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An Analysis and Criticism of the English Series of the South African "Individual Intelligence Scale". (Provisional Tests --1925.)

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INTRODUCTION.

In December, 1924, at the Annual Congress Meeting of the Suid Afrikaanse Onderwysers Unie a paper was read by Dr. H.Cruse on "Intelligence Tests and their application to the Schools". As a result of this paper it was decided to appoint a Committee to attempt to standardise tests for pupils in South African schools, since no set of tests from any one country can be adequately adopted in any other country in view of the vast differences existing in racial and climatic conditions.

The Committee approached the Department of Education for financial support. The Superintendent-General agreed to give financial aid but suggested that the South African Teacher's Association be allowed to co-operate, so as to obtain a double series of tests; one in Afrikaans and one in English, the two being equivalent as nearly as possible. A sub-committee was appointed in May, 1925 consisting of Prof. Reyburn, Dr. Cruse and Dr. Malherbe, who were to be responsible for collecting the material for such tests. Prof. Reyburn undertook the collecting of the material for the English, while Drs. Cruse and Malherbe undertook the collecting for the Afrikaans series. The full committee compiled a team of tests which they thought to be suitable. It was at this stage in the history of the Intelligence Tests for South African pupils, that the present investigation was undertaken. Its object was to collect material in order to determine the value and validity of the Tests arranged by the Committee.

The results of this investigation, as given in this report, are dealt with from two aspects. In Part I is given the general analysis of

(1) the suitability of the text and arrangement of the tests.

(2) the order of difficulty of items constituting each test.

This is followed by suggestions for regrading.

In Part II the results are analysed statistically.

The/

The Tests - Origin and Description.

The team of tests compiled by the Committee in 1925, were eleven in number. These were taken from various standardised sets, together with two original tests. The first of the series, Test 1 owes its origin to Dr.E.G. Malherbe, of the Department of Education, Cape Town University, and is a Match Design Construction Test. As seen in the appendix (Fig. 24) it consists of a series of stiff cards numbered 1 to 9 on each of which some headless matches are glued to form a design. Numbers 1 to 6 consecutively increase in number of designs and each card thus offers a little more difficulty than the preceeding one. Item 7 and following of the series are a little different. Here, the stiff card has on it but one figure and the subject was required to complete the design on the card. Throughout the test, each card was exposed to the subject for exactly 6 seconds and then put away. The subject, having been given some headless matches was asked to reproduce the design.

Test 2 is a reasoning test and is a modified type of "Burts' Reasoning Test". The test is in the form of problems and consists of a set of cards numbered 1 to 10 on each of which is a problem, (appendix p 1.). The subject was told to read the problem and try and give an answer. When the child gave an answer, the reason for that answer was asked for and was accepted whether right or wrong.

Test 3 is the Cube Test(appendix p. 3.). This test was taken from Knox (American Tests). The apparatus used was a board 16" x 4" divided into four equal squares, coloured red, blue, green and yellow respectively; each square had mounted on it a one inch cube of the same colour. The coloured cubes on the board were referred to as follows :-

red = 1, blue = 2, green = 3 and yellow = 4. The board was placed in front of the child so that the red end (1) was on the subjects left. The examiner used a black cube with which to touch each of the mounted cubes in turn according to the numbers given in the instructions.

Test/

Test 4A was taken from the Binets' test of Repetition of Digits. The series of numbers from the instruction book was read to the subject who was asked to repeat them(for digits given see appendix p 4.).

Test 4B was taken from Terman (Stanford Revision) and was similar to 4A, the only difference being that the subject was asked to repeat the digits backwards(see appendix for digits given p. 4).

Comprehension of situations forms the 5th Test and was taken from Terman. In this test, the subject was asked some questions involving a situation which was in the form of "what would you do if..." A reasonably sensible answer was required(for set of questions see appendix p 5).

Test 6 was originated by Mr. J.G. Taylor of the Department of Psychology, Cape Town University. This is an orientation test, the apparatus for which was provided by Mr. Taylor. The apparatus was a wooden cube of 1 inch side made up of eight ½ inch cubes (appendix p Fig 25) The outer surface of the large cube was painted black, but the inner surfaces were left white. A similar cube of 1½ inch side, made up of 27 half inch cubes was also used. The outer surface of this was painted black. The constituents of the 1 inch side cube were left free while those of the larger cube were glued together with the exception of 1 cube(a) having one black face, 1 cube (b) having 2 black faces and 1 cube (c) having 3 black faces. In addition to this there was a ½ inch cube with 4 black faces and another with 5 black faces. The subject was asked to re-assemble the cube of 1 inch side, the pieces of which had been scattered; also to fill in the larger cube.

Test 7 is a mental arithmetic test, there being 14 problems in all (appendix p 6.). Problems numbered 1 to 10 were compiled by various members of the Committee but numbers 11 to 14 were taken from the Stanford Revision set of Arithmetic tests.

Test 8 is a "Dissected Sentences" test. The idea was taken from the Binet test but in this case the Committee compiled the actual dissected sentences. These sentences were printed in capitals on two cards (appendix p. 7.) and were given to the subject who was asked to re-construct the sentence to make sense.

Test 9A is an Absurdity Test adapted by the Committee from the Binet picture test and the American Group Test. Instead of inserting discrepancies(the American form) the Committee inserted absurdities into each picture. There are 6 pictures in all. The child was asked to pick out the absurdity in the picture and if a minor one was discovered, the child was asked for the more important ones.

Test 9B is similar to Test 9A, in that it is an absurdity test, but is given in a different form. The absurdities involved here were given in the form of sentences. There are 12 cards used in this test, and on each card is a statement containing an absurdity (appendix p. 8.). The procedure was the same as that for Test 9A.

Test 10. Here the well known Porteus Maze Test was used (appendix p. 29. By some means or other, number 11 was not faithfully reproduced. There were 2 lines missing in the prints used for this testing. By this mistake, two extra exits were offered; one extra in the path adjoining the centre and one extra in the path adjoining the final exit. The extra exit offered in the first case, was about equidistant however, and thus could make but little difference in finding"the shortest way out" as was requested. The second extra exit made an appreciable difference in this way, since it was nearer the final exit than the official one. However, as the time factor(although recorded) was ignored for the results of this investigation, and as all sets of mazes were exactly the same, the chances were equal for each child, and thus the mistake is of no account here.

Test 11 is a vocabulary test and consists of two lists (A and B), of 100 words each(appendix p. 9.). The method adopted by the Committee for obtaining these lists was the same as the method for the "Stanford Revision". The idea being to obtain 10^0 words evenly spaced throughout the Dictionary, the Committee decided upon a certain numbered word on a certain numbered page, e.g. (say) the 10th word on every 10th page. The list thus obtained was graded in order of difficulty by the Committee. The Dictionary used, was the Oxford Concise Dictionary.

The method of scoring was that laid down by the Committee in "Instructions for Examiners", for all tests other than Test 2, 4A and 4B, the divergence in these being inevitable. The instructions for Test 2 in the book mentioned above were"make no entry in the column for results". Here, the examiner used her own discretion as to the validity of the answer given and the usual plus (+) or minus (-) sign was recorded, + being scored for any logical reason given, but - for any correct answer not followed by a logical reason.

For tests 4A and 4B, the usual method adopted is the "1 in 3" method of Terman. Since some groups of digits were limited to 2 sets, and in order to obtain a detailed graph for each set of digits, the examiner scored according to the number of digits remembered e.g. If 4 digits were remembered, the subject scored 4 and so on.

Part 1.

As has been shown, the present set of tests under investigation has been selected freely from several well known standardised sets of tests used both in Europe and America. In some cases the tests were taken verbatim from the standardised sets, while in other cases the tests have been adapted, as was thought fit, to the needs of this country. It has been essential, therefore to treat the whole set of tests as original tests for the purpose of this investigation. Although norms are known for the tests taken verbatim from the standardised tests, the acceptance of such norms could not be justified without extensive trials of such tests in this country, due to the different racial and environmental conditions; this applies with greater force to those tests which have been adapted.

In the selection of subjects for testing, all possible precautions have been taken to eliminate such interfering factors as sex and " "selected" group. Consequently the subjects chosen were all boys and the two schools from which the subjects were drawn were entirely different. Furthermore, the subjects of the particular age tested were taken at random from three different classes in each school.

The original intention was to confine the testing to boys of average age 9 as this represents the median school age. However, the set of tests, indicated that they were applicable to older subjects; thus, the testing was extended to include boys of ages 13 to 15. The results of the testing of the first and second

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group of subjects, ages 8 to I0 and I3 to I5 respectively, are treated separately in the detailed discussion of the tests below.

Testing of the First Group.

On completing the testing of a group of 60 boys of ages 8to I0 it appeared justifiable to review the results for indications of any serious faults in the text of the tests or in the method of testing.

A list of marks was compiled for each test and a graph plotted to show the order of difficulty of the separate items of each test as measured by the number of subjects passing each item.

Test I. the match design test, indicates that the test is inclined to be too easy for ages 8to I0. The grading in order of difficulty, is quite good (Figure I). The position of question one is no doubt due to the subject's unfamiliarity with the test, and may be overcome, were a practice design given first. No 6 and 9 of test I call for attention and will be discussed later under the heading " regrading of tests". Were this test given a trial on younger children, it may prove to be of more value.

Test 2. gave more favourable results (Figure 2) although it is apparently slightly difficult for children of age 9. To obtain a better order of difficulty this test needs a slight regrading and the latter part of the test needs further trial on older boys.

Test 3. gave quite a fair result. Although the first part shows regular steps, yet there is a rather long one between the third and fourth step (Items 6&7 Figure 3) A further trial for the latter part on older boys is essential.

Test 4a. proved fairly satisfactory. The steps in the graph (Fig 4) are rather apt to follow those of the latter part of test 3. "Steps" of fair range were expected but although they are regular, they are too steep to qualify as a good test.

Test 4b. being similar to 4a gave almost identical results (Fig 5) and the note on 4a can also be applied here.

The result of Test 5 shows it to be too simple in the early stages for age 9 (Fig 6) and the order of difficulty does not seem to be quite a fair one.

The test needs regrading accordingly. Item 10 of this test gave poor results; this is due to the form of the answer generally given. The answer invariably given in these records was"Actions speak louder than words", and when an explanation of that phrase was requested, to see if the child realised its meaning, there was none forthcoming. The subject in such a case was given minus (-).

Test 6 is unfortunately of no value for ages 9 and over (figure 7). All the subjects found the test very easy. The test gave an interesting result as regards difficulty, however, as it is exactly opposite to all previous tests. The child finds it easier as he proceeds. This may be due to practice and an increasing familiarity with the number of black faces on the cubes. This test may be very valuable for younger children and is certainly worthy of further trial.

Test 7 gave excellent results(figure 8). With an insertion between numbers 3 and 4 or an alteration of number 4, where the only long 'step' in the graph occurs, the first part of this test should be a very reliable test for this age. The latter part requires further trial on older boys.

The result of Test 8 was decidedly pleasing(figure 9) but needs regrading, while the latter part should be given to older boys. With this done, Test 8 should prove very suitable.

Test 9A gave similar results to that of Test 6. With the exception of the first picture, 66 per cent of the boys scored fully on each question(figure 10). The graph is similar to that of Test 6 and is probably due to practice in observation. The pictures have their absurdities rather too obviously indicated and were there more obscure absurdities involved, the test might prove more valuable.

Test 9B; an absurdity test in the form of a statement - proved far superior as a test of finding absurdities than the picture test(figure 11). Regrading in order of difficulty is needed, also a further trial on older boys.

Test 10. The result here was most disappointing(figure 12). All subjects scored exceedingly high marks. A suggestion for a different method of scoring is given under the heading"Regrading". Item 9 is rather low on the graph and is probably due to the fact

that although it is similar in structure to items 10 and 11, for which 4 tries are allowed, yet, following the instructions given, it was necessary to mark it in the same way as the preceding mazes, for which only two trials are allowed.

The vocabulary test(lists 11A and 11B) proved to be good lists. The latter part of each is too difficult for these ages, as was anticipated. For true results on the latter parts of these lists, they should be given to older boys.

Summing Up.

From the above results, it is shown that Tests 2,7,8 9B and 11A are the outstanding ones but need regrading in order of difficulty and a further trial on older boys for the latter parts of the tests.

Tests number 1,3, 4A and 4B proved to be of fair value only while Tests number 5,6,9A and 10, being too easy for subjects of age 9, should be omitted in testing children over this age but should be given trial on younger children.

Preliminary Regrading of Tests 2, 7,8 and 9B.

These tests, from the results obtained, needed regrading, and this was done in various ways:- in some cases the figures in the text were altered, where the problem appeared too difficult as expressed in the original form (Test 7). In others, the positions of the words were changed(Test 8) while in a few the order of presentation was the only alteration (Tests 2 and 9B)

For the regrading of Test 2 the order of presentation of the cards was changed. This revised order was chosen from the graph which suggests that with interchange of the numbers of the question, the scale of distribution should be quite good(figure 2) The new order was as follows :- 1,3,2,4,6,7,5,8,9 and the cards were re-numbered accordingly for further trials.

Test 7 needed but little regrading. Item 4 is obviously too hard. Were this problem rendered easier of solution the difficulty may be abridged(appendix p. 6. for problem). Consequently item 4 was changed into "If 2 pencils cost 6d. how many can you buy for 24d?" The examiner found that most children, in the original problem,divided the 5d. by 2 and then

divided/

divided the 50d. by that answer. Thus, by making the answer of the first division a whole number, (3d. instead of 2½d) the second division was rendered easier. Item 9 of Test 7 appears rather easy in that position but it may be advantageous to let it remain so as an impetus for further effort in the succeeding difficult problems.

For the purpose of regrading Test 8, the method adopted was that of changing the position of the words, since the sentences were already graded according to the number of words employed. Item 2 (figure 9) is apparently too difficult. To rectify this, the recorded answers were examined. From these it was seen that the main difficulty arose from Sun and Day being adjacent words and being taken as one word "Sunday". The position of the words was changed and "the" was interposed between the two offending words; the new dissected sentence ran "Day the sun shines by". The next sentence to be changed was item 4 (figure 9) which seemed rather too easy and so the word "a" was placed between "dog" and "trees" as a complication. Item 5 (figure 9) was just a little too hard. The same method of inspecting recorded answers was employed and it was found that most subjects persisted in asserting that "monkeys have some very short tails". It was hoped that by placing "some" next to "monkeys", the suggestion would be taken and the difficulty overcome.

Items 8,9 and 10 of Test 8 are far too complicated for boys of 9 to 11. From the recorded answers it is obvious that the meaning of the actual words employed is far beyond the child's knowledge. Three new sentences should be inserted in their stead.

Test 9B. needed regrading in order of difficulty and the method employed here was the same as that employed for regrading Test 2, viz., interchange of the numbers of the problems. The new order, chosen from the graph(figure 11) was:- 1,2,7,6,4,9,5,8,3,10,11,12.

Test 11 was graded according to order of difficulty and a new list of 50 words for ages 9 to 11(see appendix p.21.)

was compiled.

Discussion of Remaining Tests.

Although Test 1 did not give favourable results for these ages, yet it should be tried out on younger boys. Before doing so, it is worth while examining the graph(figure 1). Items 1,6 and 9 of the Test are very low on the graph. Item 1 may be overcome by giving a practice Test. The position of items 6 and 9 may be due to the fact that although these two bear resemblance to the main theme of construction yet they are very different as a whole. Were Items 5 and 6 interchanged, the graph may give a better line. The difficulty may be due to both end matches of the design in Item 5 being moved central and then moved outwards again in Item 6 . Perhaps the moving of only 1 match central, as it would be if Item 6 followed item 4, followed by the moving of both end matches central as in item 5, would give better results. That however, needs trial.

A further trial on Test 5 may give better results as to order of difficulty and should be tried thus with the order changed according to the graph (figure 6) to 3,2,1,4,5,7,6,9, 8,10.

Test 10 ,differently marked,may be of some value and should be given further trial with this object in view. Instead of allowing 1 mark for solving the maze in the allotted number of trials, the subject who only uses 1 try should gain more marks than he who makes use of the full number allowed. The following method of marking could be given trial :- In the case of 2 trials being allowed, 1 try scores 2, while 2 tries score only 1. Those items allowed 4 trials score likewise, the subject needing 1 try scores 4, while the subject needing the allotted 4 trials scores but 1 mark.

Tests 3, 4A and 4B should be retained for confirmation of results.

Since Tests 6 and 9A are very obviously too simple they should be omitted for children over 9 but given trial on younger children.

Testing of 2nd. Group and the Results.

The regraded tests required to be tried out in their new form and in most cases, the latter part demanded further trial on older boys. Consequently the 2nd. group to be tested, was one of 40 boys, of ages 13 to 15. The boys were chosen from various standards in the shcool. With these boys, tests 6 and 9A were omitted as determined from the results of the testing of Group 1. All the others were given in the form indicated under "Preliminary Regrading".

Results. On the whole, this group gave similar results to the first group.

Tests 1, 3, 4 A and 4B gave almost identical results as in group 1.

Test 2 proved a good test with these boys(figure 13) It still needs slight regrading, however, and items 5 and 6 are still too difficult. This difficulty is probably due to the Text.

The actual text of the items was examined to see if therein lay the solution. Item 5 is perhaps not quite a fair process of pure elimination(see Test 2, Item 5, appendix p.), the logic being too involved for even this age.

Perhaps the use of another flower in item 6 would be an advantage and help to overcome the difficulty encountered. Since these tests are for South African children, to whom the buttercup is unknown, it may be better to use the name of a South African flower. In this item, the child has not merely the logic with which to juggle, but he has also to make himself familiar with an unfamiliar thing- the buttercup, the colour of which he is given in the text above the problem. Perhaps the problem could be tried out using the name of a South African common flower and the results recorded. It might here be added that it would be useless to insert "aloe" as only 10 per cent of the younger children knew this flower when used in the vocabulary list of Test 11.

Although Test 5 was regraded it gave no results of any

value, since the whole of the test is too easy for age 14(figure 14)

Test 7 gave a better result when the altered problem(number 4) was given (figure 15). The test is a very good one for this age and now that it has been tried on boys of ages 9 to 11, and 13 to 15 it is ready for regrading.

Item 3 still offers slight difficulty. The recorded answers were re-read and the answer was invariably found to be 2/3. Evidently the children were careless and read the problem as "4 pears for 3d". There may be no need for a great change here, were the examiner in future be allowed, in the case of such an answer being received, to diverge from the instructions "accept the answer whether it is right or wrong" and to ask the subject to re-read the problem carefully. Were the problem to read "4 pears at 3d. per pear", the difficulty may prove less.

Pfoblem 8 appears to be too difficult even for these ages (13 to 15) and it is suggested that this problem be either omitted from the Test or given as the last problem of the test.

A further suggestion is made here for Test 7, with regard to the last four problems, viz., 12 to 14 inclusive(appendix p.6)

Problem 11 is of quite fair difficulty but as soon as it becomes necessary to throw water away, as it is in problems 12, 13 and 14, the children find the problems very difficult. As these problems are used by Terman for adults, younger subjects might be given help and told that any water they do not require can be thrown away.

Although Test 8 was so promising with the first group it was unfortunately very disappointing with this group (figure 16). From the graph it appears that while items 1 - 7 are too easy, and therefore of little value for age 14, yet items 8 to 10 inclusive are not of any more value since they are too difficult. This is due to the words chosen for the sentences - wofds incomprehensible to children.

Test 9B gave excellent results. About half of the statements are rather easy for this age(figure 17) while the other half are quite fair tests. The test needs further regrading so that all the easy statements together lead up to the more difficult ones which should form the latter part of the test and thus be valid

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for ages 9 to 14.

It is interesting to note that no one managed to explain the absurdity of number 12 of this test 9B.

Test 10 was given to these older boys as a trial for the new method of marking. This marking proved of no avail however, for only 1 boy scored lower than 77 per cent.

Test 11, the vocabulary test, again proved an excellent test.

Summing Up.

On the whole the results resemble those of the 1st group. Tests 1,3,4A,4B,5 and 10 are valueless as tests for ages 13 and over.

Tests 2,7,9B and 11 are good tests, but still need slight regrading.

Test 8, although so promising in the 1st group, was disappointing and needs an entirely new latter half, as the words in numbers 8,9 and 10 are beyond the comprehension of these boys.

COMBINED RESULTS.

Reviewing the results of the testing of both groups, it appears that Tests 1,3,4A,4B and 5 yield but poor results while Tests 6, 9A and 10 are useless for children of age 9 and over. Test 8 yielded good results with group I.

Tests 2,7,9B and 11 gave excellent results in both testings but in each test, regrading is essential.

For this purpose the 100 subjects were considered as one group so that the tests could be made valid for ages 9 to 14.

The performance scale of the 100 subjects in Tests 2,7,8,9, was plotted and regrading in order of difficulty was based on these graphs.

For Test 11, the percentage correct for each of the 205 words was calculated.

Regrading of Tests. 2,7,8,9B and 11.

Test 2. From the graph(figure 18) items 5 and 6 appear too difficult, and the suggestions for regrading given under the heading"Testing of the 2nd. Group" were followed. Item 5 could be changed slightly so as to exclude Funanie's chance of being called the thief, as many answers given for this problem were "Funanie". Thus, the words"The sheep must have been carried there as there were no sheep marks" should be interpolated. In Item 6, the name of the flower could be changed from butter-cup to sunflower as few children in South Africa know or have ever seen a buttercup whereas sunflowers are common in this country. The order of presentation should be changed to : 1,3,2,4,6,7,8,9,5.

Test 7. This test needs but slight regrading(figure 19). Item 3 can be made a little more emphatic by saying"4 pears at 3d. per pear", while in Item 4 the altered figures used for the 2nd. group testing"If 2 pencils cost 6d. how many can you buy for 24d". should be retained.

Item 8 is far too difficult but could be retained were it given as the last problem of the series. For problems 12,13 and 14 the inclusion in the instructions of the words" you can throw away any water you do not rdquire" should help the child.

Test 8. This test needs rather much alteration(figure 20). Items 2,4,and 6 should be retained in the changed order as given to the 2nd. group, while items 8,9 and 10 must be omitted and substitutes formed.

The following substitutes are suggested but need trial. Item 8 now reads"Generally those very us who to are love we kind". Item 9. "Some a pity do that is work it not like people". and 10 "It better the win like is a harder the to game we it".

Test 9B. Here, the change of order of presentation seems to be all that is necessary. Taking this order from the graph(figure 21 the items should be as follows :- 1,2,7,6,4,5,9,8,3,11,10,12.

Test 11. The vocabulary test includes 200 words and from these 100 words have been selected which are suitable for ages 9 to 15. These are given in order of difficulty chosen from the percentage correct for each word. The first 50 words are chosen from the results of the testing of the 1st. group and the second 50 words from the results of the testing of the 2nd. group.

PART 2.

INTRODUCTION.

The general analysis of the tests as given in Part I is confined entirely to the consideration of the suitability of the form of presentation of the tests, both as to order of difficulty and the age limits for which the tests are valid. Such a general analysis based for the greater part on observations during the actual testing, although valuable as a means of adjustment of the tests does not yield any numerical index of the value of the tests.

The greater number of the standardised sets of tests in existence to-day were compiled on the evidence of general analysis alone, their value as tests were based on trial and error, and it is surprising, as has been pointed out by Spearman that they have proved so efficient. Such methods are not justifi--able to-day when means are available of obtaining definite numerical indices of the qualitative factors measured by such tests, and the quantitative measurements of those factors.

Before proceeding with the general outline of the methods used in the statistical analysis of the data it may be well to give some consideration here to the controversies which have arisen around the measurement of intelligence. It is only natural that with the development of specialised statistical methods for the analysis of measurements of mental activity that controversies should arise around the interpretation of observed phenomena are due to the unavoidable limitations imposed by the gradual evolution of the statistical methods.

The basis of the modern development in the statis--tical processes of analysis of mental activity measurements was in the observation by Spearman (I904) that the correlation coefficients tended towards a" peculiar arrangement which could be expressed mathematically". The mathematical expression is the now well known Tetrad Equation. Spearman postulated his "Two Factor Theory" as the direct outcome of this equation, the "g" factor which is general in all measurements, and the "s" factor which is specific to each measurement. He stated that

if the measurement of any mental ability is divisible into these two factors only then the tetrad equation is obeyed. Thomson(2) however, by an artificial arrangement of dice was able to obtain hierarchy without a general factor and advanced in opposition to Spearman's "two factor theory" his " sampling theory". Thomson prefers to consider that in any mental activity a number of factors ("e") are used by the individual , these factors being merely a sample of the number of factors which the individual has at his command.

At this stage in the controversy it appeared that an impasse had been reached. Garnett(3) on purely mathematical grounds was able to prove that Thomson's "e" factors and the "G" and "s" factors of Spearman were merely mathematical transformations of each other and he proved the converse of Spearman's theorem - that if equiproportion exists then "g" and "s" alone are present.

Since the "e" factors and the "g" and "s" factors are both able to satisfy the Tetrad Equation the selection of the interpretation rests entirely with the immediate aims in view. "It is generally agreed upon that for the purpose of measurement and prediction of mental ability the "g" and "s" factors are far simpler and more useful." (Dodd.(4)).

Adopting the "g" and "s" factors as indices it is possible to submit mental activity data to a fairly comprehensive analysis as laid down by Spearman in " The Abilities of Man ". The procedure as given by Spearman is therefore adopted throughout the statistical analysis of the present data.

The results of a statistical analysis of the tests singly and as a team is presented in part two. The set of data for this analysis is taken from the scores of the two groups tested (100 boys) as enumerated in part one.

Test 6 and 9a are omitted from the statistical analysis as they proved to be valueless for the age of subjects tested. As lists IIa and IIb gave a high correlation coefficient (.77) only the first list was taken for analysis in part two.

Weighting of Scores.

The scoring of each test is designed with the idea of simplicity and accuracy as the chief factors. Each test calls for its own method of marking to attain these ends. Hence when the question of aggregating the scores for the team of tests arises, the summation of the scores for the individual tests does not give the true aggregate for the performance of each subject, Subjects who score relatively highly in those tests with high maximum marks, as compared with their scoring in tests with low maximum marks, obtain an aggregate score which is not commensurate with their general performance. To obtain true aggregates it is therefore necessary to balance the scoring of the different tests so that each test will have equal weight in the pooled scores. The equalising factor is obtained from the Standard Deviation of the tests. Making the largest S.D. unity and expressing the remainder as reciprocals of their relation to the largest S.D. a factor is thus obtained for multi-plying the score of each test. The summation of the corrected scores for the tests thus gives a true aggregate for each subject's performance.

The standard deviation is derived from the formula

$$\sigma = \sqrt{\frac{\Sigma x^2}{N}}$$

Σx^2 = summation of squares of all deviations.

N = number of subjects. (I00).

The S.D. for the eleven tests under investigation and the equalising factor for each test are presented in table I.

The magnitude of the equalising factors is sufficient explanation in itself to stress the necessity of balancing each test in " pooling" the scores. In order to estimate the magnitude of the errors involved in ranking on aggregate scores without balancing the individual tests , 22 boys from one class were ranked according to the unbalanced and balanced scores and the deviations in position found. The maximum deviation was 8 and the average deviation was 2.2.

TABLE I.

No.of Test	S.D.	Equalising Factor
I	2.IO	8.55
2	2.49	7.2I
3	I.69	IO.63
4a	I.20	I4.97
4b	I.34	I3.40
5	2.23	8.05
7	2.79	6.44
8	2.20	8.I6
9b	2.I7	8.28
IO	0.85	2I.I3
II	I7.96	I.00

Inter-correlation of Tests

In a set of tests which are eventually to be pooled to yield an index of intelligence, a fairly close agreement is essential between the various tests. It is not sufficient to select tests indiscriminately and pool them; the tests forming a team must show a significant coefficient of correlation amongst themselves and the higher they are inter-correlated the better will be the final index of the factor which they measure. Applying this criterion to the set of tests under investigation the coefficients of correlation of the eleven tests as seen in Table 2 were calculated by the "Bravais- Pearson product moment formula"

$$r = \frac{\Sigma xy.}{\sqrt{\Sigma x^2 . \Sigma y^2}}$$

The probable error of each coefficient of correlation according to the formula

$$p.e. = .6745 \frac{(1-r^2)}{\sqrt{N}}$$

is included in Table 2.

Table 2.

	I	2	3	4a	4b	5	7	8	9b	IO	IIa
		±.04	±.06	±.06	±.06	±.06	±.05	±.05	±.06	±.05	±.05
I		.60	.30	.40	.28	.22	.5I	.5I	.4I	.43	.55
			±.05	±.05	±.06	±.04	±.03	±.02	±.03	±.06	±.02
2	.60		.44	.52	.35	.66	.74	.8I	.74	.39	.8I
				±.06	±.06	±.06	±.06	±.06	±.06	±.06	±.06
3	.30	.44		.38	.33	.32	.25	.40	.42	.34	.40
					±.06	±.06	±.05	±.05	±.05	±.06	±.05
4a	.40	.52	.38		.35	.37	.52	.50	.46	.30	.50
						±.06	±.06	±.05	±.06	±.06	±.05
4b	.28	.35	.33	.35		.36	.4I	.53	.35	.36	.45
							±.05	±.05	±.05	±.06	±.05
5	.22	.66	.32	.37	.36		.43	.48	.46	.30	.5I
								±.03	±.04	±.06	±.03
7	.5I	.74	.25	.52	.4I	.43		.73	.6I	.32	.78
									±.03	±.05	±.02
8	.5I	.8I	.40	.50	.53	.48	.73		.70	.53	.85
										±.05	±.04
9b	.4I	.74	.42	.45	.35	.46	.6I	.70		.47	.67
											±.05
IO	.43	.39	.34	.30	.36	,30	.32	.53	.47		.43
IIa	.55	.8I	.40	.50	.45	.5I	.78	.85	.67	.43	

From the above table it may be seen that while no coefficient is insignificant (each being greater than three times the P.E.) yet some are prominently high. On closer inspection it will be noticed that these high coefficients all occur in inter-correlations between five tests viz, tests 2,7,8,9b, and IIa. One suspects from this, that the factor measured by these tests, is common in some degree or other in all five tests. They are all literary tests and not performance tests, but how far this is responsible it is impossible to judge until further analysed.

Qualitative Determination of Mental Factors Measured by the Tests

The coefficients of correlation, valuable as they are in providing an index of the efficiency of the tests in relation to each other give but slight indication of the true efficiency of each individual test as a measure of intelligence. According to Spearman the mental abilities measured by most intelligence tests are highly inter-correlated and that in all probability the correlation is due to the presence of one general factor. This factor he designates "g". He does not preclude the possibility of the measurement of factors other than "g",; factors which while common to some tests are not common to all. These factors he designated as specific factors "s". As specific abilities will naturally vary from individual

to individual and from test to test, the inclusion in a team of tests of any tests with overlapping specific abilities will vitiate the results when a measure of general ability is required.

The fundamental criterion which must be applied to a team of tests devolves thus into an analysis of whether any two tests measure the same specific abilities.

The Tetrad Equation

$$r_{ap} \cdot r_{bq} - r_{bp} \cdot r_{aq} = 0$$

- the proof and derivation of which is given by Spearman (appendix pp. i-vi) is the criterion which is applied for this purpose. If the coefficients of correlations are submitted to the above equation the resulting tetrad differences should tend towards zero provided there are no overlapping specific abilities measured by the tests in question. All the possible combinations of coefficients of correlation have to be submitted to the equation Errors of sampling cannot be eliminated in practise and deviations from zero will occur. The significance of the tetrad difference thus depends on the magnitude of its probable error. Itis possible to calculate the probable error of each tetrad difference and differences to be accounted for by sampling must be within three times its probable error. The calculation of the probable error of each T.D. is much too laborious hence the procedure is adopted of arranging the T.D.s in a frequency distrib--ution and obtaining the Median by observation. The probable error of all the T.D.s. is obtained from the formula (Spearman. App. pxi)

$$P.E. = \frac{1.349}{\sqrt{N}} \left[r^2(1-r)^2 + (1-R)S^2 \right]^{\frac{1}{2}}$$

$$\text{where } R = 3r\frac{n-4}{n-2} - 2r^2\frac{n-6}{n-2}$$

Where :- N = number of subjects.
n = number of tests.
r = mean of coefficients in the table.
S = mean squared deviation of the coefficients.

and should agree closely with the median of the tetrad difference if overlapping specific abilities are absent. If the agreement is not close then it may be taken as evidence that group factors are included in the measurements.

The question arises of how close the agreement between the P.E. and the Median of the T.Ds should be. The P.E. of all the T.Ds is itself subject to errors which are inherent in all probable errors calculated from small samples. It is however possible to determine these errors by calculating the probable error of the probable error from the formula

$$p.e.\ of\ P.E. = \frac{.4769\ P.E}{\sqrt{N}}$$

The P.E. of all the T.Ds and the Median of the T.Ds should agree within three times the p.e. of the P.E. in order to account for the tetrad differences by errors of sampling.

The 990 possible T.Ds of the tests under investigation were calculated from the table of correlation and graded into groupes the class distinction of which is 0.02. The frequency distribution is given in table three and in graphical form in Figure 22(Appendix).

TABLE 3

Class Distinction	Frequency.
0.00----0.0199	218
0.02----0.0399	219
0.04----0.0599	188
0.06----0.0799	143
0.08----0.0999	99
0.10----0.1199	65
0.12----0.1399	29
0.14----0.1599	20
0.16----0.1799	6
0.18----0.1999	3
	990

Observed Median---------0.050

P.E.---------- ±.034

p.e. of P.E.---------- ±.0005

The difference between the Median and the P.E. of the T.Ds in this case (0.0I6) amounts to 32 times the p.e.of the P.E. and has definite significance so that the Tetrad Equation is not satisfied by the data.

The disturbing influence may be accounted for in one of two ways - the inclusion of group factors in the tests and/or the effect of spurious correlation.

Before further analysing the data for the disturbing influence, the results obtained from the Afrikaans set of tests were examined. The Afrikaans set of data is based on the testing of about 400 subjects . The P.E. of the T.Ds. is given as ± 0.0I95 and the observed median as 0.0383. The investigators of the Afrikaans tests accepted the figures as being sufficiently close to satisfy the Tetrad Equation. Calculating the p.e. of the P.E. as above we obtain ± 0.0003 and a difference between the P.E. of the T.Ds. and the Median of 0.0I88. The difference in this case is even more significant, being 62 times the p.e. of the P.E..

In searching for the disturbing factor in the data of this investigation, consideration was first given to the effect of spurious correlation. Spearman enumerates the disturbances which are likely to give rise to spurious correlation as follows ;

(I) Diversity of Ages.

(2) Diversity of Training.

(3) Diversity of Sex.

(4) Plurality of Examiners.

The first two disturbances enter into the present data while all four enter into the data analysed for the

/ Afrikaans

set of tests.

The present data is based on the scores of 100 boys drawn from two schools with ages varying from 8 to 15. All the testing was carried out by the writer.

The set of data for the Afrikaans set of tests was obtained from a large number of schools all over the Union with children of both sex and covering a much wider range of ages. The testing also, was carried out with the aid of a number of students as well as the two principal investigators.

It thus appeared that the disturbning factors would in all probability be accounted for by spurious correlation and in order to eliminate these as much as possible a new set of correlations was calculated for 60 boys of average age 9 but ranging from 8 to 10. Unfortunately the two schools had to be included as it was impossible to obtain a group of over 30 boys of average 9 in any one school in Cape Town.

The correlation coefficients with their p.e. for the eleven tests based on the score of 60 boys are given in Table 4.

Table 4.

	1	2	3	4a.	4b.	5.	7.	8	9b.	10	11A
		±.06	±.08	±.08	±.09	±.09	±.07	±.08	±.08	±.08	±.08
1		.50	.28	.21	.21	.05	.42	.34	.21	.33	.32
			±.07	±.07	±.08	±.06	±.07	±.06	±.06	±.08	±.05
2	.50		.48	.41	.28	.56	.48	.59	.56	.24	.61
				±.07	±.08	±.08	±.08	±.07	±.08	±.08	±.07
3	.28	.48		.37	.32	.33	.26	.44	.31	.29	.45
					±.08	±.08	±.07	±.08	±.08	±.08	±.08
4a.	.21	.41	.37		.24	.22	.35	.33	.28	.13	.28
						±.08	±.08	±.07	±.08	±.08	±.08
4b.	.21	.28	.32	.24		.26	.12	.42	.12	.27	.21
							±.08	±.08	±.08	±.08	±.07
5	.05	.56	.33	.22	.26		.18	.33	.33	.22	.38
								±.07	±.07	±.08	±.07
7	.42	.48	.26	.35	.12	.18		.43	.35	.08	.43
									±.06	±.07	±.04
8	.34	.59	.44	.33	.42	.33	.43		.53	.43	.69
										±.07	±.06
9b.	.21	.56	.31	.28	.12	.33	.35	.53		.41	.5
											±.08
10	.33	.24	.29	.13	.27	.22	.08	.43	.41		.28
11A.	.32	.61	.45	.28	.21	.38	.43	.69	.58	.28	

It will be noted that the coefficients of correlations are all much lower than the previous set but that the general trend is much the same - the high coefficients occur in the intercorrelations of the same tests, viz, 2,7,8,9b, and 11. The frequency distribution of the tetrad differences of these new correlations are presented in table form (5) and in graph

form in the appendix (figure 23).

Table 5.

Class Interval.	Frequency.
0.00 ---- 0.0199	214
0.02 ---- 0.0399	218
0.04 ---- 0.0599	190
0.06 ---- 0.0799	151
0.08 ---- 0.0999	92
0.10 ---- 0.1199	51
0.12 ---- 0.1399	44
0.14 ---- 0.1599	19
0.16 ---- 0.1799	8
0.18 ---- 0.1999	1
0.20 ---- 0.2199	1
0.22 ---- 0.2399	1
	990

Observed Median = 0.047

P.E. of Tetrad Differences = ± 0.042

p.e. of P.E. = ± 0.0006

The median and the P.E. of the Tetrad Differences show much closer agreement than in the previous data. The difference between them is slightly over 8 times the p.e. of the P.E. The Tetrad equation is thus not yet satisfied.

The effect of eliminating spurious correlation is demonstrated very forcibly in this analysis in the reduction of the differences between the median and the P.E. of the tetrad differences from 32 to 8 times the p.e. of the P.E. This indicates the vast importance which must be attached to the planning of the scheme of investigation.

The disturbances which are likely to produce spurious correlation are present to a far greater extent as well as in actual number in the data for the Afrikaans set of tests. Since the tests are almost identical to the English set of tests, and as the divergence between the p.e. of their Tetrad Differences and their observed median is also much greater, it is justifiable to assume that spurious correlation also enters into that set of data, but for some reason or other this was not detected by the investigators/

investigators and all subsequent steps in the statistical analysis of their data is not valid since their data does not satisfy the Tetrad Equation. It is more than likely that their very high coefficients of r_{ag} are also due to these disturbing factors (app,24)

Since the tetrad equation is not satisfied even by the data for 60 subjects, it is possible that all the effect of spurious correlation has not been eliminated since the subjects were drawn from two schools. In order to test this, the set of data for 30 subjects from one school was submitted to the same statistical analysis.

The following values were obtained.

Observed Median = 0.0580

P.E.of Tetrad Differences $= \pm 0.0468$

p.e of P.E. $= \pm 0.0007$

The difference between the median and the P.E. of the tetrad differences is I6 times the p.e. of the P.E. and hence this set of data is again unable to satisfy the tetrad equation.

The fact that this set of data shows greater divergence between the median and the P.E. of the tetrad differences than the set of data for 60 boys is not easy to explain. [It may be that the influence of spurious correlation has served to reduce the effect of group factors in the set of data for 60 subjects.]

Reviewing the results of the analysis, it is obvious that spurious correlation is not alone responsible for the data failing to satisfy the tetrad equation. It is necessary thus to extend the analysis of the data to obtain more specific values for the individual tests and thus see whether the elimination of tests which are not highly saturated with "g" will remove the disturbing influence.

As an empirical method, the set of data which most nearly satisfies the tetrad equation (viz., the data for 60 subjects) was taken as a first approximation and the values of r_{ag} were calculated from Spearman's[#] formula:-

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[#] Spearman, The Abilities of Man . Appendix pp. 16.

$$r_{ag} = \frac{(A^2 - A')^{\frac{1}{2}}}{(T - 2A)^{\frac{1}{2}}}$$

where A= sum of correlations between "a" and every other test.

A'= sum of squares of correlations between "a" and every other test.

T= sum of correlations in the whole table.

The values of r_{ag} are given in table 6.

Table 6.

Test	r_{ag}.
I	0.48
2	0.84
3	0.60
4a	0.47
4b	0.40
5	0.48
7	0.52
8	0.80
9	0.62
IO	0.44
IIa	0.74

These values are an index of the efficiency of each test as a measure of "g".

Selecting from the above table the six tests most highly saturated with "g" (viz., tests 2,3,7,8,9 & II) and submitting the inter-correlations of these tests to the tetrad equation the following frequency distribution was obtained (table 7.).

Table 7.

Class Interval	Frequency
.0 ---0.0199	17
.02---0.0399	8
.04---0.0599	6
.06---0.0799	6
.08---0.0999	2
.10---0.1199	1
.12---0.1399	4
.14---0.1599	1

Observed Median = 0.028

P.E. of Tetrad Differences = ± 0.045

p.e. of P.E. = ±0.003

The difference between the median and the P.E. of the tetrad differences is 0.017 and is more than five times the p.e. of the P.E.. The tetrad equation is not yet satisfied even on the data for the selected tests.

There is still present in this set of data some disturbing factor which may be accounted for by spurious correlation or overlapping specific abilities.

Since the set of data for 30 subjects is free from the first possibility the analysis was extended to this set and the following values obtained from the data on the selected tests.

Table 8.

Intercorrelations of selected tests for 30 boys.

.	2.	3.	7.	8.	9.	11.
2.		.36	.40	.60	.67	.61
3.	.36		.24	.02	.30	.21
7.	.40	.24		.60	.52	.53
8.	.60	.02	.60		.37	.62
9.	.67	.30	.52	.37		.59
11.	.61	.21	.53	.62	.59	

Table 9.

Frequency distribution of the Tetrad Differences.

Class Interval	Frequency.
0-----0.0399	7.
.04-----0.0799	I4.
.08-----0.II99	II.
.I2-----0.I599	5.
.I6-----0.I999	5.
.20-----0.2399	2.
.24-----0.2799	I.

Observed Median = 0.090

P.E. of Tetrad Differences = ±0.078

p.e. of P.E. = ±0.006

The Tetrad Equation is at last satisfied.

The assumption that disturbing factors other than spurious correlation were present is fully justified. The elimination of these factors is concomitant with the rejection of those tests which have a low correlation with "g". Although no definite analysis of the data has been made for these, the suggestion may be made here that a group factor is present in the rejected tests or that one or more of the rejected tests may have an overlapping specific ability with one or more of the selected tests.

Considering the three sets of data - which have been analysed above - with the view of obtaining true values of the correlations of each test with "g" and of the team of tests with "g" the sets of data for I00, 60 and 30 subjects for the complete team of tests are ruled out as they are affected by either spurious correlation or group factors. The analysis to follow is thus based on the only valid set of data (30 subjects) in the six selected tests.

The true values of r_{ag} of the six tests which satisfy the tetrad equation were calculated and are given below. (table I0.)

Table IO.

Tests.	r_{ag}
2.	0.66
3.	0.29
7.	0.69
8.	0.64
9.	0.75
II.	0.79

" Weighting " of the Individual Tests.

Since each test has its own level of significance as a measurement of "g" it becomes obvious that even the balanced scores of each test (table I.) are still subject to errors in giving a true aggregate for the performance of each subject in the pooled tests. The weighted scores for the individual tests must again be corrected relative to the different levels of significance of each test as a measure of "g". Spearman# has shown that the weight "W_μ" of any correlation $r_{\mu g}$ has to be made proportional to

$$\frac{r_{\mu g}}{(1 - r_{\mu g}^2)}$$

The values of " W_μ" are given in table II.

Table II.

Tests.	" W_μ"
2.	I.I7
3.	0.32
7.	I.32
8.	I.08
9.	I.7I
II.	2.IO

Spearman; The Abilities of Man, Appendix pp. 19.

The number of subjects being reduced to 30 for this analysi s necessitated the recalculation of the standard deviation and equalising factor for the scoring of the tests. These, for the six tests are presented in table I2.

Table I2.

Tests	Standard Deviation	Equalising Factor.
2.	I.769	5.37
3.	I.789	5.3I
7.	I.663	5 8I
8.	I.59I	5.97
9.	2.28I	4.I6
II.	9.49I	I.00

The scoring of the tests has been subject to two distinct correcti the first in correcting for the different levels of significance in the correlation of each test with "g" and the second in the equalising of the standard deviation. The application of two corrections becomes cumbersome in practice and since the application of the product of the equalising factor for S.D. and W_{ss} amounts to the same as applying each correction separately this was adopted. The new factor thus obtained (table I3.) is again too cumbersome as it involves too much arithmetic for routine testing. The new factors were reduced to the nearest whole numbers.

Table I3.

Test.	W_{ss}	X S.D. Factor	= Equalising Factor.	Approximate Equalis Factor.
2.	I.I7	5.37	6.28	6.
3.	0.32	5.3I	I.70	2.
7.	I.32	5.8I	7.67	8.
8.	I.08	5.97	6.45	6.
9.	I.7I	4.I6	7.II	7.
II.	2.I0	I.00	2.I0	2.

Correlation of Team of Tests with "g".

Now that the set of data has been subjected to thus much analysis - that the "g" and "s" criterion has been applied and obeyed, that the tests have been individually valued as to their saturation with "g" and that their true weights have been found - the final step in the analysis may now be taken. This step is the conclusive one in testing the value of the whole tests as a team, i.e., in the value of r_{tg} (correlation of team of tests with "g"). It is the final "checking up" of the whole method of analysis . If the tests have obeyed the tetrad equation and have been correctly treated as to weighting and scoring then $r_{tg.}$ should give a high correlation coefficient. The formula

$$r_{tg} = \frac{1}{(1 - \frac{1}{S})^{\frac{1}{2}}}$$

where S = summation of $W_\mu . r_{\mu g.}$

was applied and the coefficient equalled I.0

It appears thus that the six tests which have been selected have been weighted in the best possible manner to yield a team of tests for the measurement of "g".

GENERAL CONCLUSIONS.

It may appear that the method of attack in the statistical analysis was rather indefinite on account of the repeated restrictions of the data submitted tothe Tetrad Equation criterion. In the first instances (viz., reduction to 60 and 30 subjects) there was no other alternative since spurious correlation was known to influence the data and the quickest way of eliminating this was by the narrowing of the age limits of the subjects and avoiding diversity of training. The failsure of the data, for the group of 30 subjects for the eleven tests, to satisfy the criterion offered two avenues of attack; the more direct method of analysing for overlapping specific abilities or group factors and the elimination of any tests involved or the more indirect method of choosing the six tests which were most highly saturated with "g" and again submitting these to the criterion. The latter method was chosen since only six tests were required for the final team of tests and since little further calculation was invo;ved as all the tetrad differences were available. The indication of the presence of disturbing factors other than spurious correlation is interesting and is deserving of further study and it is regretted that it could not be included in the present analysis. It is also to be regretted that the analysis of the Afrikaans set of data was not pursued until the tetrad equation criterion was satisfied by that data as this would give confirmation or contradiction of the indications of group factors.

In retrospect the outstanding feature of the statistical analysis is the vast influence of spurious correlation and the ease with which spurious correlation may be introduced into any set of data. The tetrad equation is no mean criterion and the presence of any spurious correlation in the data is immediately indicated. The planning of an investigation into the validity of a team of tests is thus of primary importance as the inclusion of factors which give rise to spurious correlation which cannot later be eliminated from the data is

tantamount to courting failure.

It is also of the utmost importance that the tetrad equation criterion is correctly applied and that the further criterion of agreement between the P.E. of the T.Ds. and the Median of the T.Ds. be also applied and not merely judged by observation, since the validity of all further stages in the statistical analysis is dependent on the data satisfying the tetrad equation. The investigators of the Afrikaans set of tests applied the criterion but ommitted to determine the significance of the tetrad differences, with the result that they failed to detect the presence of spurious correlation in their data. Since their data does not obey the criterion no validity can be placed on any of the subsequent steps of their statistical analysis.

The six tests which have been selected as the result of this investigation can be accepted with a considerable degree of confidence as being suitable and reliable tests for the measurement of "g" . In their final form as given in the appendix and in conjunction with the equalising factors they are suitable for presentation in order to determine their respective age norms.

SUMMARY.

The object of the investigation is the collection of data to determine the value and validity of the Tests arranged for South African children.

A description of the tests and their source of origin is given. In Part (1) the general observations on the tests is given and the results of testing of two groups of boys ages 8 to 10 and 13 to 15 respectively.

Regrading of the tests based on the order of difficulty of the items constituting the test is suggested.

Difficulties due to unsuitable forms of the test are treated.

In Part (2) the statistical analysis of the data collected is given.

Equalising factors for each test have been calculated in order to yield true aggregate scores.

The coefficients of the inter-correlations of the tests together with their P.E. are given.

The Tetrad Differences reveal the presence of disturbing factors and the data from the 100 subjects fails to obey the tetrad equation. This is shown to be due to the effect of spurious correlation introduced by the diversity of ages of the subjects tested. The data for 60 boys of average age 9 reduces the influence of the disturbing factor but still fails to obey the Tetrad Equation.

By assuming the Tetrad Equation to be obeyed the values of r_{ag} are given.

Six tests show high saturation with "g" and the data on these tests for 30 subjects of average age 9 obey the Tetrad Equation.

The true values of each of these six tests (viz.2,3,7,8,9b and 11) with "g" as a team with "g" are given.

Further "weighting" of the tests to compensate for their difference in saturation with "g" is made and the two weightings are combined to yield one factor. The final equalising factor is further simplified to whole numbers.

The reduced set of tests in its final suggested form is presented in the appendix.

In conclusion the writer wishes to express her indebtedness to Professor H.A. Reyburn, D.Phil; (at whose suggestion this investigation was undertaken) for his unfailing guidance and criticism throughout the investigation.

The writer also wishes to thank Mr. Kipps, Mr. Allen and Mr. Chesters for the facilities provided in testing the subjects in their respective schools.

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TEAM OF TESTS AS COMPILED BY THE COMMITTEE.

TEST 2. REASONING.

1. Tom runs faster than Jim.
Jack runs slower than Jim.
Which is the slowest of the three ?

2. The person who stole Brown's purse was neither dark, nor tall, nor clean-shaven.

The only persons in the room at the time were :-

(1) Jones, who is short, dark and clean-shaven;
(2) Smith, who is fair, short and bearded;
(3) Grant, who is dark, tall, but not clean-shaven.

Who stole Brown's purse ?

3. Three girls are sitting in a row:
Mary is to the left of Susan;
Kate is to the left of Mary;

Which girl is in the middle ?

4. All insects have six legs.
This creature has eight legs.

Is it an insect ?

5. One of my sheep had been stolen. Later on I found it dead under a bush where it had been hidden. Beside the sheep was a pipe and on the sheep's wool was red clay. There was only the footmarks of one man, and he had lost a toe on his right foot. I found out that the thief was one of four kaffirs: Belamie, Dunisie, Funanie and Matile.
Matile does not smoke, and Dunisie does not use red clay. Belamie has five toes on his left foot. Funanie is a small boy and cannot carry a sheep alone.

Who was the thief ?

6. Jack said to his sisters: "Some of my flowers are buttercups ".
His sisters knew that all buttercups are yellow.
Annie said : "All your flowers should be yellow "
Mary said, : "Some of your flowers should be yellow ".
Hester said : "None of your flowers are yellow"

Which girl was right ?

7. Jim, Tommy and Jack paid me a visit one evening. Jim drinks tea and milk but not beer and coffee. Tommy drinks milk and coffee but not tea and beer. Jack does not drink tea and coffee but does drink milk and beer.

I wish to give them all the same thing to drink.

What must I give them ?

8. My brother wrote to me: "To-day I walked from Rietfontein where I had an accident yesterday and broke one of my limbs ".

Can you find out from this what he had probably broken- his right arm, left arm, right leg or left leg ?

9. I started from the door of my house and walked 100 yards.
I turned straight to the right and walked 50 yards.
I turned straight to the right again and walked 100 yards.

How far am I from the door of my house ?

TEST 3. CUBE TESTS.

A. 1234

B. 12343

C. 12342

D. 1324

E. 1432

F. 1423

G. 13243

H. 14324

I. 13124

J. 143124

K. 132413

L. 142341

TEST 4. REPETITION OF DIGITS.

	A.		B.
1.	6-4-1	1.	2-8-3
2.	3-5-2	2	4-2-7
3.	8-3-7	3.	9-5-8
4.	4-7-3-9	4.	6-5-2-8
5.	2-8-5-4	5.	4-9-3-7
6.	7-2-6-1	6.	8-6-2-9
7.	3-1-7-5-9	7.	3-1-8-7-9
8.	4-2-8-3-5	8.	6-9-4-8-2
9.	9-8-1-7-6	9.	5-2-9-6-1
10.	3-7-4-8-5-9	10.	4-7-1-9-5-2
11.	5-2-1-7-4-6	11.	5-8-3-2-9-4
12.	2-1-8-3-4-3-9	12.	7-5-2-6-3-8
13.	9-7-2-8-4-7-5	13.	4-1-6-2-5-9-3
14.	7-2-5-3-4-8-9-3	14.	3-8-2-6-4-7-5
15.	4-9-8-5-3-7-6-2	15.	9-4-5-2-8-3-7.
16.	8-3-7-9-5-4-8-2		

TEST 5. Comprehension of Situation.

1. What must you do when you are sleepy ?

2. What ought you to do when you are cold ?

3. What ought you to do when you are hungry ?

4. What is the thing for you to do if it is raining when you start for school ?

5. What is the thing for you to do if you find that your house is on fire ?

6. What is the thing for you to do when you have broken something that belongs to someone else ?

7. What is the thing for you to do when you notice on your way to school that you are in danger of being late ?

8. What is the thing for you to do if another child hits you without meaning to do it ?

9. What ought you to say when someone asks your opinion about a person you don't know very well ?

10. Why should we judge a person more by his actions than by his words ?

TEST 7. ARITHMETIC.

1. On your birthday you receive 7 pennies from your father and five pennies from your mother. How much money will you have then ?

2. John's grandmother is 86 years old. If she lives, in how many years will she be 100 years old ?

3. You buy 4 pears at 3d. each. How much change will you receive back out of half-a-crown ?

4. If 2 pencils cost 5d. how many can you buy for 50d.

5. If a lad's wage is 25/- a week and he spends 14/- a week, how long will it take him to save 300/- ?

6. A gardener plants 5 rows of potatoes, putting 12 in one row. How many rows will he have if he plants only 4 in a row. ?

7. If Frank can ride a bicycle 300 yards while George runs 200 yards, how far can Frank ride while George runs 300 yards ?

8. If a wire 20 ins. long is to be cut so that one piece is two-thirds of the length of the other piece, how long must the longest piece be ?

9. A man starts on Monday on a journey of 100 miles. He walks 30 miles the first day and 5 miles less on each succeeding day. On what day will he finish his journey ?

10. A motor-car goes a mile in 3 minutes; if it took 6 minutes less on a 22 mile journey, what would be its speed in miles per hour ?

11. Given a three-pint measure and a five-pint measure, how will you measure out <u>one</u> pint exactly using nothing but these two vessels and <u>not</u> guessing at the amount. Begin by filling the three-pint vessel first.

12. Given a three-pint and a five-pint vessel measure out exactly 7 pints.

13. Given a five-pint and seven-pint vessel measure out exactly eight-pints.

14. Given a four-pint and nine-pint vessel measure out exactly 7 pints.

TEST 8. DESSECTED SENTENCES.

1. GIVE MILK COWS.

2. SUN DAY THE SHINES BY.

3. CANNONS LOUD MAKE NOISE A.

4. DOG TREES CLIMB A NOT CAN.

5. TAILS HAVE SOME SHORT VERY MONKEYS.

6. WATER CORK ON FLOAT WILL AND WOOD.

7. FOR THE STARTED AN WE COUNTRY EARLY AT HOUR.

8. NOT GOOD WORTH BE OF EASILY A OVERESTIMATED THE NAME CAN.

9. HARDEST THE US SOLUTION GIVES THE SATISFACTION OF PROBLEMS GREATEST THE.

10. OF SO MANY AS VIRTUES FOR CLEMENCY ANSWER THE CRIMES TO NONE HAS.

TEST 9B. ABSURDITIES.

1. A man said: "I know a road from my house to the church which is downhill all the way to the church and downhill all the way back home ".

2. A man was thrown from his horse. He struck his head against a stone and was instantly killed. They picked him up and carried him home and they do not think he will get well again.

3. A man had a cat and cut a hole in the back door to let the cat in and out. Then the cat had a kitten, and so the man cut another and smaller hole in the door to let the kitten in and out.

4. A lady said." I am expecting five people at the dinner table today", and so she only set places for four.

5. In a letter to a friend a man said: " If you don't get this letter, please send me a telegram to let me know".

6. A man had 40 sheep, 10 horses and 10 calves. He said he had 60 sheep.

7. A hunter who had used up all his bullets was chased by a tiger. A bright idea struck him: he would climb a tree. When he got to the top he remembered that the tiger could also climb a tree; but he got out of his difficulty by pulling the tree up after him.

8. Jack said: "Don't those two girls look much alike ? "Yes" said Peter, "especially the one on the other side".

9. The moon is more useful than the sun, for it gives us light in the night when we really need it, while the sun gives us light in the day when we don't need it.

10. "I don't like onions" said the boy "and I'm glad that I don't; for if I did, I should be eating them all day, and I hate the beastly things."

11. The three men laughed; then stopped suddenly as the eyes of each met those of the others across the table.

12. Every rule, even this one itself, has an exception.

Appendix (P.9)

VOCABULARY TEST.

FORM A.

No.	Result.	Word.	Answer.	No.	Result.	Word.	Answer.
1	.....	orange.....		35	.....	recharge	
2	.....	gold		36	.....	independent.....	
3	.....	grip		37	.....	heroism	
4	.....	coal		38	.....	shame.....	
5	.....	parent		39	.....	tunic.....	
6	.....	keeper		40	.....	unit .....,.....	
7	.....	steamer		41	.....	prank	
8	.....	midsummer		42	.....	princely.....	
9	.....	four		43	.....	crest.....	
10	.....	ruin		44	.....	behindhand	
11	.....	search		45	.....	chrysanthemum.....	
12	.....	imagine		46	.....	common.....	
13	.....	lord		47	.....	overdue	
14	.....	slang.....		48	.....	due.....	
15	.....	report		49	.....	isolate.....	
16	.....	soak		50	.....	taunt	
17	.....	polo.....		51	.....	strain.....	
18	.....	land.....		52	.....	exhibit.....	
19	.....	suppose.....		53	.....	leisurely.....	
20	.....	spark.....		54	.....	eject	
21	.....	advance.....		55	.....	farther	
22	.....	news		56	.....	blame	
23	.....	rabbit.....		57	.....	mutineer.....	
24	.....	bottle.....		58	.....	unbridled	
25	.....	rogue.....		59	.....	array	
26	.....	plan.....		60	.....	dab	
27	.....	tower.....		61	.....	fluke.....	
28	.....	salute.....		62	.....	grim.....	
29	.....	household.....		63	.....	finality.....	
30	.....	reverse		64	.....	sublime	
31	.....	scenery		65	.....	sentimental.....	
32	.....	hang		66	.....	dome.....	
33	.....	pellet.....		67	.....	barb.....	
34	.....	carriage.....		68	.....	instrumental.....	

FORM A.

No.	Result.	Word.	Answer.	No.	Result.	Word	Answer.
69	....	sprightly	.....	85	.....	nullify	.....
70	....	theatrical	.....	86	.....	perennial	.....
71	.....	refinement	.....	87	.....	sidereal	.....
72	....	behoof	.....	88	.....	linguistic	.....
73	....	grandiloquent	.....	89	.....	offing	.....
74	....	brotherhood	.....	90	.....	cairn	.....
75	....	corona	.....	91	.....	philology	.....
76	....	discourse	.....	92	.....	monitory	.....
77	....	aloe	.....	93	.....	synopsis	.....
78	....	discord	.....	94	.....	epoch	.....
79	....	authorise	.....	95	.....	pusillanimous	.....
80	....	consecrate	.....	96	.....	definite	.....
81	....	vitality	.....	97	.....	germane	.....
82	....	venerate	.....	98	.....	prosy	.....
83	....	timorous	.....	99	.....	monochromatic	.....
84	....	abstinent	.....	100	.....	expiate	.....

Appendix (p. 11.).

VOCABULARY TEST.

FORM B.

No.	Result.	Word	Answer	No.	Result	Word	Answer.
1	....	duffer		35	....	fox	
2	....	orchestra		36	....	shallow	
3	....	crib		37	....	roll	
4	....	spring		38	....	imitation	
5	....	soap		39	.....	exile	
6	....	scent		40	....	insult	
7	....	kennel		41	....	adventure	
8	....	lane		42	....	vengeance	
9	....	black		43	....	trespass	
10	....	story		44	....	rum	
11	....	number		45	....	reflection	
	....	season		46	....	sample	
13	.....	separate		47	....	turban	
14	....	armour		48	....	pelt	
15	....	race		49	....	clumsy	
16	....	find		50	....	hover	
17	.....	chuckle		51	....	gabble	
18	....	blank		52	....	grit	
19	....	sparrow		53	....	develop	
2	....	tea		54	....	matter	
21	....	next		55	....	slash	
22	....	carry		56	....	overreach	
23	....	bottomless		57	....	siege	
24	....	syrup		58	....	commoner	
25	....	absurd		59	....	flurry	
26	....	protector		60	....	barbarous	
27	....	pray		61	....	parch	
28	....	brush		62	....	migrate	
29	....	town		63	....	belch	
30	....	index		64	....	adorn	
31	....	plane		65	....	polygon	
32	....	hesitate		66	....	universe	
33	....	put		67	....	uncouth	
34	....	linger		68	.....	hank	

Appendix (p. 12).

VOCABULARY TEST.

FORM B.

No.	Result.	Word.	Answer.	No.	Result.	Word	Answer.
69	....	fasinate	.....	85	....	philosophy	.....
70	....	germinate	.....	86	....	consentient	.....
71	....	monologue	.....	87	....	dominant	.....
72	....	dabble	.....	88	....	pariah	.....
73	....	deformity	.....	89	....	principality	.....
74	....	suppress	.....	90	....	element	.....
75	....	lore	.....	91	.....	repository	.....
76	....	coronet	.....	92	....	scathe	.....
77	....	elixir	.....	93	....	mutual	.....
78	....	subordinate	.....	94	....	theme	.....
79	....	supplant	.....	95	....	equanimity	.....
80	....	revert	.....	96	....	cynic	.....
81	....	italics	.....	97	....	anthropomorphous	.....
82	....	tincture	.....	98	....	coalition	.....
83	....	shank	.....	99	....	discrete	.....
84	....	demagogue	.....	100	....	repercussion	.....

SUGGESTED FORM OF REVISED TEAM OF TESTS.

Test. /. Reasoning. 1 to 9.

1. Tom runs faster than Jim.
Jack runs slower than Jim.

Which is the slowest of the three ?

2. Three girls are sitting in a row:
Mary is to the left of Susan;
Kate is to the left of Mary;

Which girl is in the middle ?

3. The person who stole Brown's purse was neither dark, nor tall nor clean-shaven.

The only persons in the room at the time were :-
(1) Jones, who is short, dark and clean-shaven.
(2) Smith, who is fair, short and bearded;
(3) Grant, who is dark, tall but not clean-shaven.

Who stole Brown's purse ?

4. All insects have six legs.
This creature has eight legs.

Is it an insect ?

5. Jack said to his sisters: "Some of my flowers are sun-flowers".
His sisters knew that all sun-flowers are yellow.

Annie said; "All you flowers should be yellow ".
Mary said: "Some of your flowers should be yellow.
Hester said: "None of your flowers are yellow ".

Which girl was right ?

6. Jim, Tommy and Jack paid me a visit one evening. Jim drinks tea and milk but not beer and coffee. Tommy drinks milk and coffee but not tea and beer. Jack does not drink tea and coffee but does drink milk and beer.
I wish to give them all the same thing to drink.

What must I give ?

7. My brother wrote to me: "To-day I walked from Rietfontein where I had an accident yesterday and broke one of my limbs."
Can you find out from this what he had probably broken - his right arm, left arm, right leg or left leg ?

8. I started from the door of my house and walked 100 yards. I turned straight to the right and walked 50 yards. I turned straight to the right again and walked 100 yards.

How far am I from the door of my house ?

9. One of my sheep had been stolen. Later on I found it dead under a bush where it had been hidden. Beside the sheep was a pipe and on the sheep's wool was red clay. There was only the footmarks of one man, and he had lost a toe on his right foot. The sheep must have been carried there as there were no sheep's marks. I found out that the sheep had been stolen by one of four kaffirs Belamie, Dunisie, Fumnie and Matile. Matile does not smoke, and

Dunisie/

Dunisie does not use red clay.
Belanie has five toes on his left foot. Nuanie is a small boy and cannot carry a sheep alone.

Which kaffir stole the sheep ?

Appendix (p 17.)

TEST 2. CUBE TESTS.

A.	1234
B.	12343
C.	12342
D.	1324
E.	1432
F.	1423
G.	13243
H.	14324
I.	13124
J.	143124
K.	132413
L.	142341

TEST 3. ARITHMETIC 1 - 14.

1. On your birthday you receive 7 pennies from your father and five pennies from your mother. How much money will you have then ?

2. John's grandmother is 86 years old. If she lives, in how many years will she be 100 years old ?

3. You buy 4 pears at 3d. per pear. How much change will you receive back out of half-a-crown ?

4. If 2 pencils cost 6d. how many can you buy for 24d?

5. If a lad's wage is 25/- a week and he spends 14/- a week, how long will it take him to save 300/- ?.

6. A gardener plants 5 rows of potatoes, putting 12 in one row. How many rows will he have if he plants only 4 in a row ?

7. If Frank can ride a bicycle 300 yards while George runs 200 yards, how far can Frank ride while George runs 300 yards ?

8. A man starts on Monday on a journey of 100 miles. He walks 30 miles the first day and 5 miles less on each succeeding day. On what day will he finish his journey ?

9. A motor-car goes a mile in 3 minutes; if it took 6 minutes less on a 22 mile journey, what would be its speed in miles per hour ?

10. Given a three pint measure and a five pint measure, how will you measure out one pint exactly, using nothing but these two vessels and not guessing at the amount. Begin by filling the three pint vessel first.

11. Given a three-pint and a five-pint vessel measure out exactly seven pints. You can throw away any water you do not require.

12. Given a five pint and seven pint vessel measure out exactly 8 pints.

13. Given a four pint and nine-pint vessel measure out exactly 7 pints.

14. If a wire 20 ins. long is to be cut so that one piece is two thirds of the length of the other piece, how long must the longest piece be ?

Appendix (p 19.)

TEST 4. DISSECTED SENTENCES. 1 -10.

1. GIVE MILK COWS.

2. DAY THE SUN SHINES BY.

3. CANNONS LOUD MAKE NOISE A.

4. DOG A TREES CLIMB NOT CAN.

5. TAILS HAVE SHORT VERY MONKEYS SOME.

6. WATER CORK ON FLOAT WILL AND WOOD.

7. FOR THE STARTED AN WE COUNTRY EARLY AT HOUR.

8. GENERALLY THOSE VERY US WHO TO ARE LOVE WE KIND.

9. SOME A PITY DO THAT IS WORK IT NOT LIKE PEOPLE.

10. IT BETTER THE WIN LIKE IS A HARDER THE TO GAME WE IT.

TEST 5. ABSURDITIES. 1 -12

1. A man said: " I know a road from my house to the church, which is downhill all the way to the church, and downhill all the way back home"

2. A man was thrown from his horse. He struck his head against a stone and was instantly killed. They picke d him up and carried him home and they do not think he will get well again.

3. A hunter who had used up all his bullets was chased by a tiger. A bright idea struck him, he would climb a tree. When he got to the top he remembered that the tiger could also climb a tree: but he got out of his difficulty by pulling the tree up after him.

4. A man had 40 sheep, 10 horses and 10 calves. He said he had 60 sheep.

5. A lady said; "I am expecting five people at the dinner-table" and so she only set places for four.

6. In a letter to a friend a man said"If you don't get this letter, please send me a telegram to let me know."

7. The moon is more useful than the sun, for it gives us light in the night when we really need it, while the sun gives us light in the day when we don't need it.

8. Jack said: "Don't those two girls look much alike ? "
"Yes"said Peter,"especially the one on the other side!

9. A man had a cat and cut a hole in the back door to let the cat in and out. Then the cat had a kitten, and so the man cut another and smaller hole in the door to let the kitten in and out.

10. The three men laughed; then stopped suddenly as the eyes of each met those of the others across the table.

11. "I don't like onions" said the boy, " and I'm glad I don't for if I did, I should be eating them all day, and I hate the beastly things.

11. Every rule, even this one itself, has an exception.

TEST 6. REVISED VOCABULARY LIST. 1 - 50 inclusive for age 9 to 13.
50 - 100 inclusive for age 14 and over.

1. Shame.
2. Imagine.
3. Separate.
4. Town.
5. Common.
6. Insult.
7. Ruin.
8. Rogue.
9. Turban.
10. Blank.
11. Matter.
12 Adventure.
13. Vengeance.
14. Unit.
15. Midsummer.
16. Unbridled.
17. Linger.
18. Develop.
19. Chrysanthemum.
20. Pelt.
21. Parch.
22. Protector.
23. Chuckle.
24. Scenery.
25. Adorn.
26. Dab.
27. Reverse.
28. Slang.
29. Coronet.
30 Slash.
31. Absurd.
32. Prank.
33. Hover.
34. Hesitate.

35. Independent.
36. Princely.
37. Polo.
38 Advance.
39. Household.
40 Behindhand.
41. Due.
42. Dome.
43 Recharge.
44. Fluke.
45. Array.
46. Grim.
47. Heroism.
48. Aloe.
49. Crest.
50. Isolate.
51 Leisurely.
52. Mutineer.
53. Barb.
54. Finality.
55. Tunic.
56. Corona.
57. Sprightly.
58. Universe.
59. Suppress.
60. Deformity.
61. Dominant.
62. Vitality.
63. Eject.
64. Suppose.
65. Hank.
66. Taunt.
67 Linguistic.
68. Monologue.
69. Brotherhood.
70. Commoner

71. Discourse.
72. Definitive.
73. Epoch.
74. Tincture.
75. Revert.
76. Uncouth.
77. Discord.
78. Authorise.
79. Refinement.
80. Cairn.
81. Consecrate.
82. Synopsis.
83. Coalition.
84. Lore.
85. Mutual.
86. Shank.
87. Perennial.
88. Offing.
89. Sentimental.
90. Sublime.
91. Theatrical.
92. Nullify.
93. Monitory.
94. Venerate.
95. Abstinent.
96. Grandiloquent.
97. Prosy.
98. Behoof.
99. Germane.
100. Expiate.

Note on r_{ag}.

In view of the consistently lower values of r_{ag} obtained for the English set of tests compared with those for the Afrikaans set of tests, the values of r_{ag} have been calculated from the data on the 100 subjects. This data is known to be influenced by spurious correlations due to diversity of age chiefly. These values of r_{ag} are given below together with the values after eliminating the chief influence of spurious correlation as described in the text.

No. of Test.	r_{ag} (on 100 subjects)	r_{ag} after elimination of influence of spurious correlation.
1.	.60	.48
2.	.90	.84
3.	.50	.60
4A.	.61	.47
4B.	.53	.40
5.	.58	.48
7.	.77	.52
8.	.90	.80
9B.	.77	.62
10.	.55	.44
11A.	.88	.74.

It will be noticed that with the exception of Test 3 the values of r_{ag} are very appreciably increased through the influence of spurious correlation.

Since the factors which introduce spurious correlation are present to a greater extent in the Afrikaans data the values of r_{ag} as given in that data are probably affected in a like manner and exceed the true values by even greater differences than shown in the table above.

Group 1. Boys 1 - 60 inclusive.
" 11. " 61 -100 "

Scores in Tests.

Boys	1.	2.	3	4A	4B	5	6	7	8	9A	9B	10	11A.
1	4	1	5	6	5	9	3	1	4	5	4	8	28
2	7	6	7	5	4	10	7	7	9	6	10	9	67
3	6	3	11	8	4	8	6	4	6	5	8	9	60
4	6	6	7	6	5	9	5	4	7	5	6	9	40
5	6	7	7	6	4	8	7	6	7	6	12	9	67
6	7	6	8	7	6	9	4	6	6	4	9	9	45
7	5	3	9	5	5	5	5	2	5	5	5	7	47
8	7	4	11	7	5	7	6	3	5	5	9	9	39
9	8	5	8	7	4	8	6	6	6	3	8	9	40
10	7	1	8	6	5	6	7	5	4	3	4	9	38
11	3	3	7	6	4	9	5	1	4	4	10	9	48
12	5	2	6	5	4	8	5	3	5	5	6	8	34
13	9	3	6	4	4	7	7	1	4	4	6	9	49
14	6	4	7	6	4	8	7	3	7	3	7	9	50
15	7	3	8	5	3	7	4	3	5	4	8	9	36
16	0	0	5	4	3	5	4	1	3	1	1	5	33
17	6	2	7	6	3	6	6	2	4	5	5	9	38
18	6	3	7	5	5	6	6	2	5	5	3	9	31
19	6	4	7	6	4	8	7	3	5	6	9	9	47
20	4	2	4	6	4	6	5	3	5	5	8	9	42
21	6	1	6	5	3	5	3	2	3	2	6	8	34
22	2	2	4	4	3	6	5	2	4	3	8	7	33
23	6	4	7	5	6	9	5	5	3	1	7	7	40
24	6	4	8	7	4	7	7	5	5	5	9	9	45
25	4	5	7	6	4	8	6	3	5	6	6	7	52
26	2	3	10	6	3	8	6	3	0	4	7	8	34
27	7	5	9	6	4	9	4	2	5	4	9	9	37
28	7	5	7	6	4	9	6	3	5	5	8	9	49
29	4	2	9	6	3	5	4	3	4	2	7	8	43
30	2	1	6	6	4	5	3	3	6	5	5	9	41
31	5	4	4	6	3	7	5	2	2	5	5	8	31
32	1	0	6	5	3	9	3	1	1	4	4	9	30
33	2	1	5	5	3	7	3	3	4	5	7	8	32
34	5	0	4	5	3	5	7	2	0	4	3	9	25
35	5	5	7	6	4	7	6	3	4	3	7	7	34

Boys.	1.	2.	3	4A	4B	5	6	7	8	9A	9B	10	11A.
36	2	3	9	5	4	7	6	3	4	3	7	7	34
37	4	1	7	6	4	7	4	2	1	4	1	7	31
38	7	0	4	6	3	4	4	3	4	4	7	8	27
39	4	0	6	4	4	7	4	4	2	4	5	8	24
40	5	0	5	6	5	3	3	3	4	0	6	9	28
41	4	2	6	5	4	6	3	3	2	5	6	8	26
42	3	3	8	6	3	7	3	2	4	3	6	9	31
43	1	0	5	6	4	6	6	3	4	4	6	8	29
44	5	5	8	6	4	7	7	1	4	5	9	9	36
45	6	0	6	3	3	3	3	2	0	6	5	8	22
46	5	1	3	6	4	6	3	1	2	4	7	7	27
47	4	1	4	6	4	6	3	3	0	3	4	5	27
48	5	3	3	6	0	5	7	3	1	6	5	8	35
49	5	3	8	7	4	9	3	3	4	6	6	8	30
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51	6	2	5	4	3	8	3	2	3	6	1	8	25
52	5	4	8	6	5	8	7	4	5	5	8	9	38
53	1	2	6	6	4	8	5	2	4	6	8	8	27
54	3	2	6	5	3	7	6	2	3	6	8	7	35
55	4	1	8	4	4	7	5	2	4	6	5	9	32
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60	1	0	5	6	0	7	5	3	2	3	5	6	28
61	7	9	8	5	5	8	-	7	7	-	10	9	82
62	7	4	6	7	5	8	-	7	7	-	6	9	75
63	5	4	7	6	6	9	-	7	7	-	8	9	60
64	3	8	6	6	5	9	-	13	8	-	11	9	74
65	7	6	9	8	5	7	-	7	7	-	10	9	71
66	7	7	7	8	5	9	-	6	7	-	9	8	76
67	2	5	9	6	6	8	-	4	8	-	8	9	72
68	6	8	10	8	7	8	-	9	7	-	10	9	71
69	8	7	5	6	5	8	-	12	9	-	10	9	73
70	7	5	8	5	5	8	-	6	7	-	9	9	63
71	4	6	9	6	0	7	-	3	5	-	7	8	64

Boys	1	2	3	4A	4B	5	6	7	8	9A	9B	10	11A
72	6	4	8	7	7	8	-	6	7	-	9	9	74
73	6	6	7	6	5	9	-	9	9	-	9	8	70
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77	7	5	10	7	6	8	-	9	7	-	10	9	71
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89	8	7	8	7	5	7	-	6	8	-	8	9	71
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98	7	7	8	8	6	8	-	8	7	-	9	9	71
99	8	4	9	9	5	8	-	9	9	-	9	9	75
100	4	5	8	8	6	9	-	7	7	-	8	9	58

Key to Figures.

Figure I.----------Test I. --------Group I.

Figure 2.---------- " 2.--------- " I.

Figure 3.---------- " 3.--------- " I.

Figure 4.---------- " 4a.-------- " I.

Figure 5.---------- " 4b.-------- " I.

Figure 6. ---------- " 5. -------- " I.

Figure 7.---------- " 6. ------- " I.

Figure 8.---------- " 7.--------- " I.

Figure 9.---------- " 8.--------- " I.

FigureIO.---------- " 9a.-------- " I.

FigureII.---------- " 9b.-------- " I.

Figure I2.---------- " IO.-------- " I.

Figure I3.---------- " 2.-------- " 2.

Figure I4.---------- " 5. ------- " 2.

Figure I5.---------- " 7. ------- " 2.

Figure I6.---------- " 8. ------- " 2.

Figure I7.---------- " 9b.------- " 2.

Figure I8.---------- " 2.-------- " 3.

Figure I9.---------- " 7.-------- " 3.

Figure 20.---------- " 8. -------- " 3.

Figure 2I.---------- 2 9b.-------- " 3.

Figures I-2I inclusive shows the order of difficulty of the separate items of each test as measured by the number of subjects passing each item. Number of subjects shown vertically. Items of tests arranged horizontally.

Figure 22. -- Frequency Distribution of Tetrad Differences (No. of Subjects = IOO.)

Figure 23. -- " " " Tetrad Differences (No. Of Subjects= 50.)

Figure 24.--Arrangement of Cards in Test I.

Figure 25.-- Perspective view of cube showing positions of missing cubes as used in Test 6.

Figure 26.-- Set of Mazes used in Test IO.

Fig. 1.

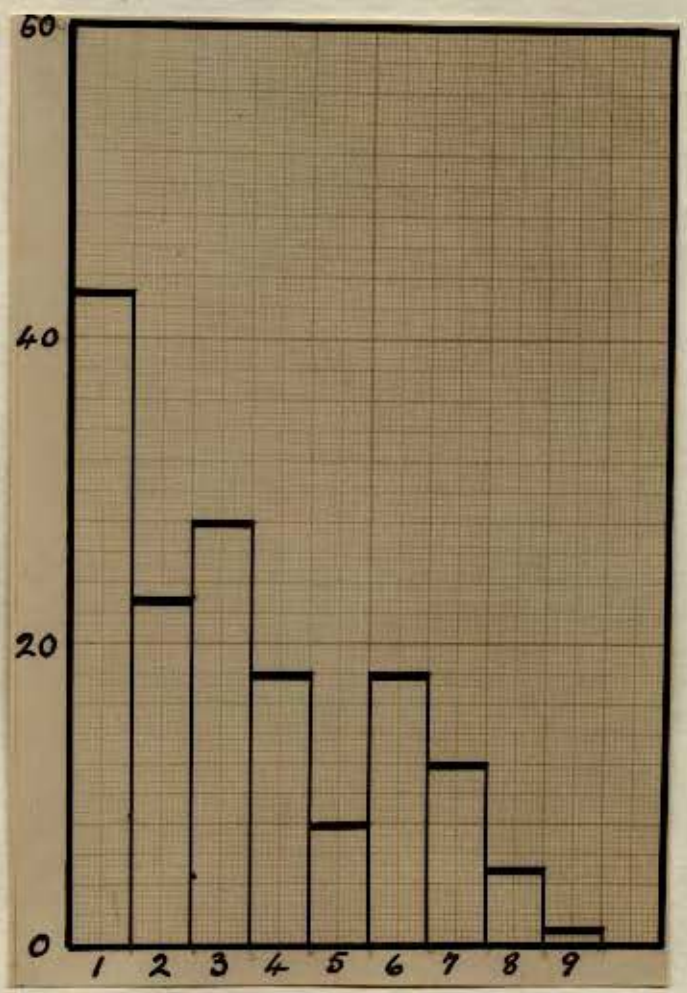
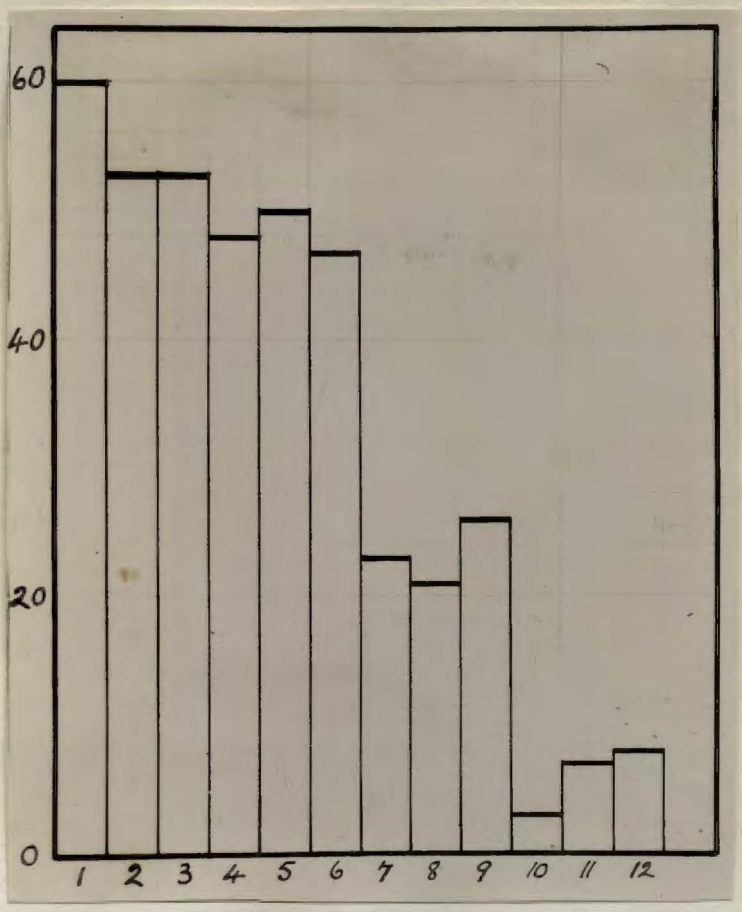


Fig. 2.



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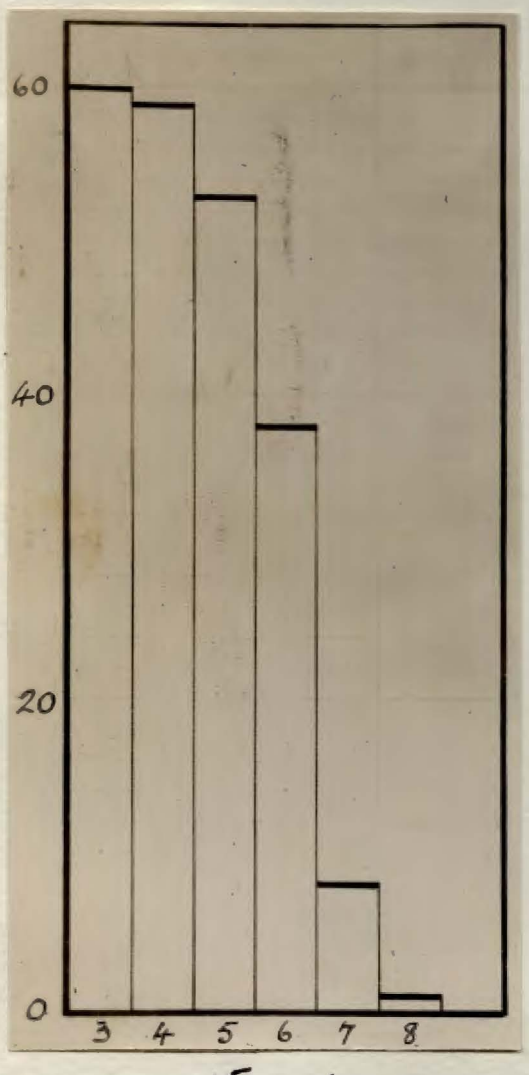

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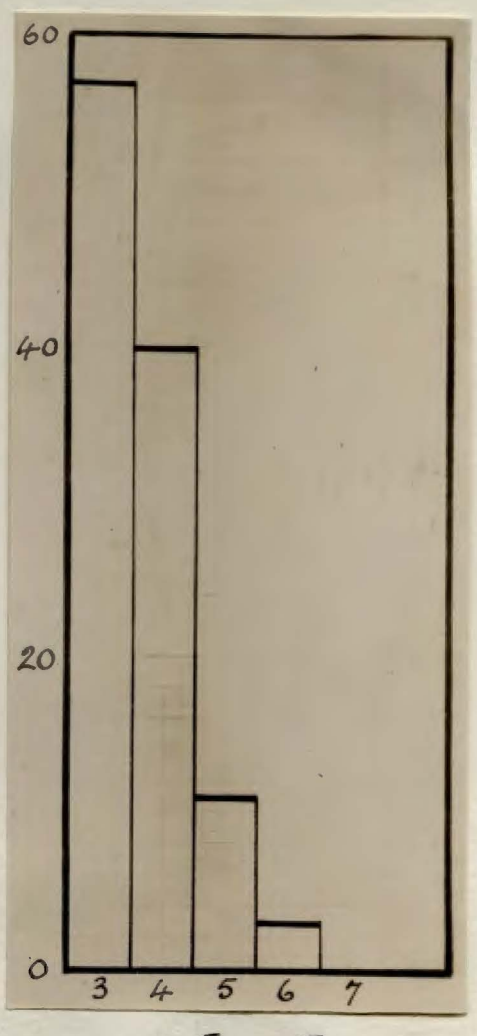

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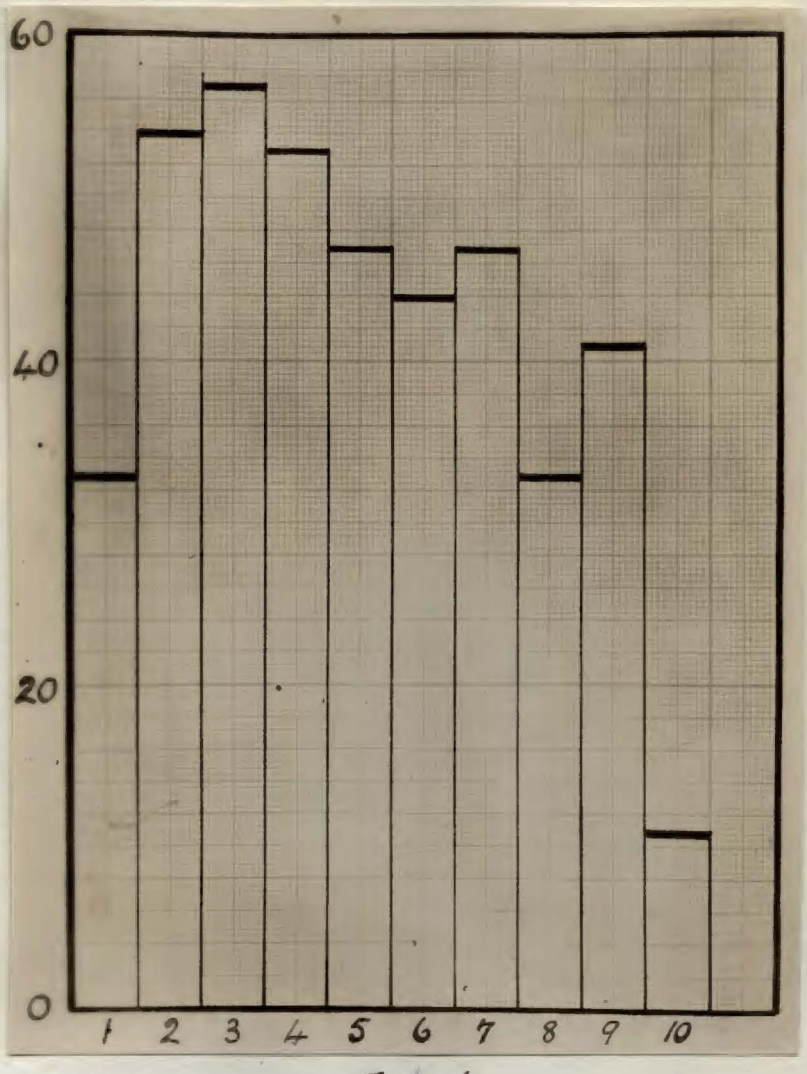

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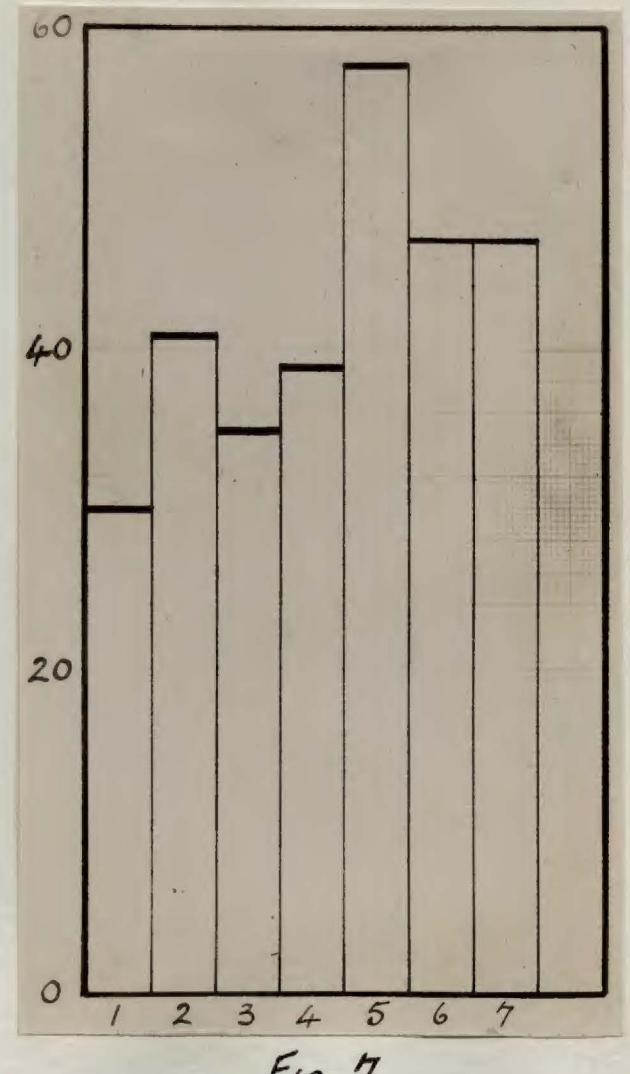

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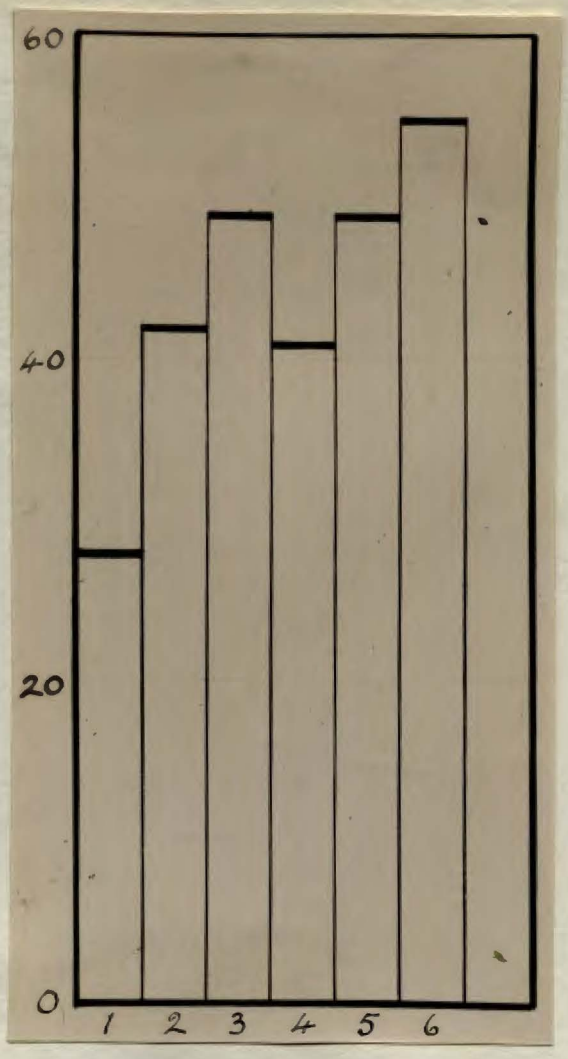
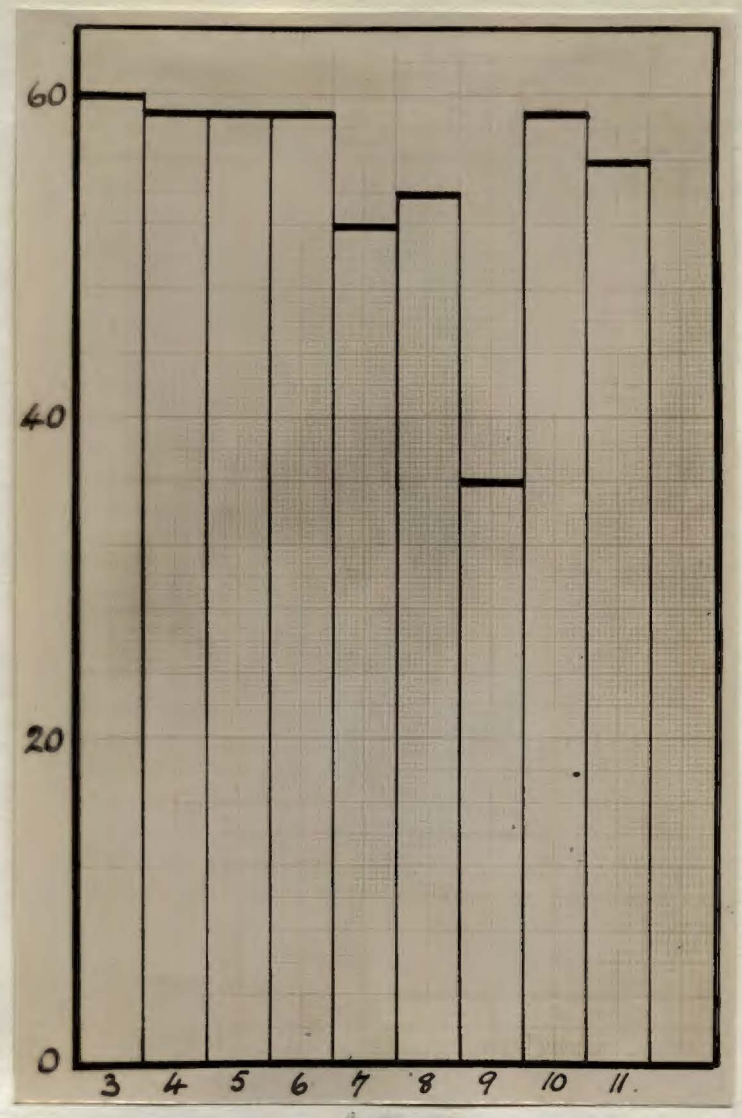


Fig. 10.

Fig. 11.



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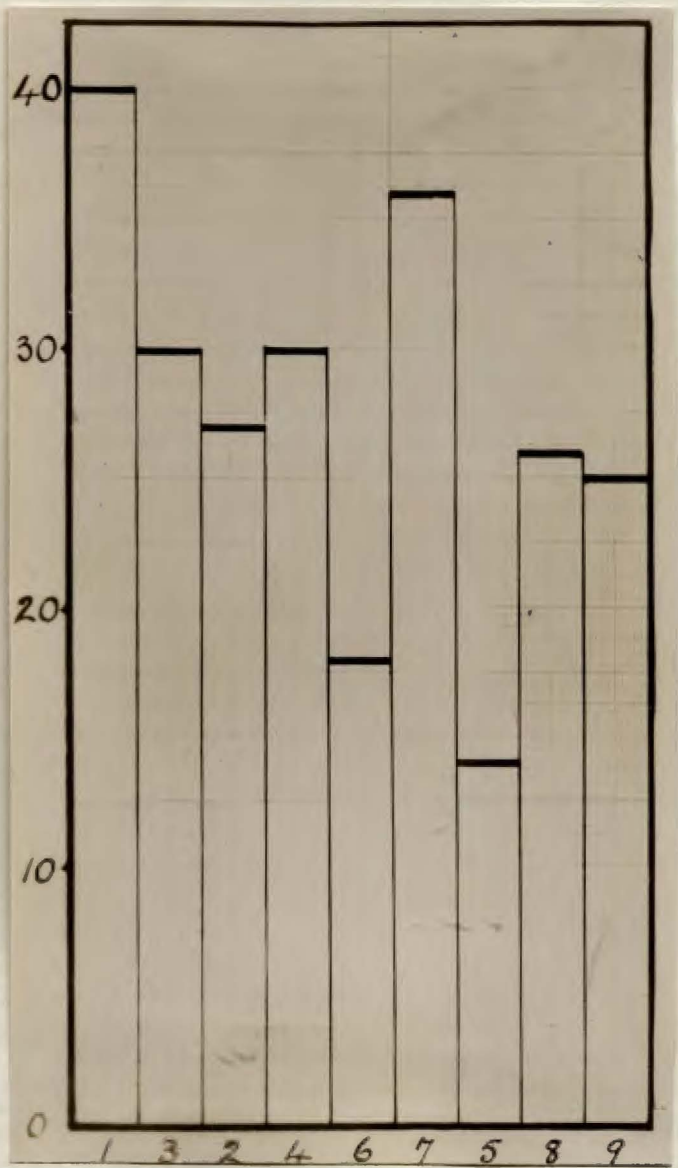

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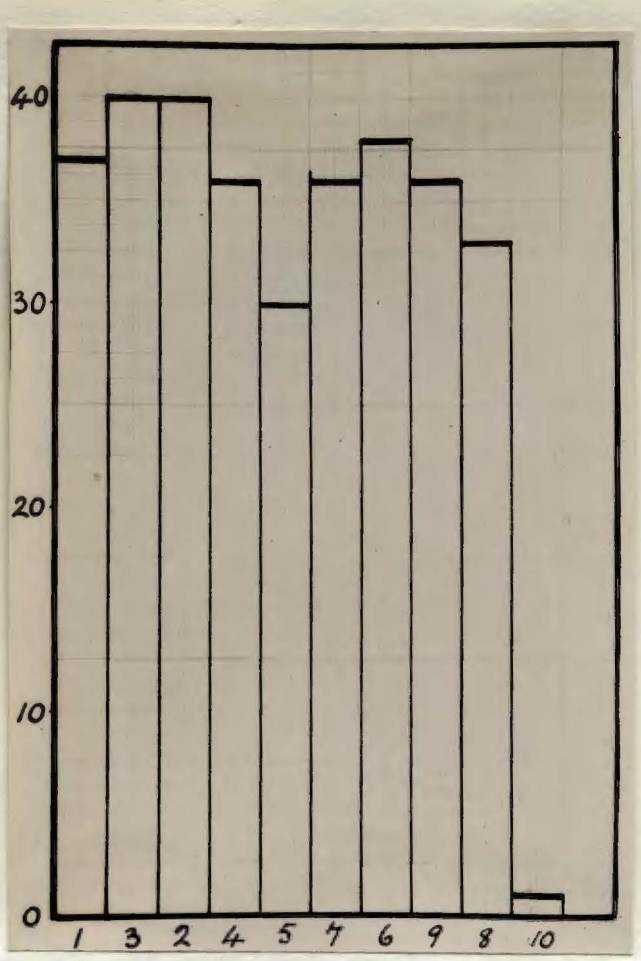

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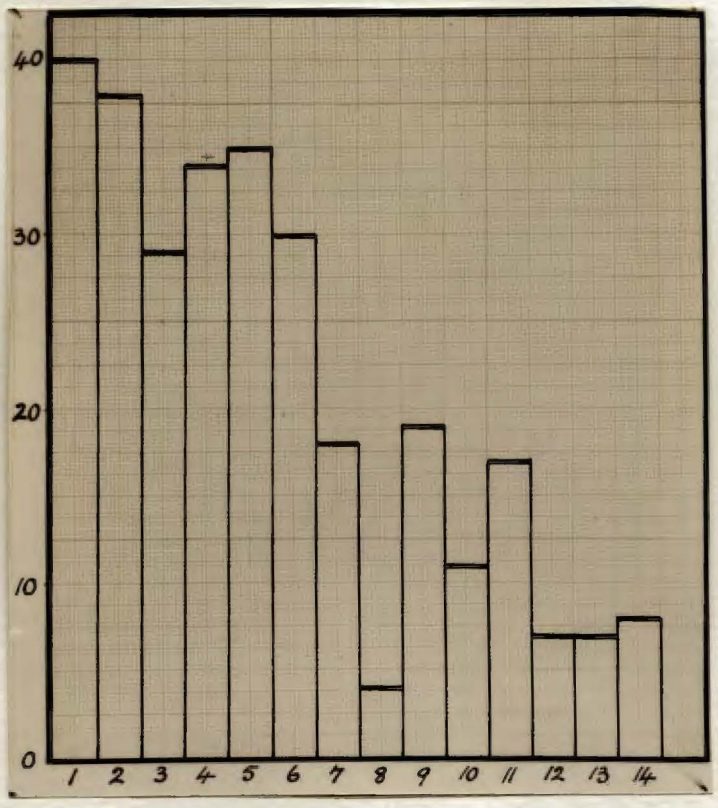

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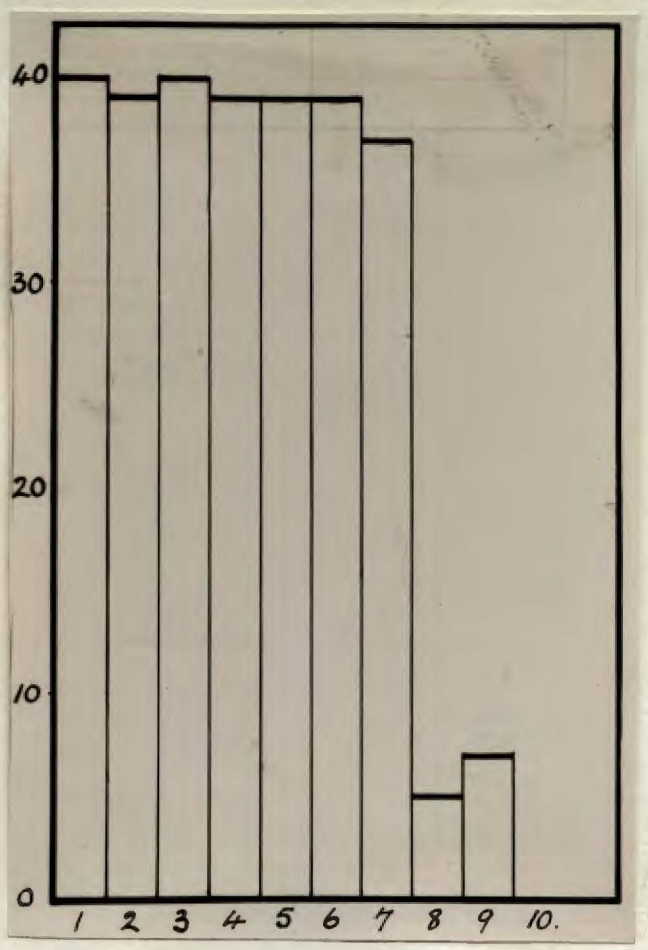

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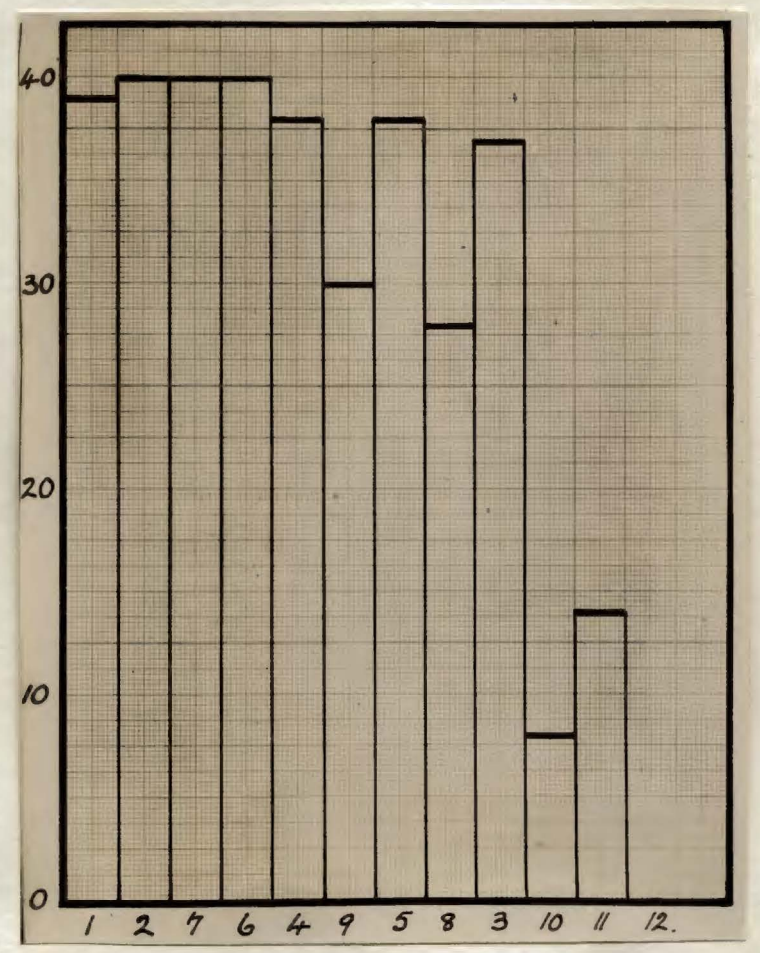

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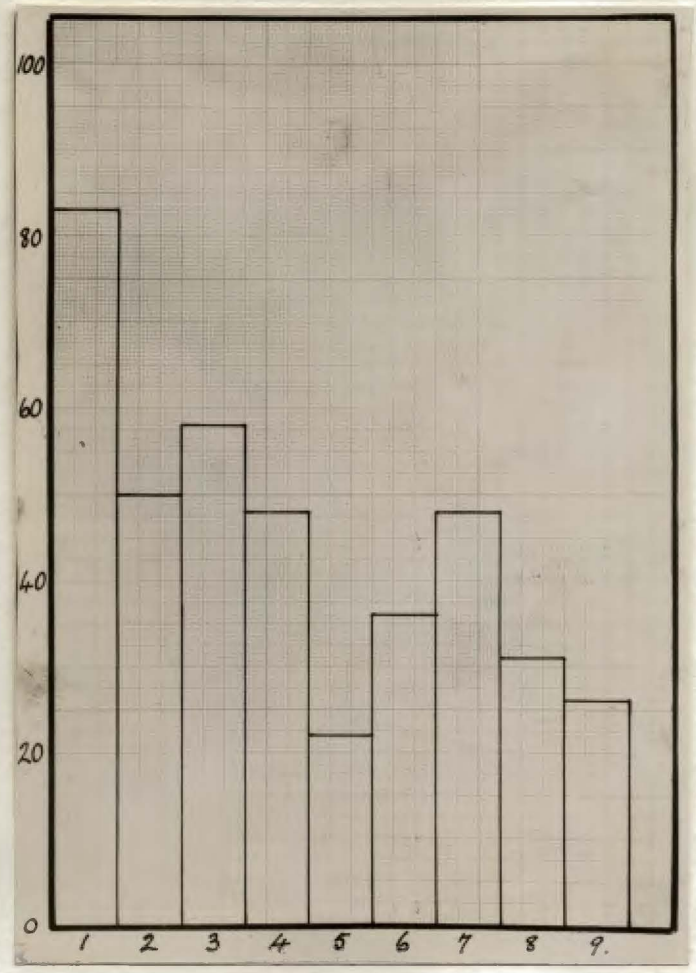
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40
20
0
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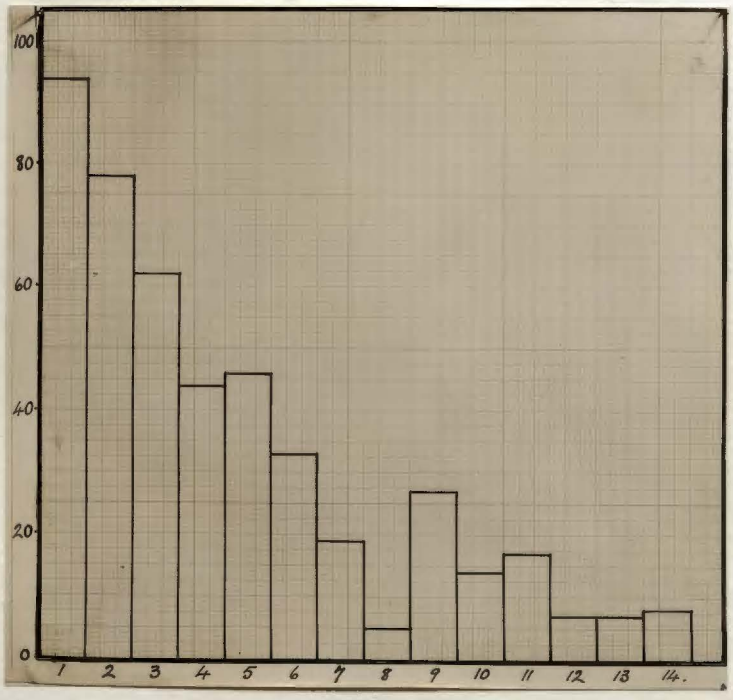
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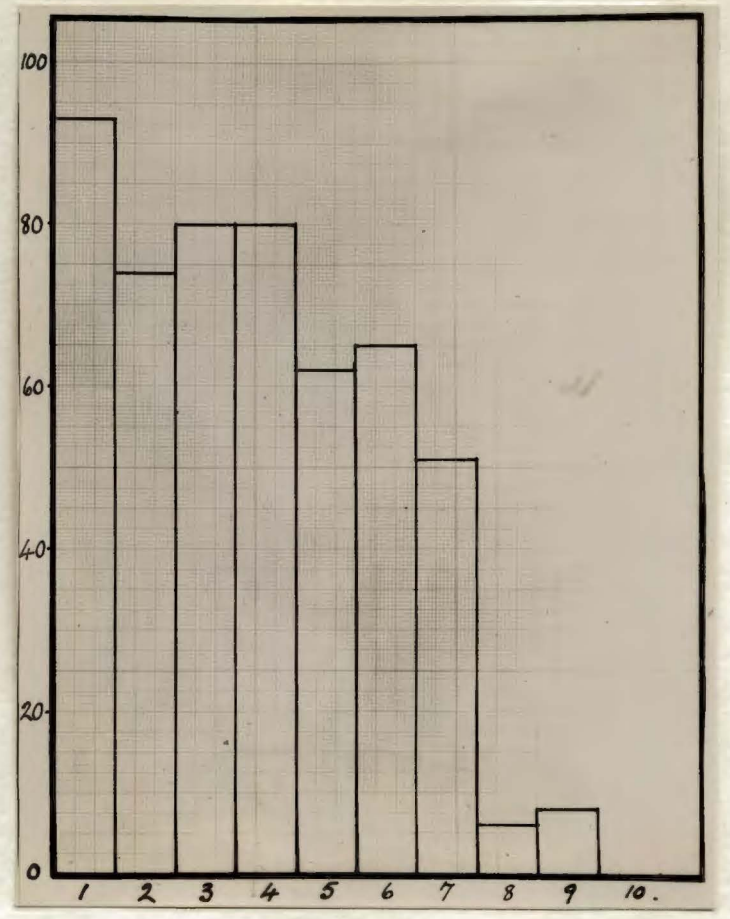
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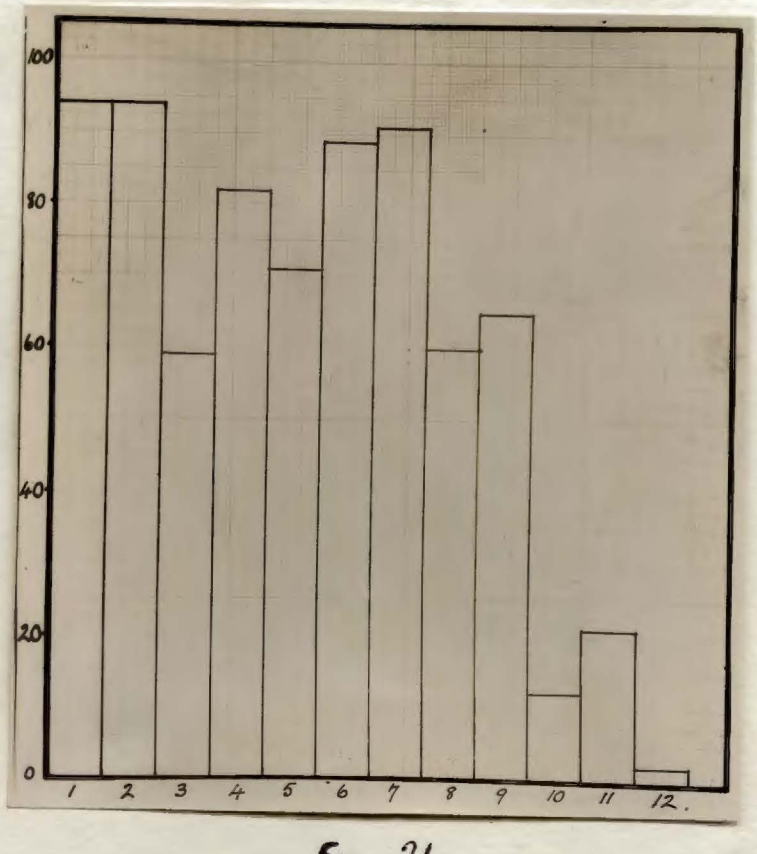
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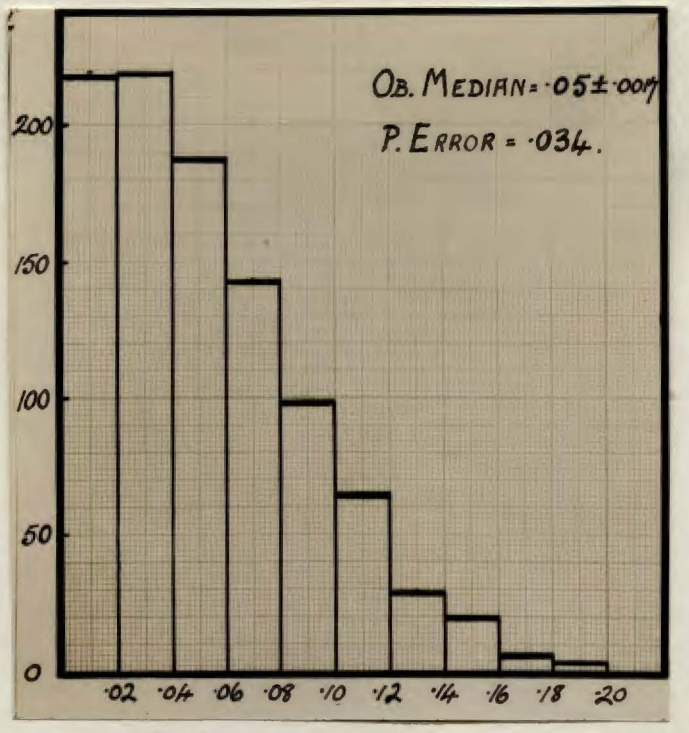
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50
0
·02 ·04 ·06 ·08 ·10 ·12 ·14 ·16 ·18 ·20

Fig. 22.

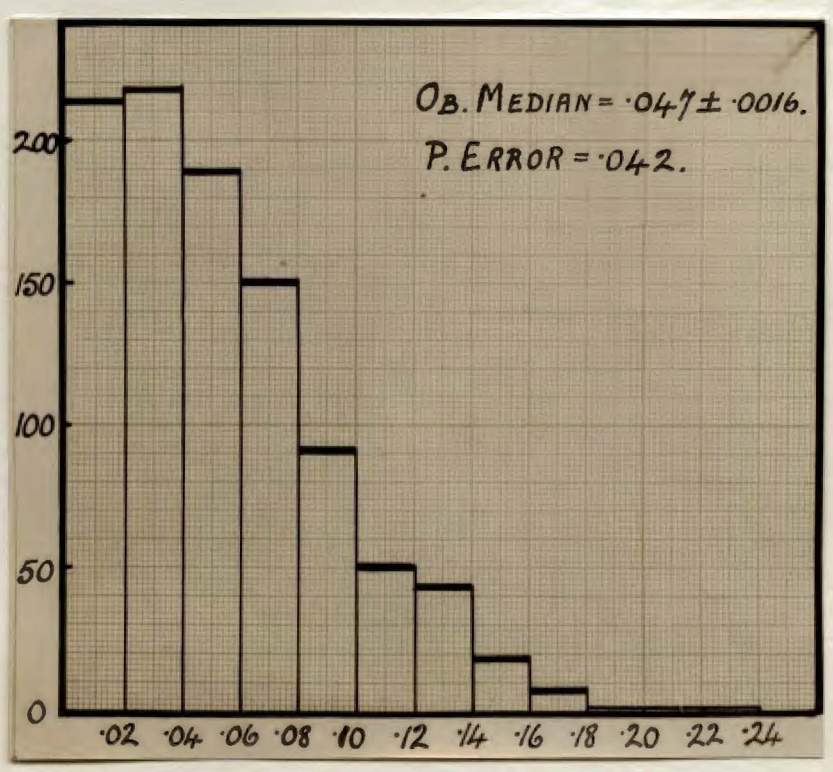
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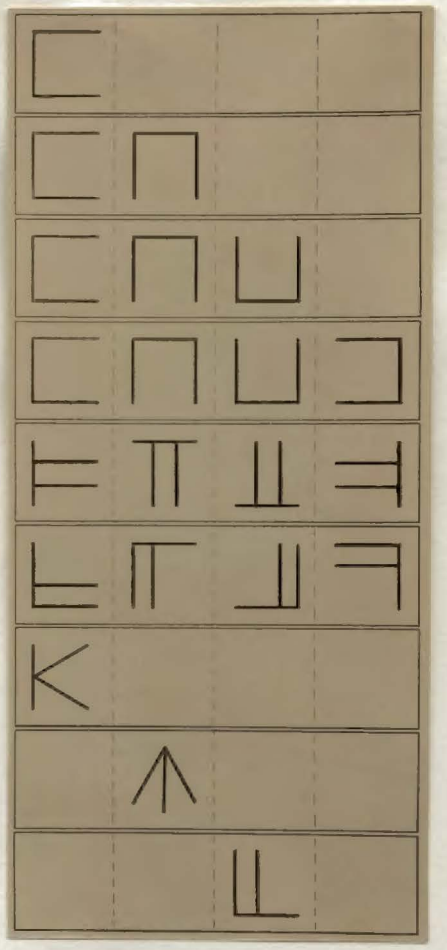
Fig. 23.



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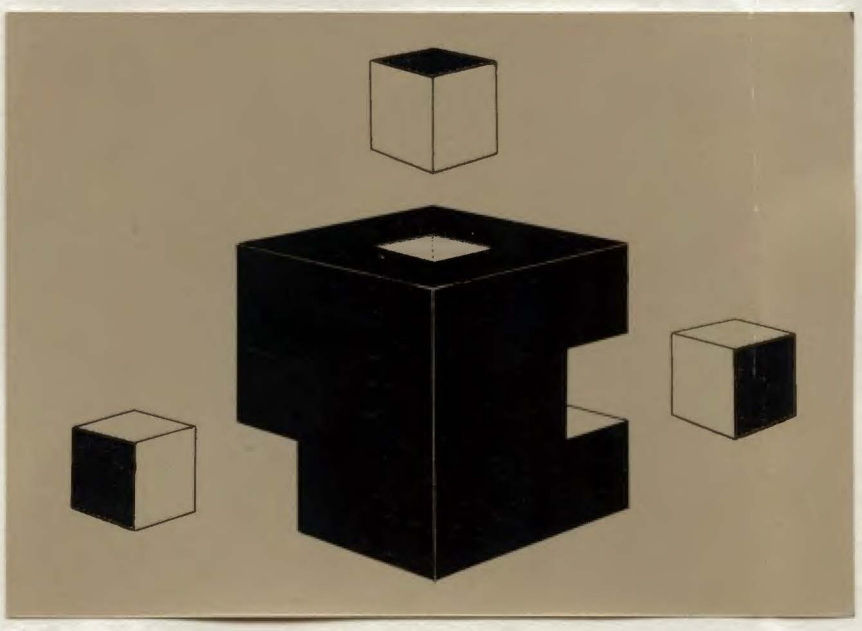

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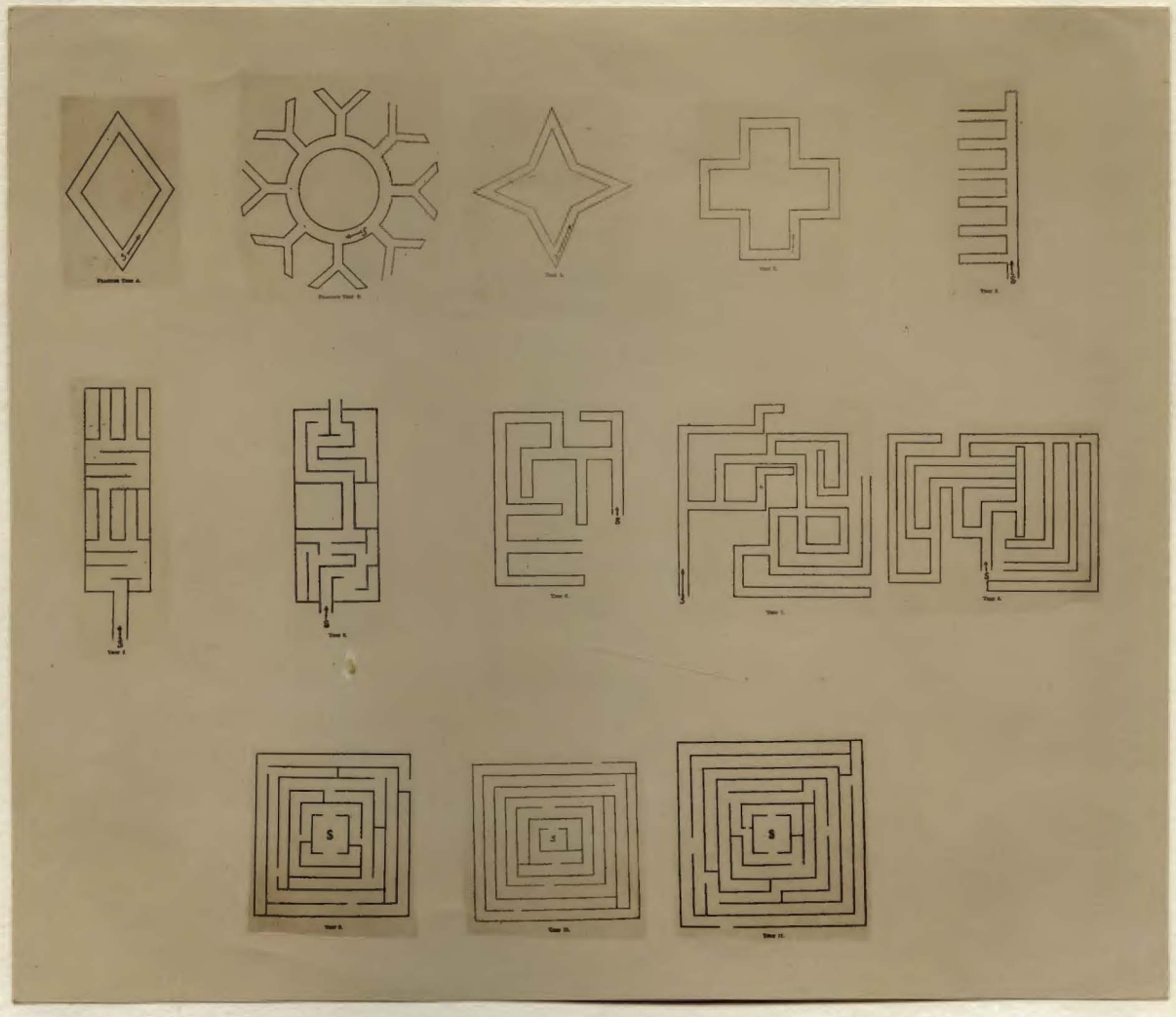

Fig. 26.