | (I.B.) | | |
|-------------|--------|--------|--------|--------|
| 2949 | -2744 | -3315 | 1.0119 | . |
| 0065 | 5231 | -2409 | . | 1.0091 |
| 1.1958 | 0960 | -4354 | . | . |
| -2349 | -4040 | 1.2068 | . | . |
| 4146 | 1.2317 | -1858 | . | . |

TABLE LX

| $\psi_{mw} = \Lambda D^{-1}U_t$ | | (I.B.) | | | | |
|---------------------------------|--------|--------|-------|--------|--------|--------|
| | F_2 | G_1 | H_1 | a^* | b^* | S.Sq. |
| I | 6613 | 2656 | 4329 | 4665 | 3713 | 1.0507 |
| II | 1713 | 6361 | -1752 | -6638 | 2270 | 9568 |
| III | 1419 | -1702 | -7875 | 3218 | 5257 | 1.0492 |
| IV | 6379 | -0350 | -3099 | -1245 | -7013 | 1.0115 |
| V | -3414 | 7041 | -2105 | 4979 | -2472 | 9656 |
| S.Sq. | 1.0103 | 1.0011 | 9786 | 1.0252 | 1.0187 | |

TABLE LXI

| | S.Sq.. | h^2 |
|----|--------|-------|
| 1 | 6398 | 6269 |
| 2 | 3808 | 3638 |
| 3 | 5877 | 5830 |
| 4 | 5220 | 5167 |
| 5 | 4094 | 3999 |
| 6 | 4270 | 3848 |
| 7 | 2165 | 2183 |
| 8 | 2441 | 2479 |
| 9 | 3656 | 3671 |
| 10 | 5714 | 5554 |
| 11 | 4201 | 4144 |
| 12 | 2919 | 2985 |
| 13 | 4267 | 4262 |
| 14 | 4489 | 4470 |
| 15 | 8092 | 8051 |
| 16 | 7596 | 7549 |
| 17 | 4783 | 4394 |
| 18 | 7190 | 6470 |
| 19 | 7050 | 6353 |

(I.B.)

* These symbols were retained here because the entries for the last two columns in the previous matrix were not so nearly zero as with the N.B's or the N.G's. This was due, I think, to the last residuals of the second order factor matrix being larger with the I.B's. This led to the small discrepancies marked "?" in those tests highly loaded in a and b. And it is seen that ψ_{mw} is not such a close approximation to an orthogonal matrix as with the N.B's and the N.G's.

TABLE LXII

$F_0 T'$

| N.B. | (1) T_c | (2) T_F | (3) T_A | (4) T_B | (5) T_D |
|------|--------------|--------------|--------------|--------------|--------------|
| 1 | 30 | 36 | 38 | 26 | 21 |
| 2 | 29 | 25 | 45 | -07 | 27 |
| 3 | 24 | 24 | 32 | 07 | 46 |
| 4 | 31 | 12 | 10 | 06 | 74 |
| 5 | 43 | 05 | 31 | 29 | 52 |
| 6 | 27 | -15 | 18 | 28 | 48 |
| 7 | 19 | -13 | 41 | 37 | -03 |
| 8 | 25 | -02 | -10 | 74 | 31 |
| 9 | 22 | 09 | 10 | 36 | 28 |
| 10 | 24 | 41 | 24 | 29 | 20 |
| 11 | 26 | 25 | 05 | 34 | 40 |
| 12 | 31 | 42 | 08 | 22 | 20 |
| 13 | 67 | 06 | 28 | 18 | 30 |
| 14 | 64 | 18 | 37 | 02 | 25 |
| 15 | 68 | 22 | 35 | 07 | 13 |
| 16 | 67 | 24 | 37 | 16 | 16 |
| 17 | 37 | 53 | 21 | 14 | -07 |
| 18 | 49 | 59 | -06 | 13 | 12 |
| 19 | 57 | 52 | 26 | 16 | 02 |

| N.G. | | | | | |
|------|-------|-------|-------|-------|-------|
| | T_F | T_D | T_c | T_A | T_B |
| 1 | 45 | 64 | 52 | -04 | 58 |
| 2 | 51 | 42 | 72 | -09 | 40 |
| 3 | 56 | 34 | 42 | 07 | 74 |
| 4 | 37 | 30 | 42 | 07 | 74 |
| 5 | 71 | 29 | 53 | -18 | 66 |
| 6 | 42 | 14 | 21 | 34 | 19 |
| 7 | 28 | 30 | 56 | 06 | 29 |
| 8 | 15 | 15 | 21 | 51 | 07 |
| 9 | 50 | 29 | 67 | -00 | 68 |
| 10 | 53 | 59 | 47 | 08 | 62 |
| 11 | 39 | 58 | 52 | -05 | 52 |
| 12 | 28 | 64 | 47 | 22 | 28 |
| 13 | 60 | 53 | 66 | -21 | 59 |
| 14 | 69 | 57 | 59 | -22 | 60 |
| 15 | 82 | 46 | 43 | -14 | 45 |
| 16 | 64 | 54 | 49 | -11 | 34 |
| 17 | 42 | 67 | 42 | -16 | 32 |
| 18 | 64 | 70 | 47 | 00 | 29 |
| 19 | 72 | 63 | 45 | 17 | 41 |

| I.B. | | | | | |
|------|-------|-------|-------|-------|-------|
| | T_D | T_c | T_F | T_A | T_B |
| 1 | 16 | 28 | 51 | 05 | 29 |
| 2 | 03 | 34 | 24 | 12 | 35 |
| 3 | 07 | 50 | 44 | -02 | 24 |
| 4 | 08 | 40 | 47 | 07 | 10 |
| 5 | -08 | 37 | 23 | 06 | 45 |
| 6 | -32 | 24 | 35 | 28 | 48 |
| 7 | -29 | 39 | 38 | 14 | 15 |
| 8 | -23 | 36 | 07 | 44 | -02 |
| 9 | 17 | 03 | 42 | -19 | 19 |
| 10 | 23 | 31 | 46 | 07 | 30 |
| 11 | -11 | 47 | 41 | 00 | 35 |
| 12 | 30 | 08 | 08 | -12 | 21 |
| 13 | 20 | 23 | 19 | 33 | -07 |
| 14 | 32 | 19 | 19 | 18 | -06 |
| 15 | 44 | 28 | -25 | 51 | -32 |
| 16 | 44 | 26 | -01 | 42 | -20 |
| 17 | 30 | -04 | 09 | 20 | 25 |
| 18 | 15 | 28 | 00 | 52 | 23 |
| 19 | 27 | 15 | -09 | 49 | 17 |

TABLE LXIII

$F_0 \psi_{m\omega}$

| N.B. | (1) F_2 | (2) E_7 | (3) G_1 | (4) B_3 | (5) H_1 |
|------|--------------|--------------|--------------|--------------|--------------|
| 1 | 22 | 56 | 32 | 25 | 24 |
| 2 | 19 | 49 | 40 | -06 | 33 |
| 3 | 10 | 48 | 27 | 08 | 51 |
| 4 | 14 | 34 | 03 | 03 | 75 |
| 5 | 30 | 28 | 23 | 26 | 54 |
| 6 | 16 | 01 | 12 | 27 | 49 |
| 7 | 17 | 00 | 38 | 40 | 02 |
| 8 | 20 | 00 | -16 | 70 | 25 |
| 9 | 16 | 20 | 05 | 34 | 28 |
| 10 | 17 | 56 | 20 | 28 | 22 |
| 11 | 17 | 38 | -01 | 31 | 39 |
| 12 | 29 | 45 | -19 | 13 | 12 |
| 13 | 62 | 22 | 15 | 06 | 24 |
| 14 | 58 | 38 | 25 | -08 | 22 |
| 15 | 66 | 39 | 22 | -06 | 07 |
| 16 | 64 | 42 | 24 | 04 | 11 |
| 17 | 38 | 62 | 14 | 06 | -10 |
| 18 | 49 | 63 | -16 | -02 | 01 |
| 19 | 57 | 64 | 11 | 04 | -05 |

| N.G. | | | | | |
|------|-------|-------|-------|-------|-------|
| | G_1 | D_4 | F_2 | A_5 | H_1 |
| 1 | 28 | 45 | 37 | 13 | 47 |
| 2 | 28 | 04 | 66 | 09 | 23 |
| 3 | 43 | 16 | 18 | 25 | 62 |
| 4 | 23 | 15 | 18 | 24 | 68 |
| 5 | 57 | -01 | 35 | 00 | 46 |
| 6 | 38 | -01 | 17 | 42 | 05 |
| 7 | 08 | 03 | 52 | 20 | 20 |
| 8 | 08 | 04 | 21 | 58 | 01 |
| 9 | 27 | -04 | 49 | 21 | 56 |
| 10 | 38 | 41 | 30 | 25 | 48 |
| 11 | 21 | 38 | 38 | 11 | 43 |
| 12 | 12 | 47 | 42 | 36 | 20 |
| 13 | 39 | 22 | 52 | -02 | 42 |
| 14 | 52 | 28 | 44 | -03 | 40 |
| 15 | 74 | 19 | 33 | 01 | 18 |
| 16 | 51 | 27 | 43 | 03 | 13 |
| 17 | 29 | 51 | 36 | 07 | 19 |
| 18 | 52 | 46 | 43 | 14 | 06 |
| 19 | 61 | 39 | 36 | 32 | 18 |

| I.B. | | | | | |
|------|-------|-------|-------|-----|-----|
| | H_1 | F_2 | G_1 | a | b |
| 1 | 40 | 40 | 46 | 23 | 22 |
| 2 | 16 | 40 | 14 | 17 | 38 |
| 3 | 30 | 61 | 30 | 00 | 18 |
| 4 | 32 | 51 | 38 | 13 | 01 |
| 5 | 06 | 39 | 13 | 08 | 48 |
| 6 | -22 | 16 | 28 | 34 | 40 |
| 7 | -14 | 34 | 27 | 08 | 00 |
| 8 | -19 | 32 | -06 | 32 | 00 |
| 9 | 36 | 12 | 46 | 01 | 07 |
| 10 | 40 | 46 | 19 | 18 | 37 |
| 11 | 08 | 51 | 29 | -01 | 28 |
| 12 | 39 | 22 | 07 | -01 | 30 |
| 13 | 33 | 36 | 13 | 41 | -01 |
| 14 | 46 | 36 | 16 | 29 | 00 |
| 15 | 45 | 49 | -36 | 48 | 00 |
| 16 | 54 | 48 | -09 | 48 | 01 |
| 17 | 38 | 08 | 13 | 42 | 37 |
| 18 | 20 | 37 | -09 | 58 | 44 |
| 19 | 28 | 27 | -15 | 59 | 43 |

TABLE LXIV

| $H^1 F_0 T^1$ | | | | | |
|---------------|-------|------------------|---------------|-------------------|-------|
| N.B. | (1) | (2) | (3) | (4) | (5) |
| | T_c | T_F | T_A | T_B | T_D |
| 1 | 39 | 46 | 48 | 33 | 27 |
| 2 | 39 | 33 | 60 | -09 | 36 |
| 3 | 32 | 32 | 59 | 09 | 60 |
| 4 | 37 | 14 | 12 | 07 | 89 |
| 5 | 56 | 07 | 41 | 38 | 68 |
| 6 | 46 | -25 | 30 | 47 | 80 |
| 7 | 33 | -22 | 71 | 64 | -06 |
| 8 | 31 | -03 | -12 | 94 | 39 |
| 9 | 44 | 18 | 19 | 70 | 56 |
| 10 | 33 | 56 | 33 | 40 | 28 |
| 11 | 35 | 34 | 07 | 46 | 54 |
| 12 | 52 | 70 | 14 | 37 | 32 |
| 13 | 92 | 08 | 39 | 25 | 41 |
| 14 | 82 | 23 | 48 | 03 | 32 |
| 15 | 84 | 27 | 44 | 08 | 16 |
| 16 | 82 | 29 | 45 | 19 | 20 |
| 17 | 48 | 69 | 28 | 18 | -09 |
| 18 | 59 | 71 | -07 | 16 | 14 |
| 19 | 65 | 59 | 29 | 18 | 02 |
| N.G. | | | | | |
| | T_F | T_D | T_c | T_A | T_B |
| 1 | 56 | 79 | 65 | -05 | 72 |
| 2 | 68 | 55 | 95 | -12 | 53 |
| 3 | 67 | 41 | 50 | 08 | 89 |
| 4 | 47 | 38 | 53 | 09 | 93 |
| 5 | 88 | 36 | 65 | -23 | 82 |
| 6 | 71 | 24 | 35 | 56 | 32 |
| 7 | 47 | 51 | 94 | 10 | 48 |
| 8 | 24 | 25 | 34 | 82 | 11 |
| 9 | 61 | 35 | 82 | 00 | 83 |
| 10 | 63 | 70 | 56 | 10 | 74 |
| 11 | 53 | 79 | 71 | -07 | 72 |
| 12 | 37 | 84 | 62 | 30 | 37 |
| 13 | 74 | 66 ⁸² | 92 | -26 | 74 |
| 14 | 82 | 68 | 71 | -26 | 72 |
| 15 | 97 | 55 | 51 | -07 ¹⁷ | 53 |
| 16 | 87 | 74 | 67 | -15 | 47 |
| 17 | 58 | 94 | 59 | -22 | 45 |
| 18 | 77 | 84 | 57 | 00 | 34 |
| 19 | 81 | 70 | 51 | 19 | 46 |
| I.B. | | | | | |
| | T_D | T_c | T_F | T_A | T_B |
| 1 | 20 | 35 | 64 | 06 | 37 |
| 2 | 05 | 56 | 40 | 20 | 57 |
| 3 | 09 | 65 | 57 | -03 | 31 |
| 4 | 11 | 55 | 66 | 09 | 13 |
| 5 | -13 | 58 | 37 | 09 | 72 |
| 6 | -51 | 39 | 56 | 46 | 77 |
| 7 | -61 | 83 | 82 | 29 | 32 |
| 8 | -46 | 73 | 15 | 89 | -04 |
| 9 | 28 | 05 | 70 | -31 | 32 |
| 10 | 31 | 41 | 62 | 09 | 40 |
| 11 | -17 | 73 | 64 | 00 | 55 |
| 12 | 56 | 15 | 14 | -22 | 38 |
| 13 | 31 | 36 | 29 | 51 | -11 |
| 14 | 48 | 28 | 29 | 27 | -09 |
| 15 | 50 | 31 | -28 | 57 | -36 |
| 16 | 50 | 30 | -01 | 48 | -23 |
| 17 | 46 | -07 | 14 | 30 | 37 |
| 18 | 19 | 34 | 00 | 64 | 29 |
| 19 | 33 | 18 | -12 | 61 | 22 |

TABLE LXV

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| $H^1 F_0 \psi_{m\omega}$ | | | | | |
|--------------------------|-------|-------|-------|-------|-------|
| N.B. | (1) | (2) | (3) | (4) | (5) |
| | F_2 | E_7 | G_1 | B_2 | H_1 |
| 1 | 29 | 73 | 42 | 33 | 31 |
| 2 | 25 | 66 | 54 | -09 | 44 |
| 3 | 14 | 63 | 35 | 10 | 67 |
| 4 | 17 | 41 | 04 | 03 | 90 |
| 5 | 38 | 37 | 30 | 34 | 70 |
| 6 | 27 | 01 | 20 | 46 | 82 |
| 7 | 30 | -01 | 66 | 69 | 03 |
| 8 | 26 | 01 | -21 | 89 | 32 |
| 9 | 31 | 38 | 10 | 67 | 54 |
| 10 | 23 | 79 | 27 | 39 | 30 |
| 11 | 26 | 58 | -01 | 47 | 60 |
| 12 | 48 | 75 | -31 | 21 | 19 |
| 13 | 85 | 31 | 21 | 08 | 33 |
| 14 | 74 | 49 | 32 | -11 | 28 |
| 15 | 82 | 48 | 27 | -08 | 09 |
| 16 | 77 | 51 | 29 | 05 | 14 |
| 17 | 50 | 82 | 19 | 08 | -13 |
| 18 | 59 | 76 | -19 | -02 | 01 |
| 19 | 65 | 73 | 13 | 04 | -06 |
| N.G. | | | | | |
| | G_1 | D_4 | F_2 | A_5 | H_1 |
| 1 | 34 | 56 | 45 | 16 | 58 |
| 2 | 37 | 05 | 87 | 12 | 31 |
| 3 | 52 | 19 | 22 | 30 | 74 |
| 4 | 29 | 19 | 23 | 30 | 86 |
| 5 | 70 | -01 | 43 | 00 | 57 |
| 6 | 65 | -02 | 29 | 71 | 08 |
| 7 | 14 | 05 | 87 | 33 | 34 |
| 8 | 14 | 06 | 34 | 93 | 02 |
| 9 | 33 | -04 | 60 | 25 | 68 |
| 10 | 46 | 49 | 35 | 30 | 58 |
| 11 | 29 | 53 | 52 | 15 | 59 |
| 12 | 16 | 62 | 55 | 47 | 26 |
| 13 | 49 | 27 | 65 | -02 | 52 |
| 14 | 62 | 34 | 53 | -03 | 48 |
| 15 | 87 | 22 | 39 | 01 | 21 |
| 16 | 70 | 37 | 58 | 04 | 17 |
| 17 | 40 | 72 | 50 | 09 | 27 |
| 18 | 63 | 55 | 52 | 17 | 08 |
| 19 | 69 | 43 | 41 | 36 | 20 |
| I.B. | | | | | |
| | H_1 | F_2 | G_1 | a | b |
| 1 | 51 | 51 | 59 | 29 | 28 |
| 2 | 26 | 67 | 24 | 28 | 63 |
| 3 | 39 | 80 | 40 | 00 | 24 |
| 4 | 44 | 71 | 53 | 18 | 01 |
| 5 | 09 | 62 | 20 | 12 | 76 |
| 6 | -36 | 25 | 46 | 55 | 64 |
| 7 | -31 | 73 | 58 | 16 | 01 |
| 8 | -39 | 64 | -12 | 64 | 01 |
| 9 | 59 | 20 | 77 | 01 | 11 |
| 10 | 53 | 62 | 25 | 24 | 49 |
| 11 | 12 | 78 | 44 | -01 | 43 |
| 12 | 71 | 41 | 12 | -01 | 54 |
| 13 | 51 | 55 | 20 | 63 | -02 |
| 14 | 69 | 53 | 23 | 44 | 00 |
| 15 | 51 | 55 | -41 | 53 | 00 |
| 16 | 62 | 55 | -10 | 56 | 01 |
| 17 | 57 | 12 | 20 | 64 | 56 |
| 18 | 24 | 46 | -11 | 72 | 55 |
| 19 | 35 | 34 | -18 | 74 | 53 |

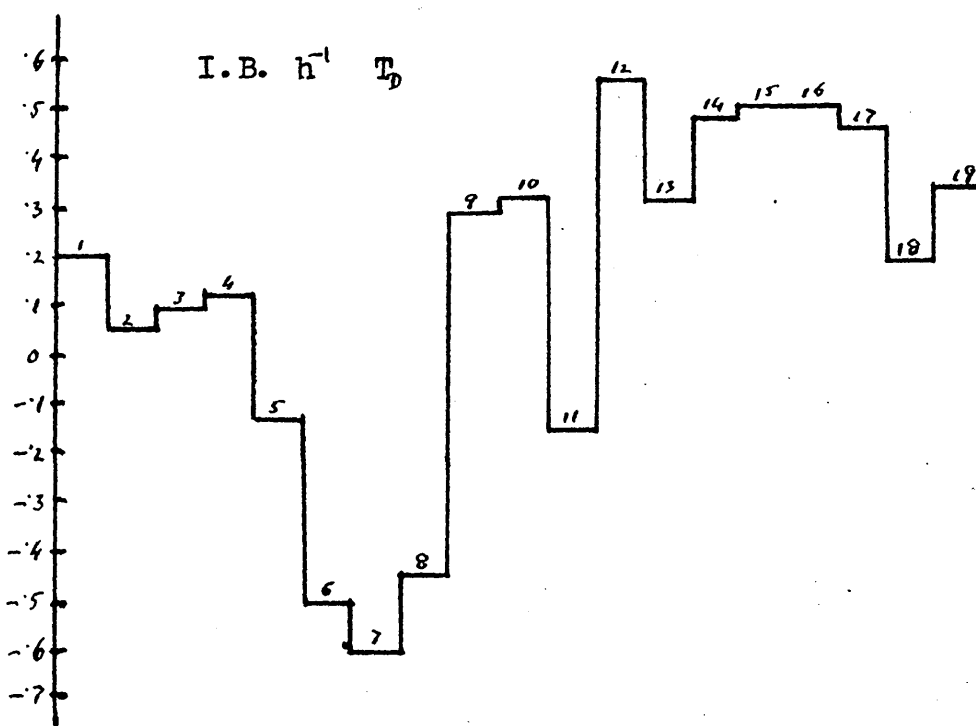
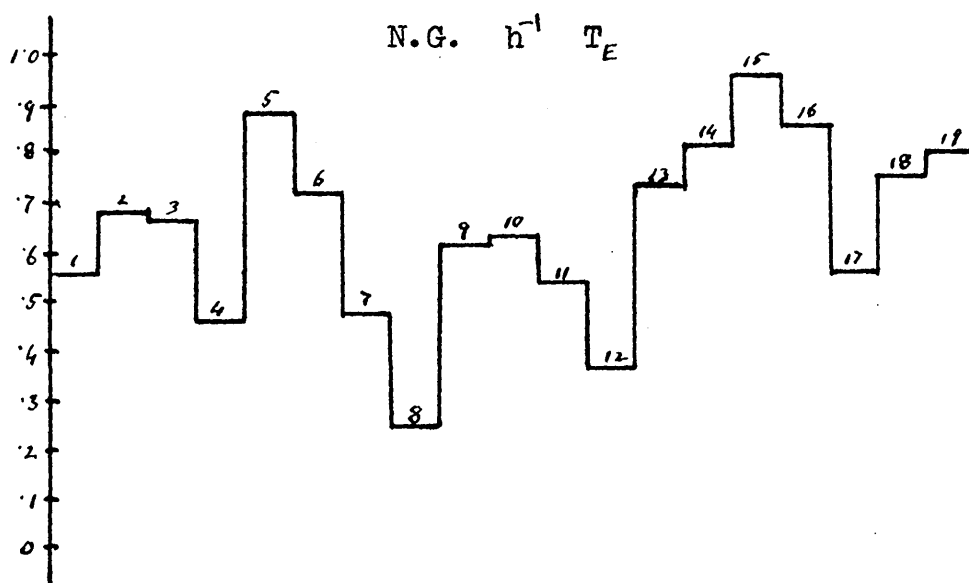
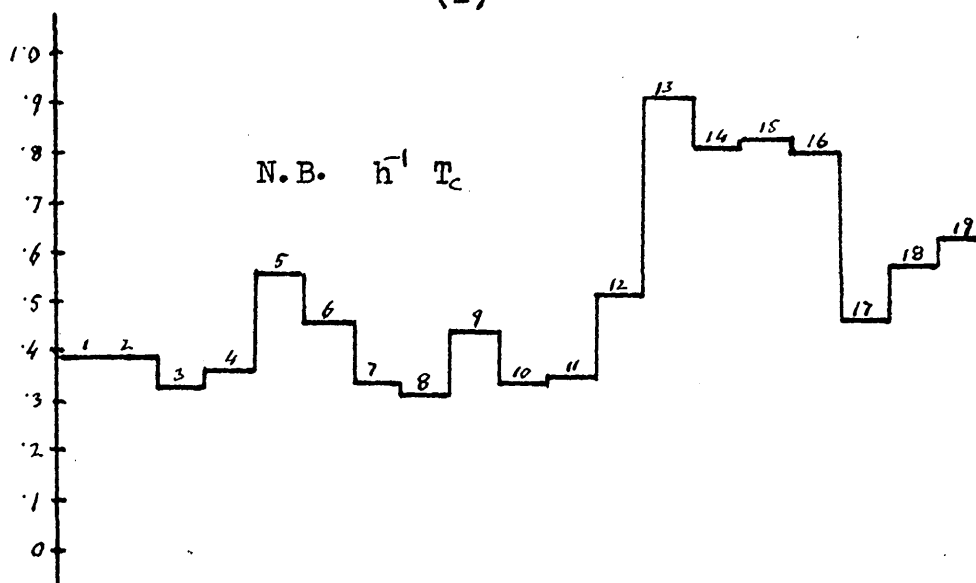
Profiles of the loadings of the tests in the five Primary Factors were made using first the $F_o T'$ data of Table LXII and then the $H^{-1} F_o T'$ data of Table LXIV. The latter seemed to give the clearer picture. A considerable amount of difficulty was experienced in relating a Primary Factor in one population to one in another, but after trying several ways of matching them I decided to put the factors in the order shown by the numbers in brackets at the heads of the columns in the Tables LXII - LXIV, and Figures 2 - 6 are arranged in this same order. Greater difficulty was experienced in matching the factors of the I.B's to either the N.B's or N.G's than between these two groups.

Negative loadings numerically too great to be regarded as insignificant are seen to occur in some places especially with the I.B's, the most extreme case being with I.B. T_o , though these are not so marked in the $F_o \psi_m w$ matrices. Negative loadings perhaps might be ascribed to a Bi-polar personality factor of Taste-Distaste. Thus it is thinkable, though this is not necessarily found here, that a child, finding himself good at mathematics, say, may acquire a distaste for English/s-objects.

The following tentative description of the Primary Factors is deduced from these profiles where the numbers in brackets after the symbols for the Primary Factors refer to their loadings on the First Centroid Axes, reproduced from the Columns I of the T matrices of Tables XXI, XXX and XXXVII:

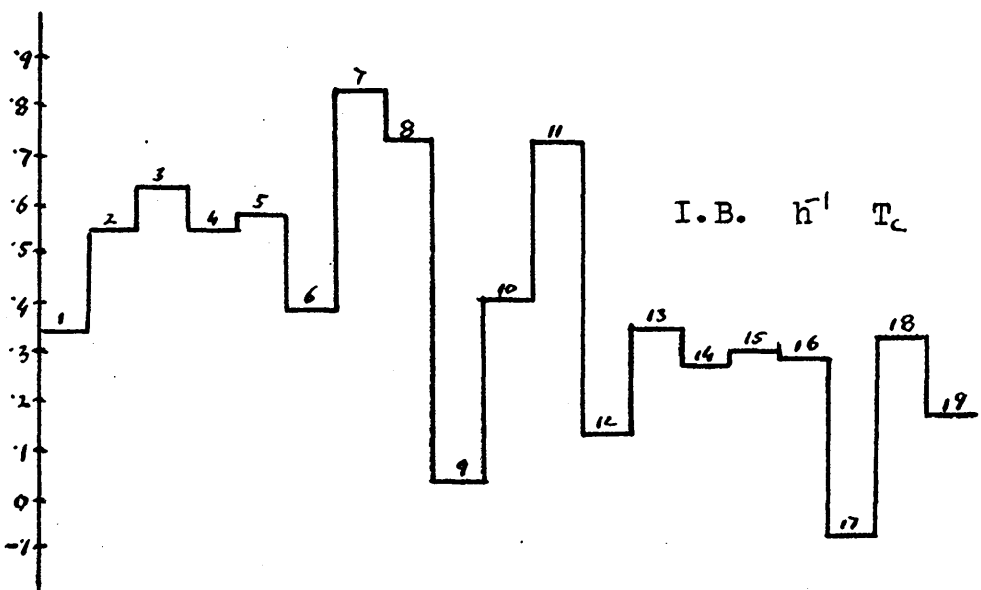
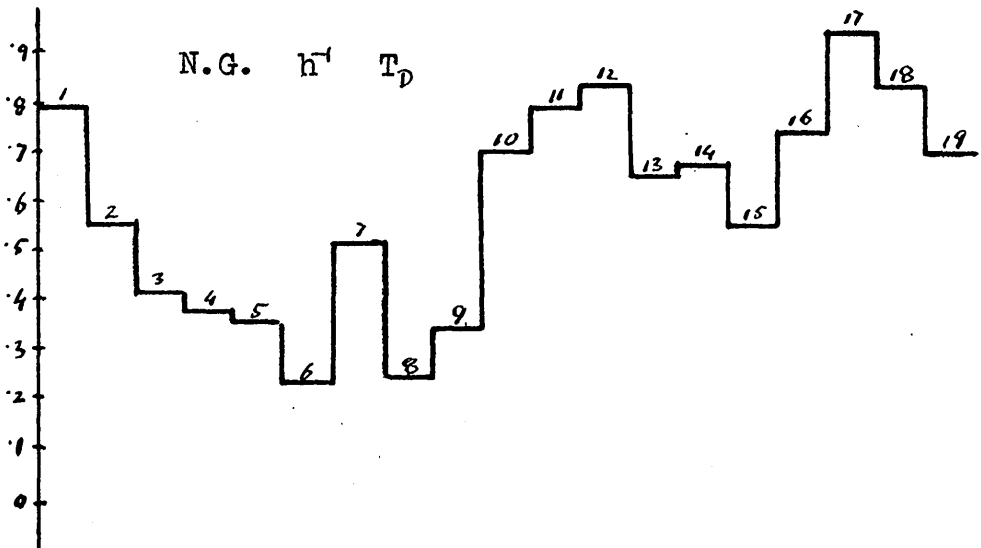
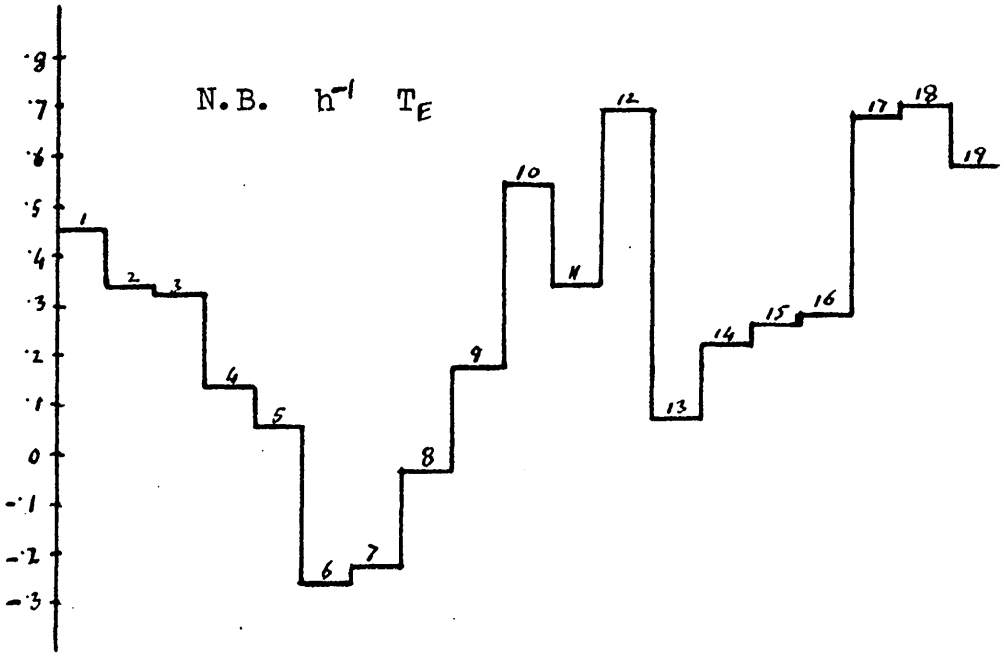
- (1) N.B. T_c (.65) Numerical Ability
 N.G. T_e (.76) " "
 I.B. T_o (.20) " "
- (2) N.B. T_e (.37) English and ability to recognise
 Functions of objects (2-Alike) and
 ability to deal with material
 presented in the form of pictures.

(1)



Figure, 2.

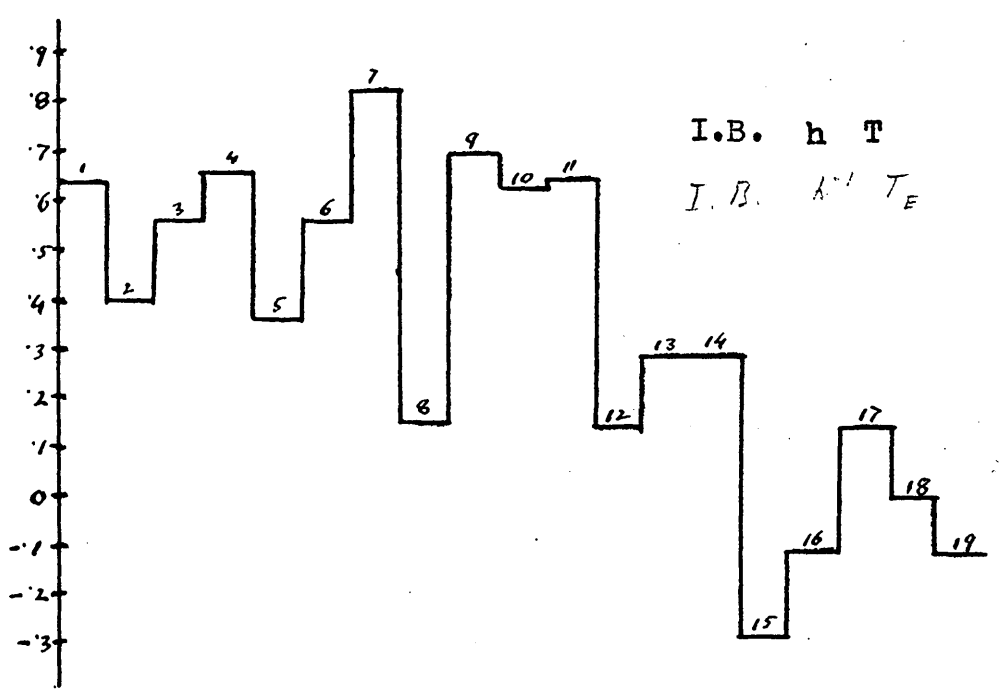
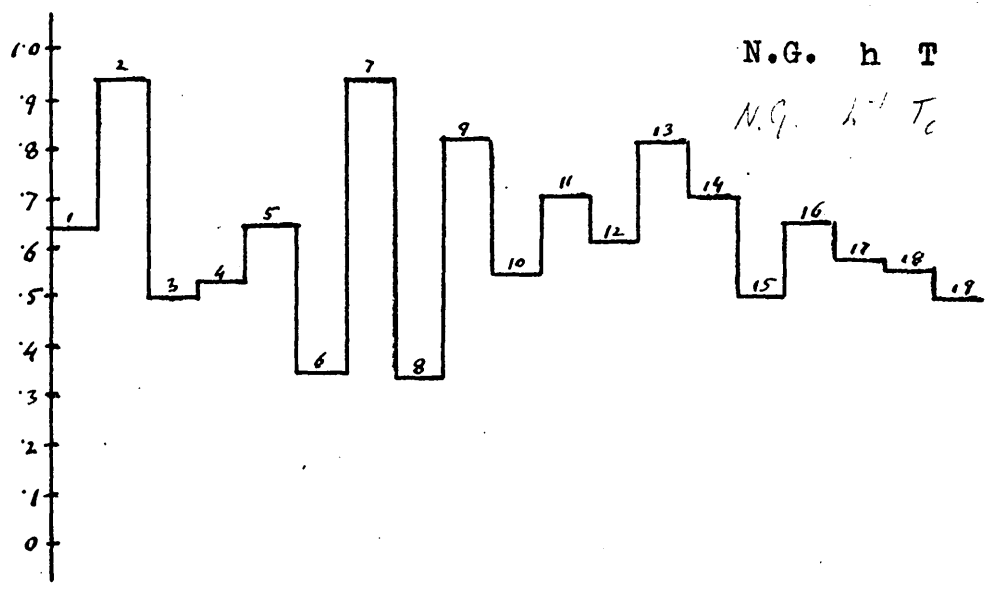
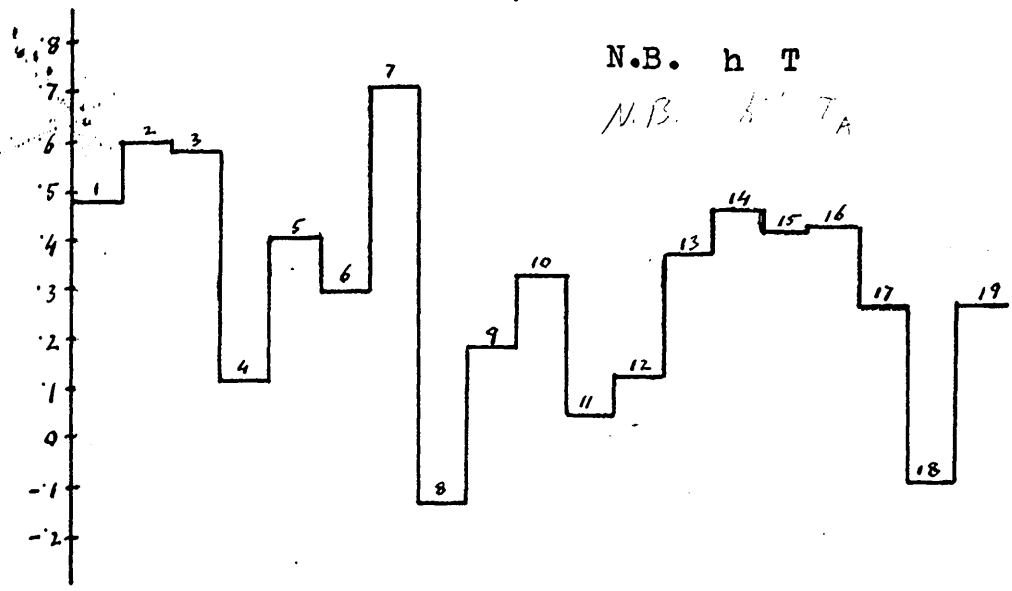
(2)



This does not match at all here
 it would match better with N.B. $h^{-1} T_A$
 but then I.B. $h^{-1} T_E$ has no place.

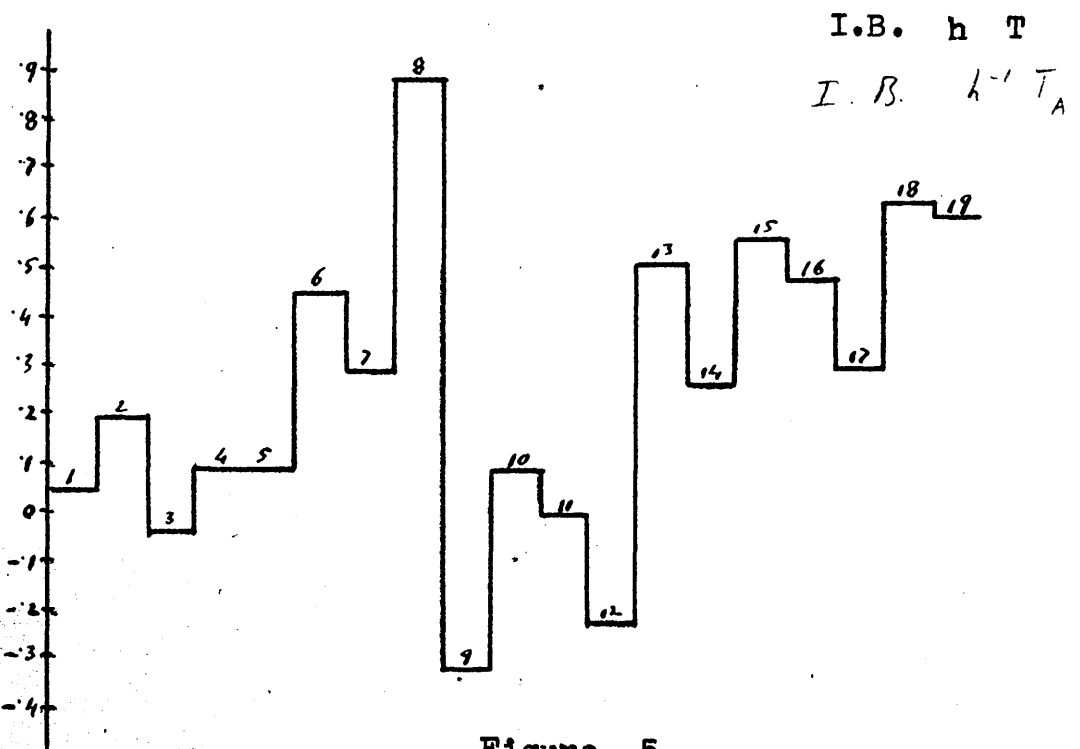
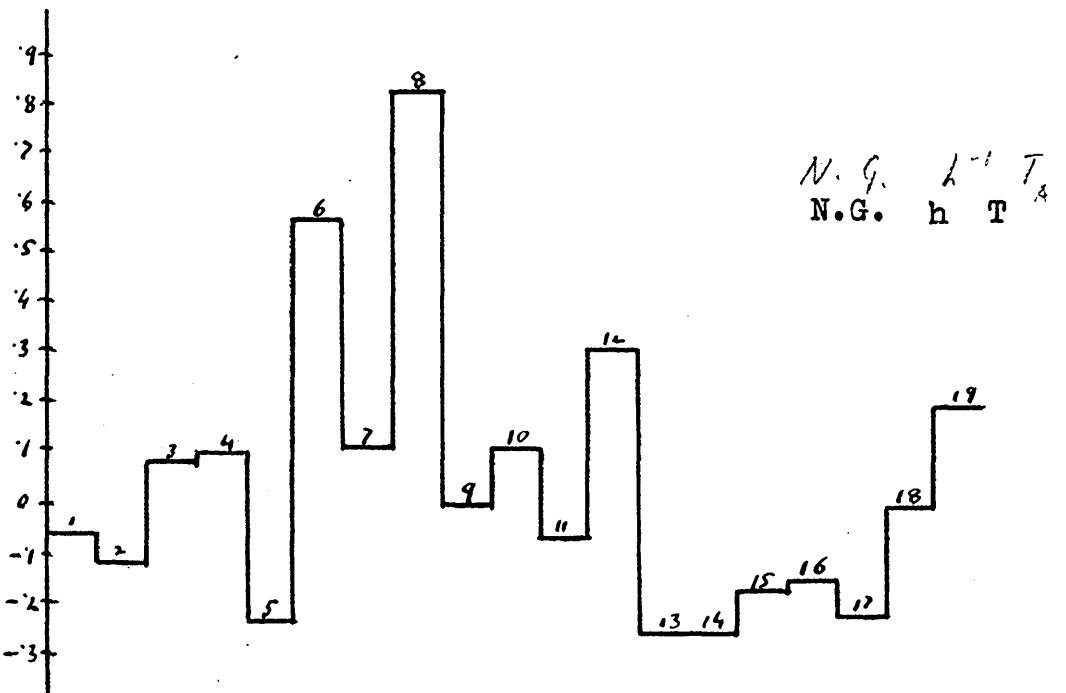
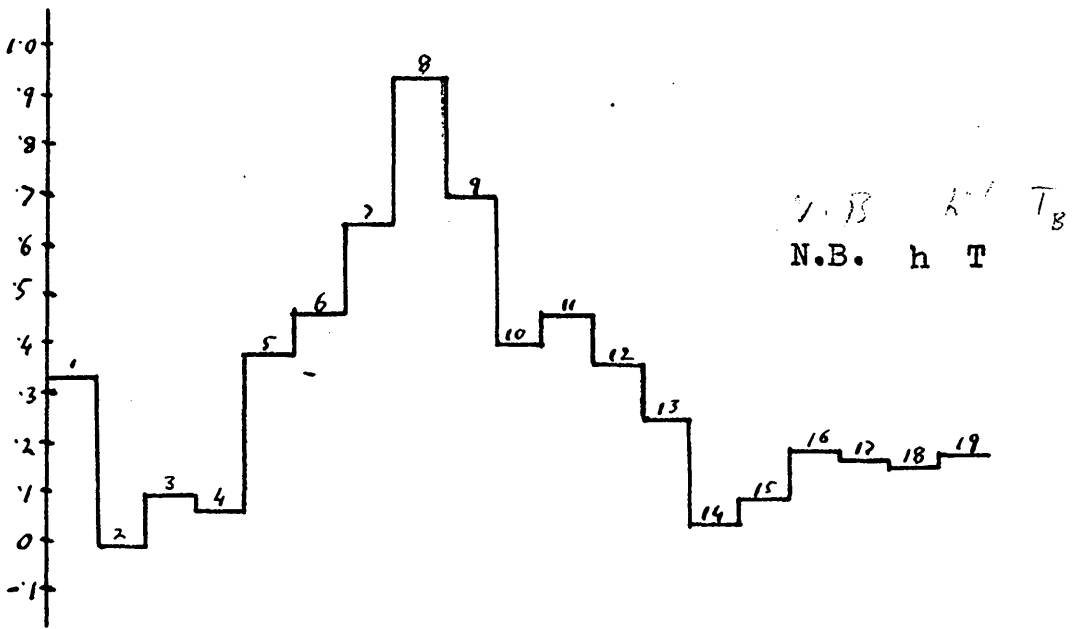
Figure, 3.

(3)



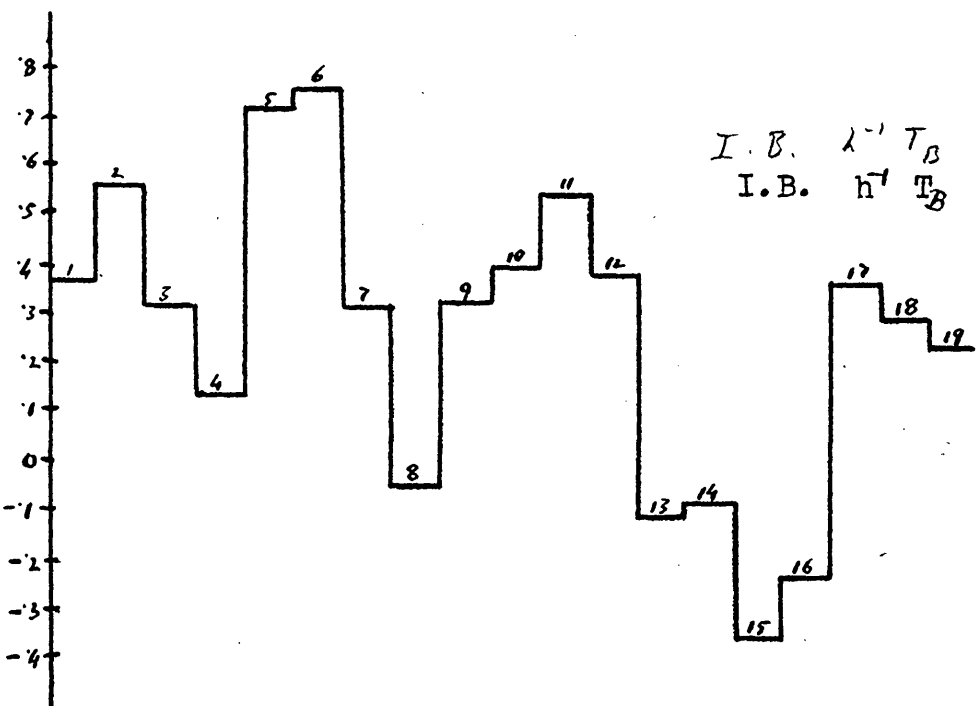
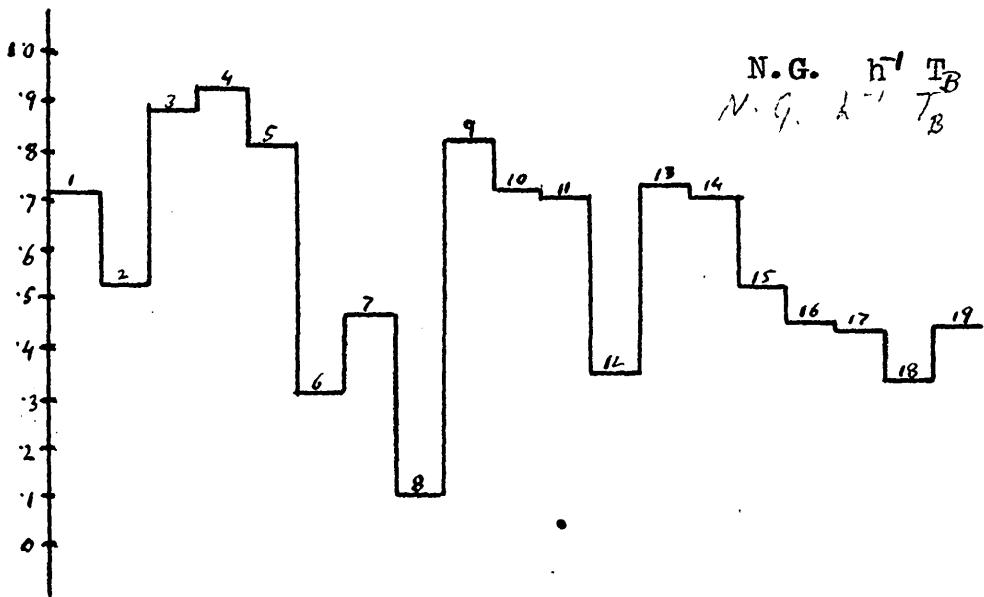
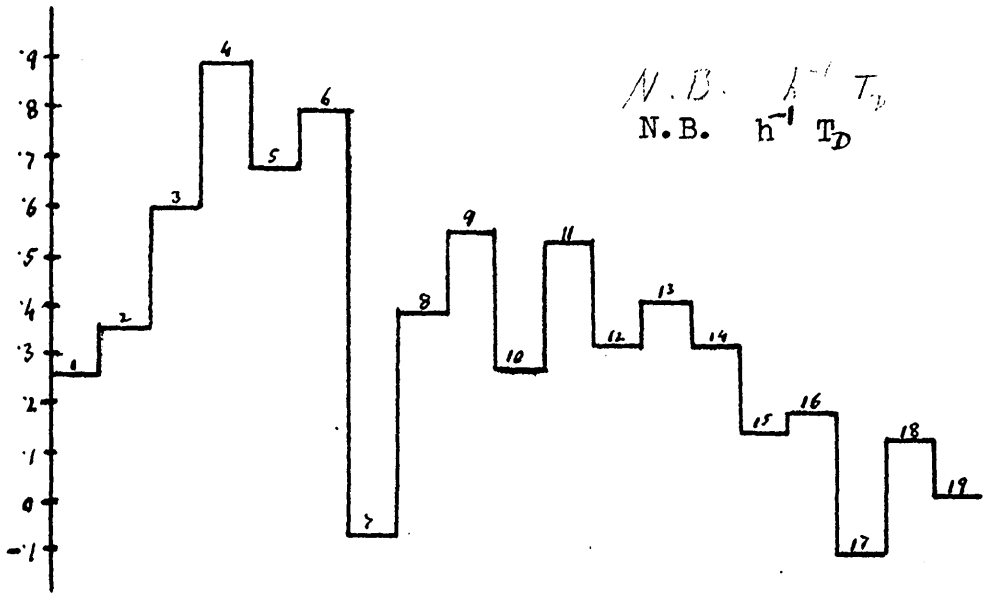
Figure, 4.
Figure, 4.

(4)



Figure, 5.
Figure, 5.

(5)



Figure, 6.
 Figure, 6.

- N.G. T_D (.68) Same as for N.^B.
- I.B. T_C (.49) Space, and Picture Sequences
- (3) N.B. T_A (.36) Ability to distinguish between Mirror-Images (+Non-Verbal and Mathematical Ability)
- N.G. T_C (.73) Same as for N.B.
- I.B. T_E (.40) Same as for N.B. but substitute Change of Shape (Links) and Picture Ability for "Non-Verbal & Maths".
- (4) N.B. T_B (.36) 3-dimensional Space
- N.G. T_A (.04) Same as for N.B.
- I.B. T_A (.35) Same as for N.B.
- (5) N.B. T_D (.43) General Non-Verbal Ability with change of Shape, Picture Sequences and Mathematics.
- N.G. T_B (.68) Same as for N.B. with the addition of Picture Analogies.
- I.B. T_B (.30) General Non-Verbal and English with Change of Shape and Picture Ability.

In giving psychological terms to the tests and groups of tests I am admittedly guessing. I cannot with certainty state that Test 7, for instance, measures ability to distinguish Mirror Images. It is what it was designed to do but its communalities is low so that this may not be a feature of the test contained in its communal part, or it may even not be a feature of the test at all; there are so many unpredictable possible components attending the purpose for which a test was designed such as its length, bringing in the trait of perseverance, or whether it was the first or last test of the day, that, unless Factorial Analysis reveals something in common between it and other tests, one must be chary of giving the test a label. Still, from the profiles, Test 7 does seem to have something original about it which I find hard to explain by incidental elements which would as likely be possessed by quite a lot of the other tests. And so it may be with the other tests.

In all of the populations Tests 6, 7 and 8 have loadings near zero, or less than zero, in one factor - N.B's, T_E ; N.G's T_D ; I.B's T_D - but we do not find any factor in which these tests have, all three of them, high loadings. Their test vectors project into separate dimensions. So that it could not be said that a Space Factor had been established.

The intention when designing the battery was not to produce factors - this would have been easy enough by giving tests within groups of which there were evident common characteristics. The purpose was to give a battery where the tests could be related perhaps, but were not certainly so from the start, and to see if they turned out to be so. If a factor appeared which was common to a wide range of tests this would be all the more valuable, for we might presume that the factor would operate outside the compass of the battery. The value of a factor, it seems to me, varies inversely with the probability of its existence. The existence of merit from the point of view of artistic creation may be far more difficult to determine in the case of a non-naturalistic painting than in the case of a naturalistic one where there is none.

Assuming for the present that we have justification for endowing the tests with psychological terms, we have the scheme presented above, in reverse:

| Tests | Ability | Pop. | Primaries |
|-------------|-------------|------|-----------|
| 13,14,15,16 | Mathematics | N.B. | (1) + (3) |
| | | N.G. | (1) + (3) |
| | | I.B. | (1) + (4) |

| | | | |
|-------------|---------------------------------|------|-----------------|
| 17,18,19 | English | N.B. | (2) |
| | | N.G. | (2) |
| | | I.B. | (4) |
| 1,2,3,4,5,6 | Non-Verbal | N.B. | (5) + (2) + (3) |
| | | N.G. | (5) + (2) + (3) |
| | | I.B. | (5) + (2) + (3) |
| 7 | Mirror Images | N.B. | (3) |
| | | N.G. | (3) |
| | | I.B. | (3) + (2) |
| 8 | 3-dim Space | N.B. | (4) |
| | | N.G. | (4) |
| | | I.B. | (4) + (2) |
| 7,8,9 | Space | N.B. | (3) + (4) |
| | | N.G. | (3) + (4) |
| | | I.B. | (3) + (4) + (2) |
| 9,10,11,12 | Picture & Change of Shape | N.B. | (2) + (5) |
| | | N.G. | (2) + (5) |
| | | I.B. | (2) + (5) + (3) |

I feel that if I had made an analysis of only one of the populations I might have been tempted to expound at length and show in great detail how well the factors revealed the processes of thought going on in the brains of the children doing the tests. And I believe that most of what I should have said would have been wrong. If I took the analysis of each population on its own merits I should be led into making great distinctions between the sexes and races some of which I believe might be artifacts caused by a possible lack of uniqueness in the determination of the rotating matrices. It is clear from the Centroid Analysis, however, that there are differences between the populations, so that it is not surprising that we do not find very much correspondence between the Primary Factors from population to population. It was partly in order to find out definitely whether there were differences of mental structure between the populations and partly to throw more light on

the inter-relations between the factors involved in the non-verbal tests that the following further analysis of the first 9 tests was made into 3 factors. With only this number of factors, should Simple Structure emerge, it was felt that uniqueness in rotation would be assured, and, having in mind my previous experience (page 241) with communalities and because I wished the results I obtained to be beyond doubt correct, I decided to continue with the Centroid Analysis approximations until almost exact convergence was obtained, or found to be unobtainable. I, therefore, postpone further considerations of the psychological interpretation until the results of this "9-Test Analysis" are presented.

9-TEST ANALYSIS

It seemed fairly clear from the previous analyses that Tests 13 - 19 depended to a great extent on "schooling". Test 10 is found to be rather closely linked to Test 1. Test 11 does not seem to have any very great importance and Test 12 tends to go with the schooling tests; so that for a further analysis Tests 1 - 9 were chosen as constituting a sub-battery which, it was hoped, might throw light on the previous analysis and determine positively whether there were sex or race differences in factorial composition.

The Correlation matrices for the three populations were, of course, ready to hand and were those parts of Tables VI, VII and VIII relating to Tests 1 - 9. In the following tables t_s^t ($s = 1, 2, \dots, t$) stands for the Trial Communalities used in (or put into) the correlation matrix in the s th., approximation, and h_s^t stands for the S.Sq's of the loadings obtained (or the communalities got out). To speed up the process t_s^t was not always put equal to h_s^t , but was estimated

from the trend of the previous h^2 's. The aim was to continue with the approximations until t_2^2 and h_2^2 were almost exactly equal, that is until there was convergence. t_1^2 was put equal to the communalities obtained in the 19 test analysis. When D. N. Lawley's method of Maximum Likelihood was used as described by W. G. Emmett in the British Journal of Psychology (Statistical Section) Vol II Part II 1949, his symbols are employed, where l_1, l_2, l_3 are the first trial loadings, l_1', l_2', l_3' , the loadings obtained from the first iteration and the trial loadings for the second iteration, and so on. The following tables summarise the results obtained:

TABLE LXVI

N.B. 3 Factors. Centroid Method

| | Trial (t^2) and obtained (h^2) communalities | | | | | | | | | | | | Factors | | |
|---|--|---------|---------|---------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|------|------|
| | t_1^2 | h_1^2 | t_2^2 | h_2^2 | * t_3^2 | h_3^2 | t_4^2 | h_4^2 | t_5^2 | h_5^2 | t_6^2 | h_6^2 | I | II | III |
| 1 | 605 | 603 | 603 | 616 | 660 | 649 | 630 | 620 | 620 | 620 | 620 | 621 | 682 | 228 | -323 |
| 2 | 560 | 523 | 500 | 497 | 500 | 489 | 494 | 493 | 490 | 488 | 488 | 488 | 602 | 353 | -036 |
| 3 | 591 | 589 | 588 | 606 | 590 | 604 | 610 | 627 | 630 | 629 | 629 | 630 | 695 | 348 | 161 |
| 4 | 696 | 581 | 500 | 495 | 530 | 506 | 480 | 473 | 485 | 487 | 487 | 488 | 676 | 166 | 056 |
| 5 | 588 | 590 | 591 | 601 | 600 | 593 | 585 | 589 | 592 | 592 | 592 | 593 | 756 | 035 | 143 |
| 6 | 355 | 371 | 380 | 400 | 480 | 474 | 460 | 449 | 460 | 461 | 461 | 462 | 551 | -183 | 354 |
| 7 | 334 | 319 | 315 | 323 | 200 | 244 | 330 | 332 | 322 | 320 | 320 | 326 | 387 | -345 | -239 |
| 8 | 617 | 611 | 605 | 620 | 700 | 696 | 685 | 649 | 650 | 639 | 598 | 601 | 513 | -573 | -100 |
| 9 | 264 | 221 | 200 | 208 | 230 | 212 | 210 | 206 | 205 | 207 | 207 | 207 | 454 | -031 | -015 |

*After the 3rd., Iteration by Lawley's Method

TABLE LXVII

N.B. 3 Factors. Lawley's Method using loadings obtained after the 2nd., Centroid Approximation above, i.e. $\sum l^2 = h^2$

| | Trial | | | First | | | Second | | | Third | | | Fourth Iteration | | |
|---|-------------|---------|-------|-------------|---------|--------|-------------|---------|---------|-------------|----------|----------|------------------|------------|------------|
| | l_1 | l_2 | l_3 | l_1' | l_2' | l_3' | l_1'' | l_2'' | l_3'' | l_1''' | l_2''' | l_3''' | l_1^{IV} | l_2^{IV} | l_3^{IV} |
| 1 | 681 | 222-321 | | 708 | 123-300 | | 704 | 096-389 | | 721 | 091-354 | | 717 | 119 | |
| 2 | 605 | 358-053 | | 613 | 323-156 | | 616 | 340 010 | | 613 | 341-076 | | 601 | 369 | |
| 3 | 689 | 335 141 | | 621 | 272 040 | | 720 | 264 073 | | 718 | 260 005 | | 706 | 292 | |
| 4 | 680 | 168 069 | | 686 | 143 217 | | 698 | 127 080 | | 689 | 112 219 | | 691 | 139 | |
| 5 | 758 | 030 161 | | 760 | 013 164 | | 760 | 010 124 | | 755 | 003 155 | | 752 | 051 | |
| 6 | 537-143 | 302 | | 526-200 | 339 | | 528-189 | 380 | | 527-201 | 393 | | 532-153 | | |
| 7 | 387-350-224 | | | 353-327-043 | | | 339-299-140 | | | 339-303 057 | | | 345-268 | | |
| 8 | 515-589-083 | | | 472-636-143 | | | 469-660-060 | | | 475-695-117 | | | 507-685 | | |
| 9 | 454-037-010 | | | 455-126-066 | | | 456-129-019 | | | 455-141-063 | | | 460-107 | | |

This was discontinued since the loadings were converging very slowly from iteration to iteration, and the communality after the 3rd., iteration was used as t_3^2 to continue the Centroid Analysis above.

TABLE LXVIII

N.G. 3 Factors. Centroid Method

| | Trial (t^2) and obtained (h^2) communalities | | | | | | | | | | | | | | Factors | | | | |
|---|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|------|------|
| | t_1^2 | h_1^2 | t_2^2 | h_2^2 | t_3^2 | h_3^2 | t_4^2 | h_4^2 | t_5^2 | h_5^2 | t_6^2 | h_6^2 | t_7^2 | h_7^2 | t_8^2 | h_8^2 | I | II | III |
| 1 | 648 | 622 | 600 | 540 | 480 | 491 | 510 | 503 | 495 | 494 | 493 | 491 | 491 | 491 | | | 687 | 121 | 063 |
| 2 | 568 | 507 | 460 | 498 | 510 | 512 | 513 | 556 | 600 | 601 | 602 | 597 | 600 | 598 | | | 673 | -240 | -295 |
| 3 | 693 | 685 | 680 | 716 | 750 | 748 | 747 | 774 | 800 | 805 | 820 | 817 | 814 | 817 | | | 808 | 274 | 298 |
| 4 | 630 | 591 | 570 | 566 | 560 | 557 | 555 | 565 | 570 | 566 | 564 | 561 | 555 | 557 | | | 694 | 253 | 108 |
| 5 | 654 | 657 | 660 | 684 | 700 | 607 | 550 | 600 | 630 | 646 | 660 | 658 | 654 | 658 | 665 | 667 | 699 | 273 | -322 |
| 6 | 355 | 306 | 280 | 301 | 310 | 303 | 298 | 308 | 306 | 320 | 350 | 343 | 332 | 334 | | | 446 | -301 | 210 |
| 7 | 355 | 335 | 320 | 340 | 350 | 326 | 280 | 301 | 310 | 312 | 314 | 311 | 311 | 311 | | | 512 | -221 | -017 |
| 8 | 383 | 287 | 200 | 214 | 235 | 213 | 280*261 | 200 | 208 | 220 | 214 | 210 | 212 | | | | 350 | -280 | 105 |
| 9 | 672 | 692 | 720 | 696 | 690 | 665 | 600 | 642 | 650 | 657 | 670 | 663 | 660 | 659 | | | 788 | 123 | -153 |

* I probably meant to try 180 and in error took 280

I.B.

TABLE LXIX

3 Factors Centroid Method

| | Trial (t^2) and obtained (h^2) communalities | | | | | | | | | | | | | | Factors | | |
|---|--|---------|---------|---------|---------|---------|------------|------------|---------|---------|---------|---------|------------|------------|---------|-------|--------|
| | t_1^2 | h_1^2 | t_2^2 | h_2^2 | t_3^2 | h_3^2 | t_4^2 | h_4^2 | t_5^2 | h_5^2 | t_6^2 | h_6^2 | t_7^2 | h_7^2 | I | II | III |
| 1 | 627 | 624 | 617 | 600 | 599 | 599 | 599 | 598 | 598 | 607 | 612 | 607 | 607 | 606 | 730 | -246 | -115 |
| 2 | 364 | 338 | 300 | 328 | 333 | 333 | 333 | 334 | 334 | 336 | 340 | 335 | 335 | 335 | 569 | 058 | 086 |
| 3 | 583 | 569 | 550 | 567 | 570 | 568 | 568 | 569 | 569 | 575 | 583 | 575 | 575 | 573 | 727 | -060 | 201 |
| 4 | 517 | 530 | 550 | 552 | 557 | 556 | 556 | 554 | 554 | 564 | 572 | 567 | 563 | 563 | 656 | -307 | -197 |
| 5 | 400 | 332 | 220 | 274 | 300 | 296 | 290 | 293 | 293 | 296 | 300 | 296 | 296 | 295 | 523 | 106 | 101 |
| 6 | 385 | 374 | 360 | 408 | 420 | 418 | 418 | 418 | 418 | 429 | 440 | 434 | 431 | 430 | 441 | 458 | 162 |
| 7 | 218 | 146 | 080 | 116 | 130 | 124 | 120 | 122 | 122 | 123 | 124 | 122 | 123 | 123 | 331 | 051 | 103 |
| 8 | 248 | 297 | 370 | 417 | 500 | 534 | <u>650</u> | <u>681</u> | 185 | 252 | 320 | 364 | <u>300</u> | <u>352</u> | (218) | (308) | (-458) |
| 9 | 367 | 355 | 340 | 340 | 340 | 331 | <u>331</u> | <u>322</u> | 290 | 318 | 345 | 338 | <u>325</u> | <u>330</u> | 429 | -367 | 108 |

After the 4th., Approximation the communalities of all tests except Test 8 were practically the same as the trials used. That of Test 8 increased from the unreasonably high value of 650 to 681. Accordingly a trial of lower value was used for the next approximation but after the 7th., Approximation all the tests except Test 8 had again settled down, whereas Test 8 was continuing to increase. It was concluded that this battery of 9 tests was not analysable into 3 factors and that probably one was not justified in doing so as the 2nd., residuals were rather small, the largest being .133. Accordingly analysis was carried out into 2 factors, the first trial communalities t_1^2 being obtained from the final communalities obtained in the 3-factor analysis by subtracting

the squares of the final loadings on Factor III. After this it was decided, for purposes of comparison, to re-factor N.B. and N.G. into 2 factors; but as will be shown, Test 8 gave trouble with the N.B's and no further factoring was undertaken with the N.G's.

TABLE LXX

| I.B. | 2 Factors. Centroid Method | | | | | | | | I | II |
|------|----------------------------|---------|---------|---------|---------|---------|---------|---------|-----|------|
| | t_1^2 | h_1^2 | t_2^2 | h_2^2 | t_3^2 | h_3^2 | t_4^2 | h_4^2 | | |
| 1 | 594 | 593 | 593 | 597 | 600 | 598 | | | 734 | -244 |
| 2 | 328 | 332 | 336 | 335 | 334 | 333 | | | 573 | 068 |
| 3 | 535 | 525 | 512 | 519 | 522 | 521 | | | 721 | -027 |
| 4 | 524 | 510 | 494 | 496 | 500 | 499 | | | 648 | -281 |
| 5 | 286 | 291 | 298 | 295 | 293 | 292 | | | 527 | 118 |
| 6 | 405 | 422 | 440 | 448 | 470 | 465 | 460 | 457 | 451 | 504 |
| 7 | 112 | 113 | 113 | 113 | 113 | 112 | | | 331 | 052 |
| 8 | 090 | 072 | 050 | 060 | 064 | 064 | | | 169 | 187 |
| 9 | 323 | 327 | 330 | 335 | 340 | 337 | | | 435 | -385 |

TABLE LXXI

N.B. 2 Factors. Centroid Method

| | t_1^2 | h_1^2 | t_2^2 | h_2^2 | I | II |
|---|---------|---------|---------|---------|-------|--------|
| 1 | 517 | 484 | 470 | 467 | 659 | 180 |
| 2 | 487 | 496 | 504 | 506 | 609 | 367 |
| 3 | 604 | 602 | 600 | 602 | 695 | 345 |
| 4 | 485 | 488 | 490 | 492 | 681 | 167 |
| 5 | 573 | 574 | 575 | 575 | 758 | 021 |
| 6 | 337 | 297 | 265 | 275 | 518 | -082 |
| 7 | 269 | 255 | 247 | 246 | 376 | -323 |
| 8 | 591 | 623 | 640 | 676 | (525) | (-633) |
| 9 | 207 | 210 | 212 | 212 | 459 | -042 |

The communality of Test 8 shows no sign of becoming constant, and many further trial values for this test ranging from 350 to 750 revealed that the communality obtained would always exceed the trial. This is a case of analysis being possible to 3 factors but not to 2. With the I.B's the reverse was the case with the same test. From the correlation table one would not expect a high communality.

Test 8 is not a "Heywood Case" because the correlation matrices are not of unit rank, for one thing. Thurstone in M.F.A. points out that if the rank of the matrix were the Heywood case is found be increased to

2: the matrix is analysable. We might suppose the First Residual of the N.B's to be an example of this; but with the I.B's the matrix is analysable into 2 but not into 3 factors, Test 8 being the offending test in both cases. Further study of the magnitudes of the residuals and their significance should be made.

The Extended Vector Matrices, E_0 from the Factor Matrices of Tables LXVI, LXVIII and LXIX are given in the following tables. The omission of Test 8 from the I.B's will make only negligible differences in the configurations of the other tests.

Extended Vector Matrices, E_0 .

TABLE LXXII

| N.B. | I | II | III |
|------|------|-------|-----|
| 1 | 1.00 | 33 | -47 |
| 2 | 1.00 | 59 | -06 |
| 3 | 1.00 | 50 | 23 |
| 4 | 1.00 | 25 | 08 |
| 5 | 1.00 | 05 | 19 |
| 6 | 1.00 | -33 | 64 |
| 7 | 1.00 | -89 | -62 |
| 8 | 1.00 | -1.12 | -19 |
| 9 | 1.00 | -07 | -03 |

TABLE LXXIII

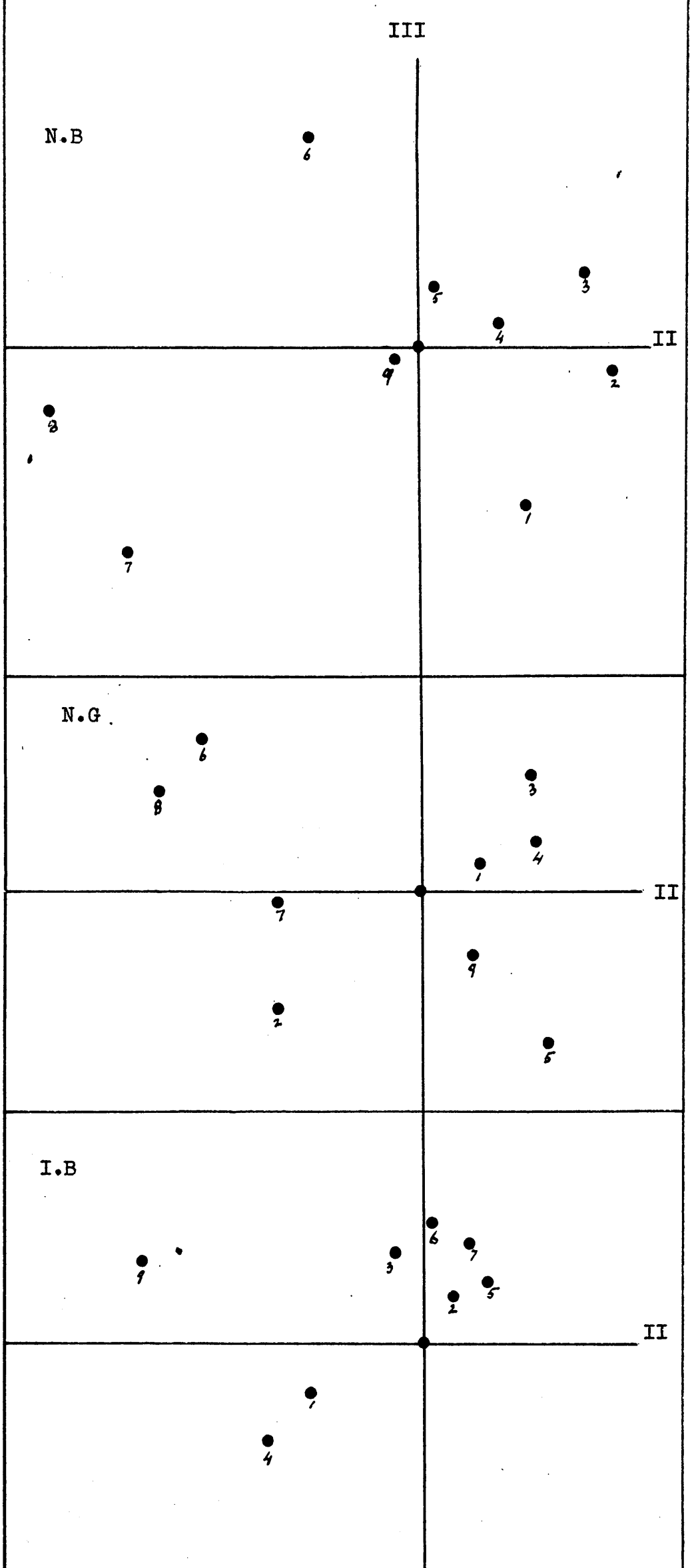
| N.G. | I | II | III |
|------|------|-----|-----|
| 1 | 1.00 | 18 | 09 |
| 2 | 1.00 | -36 | -44 |
| 3 | 1.00 | 34 | 37 |
| 4 | 1.00 | 36 | 16 |
| 5 | 1.00 | 39 | -46 |
| 6 | 1.00 | -67 | 47 |
| 7 | 1.00 | -43 | -03 |
| 8 | 1.00 | -80 | 30 |
| 9 | 1.00 | 16 | -19 |

TABLE LXXIV

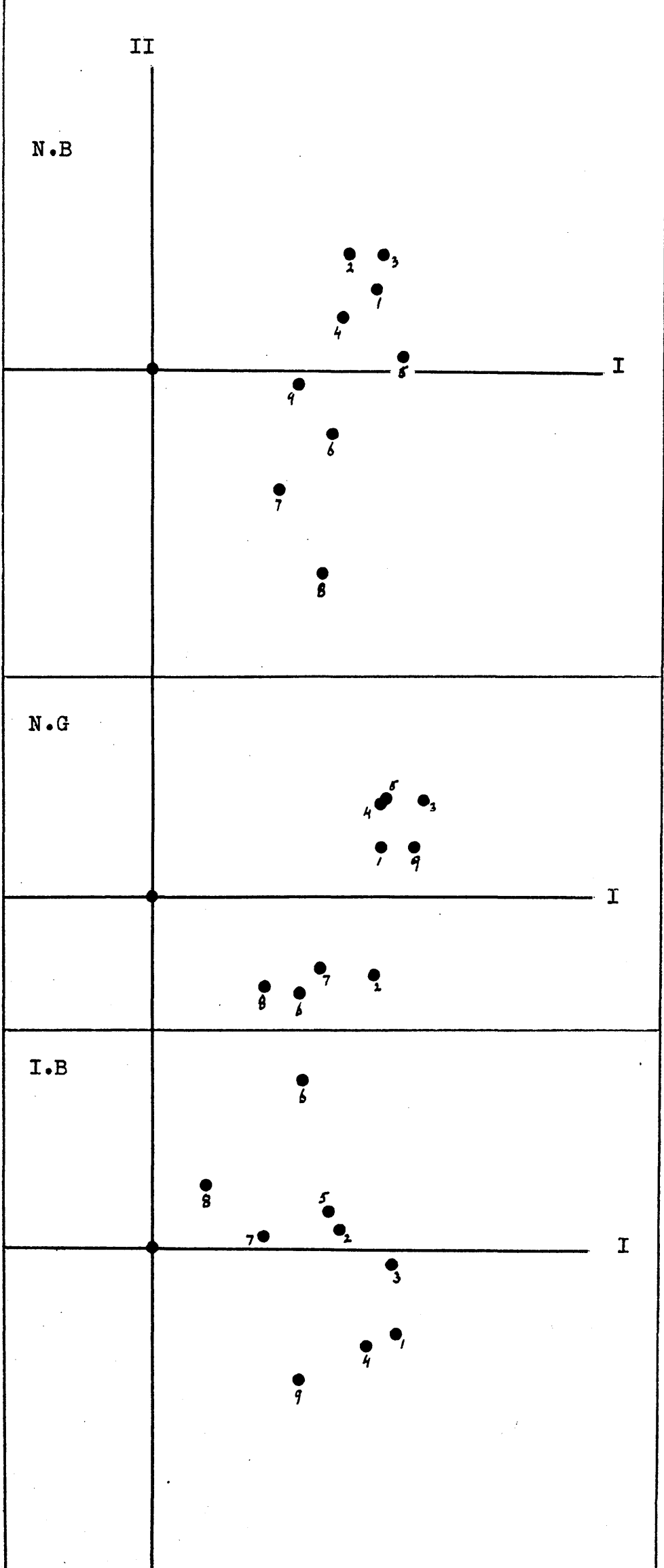
| I.B. | I | II | III |
|------|------|------|-----|
| 1 | 1.00 | -34 | -16 |
| 2 | 1.00 | 10 | 15 |
| 3 | 1.00 | -08 | 28 |
| 4 | 1.00 | -47 | -30 |
| 5 | 1.00 | 20 | 19 |
| 6 | 1.00 | 1.04 | 37 |
| 7 | 1.00 | 15 | 31 |
| 8 | - | - | - |
| 9 | 1.00 | -86 | 25 |

From these matrices are plotted the termini of the Extended Vectors in Figure, 7. The unbalanced configuration in the I.B. is due to the omission of Test 8 which would occupy the south-east quadrant. Simple Structure is not discernable in any of these plots; nor are the configurations of points in the plots at all comparable, even if the arbitrary signs of the loadings on a factor are reversed throughout.

Plots made from the 2-Factor Analyses of the N.B's and the I.B's of Tables LI and L show almost exactly the same configurations of points as plots made from the first two columns of the 3-Factor Analyses of Tables LXVI and LXIX, as would obviously be so. So that those plots in which Test 8 can be legitimately included are selected for comparison and shown in Figure, 8. The N.B. and N.G. are from the first 2 columns of the 3-Factor analysis and the I.B. from the 2-Factor Analysis.



Figure, 7.



Figure, 8.

With the N.G's two clusters are seen. Points 1, 3 and 4 are never very far apart. 2 is associated with 6, 7 and 8 with the N.G's, and 5 and 9 in this population are part of the other cluster.

PSYCHOLOGICAL INTERPRETATION II

The 9-Test Analysis clearly shows two things:

(1) The battery of 9 tests does not yield any factors which can be translated into psychological terms, and since no rotation has been done here there is no possibility of this being due to any lack of uniqueness. The cluster 2, 6, 7, 8 with the N.G's might be an exception and constitute a Space Factor, but it is difficult to see why 2 should be put with the others. The Simple Structures obtained from the whole 19-Test Battery evidently depended upon the other tests as well as the first 9.

(2) Since the results from the 9-Test battery are unique there is no doubt at all that the mentalities of the three populations are structurally different. This will also be brought out very clearly in the section, Analysis for Practical Estimations, where results independent of the previous analyses give three sets of quite different regression coefficients. Problems can be solved and the same scores can be made by mental methods which differ between the sexes and between the races studied. What these differences are still remains undetermined. Introspection by the psychologist is not likely to solve the problem, rather would individual application of the tests by the teachers. They might find out by sympathetic questioning how a little Negro girl sets about answering Tests 2 and 7, and how a little Negro boy does the same thing. Or how a little Negro boy and a little Indian boy tackle Tests 5 and 9. With such information a further battery of group tests might yield factors ^{with} ~~which~~ psychological meanings characteristic of the sex

or racial groups. That differences in mental structure exist is important in itself. A theory of intelligence and aptitudes to be general must embrace both sexes and all races. This is not the place to speculate on what possible implications there are outside the field of psychology.

GENERAL MENTAL ABILITY (INTELLIGENCE)

So far we have not dealt with the estimation of a factor for General Mental Ability or Intelligence. The Second Order Analysis was undertaken with this in view but the Primary Factors were so disposed that such a General Second Order Factor could not be extracted which would account for the correlations between them. This was not surprising when we remember that in the rotations carried out on the F_0 matrices near orthogonality of the Reference Vectors was aimed at. The First Centroid Axes of the F_0 matrices might be taken as the best General Mental Ability Factor for the battery, and therefore, as the best General Intelligence Factor. But that is making the assumption that the battery as a whole is satisfactorily balanced to measure intelligence. None of the factors of the V matrices could possibly contain positive loadings on all the tests where Simple Structure occurs because of the nature of it. But we could take that factor which is closest to the First Centroid Axis as the most General Mental Ability Factor, disregarding those tests which have zero loadings on it as not requiring this factor. But the question is which set of axes to choose, The Reference Vectors, The Primary Axes or The Rotated Orthogonal Axes? Looking, at the first rows of the Λ matrices of Tables XVI, XXV and XXXII we should choose E_7 , D_4 , and D_5 respectively for the N.B's, N.G's and I.B's; at the first columns of the T matrices of Tables XXI, XXX and XXXVII we should choose T_c , T_c , T_c , or at the first rows of the $\psi_{m\omega}$ matrices of Tables XLVI,

LIII and LX we should choose E_7 , F_2 , f_2 respectively. But these are not corresponding axes. From a study of the $F_0\psi_m$ matrices of Table LXIII I tend to think that E_7 for the N.B's (disregarding Tests 6, 7 and 8), F_2 for the N.G's and f_2 for the I.B's (disregarding Test 17) offer the best set of factors for General Mental Ability. And, if we selected the 6 tests with the greatest loadings on these factors we should take Tests 1, 2, 3, 17, 18, 19 for the N.B's; 2, 7, 9, 13, 14, 18 for the N.G's; and 3, 4, 10, 11, 15, 16 for the I.B's. From the loadings of these tests on their respective factors as criteria and their intercorrelations it would be possible to derive regression equations to give the children's endowments in General Mental Ability. This has not been done and I am not satisfied that the First Centroid Axes, after all, would not constitute more uniform General Mental Ability Factors. However, in the section, Analysis for Practical Estimation, I take what I consider to be more useful and practical criteria.

RECONSIDERATION OF THE BATTERY

The analysis so far has demonstrated how dangerous it is to label tests as measuring certain Special Aptitudes without using Factorial Analysis or outside criteria. My a priori grouping of the tests is probably as good as the next man's, but, in many ways, it has not stood up to experiment. Tests 5, 6, 7, 9 were to have formed a sequence: Recognizing Shapes the same way up - turned round turned over - changing. 7, 8 and 9 were to have been grouped as Space Tests. Tests 10, 11 and 12 were to have required ability to appreciate material presented as pictures. 13 and 14 were to have tested numerical ability separately from 15 and 16 which needed attainment as well. Certainly some of the tests 1 - 5 in all the populations seem

to be measures of a non-verbal ability and Tests 13 - 16 and 17 - 19 measure numerical and English abilities respectively, and both groups can be put together and constitute a measure of scholastic attainment.

It is quite possible that any of the tests brigaded with others not in the battery would prove of great value in determining factors. Test 9, for instance, may yet prove valuable along with other tests in determining a Mechanical Aptitude Factor. The only trouble about this is that I cannot think of any other tests to put with it which would obey the restrictions I should impose: (i) they must consist of a series of items of increasing difficulty but be all on the same theme, (ii) they must not depend on pulleys or gear wheels where, as soon as the knowledge is gained of the law of the direction of rotation of two such connected wheels, the rotations of a whole train of them are obvious, ^{(iii) they must not be composed of pivoted bars.} I should welcome suggestions in this matter.

A NOTE ON THE RELIABILITY OF THE TESTS

Some attempts were made in the early stages of construction of the tests to determine Answer Patterns with the Q.R.C. material. Each test consists of a number of items of the same type. There is a limit to one's power to devise more than a certain number of these. So that increasing the average efficiency coefficients meant cutting down the number of items in a test. This it was realised would reduce the reliability. A method was devised to maximise the reliability* but there was no time to apply it.

* "Determination of the Optimum Number of Items to Retain in a Test Measuring a Single Ability", due to appear in the December Number of Psychometrika 1950.

Some idea of the reliability may be got from the greatest values of the communalities obtained in any of the foregoing analyses. The Reliability Coefficients will lie somewhere between these values and unity. These values are set out in Table LV:

TABLE LXXV

| Test | Greatest Communality |
|------|-------------------------|
| 1 | 648 |
| 2 | 588 |
| 3 | 817 |
| 4 | 696 |
| 5 | 667 |
| 6 | 462 |
| 7 | 355 |
| 8 | (617) Suspect |
| 9 | 672 |
| 10 | 700 |
| 11 | 533 |
| 12 | 573 |
| 13 | 643 |
| 14 | 701 |
| 15 | 805 |
| 16 | 668 |
| 17 | 576 |
| 18 | 692 |
| 19 | 791 |

Nearly all the tests are of the Multiple Choice type and though there are at least 5 alternatives presented (except in Tests 6 and 7) guessing must always reduce the reliability. This is particularly so with the more difficult items, for suppose there are 5 alternatives and the facility value works out to be $\frac{2}{5}$, the value of such an item is zero. An article is already written dealing with the values of Multiple Choice Items which I hope will be published shortly. Some hold the view that guessing does not take place on a large scale. This does not hold with the children of Trinidad where almost always a child guesses if he does not know the correct answer. An experiment the results

of which I hope to publish also on the Incidence of Guessing conducted with a sample of the Queen's Royal College boys proves this conclusively.

I do not believe the reliabilities, even after the Spearman-Brown formula, would approach .90 for 100 items, in most cases. But then reliability coefficients of such values and higher are found in tests of the "omnibus" variety where there is an almost unlimited pool of items to draw from to replace those whose efficiency is low.

ANALYSIS FOR PRACTICAL ESTIMATIONS

So far the factors have been the products of internal evidence. We shall not stray outside the bounds of the Battery, indeed, apart from rough estimations of ability in schoolwork by the teachers, we have no further data to call upon. But we have established fairly well that there are factors for Numerical and English abilities, or collectively, School Attainment, of which Tests 13 - 16 and 17 - 19 are measures. It is possible to set these up as criteria separate from the rest of the tests. Two objectives will thereby be attained:

(1) From a short battery of tests which do not demand School Attainment we shall be able to predict success in school subjects as a whole. This would be of value in a place such as Trinidad where many of the elementary schools buried away in country districts are of a lower standard than others and do not send in candidates for exhibitions for secondary schools. The parents of a bright child in one of these schools may be able to send him away to the better class of elementary school but, in many cases even when the parents

have the means, his brightness will escape notice. I have come across such children in the course of the experimental testing of the schools in the centre of the Island. One child was removed to a better school where I came across him again. He was by far the best child of the 575 and scored full marks in most of the tests. He has since won an exhibition to a secondary school. Another child made a remarkably good score in some of the tests and I believe he is still in the same school which is about 12 miles from the nearest town and where the education is admittedly of a low order.

(2) Success in a battery not containing the schooling tests yet correlating with them would seem to provide a more general test of Intelligence than one containing school subjects, and I propose to term what it measures, Non-Verbal Intelligence. Such a battery might be used for a General Mental Survey possibly for the purpose suggested by the following extract: Burt in The British Journal of Educational Psychology, Vol XX Part I, Feb., 1950, states: "Here the 'quota principle' proposed by Professor Valentine seems to me to provide an admirable solution. According to this plan, the results of standardized intelligence tests determine the number of places to be allotted to each *primary* school, *and the actual individuals in each school* are then selected in accordance with an order of merit, in which the teacher's report may have the same weight as the tests or an even greater weight."

The procedure adopted was as follows:

From the F₀ matrices of Tables X, XI and XII the

direction cosines of the Centroids for the two groups of tests, 13, 14, 15, 16 and 17, 18, 19 were found. The direction cosines of the vector bisecting the angle between these were next determined, this is the School Attainment Criterion*. The correlations of all the tests with this were then found. From the Tests 1 - 12 the 6 having the greatest correlations, taking all three populations into account, were selected to constitute the short battery of non-verbal tests. From their correlations with the School Attainment Criterion and their intercorrelations, were determined the required regression equations for predicting School Success.

The Centroid of this non-verbal battery constitutes the Non-Verbal Intelligence Factor. Its direction cosines were determined and the correlations of all the tests with it. Those of the tests of the Non-Verbal Battery constituted the loadings on this Factor. From these and their intercorrelations, were determined the required regression equations for estimating individuals' endowments in Non-Verbal Intelligence.

To obtain the direction cosines, λ_c (to use Thurstone's symbol), of the centroids of subgroups of the tests, the F_o loadings for these tests were summed for each of the centroid axes, and these sums normalized. The first three rows of Table LXXVI give the direction cosines

* This was thought to be a better criterion than that which would have been obtained by treating all the tests 13 - 19 as one group, because it aims at giving equal weights to Numerical and English abilities.

of the centroids through the sub-group, 17, 18, 19 constituting the English tests, for the three populations.

TABLE LXXVI

Direction cosines of centroids of sub-groups

| Sub-group | Popula- tion | Centroid Axes of F ₀ | | | | |
|-------------------------|-----------------|---------------------------------|------|------|------|------|
| | | I | II | III | IV | VV |
| 17,18,19 | N.B. | 834 | -490 | -199 | -155 | -033 |
| | N.G. | 927 | -241 | 276 | 056 | 056 |
| | I.B. | 852 | -366 | 190 | -323 | -030 |
| 13,14,15,16 | N.B. | 895 | -361 | 203 | 157 | -052 |
| | N.G. | 947 | -008 | 165 | -252 | 109 |
| | I.B. | 852 | -435 | -243 | 150 | -060 |
| (13 - 16), (17 - 19) | N.B. | 896 | -441 | 002 | 001 | -044 |
| | N.G. | 957 | -127 | 225 | -100 | 084 |
| | I.B. | 900 | -423 | -028 | -091 | -048 |
| 1,2,3,4,5,10 | N.B. | 930 | 261 | 139 | -211 | -053 |
| | N.G. | 968 | 245 | -035 | 030 | 032 |
| | I.B. | 951 | 298 | -046 | 003 | -067 |

The loadings of all the tests on these centroids are the inner products of the direction cosines and the loadings of the tests in F₀. These are given in the first three columns of Table LXXVII. The direction cosines of the centroids for the three populations for the sub-group, 13, 14, 15, 16 were next worked out in the same way and loadings of all the tests found on these centroids. The direction cosines of the centroid bisecting the angle between the two centroids found for a population were determined by adding the direction cosines of these and normalizing. These, for the three pop-

ulations, are given in Table LXXVI and the loadings of the tests on these School Attainment criteria are given in Table LXXVII.

TABLE LXXVII

Loadings on Centroids of sub-groups

| | 17,18,19 | | | 13,14,15,16 | | | (13 - 16), (17 - 19) | | | 1,2,3,4,5,10 | | | | | |
|----|----------|-----|-----|----------------------|-----|-----|-------------------------|-----|-----|--------------|-----|-----|-----|-----|-----|
| | N.B | N.G | I.B | N.B | N.G | I.B | N.B | N.G | I.B | N.B | N.G | I.B | | | |
| 1 | 598 | 712 | 521 | 592 | 697 | 555 | 617 | 719 | 568 | } | 732 | 759 | 748 | | |
| 2 | 505 | 567 | 475 | 574 | 646 | 378 | 559 | 619 | 450 | | 695 | 617 | 573 | | |
| 3 | 433 | 607 | 392 | 499 | 671 | 492 | 483 | 653 | 467 | | 757 | 801 | 737 | | |
| 4 | 315 | 488 | 364 | 440 | 548 | 529 | 391 | 529 | 472 | | 724 | 737 | 654 | | |
| 5 | 398 | 585 | 421 | 553 | 744 | 257 | 493 | 679 | 359 | | 722 | 737 | 544 | | |
| 6 | 094 | 407 | 352 | 270 | 370 | 102 | 188 | 397 | 240 | | 441 | 383 | 334 | | |
| 7 | 135 | 396 | 090 | 246 | 422 | 131 | 197 | 417 | 117 | | 266 | 459 | 296 | | |
| 8 | 136 | 305 | 235 | 170 | 190 | 244 | 159 | 252 | 253 | | 299 | 280 | 160 | | |
| 9 | 254 | 527 | 199 | 293 | 647 | 261 | 283 | 599 | 243 | | 424 | 761 | 449 | | |
| 10 | 562 | 750 | 589 | 506 | 726 | 562 | 554 | 754 | 608 | | 665 | 806 | 725 | | |
| 11 | 397 | 631 | 308 | 396 | 626 | 291 | 411 | 642 | 317 | | 508 | 686 | 599 | | |
| 12 | 533 | 656 | 361 | 426 | 526 | 330 | 497 | 603 | 365 | | 406 | 581 | 395 | | |
| 13 | 555 | 679 | 505 | } | 706 | 770 | 627 | } | 654 | | 740 | 598 | 527 | 757 | 491 |
| 14 | 656 | 750 | 483 | | 774 | 829 | 633 | | 741 | | 806 | 589 | 608 | 786 | 539 |
| 15 | 712 | 743 | 668 | } | 807 | 812 | 838 | } | 792 | | 794 | 795 | 540 | 681 | 446 |
| 16 | 733 | 700 | 694 | | 812 | 719 | 867 | | 801 | | 724 | 825 | 606 | 609 | 588 |
| 17 | } | 744 | 687 | 614 | 623 | 620 | 475 | } | 708 | | 668 | 575 | 504 | 581 | 467 |
| 18 | | 806 | 826 | 787 | 665 | 760 | 627 | | 762 | | 810 | 747 | 494 | 646 | 556 |
| 19 | | 870 | 815 | 789 | 793 | 811 | 631 | | 862 | | 852 | 750 | 585 | 753 | 494 |
| | 17,18,19 | | | 860 | 917 | 792 | 964 | 979 | 947 | 655 | 832 | 693 | | | |
| | | | | 13,14,15,16 | | | 964 | 979 | 947 | 736 | 905 | 696 | | | |
| | | | | (13 - 16), (17 - 19) | | | | | | 721 | 887 | 734 | | | |

Tests 1,2,3,4,5,10, taking all three populations into account, have the highest loadings on these School Attainment criteria and constitute the tests of the shortened Non-Verbal Battery. The direction cosines of the centroids (Non-Verbal Intelligence Factors) of this battery for each population were found and the loadings of all the tests on these determined. The cosines of the angles between the centroids are given at the foot of Table LXXVII. The identity of those between the sub-groups 17 - 19, 13 - 16 and the centroid through the combined group illustrates that this centroid bisects the angle between those of the sub-group^s, as it was intended it should. The values of the loadings in

Table LXVII within the sub-groups give some idea of their unity.

From the original correlation matrices of Tables VI, VII and VIII the correlation matrices, R_b , for the 6 non-verbal tests were obtained, the tests being arranged in descending order of loadings on the Non-Verbal Intelligence Factors for a reason which will soon appear. These R_b matrices are set out in Tables LXXVIII, LXXIX and LXXX, and their reciprocals in Tables LXXXI, LXXXII and LXXXIII.

TABLE LXXVIII

N.B. Correlation Matrix R_b

| | 1 | 2 | 10 | 5 | 3 | 4 |
|----|--------|--------|--------|--------|--------|--------|
| 1 | 1.0000 | 5031 | 6248 | 4942 | 5613 | 4080 |
| 2 | 5031 | 1.0000 | 4098 | 4547 | 4361 | 5702 |
| 10 | 6248 | 4098 | 1.0000 | 4383 | 4804 | 3938 |
| 5 | 4942 | 4547 | 4383 | 1.0000 | 5943 | 4841 |
| 3 | 5613 | 4361 | 4804 | 5943 | 1.0000 | 5437 |
| 4 | 4080 | 5702 | 3938 | 4841 | 5437 | 1.0000 |

TABLE LXXIX

N.G. Correlation Matrix R_b

| | 10 | 1 | 5 | 3 | 2 | 4 |
|----|--------|--------|--------|--------|--------|--------|
| 10 | 1.0000 | 6331 | 5573 | 5948 | 4883 | 6244 |
| 1 | 6331 | 1.0000 | 4072 | 6537 | 4550 | 5716 |
| 5 | 5573 | 4072 | 1.0000 | 5762 | 3862 | 5075 |
| 3 | 5948 | 6537 | 5762 | 1.0000 | 4371 | 6247 |
| 2 | 4883 | 4550 | 4862 | 4371 | 1.0000 | 3520 |
| 4 | 6244 | 5716 | 5075 | 6247 | 3520 | 1.0000 |

TABLE LXXX

I.B. Correlation Matrix R_b

| | 10 | 1 | 4 | 3 | 2 | 5 |
|----|--------|--------|--------|--------|--------|--------|
| 10 | 1.0000 | 5943 | 4561 | 5003 | 3665 | 3846 |
| 1 | 5943 | 1.0000 | 5522 | 5076 | 4179 | 3271 |
| 4 | 4561 | 5522 | 1.0000 | 4918 | 2437 | 3070 |
| 3 | 5003 | 5076 | 4918 | 1.0000 | 4638 | 3887 |
| 2 | 3665 | 4179 | 2437 | 4638 | 1.0000 | 3526 |
| 5 | 3846 | 3271 | 3070 | 3887 | 3526 | 1.0000 |

TABLE LXXXI

N.B.

 R_b^{-1}

| | | | | | |
|----------------------|--------|--------|--------|--------|--------|
| 2.0904 ⁴⁰ | -4598 | -8243 | -2150 | -5143 | 1162 |
| -4598 | 1.7378 | -0777 | -2212 | 0439 | -6895 |
| -8243 | -0777 | 1.7548 | -1521 | -1807 | -1386 |
| -2150 | -2212 | -1521 | 1.7618 | -6275 | -2379 |
| -5143 | 0439 | -1807 | -6275 | 2.0231 | -5403 |
| 1162 | -6895 | -1386 | -2379 | -5403 | 1.9093 |

TABLE LXXXII

N.G.

 R_b^{-1}

| | | | | | |
|--------|--------|--------|--------|--------|--------|
| 2.3186 | -6942 | -4657 | -1312 | -3134 | -6223 |
| -6942 | 2.2184 | 3103 | -8619 | -3252 | -3391 |
| -4657 | 3103 | 1.8492 | -6228 | -4421 | -2804 |
| -1312 | -8619 | -6228 | 2.3987 | -0862 | -5776 |
| -3134 | -3252 | -4421 | -0862 | 1.5084 | 1290 |
| -6223 | -3391 | -2804 | -5776 | 1290 | 2.0404 |

TABLE LXXXIII

I.B.

 R_b^{-1}

| | | | | | |
|--------|--------|--------|--------|--------|--------|
| 1.7691 | -6713 | -1821 | -3162 | -0883 | -2509 |
| -6713 | 1.9807 | -5970 | -2204 | -3330 | -0034 |
| -1821 | -5970 | 1.6231 | -4327 | 1648 | -1230 |
| -3162 | -2204 | -4327 | 1.7635 | -4312 | -2070 |
| -0883 | -3330 | 1648 | -4312 | 1.4156 | -2391 |
| -2509 | -0034 | -1230 | -2070 | -2391 | 1.3001 |

For each of the three populations the correlations of the tests of the short battery with the two criteria (i) (13 - 16), (17 - 19)

(ii) 1, 2,3,4,5,10

were taken from Table LXXVII and set out again in Tables LXXXIV, LXXXV and LXXXVI, and, following the technique described in Factorial Analysis of Human Ability, Godfrey H. Thomson, the inner products of these with the rows of R_b^{-1} gave the regression coefficients on each criteria.

TABLE LXXXIV

N.B. Regression Coefficients

| | | 1 | 2 | 10 | 5 | 3 | 4 |
|----------|--|------------|------------|------------|------------|------------|-------------|
| Criteria | (i) (13 - 16), (17 - 19) | 617 | 559 | 554 | 493 | 483 | 391 |
| | (ii) 1,2,3,4,5,10 | 732 | 695 | 665 | 722 | 757 | 724 |
| β | (i); _{1,2,3,4,5,10} s.e. _{β} | 269 089 | 287 081 | 204 082 | 132 082 | 064 088 | -061 083 |
| β | (i); _{1,2,10} s.e. _{β} | 321 085 | 304 073 | 229 080 | | | |
| β | (ii); _{1,2,3,4,5,10} s.e. | 205 042 | 194 039 | 163 039 | 213 039 | 221 042 | 243 039 |

TABLE LXXXV

N.G. Regression Coefficients

| | | 10 | 1 | 5 | 3 | 2 | 4 |
|----------|---|------------|------------|------------|------------|------------|-------------|
| Criteria | (i) (13 - 16), (17 - 19) | 754 | 719 | 679 | 653 | 619 | 529 |
| | (ii) 1,2,3,4,5,10 | 806 | 759 | 737 | 801 | 617 | 737 |
| β | (i); _{1,2,3,4,5,10} s.e. _{β} | 324 072 | 339 070 | 299 064 | 066 073 | 175 058 | -121 067 |
| β | (i); _{1,5,10} s.e. _{β} | 326 071 | 372 064 | 346 060 | | | |
| β | (ii); _{1,2,3,4,5,10} s.e. _{β} | 242 045 | 212 044 | 245 041 | 224 046 | 131 037 | 155 043 |

TABLE LXXXVI

I.B. Regression Coefficients

| | | 10 | 1 | 4 | 3 | 2 | 5 |
|-----------------------------|-----------------------------|------------|------------|------------|------------|------------|------------|
| Criteria | (i) (13 - 16), (17 - 19) | 608 | 568 | 472 | 467 | 450 | 359 |
| | (ii) 1,2,3,4,5,10 | 725 | 748 | 654 | 737 | 573 | 544 |
| $\beta_{(i);1,2,3,4,5,10}$ | $s.e._\beta$ | 331 093 | 182 098 | 144 089 | 034 093 | 185 083 | 050 079 |
| $\beta_{(i);1,2,10}$ | $s.e._\beta$ | 381 088 | 257 090 | | | 203 078 | |
| $\beta_{(ii);1,2,3,4,5,10}$ | $s.e._\beta$ | 241 050 | 249 052 | 192 047 | 263 050 | 158 044 | 153 042 |

The Multiple Correlations were found from which were obtained the standard errors, $s.e._{\hat{\chi}}$, of the estimates of the standard scores and the Probable Errors of the estimates of the Normalized Scores, $P.E._{\hat{\chi}}$, of Tables III, IV and V. These results are given in Table LXXXVII.

TABLE LXXXVII

| | N.B. | N.G. | I.B. |
|-------------------------|------|------|------|
| $R_{(i);1,2,3,4,5,10}$ | 7152 | 8823 | 6998 |
| $s.e._{\hat{\chi}}$ | 4714 | 4706 | 7143 |
| $P.E._{\hat{\chi}}$ | 7.07 | 4.76 | 7.23 |
| $R_{(i);1,2,10}^*$ | 7035 | 8650 | 6848 |
| $s.e._{\hat{\chi}}$ | 7107 | 5018 | 7287 |
| $P.E._{\hat{\chi}}$ | 7.19 | 5.08 | 7.37 |
| $R_{(ii);1,2,3,4,5,10}$ | 9436 | 9545 | 9242 |
| $s.e._{\hat{\chi}}$ | 3313 | 2983 | 3820 |
| $P.E._{\hat{\chi}}$ | 3.35 | 3.02 | 3.87 |

* 1,5,10 for N.G.

Assuming values of $N = 135$ for N.B., $= 107$ for N.G., and $= 112$ for I.B., the Degrees of Freedom being $N - 6 - 1$, the standard errors of the regression coefficients $s.e._\beta$, were found and entered in Tables LXXXIV - LXXXVI. From these coefficients and their standard errors we see that we could dispense with 3 tests from each of the three populations and obtain almost as good predications of School

Attainment. The sets of tests retained for both the N.B's and the I.B's were 1,2,10; for the N.G's 1, 5, 10. This was done and fresh Regression Coefficients found for these further reduced batteries. With the N.B's and the N.G's it will be observed that it is the first 3 tests in the order in which they are entered which are the ones retained, and the required reciprocal matrices are already to hand. They are contained in the 4th., slab of the working for the 6 x 6 reciprocal matrices. The reason for setting the tests down in the order chosen is now apparent. With the I.B's a separate 3 x 3 reciprocal determination had to be performed. The three 3 x 3 reciprocal matrices are set out in Tables LXXXVIII, LXXXIX and XC, and the results obtained from them in Tables LXXXVI and LXXXVII.

TABLE LXXXVIII

N.B. Reciprocal matrix of reduced R_b

| | | |
|--------|--------|--------|
| 1.8648 | -5536 | -9382 |
| -5536 | 1.3663 | -2141 |
| -9382 | -2141 | 1.6739 |

TABLE LXXXIX

N.G. Reciprocal matrix of reduced R_b

| | | |
|--------|--------|--------|
| 2.0339 | -9903 | -7302 |
| -9903 | 1.6809 | -1326 |
| -7302 | -1326 | 1.4609 |

TABLE XC

I.B. Reciprocal matrix of reduced R_b

| | | |
|--------|--------|--------|
| 1.5875 | -8485 | -2272 |
| -8485 | 1.6652 | -3849 |
| -2272 | -3849 | 1.2441 |

If SA(NB), SA(NG), SA(I.B) stand for the estimates of School Attainment predicted from the "Normalized Scores*" on Tests 1,2,3,4,5,10 of Tables III, IV and V for the Negro boys, Negro girls and Indian boys respectively; and NV(NB), NV(NG), NV(IB) similarly stand for the children's estimated endowments in Non-Verbal Intelligence (with the Negro and Indian boys for their "Normalized Scores*" in Tests 1, 2, 10; with the Negro girls from their "Normalized Scores*" in Tests 1, 5, 10), we finally have the following Regression Equations for making predictions, together with the Probable Errors (P.E.) of these:

$$\text{SA(NB)} = 100 + .32(X - 100) + .30(X - 100) + .23(X - 100)$$

$$\text{P.E.} = \pm 7.19$$

$$\text{SA(NG)} = 100 + .37(X - 100) + .35(X - 100) + .33(X - 100)$$

$$\text{P.E.} = \pm 5.08$$

$$\text{SA(IB)} = 100 + .26(X - 100) + .20(X - 100) + .38(X - 100)$$

$$\text{P.E.} = \pm 7.37$$

$$\text{N.V(NB)} = 100 + .20(X - 100) + .19(X - 100) + .22(X - 100)$$

$$+ .24(X - 100) + .21(X - 100) + .16(X - 100)$$

$$\text{P.E.} = \pm 3.35$$

$$\text{N.V(NG)} = 100 + .21(X - 100) + .13(X - 100) + .22(X - 100)$$

$$+ .16(X - 100) + .25(X - 100) + .24(X - 100)$$

$$\text{P.E.} = \pm 3.02$$

$$\text{N.V(IB)} = 100 + .25(X - 100) + .16(X - 100) + .26(X - 100)$$

$$+ .19(X - 100) + .15(X - 100) + .24(X - 100)$$

$$\text{P.E.} = \pm 3.87$$

Where the X's refer to the "Normalized Scores" from Tables III, IV and V, the suffixes referring to the tests.

* Read "50" for "100" if the "Normalized Scores" have 50 as their mean.

The P.E's in the estimations of School Attainment may seem large and the predictions, therefore, only rough approximations, but it must be borne in mind that these are predictions from purely Non-Verbal Batteries and not to be compared with predictions from batteries of the "omnibus" type which are, to a very large extent, verbal in material.

The differences between the regression coefficients from population to population is apparent. I have not been able as yet to apply the tests of significance of the differences between them given by Gulliksen and Wilks in Psychometrika, Vol 15 No. 2, June 1950, which I have just received, but the differences are large and would appear to be significant. This expresses in another way that Sex and Racial differences exist. It would not be fair to predict School Attainment with the N.B's and the N.G's using the same batteries, nor should the final score be deduced in the same way for each of the three populations. This does not apply so much to the estimations of individual endowments in Non-Verbal Intelligence.

SUMMARY

A battery of 19 tests was prepared whose a priori groupings were: Non-Verbal, Space, Picture, Numerical, Verbal, Attainment. 575 children of Standards V, VI and VII belonging to 11 elementary schools were tested with this battery, the aim being to discover what mental factors were present. For this purpose only the three groups of children, the Negro Boys, the Negro Girls and the Indian Boys, were taken and studied separately. 5 factors emerged in each group, but these, after rotation to oblique axes and also after rotating to an orthogonal reference frame, by no means completely corresponded from group to group.

In order to be certain that a lack of uniqueness in the rotating technique had not caused the differences between the groups, a further analysis was made using 9 non-schooling tests. Here again differences in configuration between the groups was found.

For the purpose of selecting children from poor schools for sending to better ones, equations for estimating school success from success in non-verbal tests were derived, and also equations for estimating individual endowments in "Non-Verbal Intelligence". These equations differed from group to group, again demonstrating the existence of Sex and Race differences in mental structure. No attempt at all was made to determine whether sex or race superiority in mental ability exists, and reasons for the impossibility of determining this are given.

Many of the tests before being curtailed for the elementary schools were set to the boys of Queen's Royal College, and age norms obtained. As the ages of the boys ranged from 10 - 18 years norms have been obtained for the young adult from this school.

REFERENCES

1. Aitken, A. C. Statistical Mathematics. Edinburgh: Oliver and Boyd, 1945.
2. Aitken, A. C. The Evaluation of a Certain Triple Product Matrix. Proc. Roy. Soc. Edinburgh. 57,172-181.
3. Bedell, B. J. Determination of the Optimum Number of Items to Retain in a Test Measuring a Single Ability. To appear in the December 1950 issue of Psychometrika.
4. Burt, C. Symposium on the Selection of Pupils for Different Types of Secondary Schools. IX. Brit. J. Ed. Psych., XX, 1950, 9.
5. Emmett, W. G. Factor Analysis by Lawley's Method of Maximum Likelihood. Brit. J. Psych. (Stat. Sect.), II, 1949, 90-97.
6. Fisher, R. A. and Yates, F. Statistical Tables. Edinburgh: Oliver and Boyd, 1948.
7. Raven, J. C. Progressive Matrices. London: *H. K. Lewis, 1938.*
8. Thomson, G. H. The Factorial Analysis of Human Ability. London: University of London Press, 1948.
9. Thurstone, L. L. Multiple Factor Analysis. Chicago: University of Chicago Press, 1947.

To determine whether the regression planes for predicting School Attainment from scores on Tests 1, 2 and 10 differed significantly between the N.B's and the I.B's the technique of Harold Gulliksen and S. S. Wilks, described in Psychometrika, Vol 15 No.2, June 1950, page 91, was employed.

The first hypothesis, " H_A " is the hypothesis that the population variances (standard errors of estimate) $\sigma_1^2, \sigma_2^2, \dots, \sigma_K^2$ are all equal no matter what values the α_k and β_k may have."

The second hypothesis, " H_B " is the hypothesis that the slopes $\beta_1, \beta_2, \dots, \beta_K$ of the population regression lines are all equal assuming H_A is true (i.e., that the variances are all equal), no matter what values the regression intercepts $\alpha_1, \alpha_2, \dots, \alpha_K$ may have."

The third hypothesis, " H_C " is the hypothesis that the regression intercepts are equal assuming H_B to be true, (i.e., that the variances are equal and the regression slopes are equal)."

In Gulliksen and Wilks's example there were two ⁱⁿ⁻dependent variables and one dependent, g , the standard deviation of which is known. Here, however, there are three independent variables, the scores on Tests 1, 2 and 10, and the criterion is the Centroid through Tests (13,14,15,16) (17,18,19) the standard deviation of scores on which must first be determined.

This criterion may be defined as that which correlates (see Table LXXVII)

.654, .741, .792, .801, .708, .762, .862 for the N.B's and
.598, .589, .795, .825, .575, .747, .750 for the I.B's with
Tests/13, 14, 15, 16, 17, 18, 19 respectively.

With these correlations and knowing the intercorrelations of these tests in the two racial groups from the main correlation Tables VI and VIII, the following regression coefficients were found:

| Test | N.B. | | | I.B. | | |
|------|-------------|---------|---------|-------------|---------|---------|
| | Reg. coeff. | S.D. | Weights | Reg. coeff. | S.D. | Weights |
| 13 | .0994 | 15.7978 | 1.44196 | .1310 | 14.5066 | 1.90036 |
| 14 | .1708 | 14.7535 | 2.41974 | .0923 | 14.1671 | 1.30762 |
| 15 | .1225 | 14.3592 | 1.55695 | .1882 | 12.7098 | 2.39198 |
| 16 | .2042 | 15.4054 | 2.85786 | .2881 | 13.9954 | 4.03207 |
| 17 | .1279 | 15.3834 | 1.61861 | .1230 | 12.6553 | 1.55660 |
| 18 | .1674 | 16.1075 | 2.10187 | .1923 | 12.5560 | 2.41452 |
| 19 | .2943 | 15.7807 | 4.05801 | .2308 | 13.7887 | 3.18243 |

The standard deviations were obtained from the correlation sheets and Sheppard's correction for grouping applied.

The Weights are the products of the Regression Coefficients and the Standard Deviations. Pooling Squares were then constructed bordered by these weights from which the standard deviations of the scores which the N.B's and the I.B's would have made on their respective criteria of School Attainment, were obtained. They worked out to be $\sigma_{NB} = 13.00933$ and $\sigma_{IB} = 12.83092$.

Testing hypothesis H_A of Equality of Standard Errors of Estimate.

From Table LXXVII the correlations of Tests 1, 2 and 10 with the criteria are known, and with these and the known intercorrelations of the tests matrices of Intercorrelations similar to those of Table 2 in Gulliksen and Wilks's paper were constructed, and the following results obtained:

(see Table 3 of G. & W.)

| | N.B. | I.B. |
|---|-------------|----------|
| Δ | = .225462 | .276142 |
| Δ_{oo} | = .446209 | .519892 |
| $\frac{S_k^*}{n_k} = \frac{\Delta \sigma^{\dagger}}{\Delta_{oo}}$ | = 85.51551 | 87.44499 |
| S_k^* | = 11373.563 | 9356.614 |
| n_k | = 133 | 107 |

$$\sum S_k^* = 20730.177$$

$$\sum n_k = 240$$

$$\frac{\sum S_k^*}{\sum n_k} = 86.37573$$

$$G_A^* = .014665 \quad \text{where } G_A^* = 240 \log_e 86.37573 \\ - 133 \log_e 85.51551 \\ - 107 \log_e 87.44499$$

$$\text{Degrees of freedom} = (K - 1) = 1$$

$$.90 > P > .80 \quad (\text{from } \chi^2 \text{ table})$$

H_A is, therefore, not disproved "and we may regard the pooled value," 86.376, "as essentially representing the error of estimate both for" the N.B's and the I.B's.

Testing hypothesis H_B , that the Regression Planes are Parallel.

Following Gulliksen and Wilks the following matrices bordered with the standard deviations were formed:

N.B. $n_k = 133$

| | S.A. | 1 | 2 | 10 |
|---------|---------|---------|---------|---------|
| | 13.0093 | 15.0911 | 15.7537 | 15.9636 |
| 13.0093 | 1.0000 | 6170 | 5590 | 5540 |
| 15.0911 | 6170 | 1.0000 | 5031 | 6248 |
| 15.7537 | 5590 | 5031 | 1.0000 | 4098 |
| 15.9636 | 5540 | 6248 | 4098 | 1.0000 |

† There is an error in G. & W's paper which puzzled me somewhat. They have $\frac{\Delta}{\Delta_{oo} n_k}$, but this should read as above

I.B. $n_k = 107$

| | S.A. | 1 | 2 | 10 |
|---------|---------|---------|---------|---------|
| | 12.8309 | 15.7782 | 16.3702 | 15.0444 |
| 12.8309 | 1.0000 | 5680 | 4500 | 6080 |
| 15.7782 | 5680 | 1.0000 | 4179 | 5943 |
| 16.3702 | 4500 | 4179 | 1.0000 | 3665 |
| 15.0444 | 6080 | 5943 | 3665 | 1.0000 |

From these by multiplying the elements by the respective n_k 's and adding the two matrices the following matrix (see Table 4, G. & W) of Sums of Squares and Cross-products was obtained:

| | S.A. | 1 | 2 | 10 |
|------|-----------|-----------|-----------|-----------|
| S.A. | 40124.957 | 28414.607 | 25350.655 | 27859.895 |
| 1 | 28414.607 | 56927.414 | 27457.391 | 35113.700 |
| 2 | 25350.655 | 27457.391 | 61682.044 | 23364.815 |
| 10 | 27857.895 | 35113.700 | 23364.815 | 58110.992 |

Whence, $\dot{\Delta} / \dot{\Delta}_{...} = \dot{S}^* = 20973.08$

$$\dot{S}^*/N = 87.3878$$

$$\sum S_k^*/N = 86.37573 \quad (\text{From testing } H_A)$$

$$N = 240$$

$$G_B^* = 2.7958$$

(Where $G_B^* = 240 (\log_e 87.3878 - \log_e 86.37573)$)

Degrees of Freedom = $(K - 1)(H) = 2$

$$.50 > P > .20 \quad (\text{from } \chi^2 \text{ Table})$$

H_B is not disproved and the regression planes may be regarded as parallel.

It has been my policy not to investigate superiority of one race over another, so that the third hypothesis, H_C of Identical Regression Planes was not gone into.

From the point of view of these regressions we cannot say that the samples of N.B's and I.B's differ more than might be expected once in four times in a single population. However, this does not prove that they do not differ, and the accumulated evidence of the previous factor analysis would suggest that there may well be a racial difference in mental machinery.

The difference between the regressions of the N.B's and the N.G's is so marked that it was not thought worthwhile to apply Gulliksen and Wilks's technique.

However, Since writing the above, I decided to continue and to find the significance of the sex difference in the regressions, using Gulliksen & Wilks's method. I felt that this was necessary to round off the work and I wished to have the experience of using the method with $K = 3$ samples and where the almost certain expectation was that one of the hypotheses would be rejected.

The criterion is that which correlates (see Table LXVII)

.740, .806, .794, .724, .668, .810, .852 for N.G.'s

with Tests 13 14 15 16 17 18 19 respectively.

With these and knowing the intercorrelations of these tests from Table VII, the following regression coefficients were found:

TABLE XCVI*

| N.G. | Test | Reg. Coef. | S.D. | Weights |
|------|------|------------|---------|---------|
| | 13 | 1223 | 15.1529 | 1.85320 |
| | 14 | 2356 | 15.8920 | 3.74416 |
| | 15 | 1363 | 14.7362 | 2.00854 |
| | 16 | 1127 | 14.3841 | 1.62109 |
| | 17 | 1116 | 14.0905 | 1.57250 |
| | 18 | 2213 | 15.0105 | 3.32182 |
| | 19 | 2492 | 12.9006 | 3.21483 |

and the standard deviations and weights as with the other groups. From the Pooling Square it was found that, $\sigma_{N_g}^2 = 198.74848$ and $\sigma_{N_g} = 14.097818$

Testing Hypothesis H_A of Equality of Standard Errors of Estimate.

* Due to inadvertence the tables of Addendum I were not numbered. They should be numbered from XCI to XCV.

Since the "further reduced battery" for the N.B's and the I.B's consisted of Tests 1, 2 and 10 and for the N.G's of Tests 1, 5 and 10, it was necessary to consider the battery of Tests 1, 2, 5 and 10 for each of the samples, thus using the same 4 independent variables in each case.

From Table LXXVII the correlations of these tests with the criteria are known and the intercorrelations are known from Tables VI, VII and VIII. From these were obtained:

TABLE XCVII

| | N.B. | N.G. | I.B. |
|------------------------|------------|------------|------------|
| Δ / Δ_{oo} | .49178675 | .22957429 | .52708613 |
| S_k^* / n_k | 83.2313469 | 45.6275412 | 86.7754704 |
| n_k | 133 | 107 | 107 |
| S_k^* | 11069.769 | 4882.147 | 9284.975 |

$$\sum S_k^* = 25236.891$$

$$\sum n_k = 347$$

$$\sum S_k^* / \sum n_k = 72.72879$$

$$G_A^* = 347 \log_e 72.72879 - 133 \log_e 83.23135 \\ - 107 \log_e 45.62754 - 107 \log_e 86.77547 \\ = 13.05145$$

$$\text{Degrees of Freedom} = (K - 1) = 2$$

$$P < .01 \quad (\text{From } \chi^2 \text{ Table})$$

If we consider only the two samples N.B. and I.B. again but with the battery of Tests 1, 2, 5 and 10 we obtain:

$$\sum S_k^* = 20354.744$$

$$\sum n_k = 240$$

$$\sum S_k^* / \sum n_k = 84.81143$$

$$\text{and } G_A^* = .0516 \quad \text{Degrees of Freedom} = 1$$

so that $.90 > P > .80$ (From χ^2 Table) as before.

Hence hypothesis H_A is extremely unlikely when the Girls form one of the K samples, but is very acceptable when we only consider the two samples of Boys. From this it may be concluded that a very significant sex difference is demonstrated by the regressions, but not a race difference.

If we accept hypotheses H_A and H_B for the two groups of boys it is possible to use the pooled Sums of Squares and Cross-products of Table XVI to obtain a matrix of intercorrelations between S.A., 1, 2 and 10 for both groups lumped together. The matrix of Table XCV was first divided by 240 (= n for N.B. & I.B.) and then the rows and columns were divided by the square roots of the diagonal elements, giving:

TABLE XCVIII

N.B. + I.B.

| | S.A. | 1 | 2 | 10 |
|------|---------|---------|---------|---------|
| S.A. | 1.00000 | 55246 | 50957 | 57696 |
| 1 | 55246 | 1.00000 | 43057 | 56730 |
| 2 | 50957 | 43057 | 1.00000 | 39026 |
| 10 | 57696 | 56730 | 39026 | 1.00000 |

The reciprocal of the matrix formed by striking out the first row and the first column is:

TABLE XCIX

| | | |
|---------|---------|---------|
| 1.59606 | -39383 | -75173 |
| -39383 | 1.27685 | -27489 |
| -75173 | -27489 | 1.53374 |

Whence,

TABLE C

| | 1 | 2 | 10 |
|---|-------|-------|-------|
| (i) S.A., Criterion (13 - 16), (17 - 19) | 55246 | 50957 | 57696 |
| $\beta_{(i); 1,2,10}$ | 24734 | 27447 | 32953 |
| s.e. β | 060 | 054 | 059 |

And, $R_{(i); 1,2,10} = .6831$

s.e. \hat{x} = .7303

P.E. \hat{x} = 7.39

So that School Attainment for Boys,

$$SA(B) = 100 + .25(X - 100) + .27(X_2 - 100) + .33(X - 100) \pm 7.39$$

This equation may be used in place of the two for SA(NB) and SA(IB) on page 285.

I suggest that apart from selecting children from elementary schools of low standard for sending to better ones, these reduced batteries could conveniently be used to determine the standard of teaching in schools. Though the Probable Error for an individual child is fairly high, the mean School Attainment Scores predicted from the Non-Verbal Tests 1, 2 & 10 or 1, 5, & 10 will be fairly accurate measures of the mental material available in the schools*. When a school's attainment falls short of the mental capacity of its children it may be presumed that there is something the matter with the teaching.

* For the Probable Error of the Mean = $\frac{P.E.}{\sqrt{N}}$, where

P.E. is the probable error of an individual score and N is the number of children tested in the school.