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An investigation into educational and occupational differences in test performance on a battery of adaptability tests for Africans

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demonstration, they surpass the printed tests. [6] They reduce the variation of test demonstration almost to the vanishing point, they allow for the introduction of movement into the stimulus field, and due to the medium of instruction and demonstration, they can be introduced by testing officers untrained in the methods of applied psychology. The use of the motion picture as a medium for testing reduces the variable human factor to a minimum.

In the motion pictures used with the present test battery "the candidates are led by means of the film technique from the test as they see it in front of them, through a partial performance of the test showing the requirements of the test and samples of the correct methods of work so arranged that the candidates learn the instruction for, but not the solution of the task" [7].

The following is a typical film sequence, illustrated with enlargements made of the main sections of the actual film used:

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6. Personnel Selection - Test and Measurement Techniques - by Robert L. Thorndike. Published by John Wiley and Song, Inc., New York; Chapman and Hall, Ltd. London. 1949.

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7. Aptitude Tests for Native Labour on the Witwatersrand Gold Mines - Part II Report on investigation H 16/35 Carried out on behalf of the Transvaal Chamber of Mines by the National Institute for Personnel Research.

Film of the Screws Test:

Section 1: Close up of the test as it is placed on the table before the subject, showing all compartments clearly - see enlargement 1.

Section 2: Close up of left-hand compartment with bolts.

Section 3: Close up of right-hand compartment with nuts.

Section 4: Tester demonstrating, showing various correct as well as incorrect solutions. Close up of testers hands picking up a nut and bolt - see enlargement 2. Close up of hands screwing the nut and bolt - see enlargement 3. Close up of hands placing the assembled nut and bolt into the correct receiving compartment - enlargement 4. This process is continued through a number of correct solutions; also showing a number of incorrect choices being corrected. Followed by a close up of the full receiving compartment - enlargement 5.

Section 5: View of tester demonstrating to the subject, with further close up views as in enlargement 3.

Section 6: View of candidate seated in front of the test, he starts when the gong is struck - enlargement 6.

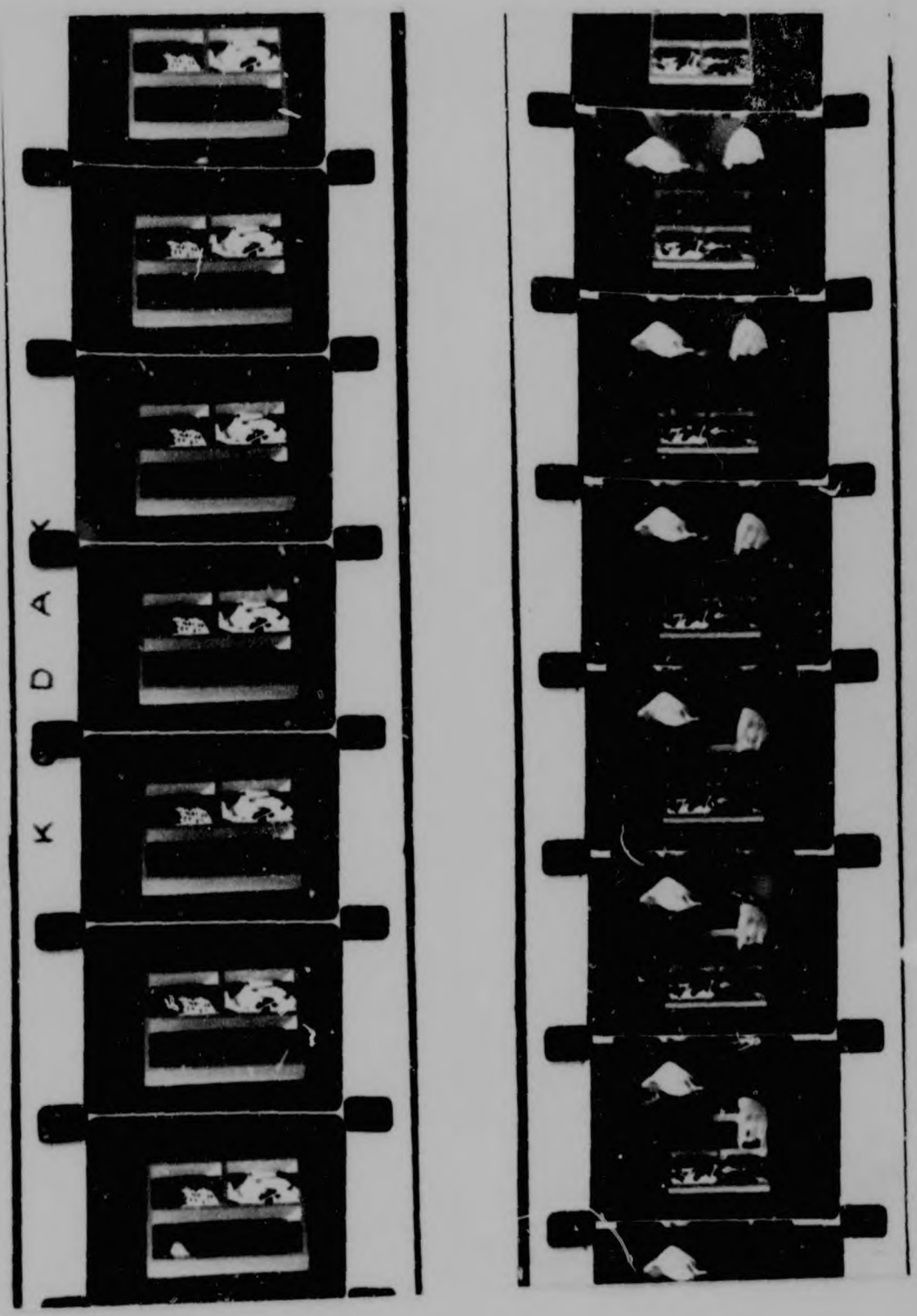
Section 7: View of candidate assembling nuts and bolts and placing them into the receiving compartment - enlargement 7. After a time the gong is again struck - enlargement 8, and the candidate stops immediately.

Section 8: View of tester demonstrating to the candidate, and correcting various incorrect solutions - enlargement 9, with close up of hands as in enlargement 3.

Section 9: View of four candidates. Gong is struck - enlargement 10, and they commence work. After a time the gong is again struck and the candidates stop, immediately.

Section 10: Close up of the test as it will appear before the subject when the lights are switched on - enlargement 11.

The total length of the film of the Screws Test is 104 feet. It runs for approximately 5½ minutes. All the other films follow this sequence, although they vary in time. (Refer to the following page for photographs of the actual film strips).



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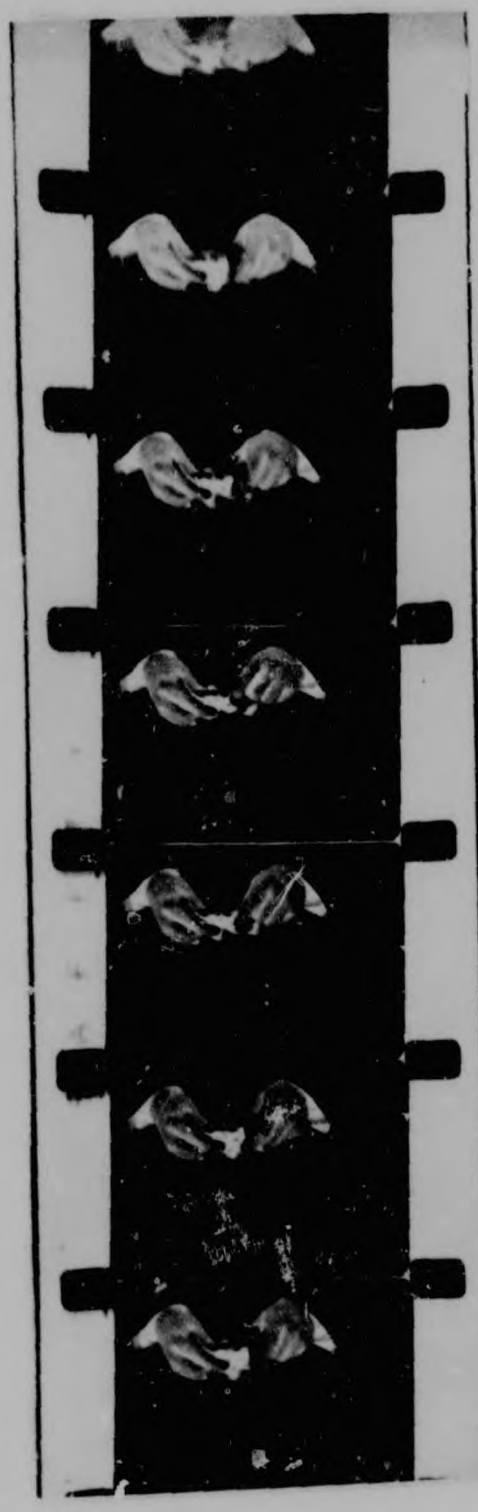

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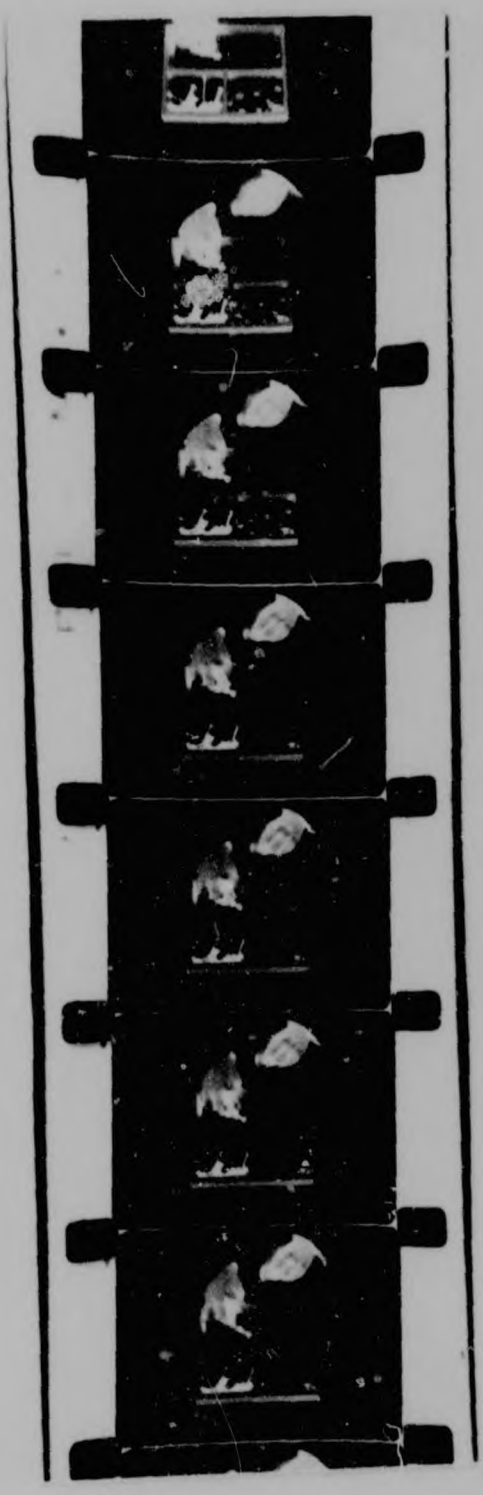

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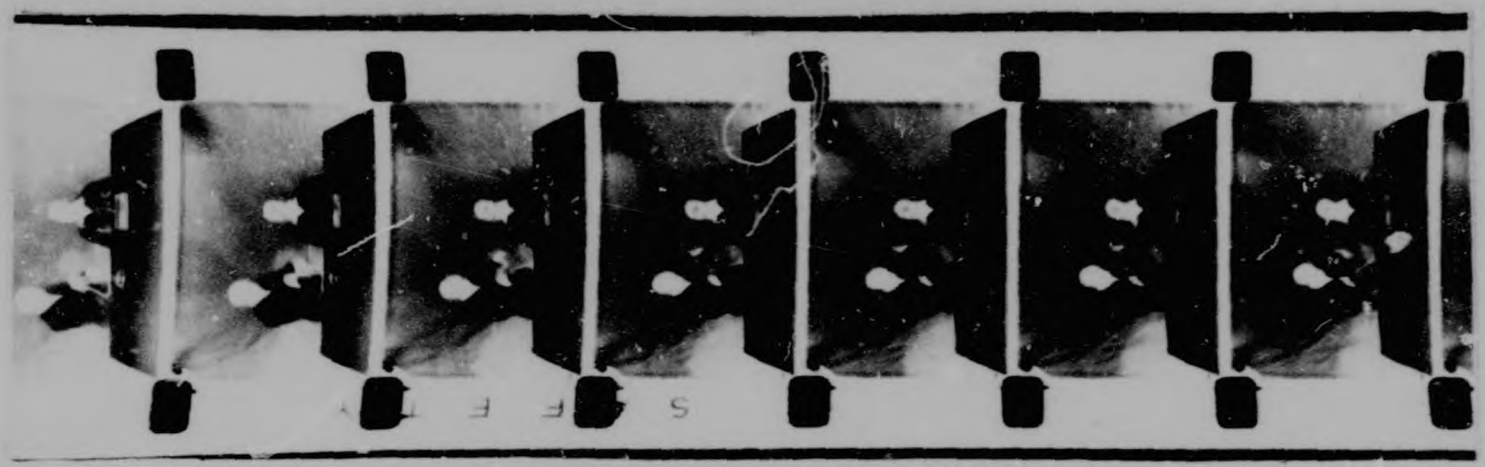

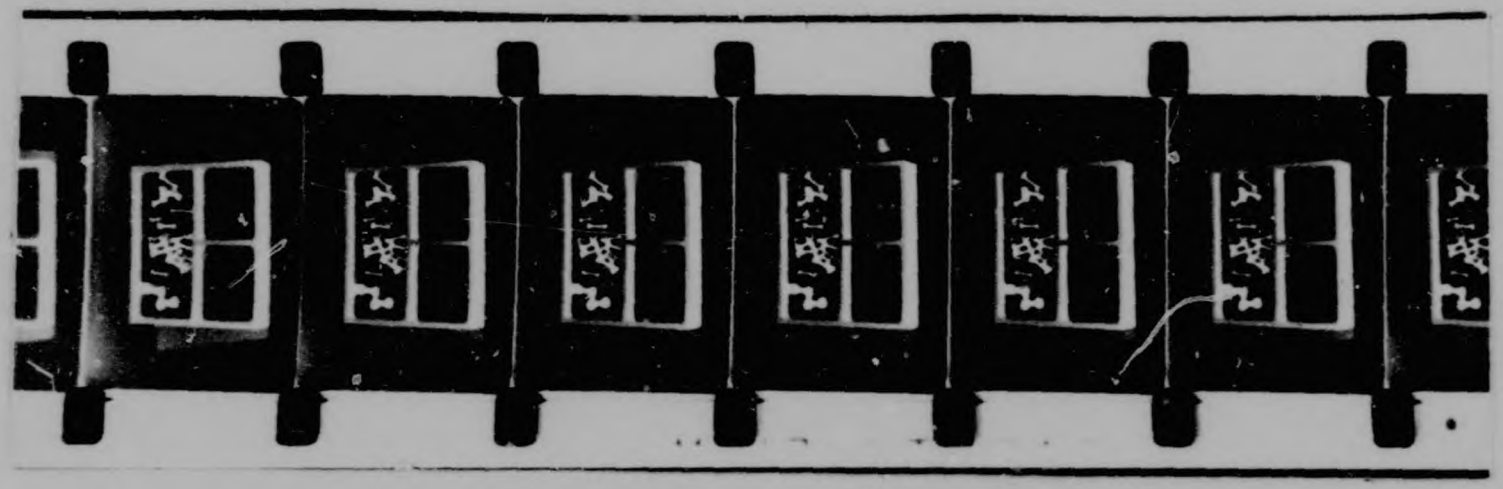

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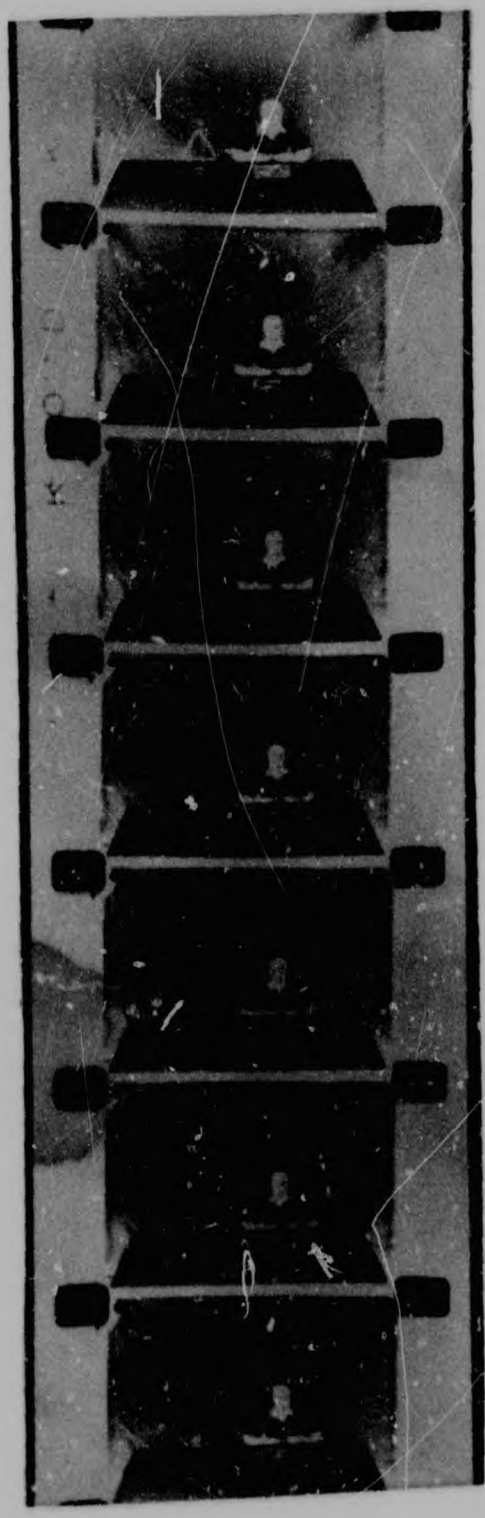

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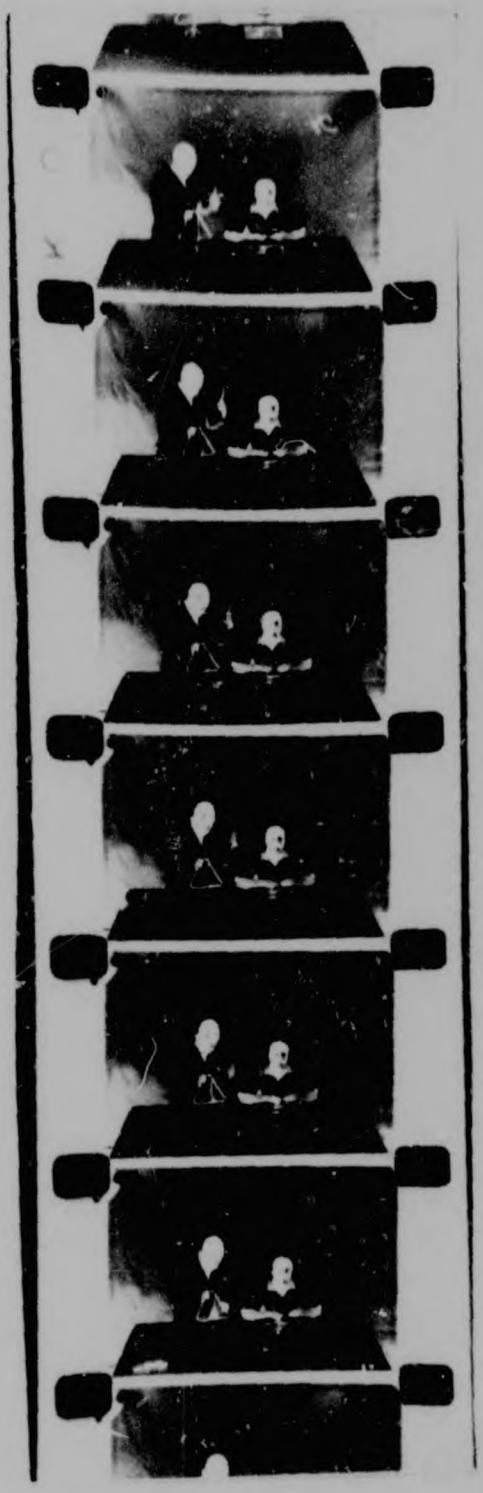

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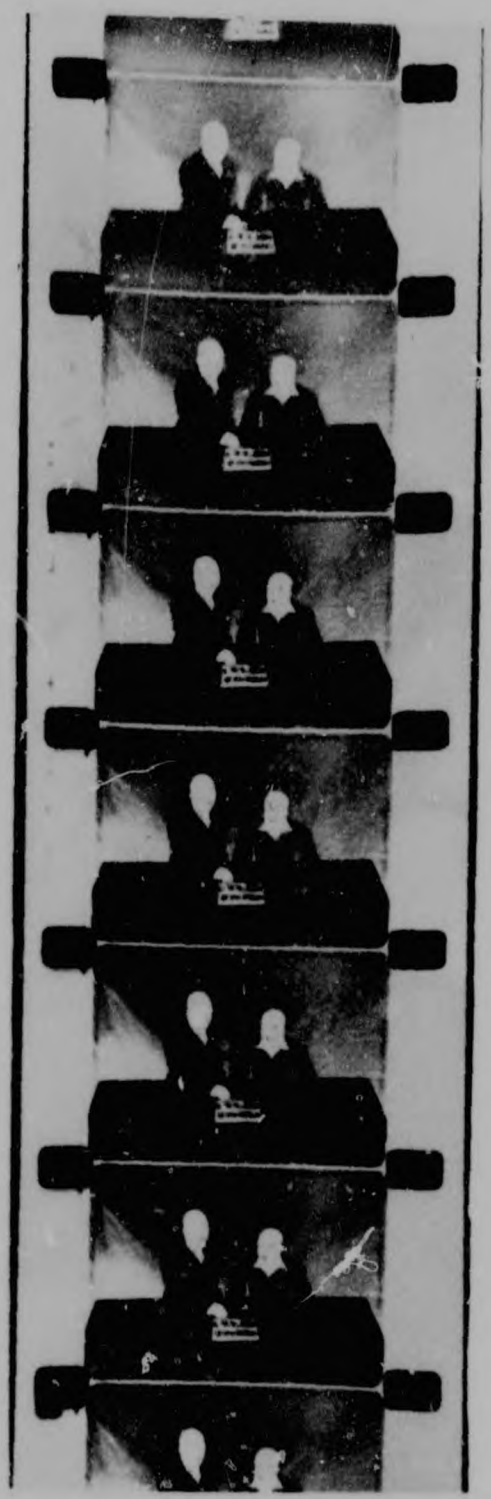

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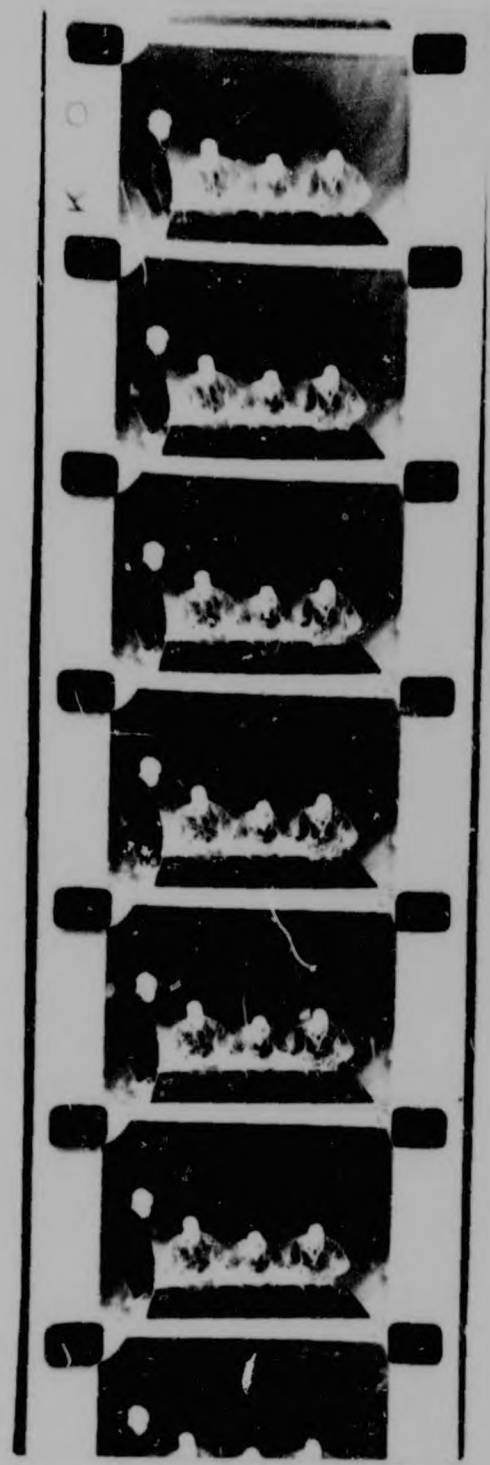

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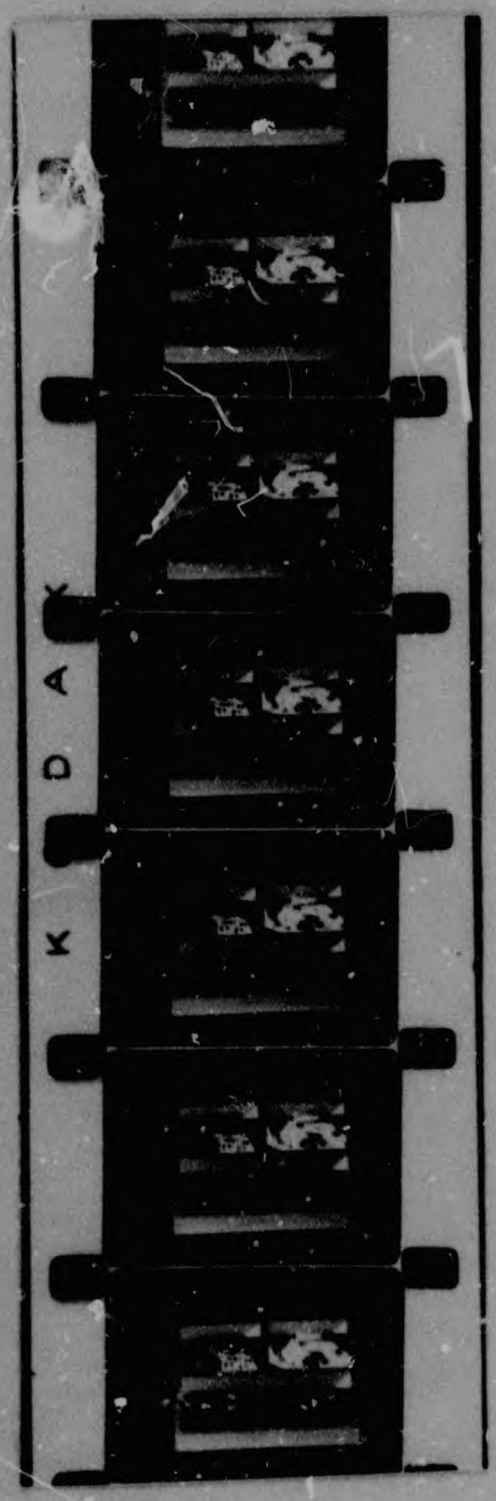

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1. The Tests:

The present battery was composed of nine tests, they are:

1. The Screws Test.
2. Sorting Test I (Mechanical Parts).
3. Sorting Test II (Letters and Numbers).
4. Cube Construction Test.
5. Tripod Assembly Test.
6. Formboards Test.
7. Mechanical Pegboard Test.
8. Wiggly Blocks Test.
9. Kohs Blocks Test.

Each test was scored in terms of work done during a fixed time according to a prepared scoring system.

Test No. 1: Screws Test:

Description:

This test consists of a wooden tray divided into one large and two smaller compartments. In the right-hand small compartment are 24 nuts and in the left-hand one 24 corresponding bolts.

Purpose:

A simple test used to emphasise the function of the gong and make sure that candidates realise the relation of the film to the test proper. It acts as a means of focusing attention upon the essential items on which the efficient administration of the battery ultimately depends.

Although essentially a buffer test it was scored as a matter of interest.

Administration:

Administered simultaneously to the group, the candidates are required to select the correct assemblies and deposit them into the receiving tray.

Scoring:

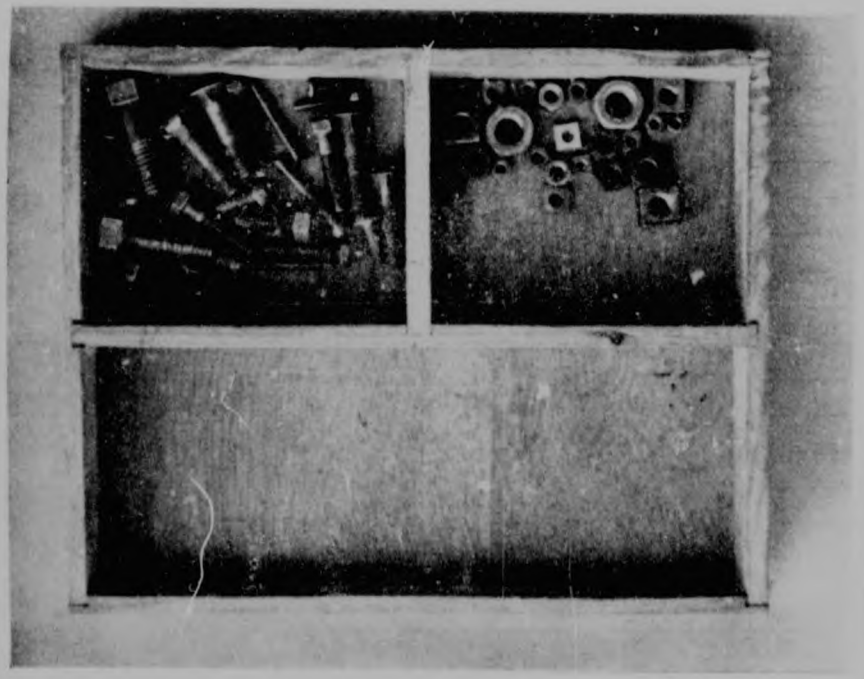
The final raw score is the total number of correct nuts and bolts assembled in one trial.

The nut needs to be screwed far enough only to maintain its grip. Each correct assembly receiving one mark.

Range of Raw Scores:

Trial I - 0 to 24 points.

Time: Trial I - 2 minutes.





(left) Screws Test ready for administration.

(right) Position of Screws Test in relation to candidate.

Test No. 2: Sorting Test 1 (Mechanical Parts).

Description:

80 different mechanical items, such as washers, nails, rivets etc., to be sorted into a wooden tray divided into 16 different compartments each fitted with the appropriate mechanical item. 5 similar items per compartment.

The loose mechanical items are sorted from a tray containing the 80 loose parts which is placed on the right hand side of the compartmentalised receiving tray.

Purpose:

Designed to test discriminative ability at an elementary level. It requires the recognition of common group factors, of similarities and of differences.

Administration:

Administered to the group simultaneously, the test material faces the candidate in the position shown in the accompanying photograph.

Scoring:

The final raw score is the total number of items correctly sorted in each of the two trials. Each item placed in the correct compartment is credited with one point. Incorrect items are ignored.

Range of Raw Scores:

Trial I - 0 to 80 points.

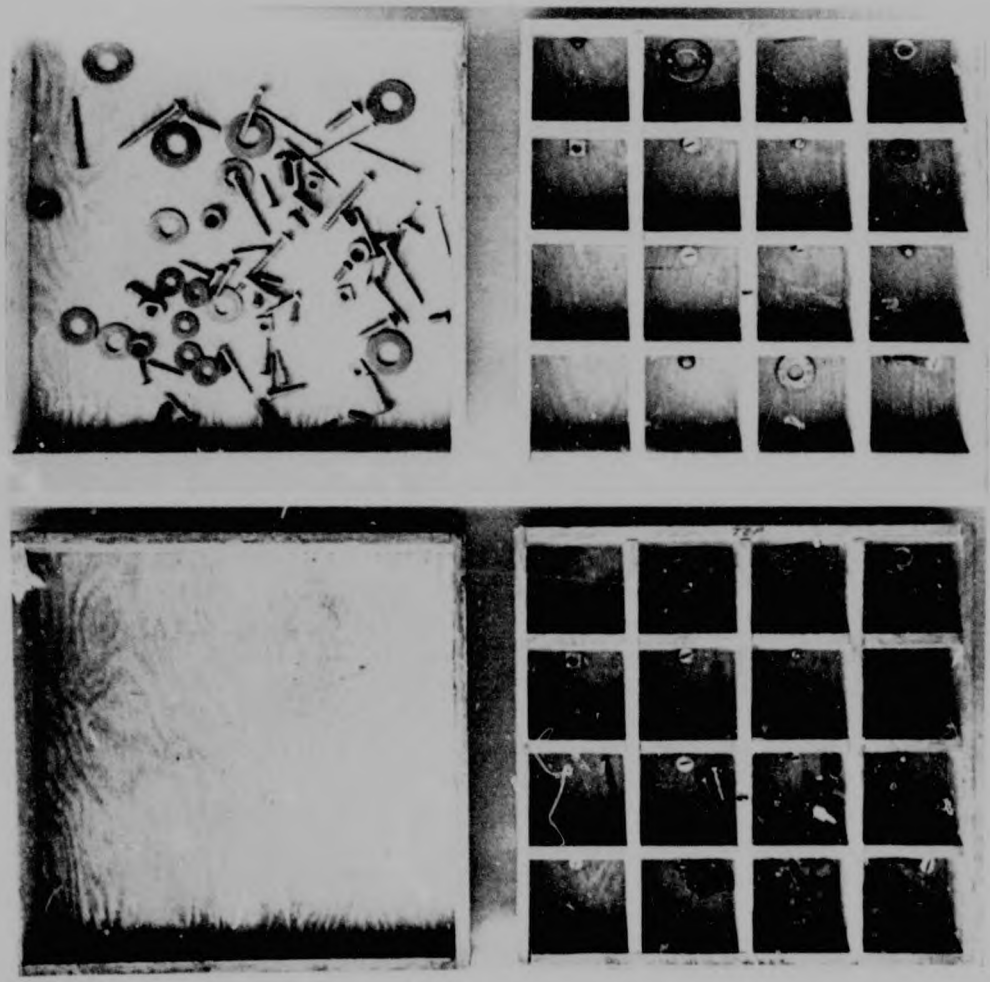
Trial II - 0 to 80 points.

Total - 0 to 160 points.

Time:

Trial I - 2½ Minutes.

Trial II - 1½ Minutes.





(left above) Sorting Test I and Administration Tray ready for administration.

(left below) Sorting Test I correctly completed.

(right) Position of Sorting Test I and Administration Tray in relation to candidate.

Test No. 3: Sorting Test II (Letters and Numbers).

Description:

Similar to Mechanical Sorting, but the objects to be sorted consist of eighty brass discs, engraved with single or pairs of letters and numbers, to be sorted into 16 compartments each fitted with the appropriate disc. There are 5 correct solutions per compartment. The loose discs lay in a tray on the right of the compartmentalised tray.

Purpose:

Designed to test discriminative ability at a slightly higher level than in Sorting Test 1.

Administration:

Administered to the group simultaneously, and placed in position as shown in the accompanying photograph.

Scoring:

The final raw score for this test is the total number of discs correctly sorted in two trials. A disc is considered as correctly sorted if it is placed in the correct compartment. Incorrect discs are ignored.

Range of Raw Scores:

Trial I - 0 to 80 points.

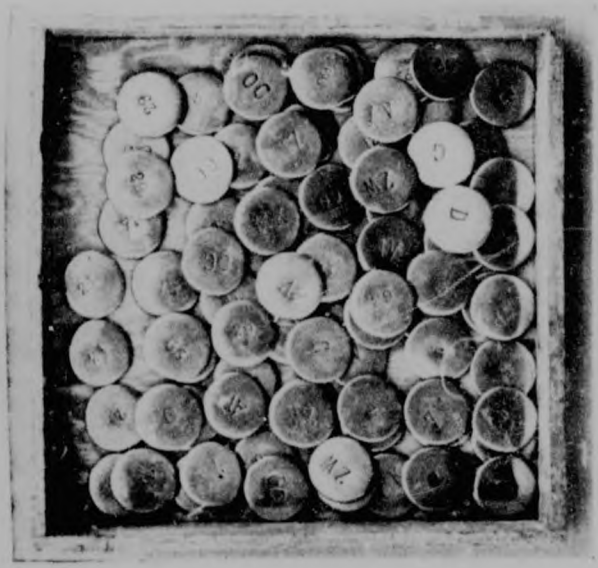
Trial II - 0 to 80 points.

Total - 0 to 160 points.

Time:

Trial I - 5 Minutes.

Trial II - 3 Minutes.









(left) Sorting Test 2 ready for administration.

(right) Position of Sorting Test 2 and Administration Tray in relation to candidate.

Test No. 4: Cube Construction Test:

Description:

The test consists of twenty-seven one inch cubes with various sides painted red or white, to be built according to the dimensions of four red model blocks, comprising 8, 12, 18 and 27 small blocks respectively.

The total material is as follows:

Sub Test 1:

Model Block: 2" x 2" x 2" painted red.

Cubes: 8 cubes with 3 sides red.

Sub Test 2:

Model Block: 3" x 2" x 2" painted red.

Cubes: 12 cubes, 8 cubes with 3 sides red.
4 cubes with 2 sides red.

Sub Test 3:

Model Block: 3" x 3" x 2" painted red.

Cubes: 18 cubes, 8 cubes with 3 sides red.
8 cubes with 2 sides red.
2 cubes with 1 side red.

Sub Test 4:

Model Block: 3" x 3" x 3" painted red.

Cubes: 27 cubes, 8 cubes with 3 sides red.
12 cubes with 2 sides red.
6 cubes with 1 side red.
1 cube with all sides white.

Purpose:

The cube test was designed to measure ability to think three dimensionally, as a test with specifically practical bias.

Administration:

Administered to a group of candidates simultaneously, the appropriate model block with the requisite number of

cubes is placed in front of the candidate as required.

Scoring:

The final raw score is calculated from Sub-tests 2, 3 and 4. Sub-test 1 is recorded for interest, especially with regard to the performance of the lower grades within the school sample.

A cube is credited with one mark when it is located in the correct position as required according to the model block. Incorrect positioning of cubes with regard to the model block are ignored.

A bonus of one point is given in Sub-tests 2, 3 and 4, if the candidate has constructed a block with the cubes that is identical in every respect to the model block.

Range of Raw Scores:

Sub-test 2 - 0 to 12 (+ 1 bonus if completely correct).
Sub-test 3 - 0 to 18 (+ 1 bonus if completely correct).
Sub-test 4 - 0 to 27 (+ 1 bonus if completely correct).

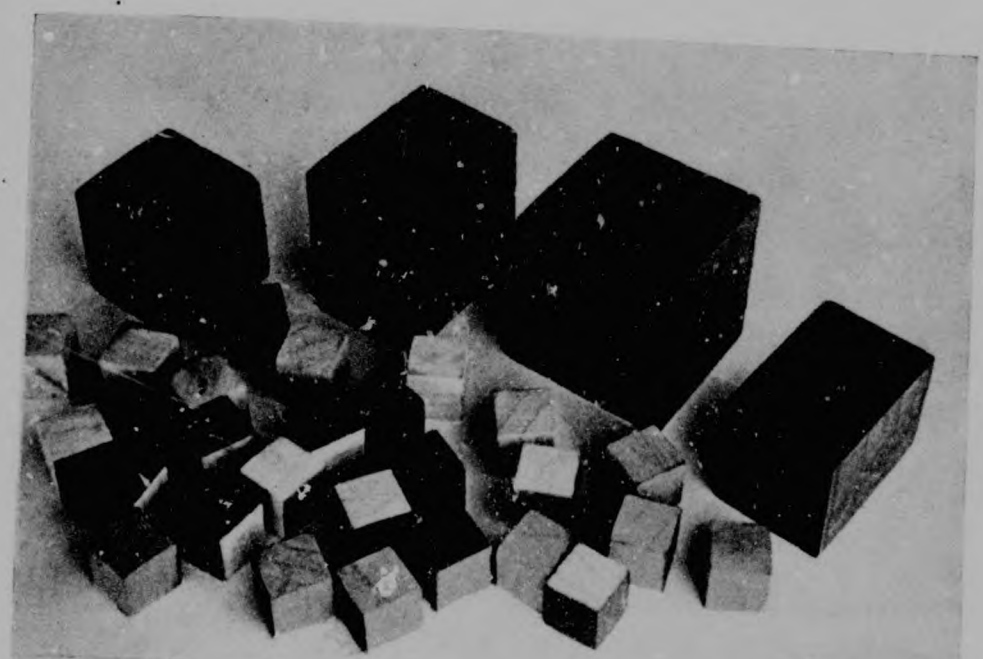
Total - 0 to 57 (+ 3 if all three sub-tests are completely correct).

Maximum - 60

Sub-test 1, scored as a matter of interest, - 0 to 8 with no bonus.

Time:

Sub-test 1 - 2 Minutes.
Sub-test 2 - 5 Minutes.
Sub-test 3 - 7 Minutes.
Sub-test 4 - 10 Minutes.



Cube Construction Test with all the cubes and model blocks.

Test No. 5: Tripod Assembly Test:

Description:

Consisting of a tray containing a number of metal parts, the required tripod must be completed as shown in the film. There are 18 separate pieces which comprise the tripod.

Purpose:

A test of mechanical comprehension, requiring observation, the ability to analyse parts, to consider detail and to assemble and position attachments efficiently and effectively.

Administration:

Administered to a group simultaneously, each candidate being required to assemble the tripod as shown in the film. The tray faces the candidate as illustrated in the accompanying photograph.

The stopping gong is struck at the end of the first trial, the tests are scored and each candidate then disassembles his own tripod, the parts of which are checked by the testers. A slide of the assembled tripod is then shown for 20 seconds and trial 2 commences. Administration thereafter being as in trial 1. Before trial 3 a slide of the assembled tripod is shown for 10 seconds. All three trials are scored.

Scoring:

1 point for each correct assembly, except the weight which gets 2 points, if incorrectly hung then only one point.

The tripod when assembled correctly corresponds to the assembly as shown in the accompanying photograph and is accorded 21 points.

If the tripod top is assembled to the legs with the hook upper most, but all the bolts and nuts correct, credit is given for the correctly assembled bolts and nuts, but not for the tripod top assembly.

The item scoring is as follows:

Correct assembly of 3 legs. (1 point each)	: 3 points.
Correct assembly of 3 legs bolts (1 point each)	: 3 points.
Correct assembly of 3 nuts to bolts. (1 point each).	: 3 points.
Correct assembly of tripod top.	: 1 point.
Correct assembly of 1 link to each leg. (1 point each).	: 3 points.
Correct assembly of 1 link to each link. (1 point each).	: 3 points.
Correct assembly of 3 links to ring. (1 point each).	: 3 points.
Correct positioning of weight.	: 1 point.
Correct assembly of weight to tripod top.	: 1 point.
Total.	: 21 points.

Range of Raw Scores:

Trial 1 - 0 to 21 points.

Trial 2 - 0 to 21 points.

Trial 3 - 0 to 21 points.

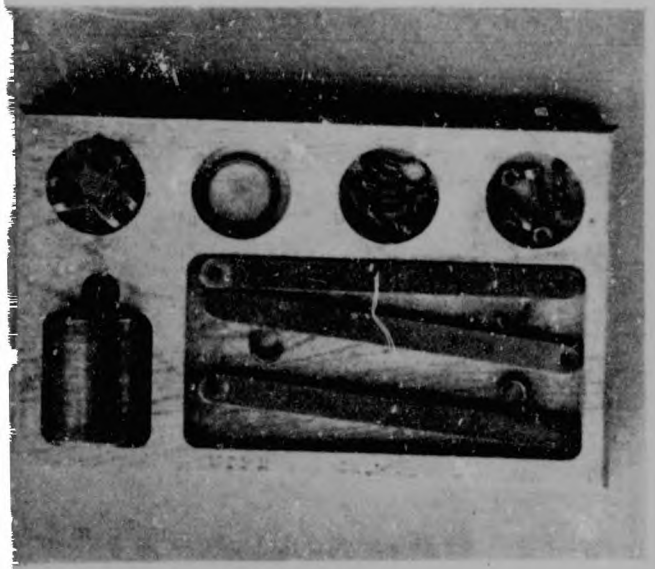
Total - 0 to 63 points.

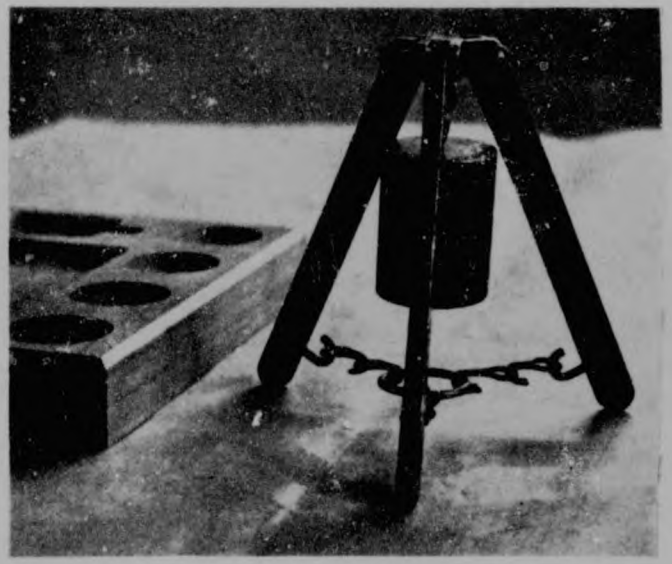
Time:

Trial 1 - 3 Minutes.

Trial 2 - 2 Minutes.

Trial 3 - 2 Minutes.







(left) Tripod Assembly Test ready for administration.

(centre) Tripod Assemly Test correctly completed.

(right) Position of Tripod Assembly Test in relation to candidate.

Test No. 6: Formboards Test:

Description:

Formboard 1: (see photograph), has six pieces to be fitted into the six appropriate recesses in the board, one piece in each recess.

Formboard 2: (see photograph), has twenty pieces to be fitted into the twenty randomly placed recesses on the board. One piece per recess.

Formboard 3: (see photograph), has fourteen pieces to fit into eight recesses in the board. In this formboard, certain recesses require more than one piece per recess. Unless every piece is fitted into the correct recess, it will not be possible to complete the board. No alternate solutions exist, and an apparently correct fit of a single piece may be wrong in relation to its fellow or fellows.

Formboard 4: (see photograph), has eighteen pieces to fit into eight recesses. As in Formboard 3, each piece has its specific place and unless this is found, the board cannot be completed. No alternate solutions exist and an apparently correct fitting may be wrong in relation to its fellow or fellows.

The formboards range in difficulty from Formboard 1 to Formboard 4. The administration board (see photographs) remains constant for all subjects.

Purpose:

This test was designed to assess the ability to perceive spatial relations, to reason, to profit by past experience and to exercise general adaptability.

Administration:

The test is administered to the group simultaneously. In each test the administration tray is placed above the

actual formboard, (as in the photographs) in test 1 the pieces are placed above formboard 1.

In formboards 2, 3 and 4, the administration tray is left on top of the formboard until each subject has a test before him, these trays are then quickly taken off and placed above each board. This is to ensure that all candidates observe the actual formboard for approximately the same length of time before the gong is struck.

Scoring:

Formboard 1 is scored as a matter of interest but not totalled with the rest of the scores. It is essentially a buffer test. Formboard 2 is credited with one mark per correctly fitted piece.

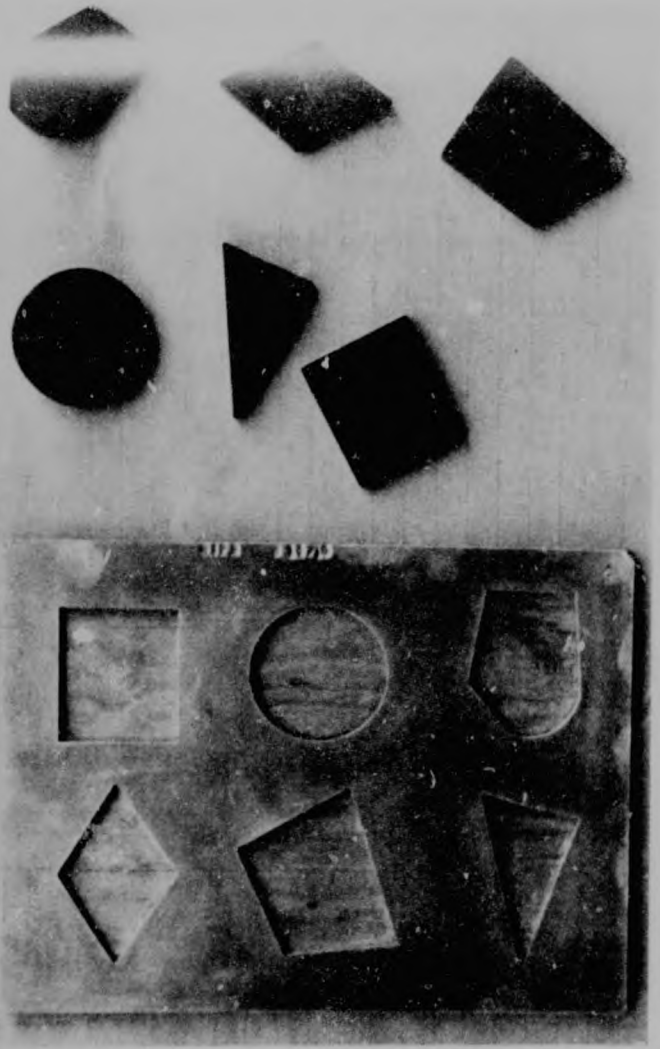
In Formboards 3 and 4, each correctly fitted piece gains one mark, a bonus of one point being credited for each completely correct recess requiring more than one piece to fill it.

Range of Raw Scores:

Formboard	2	- 0 to 20 points.
Formboard	3	- 0 to 20 points.
Formboard	4	- 0 to 24 points.
Total		- 0 to 64 points.
Formboard 1 (not totalled)		0 to 6 points.

Time:

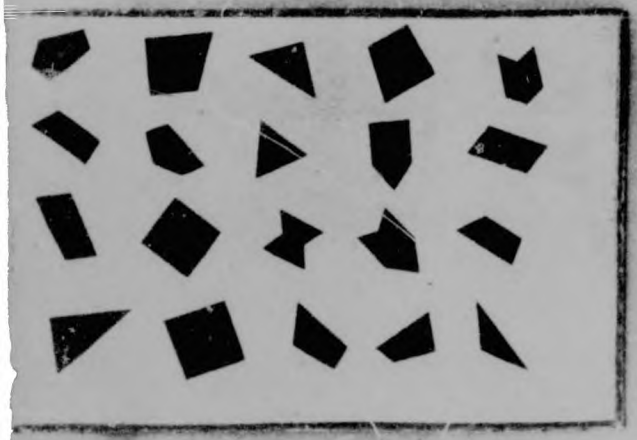
Formboard	1	- 30 Seconds.
Formboard	2	- 1¾ Minutes.
Formboard	3	- 3½ Minutes.
Formboard	4	- 15 Minutes.

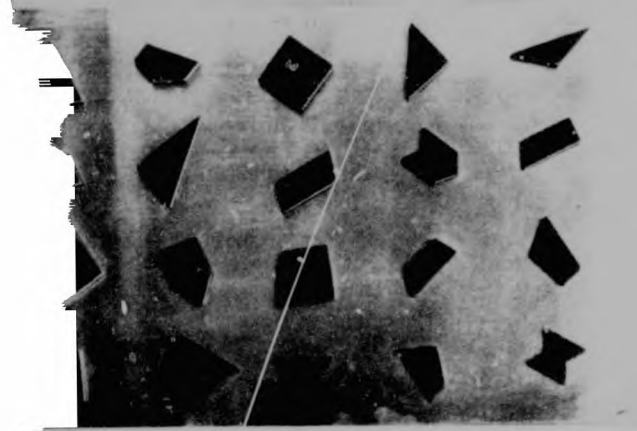




(left) Formboard I ready for administration.

(right) Position of Formboard I in relation to candidate.







(left) Formboard 2 correctly completed.

(right) Position of Formboard 2 and Administration tray in relation to candidate.

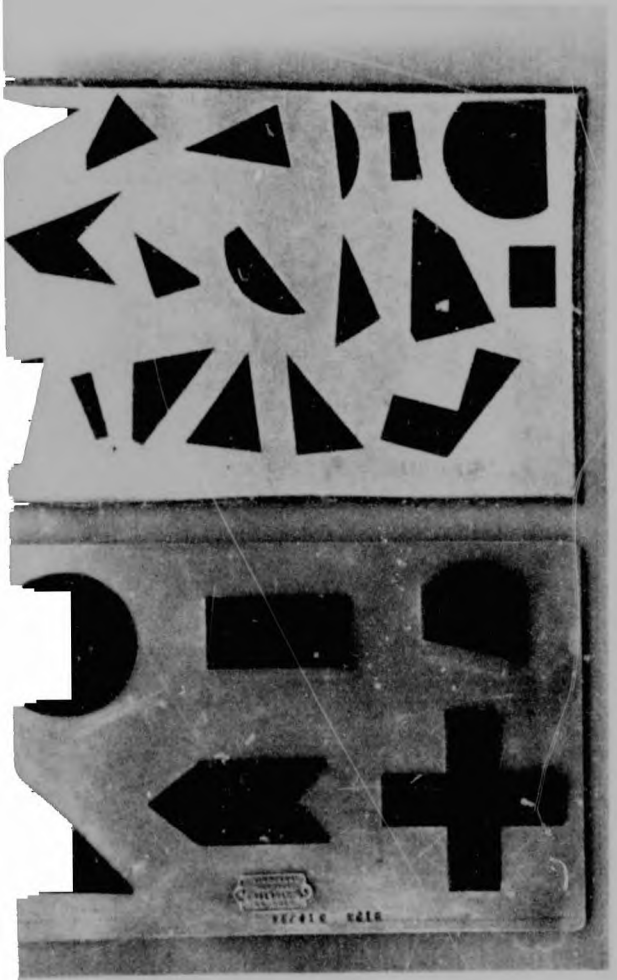






(left) Formboard 3 correctly completed.

(right) Position of Formboard 3 and Administration tray in relation to candidate.





(left) Formboard 4 correctly completed.

(right) Position of Formboard 4 and Administration tray in relation to candidate.

Test No. 7: Mechanical Pegboard Test:

Description:

This test consists of thirty pegs and a pegboard containing thirty apertures to fit them. The pegs are of four main types, pronged pegs, square or rectangular pegs, shouldered pegs and round pegs. There is only one correct aperture for each peg. These pegs are made of brass.

In addition to the pegboard, there is an administration tray into which the pegs are thrown haphazardly and from which the candidate works, (see photograph) as well as a wooden straightedge with which to level the pegs.

Purpose:

This test was designed to test the candidates ability to reason, using strictly perceptual data, and to manipulate items in mechanical assembly.

Administration:

The test is administered to the group simultaneously. The candidate being required to fit the thirty pegs into the correct holes, each peg must fit snugly and be level with the rest.

The test is placed before each candidate in a standardised position as shown in the accompanying photograph.

There are two trials, after the first trial, all pegs are deposited in the administration tray and the starting gong struck.

Scoring:

The final raw score is the total number of pegs correctly fitted in two trials. A peg is correctly fitted when it is inserted in the correct hole in the correct way.

Incorrect pegs are ignored. One point is given for each correctly inserted peg.

Range of Raw Scores:

Trial 1 - 0 to 30 points.

Trial 2 - 0 to 30 points.

Total - 0 to 60 points.

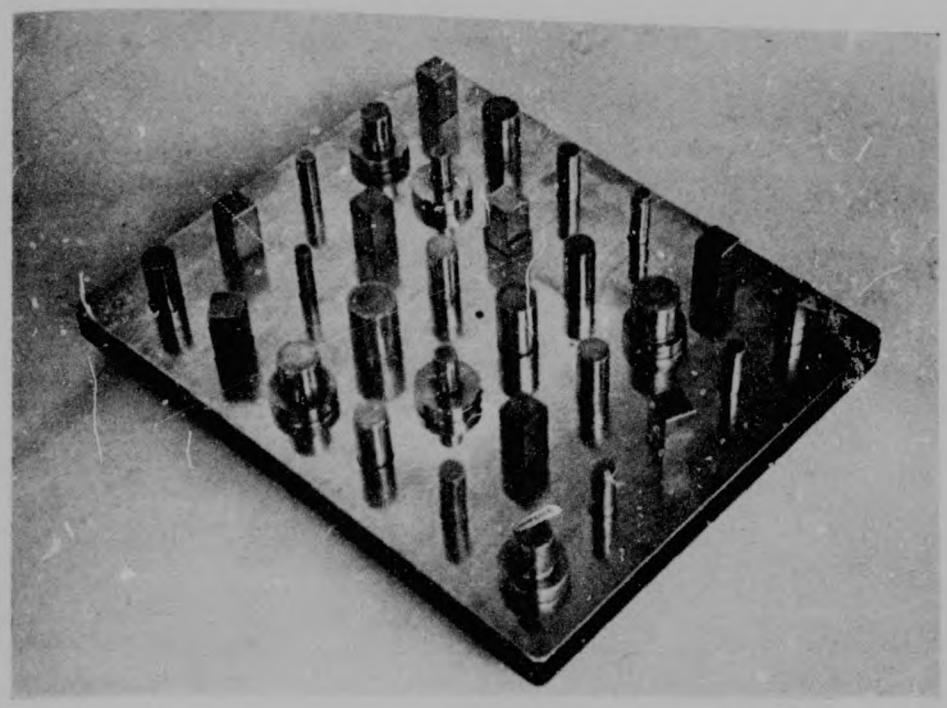
Time:

Trial 1 - 6 Minutes.

Trial 2 - 6 Minutes.

NOTE:

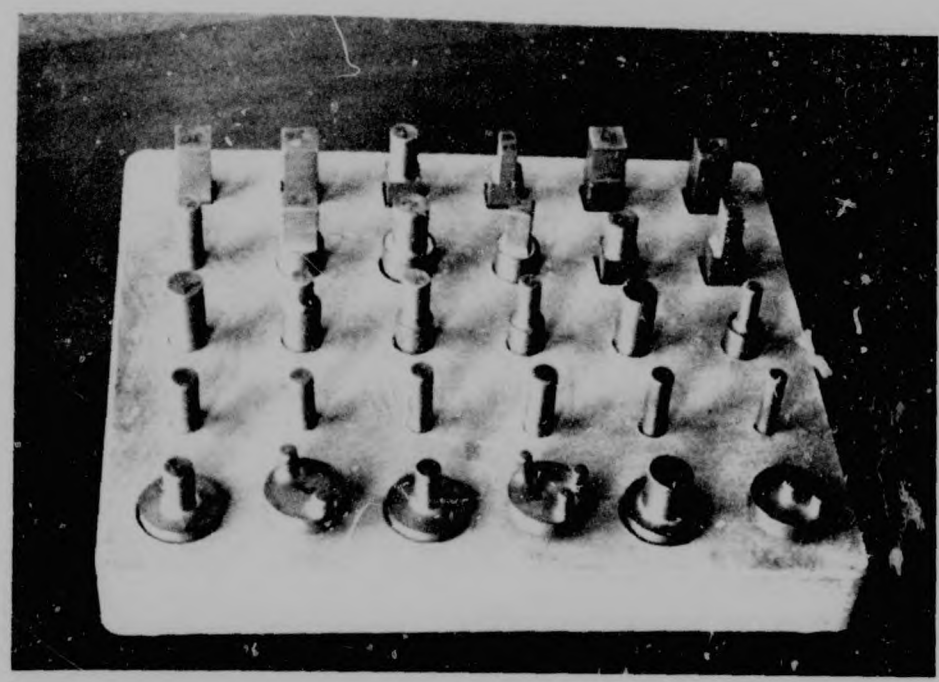
The accompanying photograph illustrates the old type of administration tray and not the new type used in the present research.

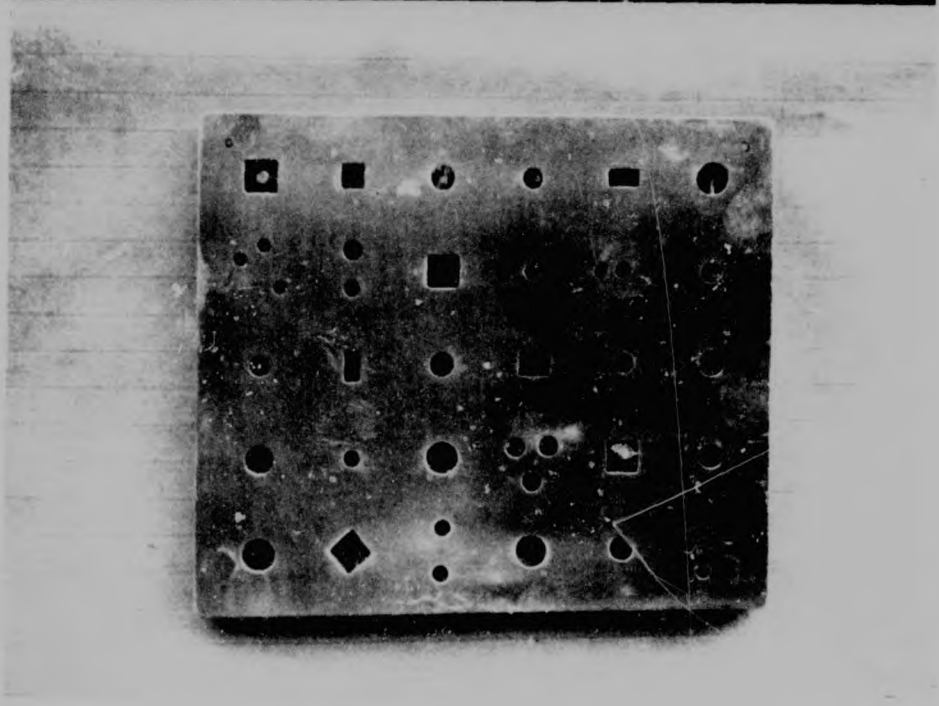




(above) Mechanical Pegboard Test correctly completed.

(below) Position of Mechanical Pegboard Test and Administration Tray in relation to candidate.





Mechanical Pegboard Test and Administration Tray showing pegs in position for administration.

Test No. 8: Wiggly Blocks Test:

Description:

This test comprises three wiggly blocks. Block 1 is subdivided into four wiggly pieces. Block 2 is subdivided into six wiggly pieces. Block 3 is subdivided into nine wiggly pieces. An idea of the wiggly sections may be gained from the accompanying photograph. All blocks are made of wood, all sections of each separate block being painted the same colour. The blocks increase in difficulty from Block 1 to Block 3.

Purpose:

This test was designed to measure insight into three dimensional spatial relations and to test intelligence of a specific practical type.

Administration:

The test is administered to the group simultaneously. The candidate is required to assemble a square block from the wiggly sections presented in a haphazard fashion to him. After the administration of Wiggly Block 1 the wiggly sections are removed and the next wiggly block sections presented.

Scoring:

The final score is the total number of pairs of pieces correctly assembled in each of the three blocks. Each pair of correctly assembled pieces received one mark. Incorrect assemblies are ignored. Block 1 has four pairings, Block 2 has seven and Block 3 has twelve pairings.

A bonus of 1 point is given for each absolutely correct block.

Range of Raw Scores:

Block 1 - 0 to 4 points (+ 1 bonus).

Block 2 - 0 to 7 points (+ 1 bonus).

Block 3 - 0 to 12 points (+ 1 bonus).

Total. - 0 to 23 points (+ 3 bonus).

Maximum - 26 points.

Time:

Wiggly Block 1 - 1 Minute.

Wiggly Block 2 - 4 Minutes.

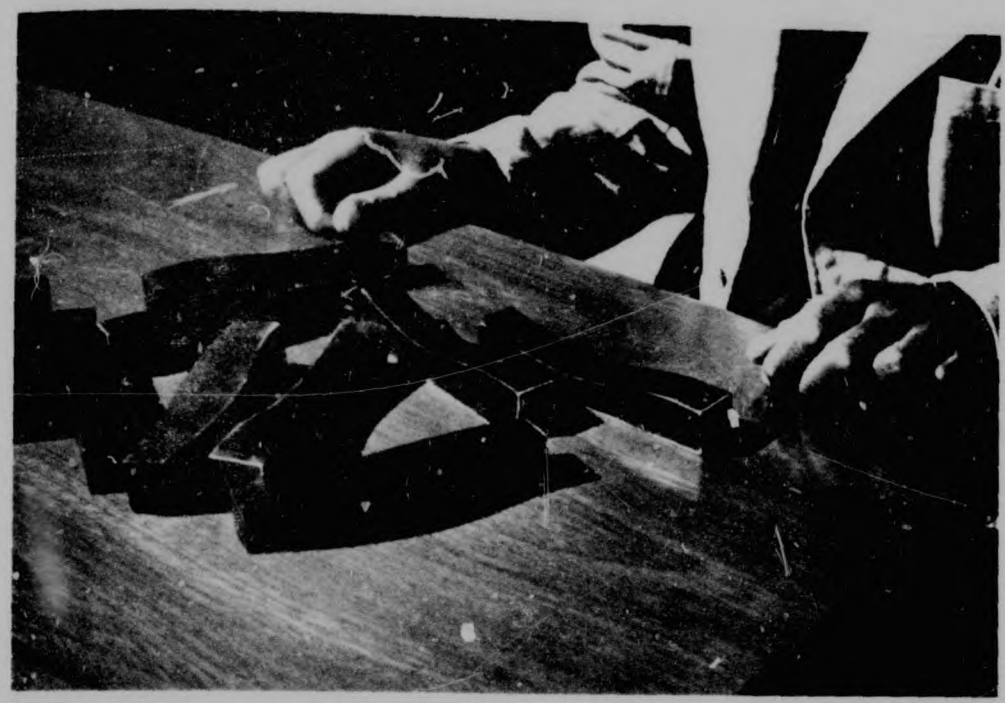
Wiggly Block 3 - 10 Minutes.





(above) Wiggly Blocks Test, Block 1 ready for administration.

(below) Wiggly Blocks Test, Block 2 ready for administration.





(above) Wiggly Blocks Test, Block 3 ready for administration.

(below) Wiggly Blocks Test, Block 3 correctly completed.

Test No. 9: Kohs Blocks Test:

Description:

This test consists of twenty-four one inch cubes, three trays and ten patterns. The cubes are painted as follows:

1) four cubes painted red on one side.
2) Sixteen cubes painted half red and half white. diagonally on one side.
3) Four cubes painted white on one side.

The test trays range from small, through medium to large. The small tray holds four cubes, the medium nine and the large tray sixteen cubes.

The patterns used are shown in the coloured illustration. The whole test being pictured in the accomparying photograph.

Purpose:

The test was designed to measure a candidates ability to analyse the essential elements of the test situation.

Administration:

The candidat is required to assemble the cubes given him in the formation required by the pattern. The correct type and number of cubes together with the right size tray and the relevant pattern are presented to the candidate. The pack of patterns are placed face downwards before the candidate, the required pattern is selected by the tester and placed face downwards next to the cubes and tray, after all subjects have the correct material before them the relevant patterns are exposed by the testers. This is done to ensure that the presentation time of the pattern is approximately the same for all subjects. On completion of the pattern it is placed face downwards on the edge of the table far away from the subject so as not to confuse him, and the next pattern

presented as before.

The general layout of material before the subject is shown in the accompanying photograph. And the order of presentation of patterns is given in the illustrations following thereon.

Scoring:

All patterns are scored, although only patterns 2 to 10 are considered. Pattern 1 being scored as a matter of interest. The final score being the number of cubes correctly assembled in the trays for patterns 2, 3, 4, 5, 6. 7, 8, 9 and 10.

If patterns 2, 3 and 4 are completely and correctly assembled a bonus of one mark is given to each. If patterns 5, 6, 7, 8, 9 and 10 are absolutely correct they receive 2 marks bonus each.

A cube is considered correctly assembled if its position in the tray coincides exactly with its position as given on the pattern. Each correct cube is credited one mark, incorrect cubes being ignored.

Should the cubes for any pattern be completely correctly assembled, but in reverse to the pattern, the candidate looses only the bonus. If, however, they are not completely correct, and in addition placed in reverse to the pattern, no marks are given.

Range of Raw Scores:

Pattern 1 (not considered in the total) 0 to 4 points.
2 0 to 4 (1 point bonus if completely correct).
3 0 to 4 (1 point bonus if completely correct).
4 0 to 4 (1 point bonus if completely correct).
5 0 to 9 (2 points bonus if completely correct).
6 0 to 9 (2 points bonus if completely correct).

Pattern 7 0 to 16 (2 points bonus if completely correct).
8 0 to 16 (2 points bonus if completely correct).
9 0 to 16 (2 points bonus if completely correct).
10 0 to 9 (2 points bonus if completely correct).

Total. 0 to 87 (15 points bonus if all patterns are correct).

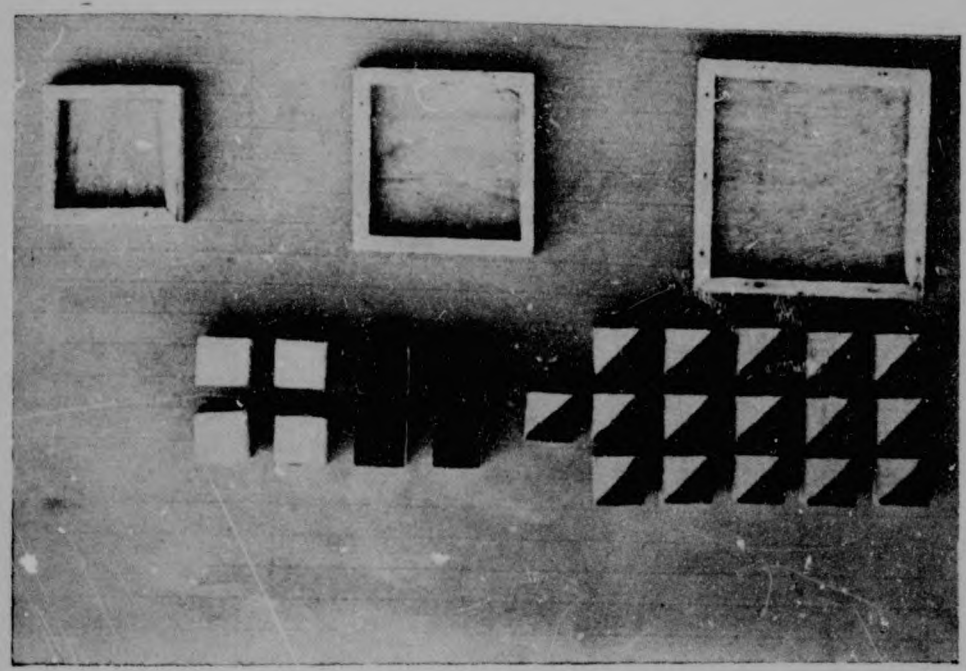
Maximum 102 points.

Time:

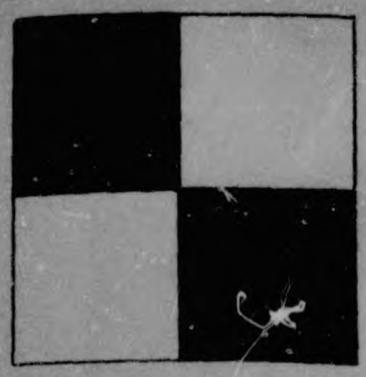
Pattern 1 - 30 Seconds.
2 - 30 Seconds.
3 - 30 Seconds.
4 - 1½ Minutes.
5 - 2 Minutes.
6 - 4 Minutes.
7 - 6 Minutes.
8 - 6 Minutes.
9 - 6 Minutes.
10 - 5 Minutes.

(See Appendix C for the complete Test Administration, Time, and Scoring Sheet).

(See Appendix D for the suggested alterations in Kohs patterns).



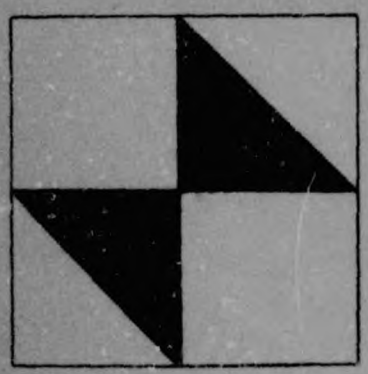
Kohs Blocks Test with all the cubes and test trays.



1



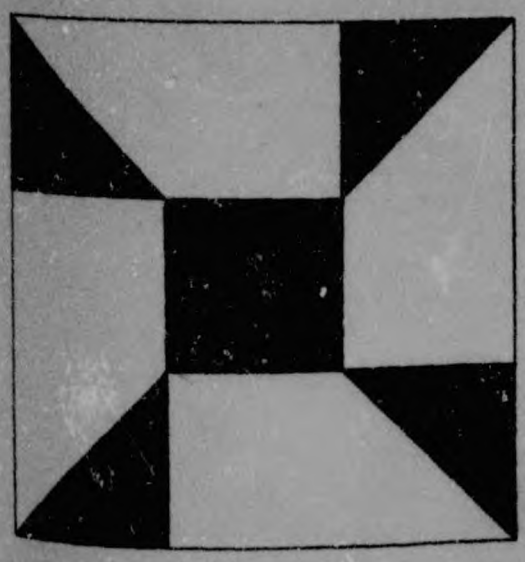
2



3



4

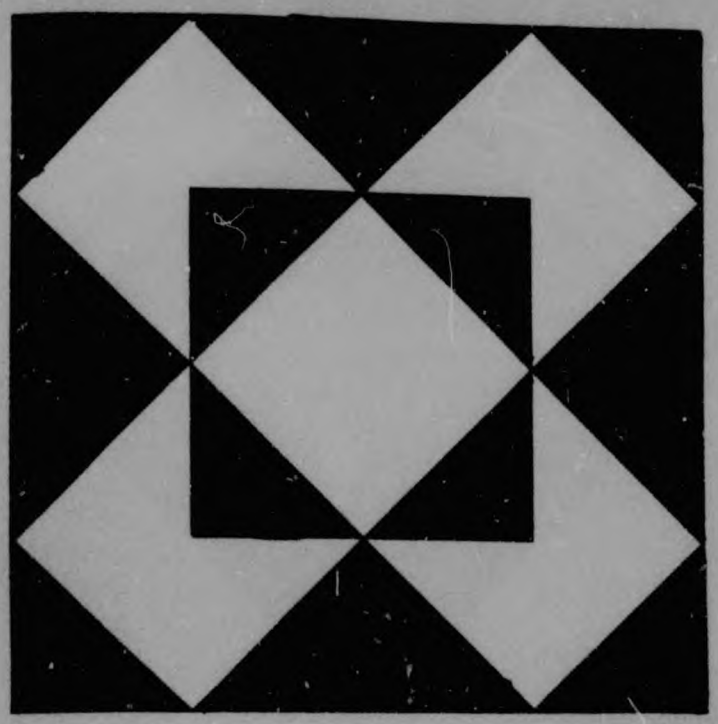


5



6

KOHS BLOCKS PATTERNS ARRANGED IN ORDER OF PRESENTATION:



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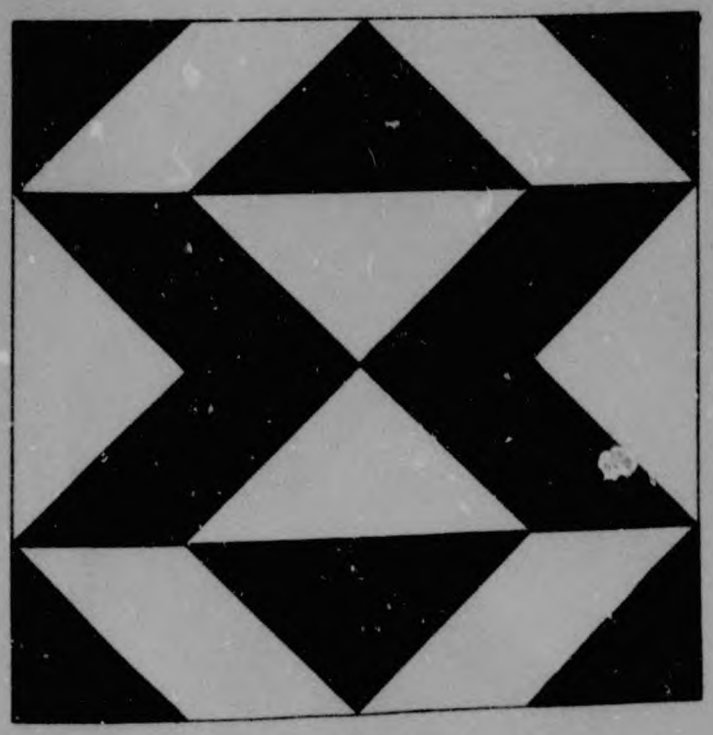
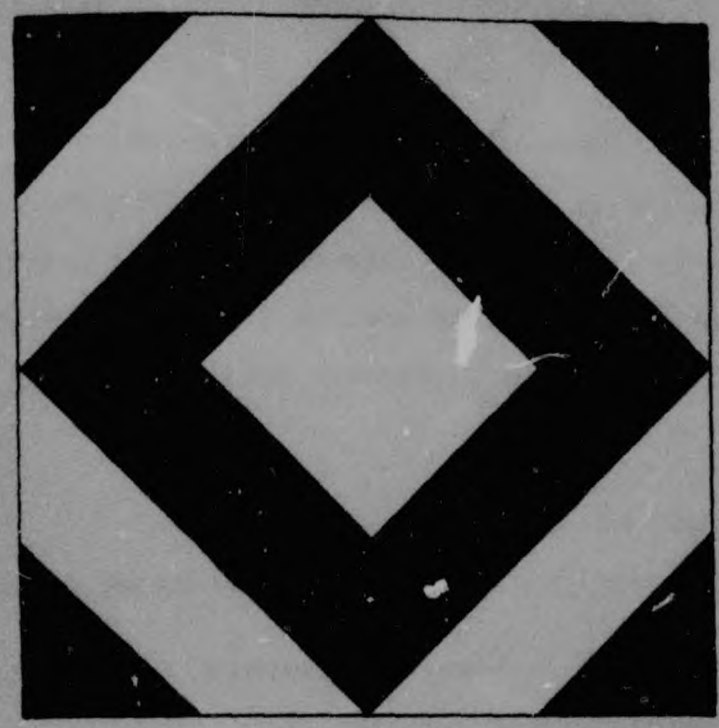


8



9



10

C.

1. Job Analysis Presentation:

The differentiation between mechanical and non-mechanical work done by Africans in the secondary industries visited, was made on the basis of a job analysis carried out at each industry. The following section gives a detailed account of each job analysis undertaken.

The presentation of these job analyses will, as far as possible, adhere to the following pattern:

A. General Section:
   a) the name and situation of the plant
   b) the products manufactured or processed.

B. Labour Position:
   a) the division of labour.
   b) the labour position at the time of study
   c) certain duties which were excluded from the job analyses, with the reasons for their exclusion.

C. Production Flow Chart:
   a) a chart giving the production flow, stressing the main labour groupings within the plant.

D. Detailed Photographic Job Sequence:
   a) photographs detailing the main duties isolated within the various production lines, portraying some of the intricacies involved in each, and generally acting as a more graphic frame of reference for classification purposes.

E. Isolation of duties on the various lines:

a) giving where possible a detailed sequence of the various line stations, sub-assemblies or positions, within the various duties.

b) or in the case of the more menial sections, a description of the main duties involved.

c) a consideration of the worker requirements for each job.

F. Job Classification:

a) job grouping on the basis of all the above information

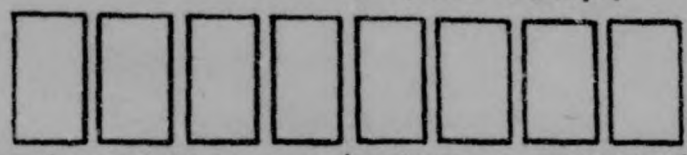
b) into Mechanical jobs and Non-Mechanical jobs

c) and the sub-divisions within these - if any.

INTERVIEW WITH MANAGEMENT — 1 STAGE

PRELIMINARY SURVEY OF PLAN. — 2

ISOLATION OF SECTIONS: — 3



ISOLATION OF SECTION DUTIES: — 4



GROUPING OF SIMILAR DUTIES: — 5



GROUPING OF SIMILAR DUTIES INTO:

MECHANICAL NON-MECHANICAL — 6

GROUPING INTO: — 7

MECH. HIGHER | NON-M. HIGHER

MECH. LOWER | NON-M. LOWER

FINAL GROUPING: — 8

MECH. ASEMS. | BDY. SH. WKS.

MECH. ASSTS. | MENIAL WKS.

DIAGRAM OF JOB ANALYSIS PROCD.

2. Stanley Motors:

General:

National Motor Assemblies Pty. Ltd., situated at Natalspruit, Germiston district, Transvaal, is essentially an automobile assembly plant.

During the period of job analysis (September 1952) the plant concentrated on the following models:

Hudson Hornet

Austin A) GS4 Somerset

B) pickup model

Peugeot

Willys 2 x 473 Station Waggon *

All models being assembled from prefabricated sections manufactured and moulded overseas.

The sequence of events leading to the assembly lines is roughly as follows:

1. The Directors decide production.
2. The Planning Department organise a schedule to implement this decision.
3. The Materials Control section following this schedule draw the required material from storage, sort and classify it, and send the necessary material to the correct assembly lines.
4. The Production Chaser on each assembly line then sees to it that the assemblers are supplied with the necessary material to keep production flowing evenly.

---

* 1953 saw the production of the Hudson Jet,
Austin A 30,
and the Aero Willys.

Labour position:

The native labour force may be divided into three main groups:

1. Productive Assemblers and Assistants
2. Non-Productive Assemblers and Assistants
3. Menial Workers.

All line assemblers are unqualified workmen, ie: they have served no apprenticeship.

The labour position during the period of job analysis may be summarised as follows:

Section	No. of employees
Maintenance	18
Distribution	8
Materials Control	24
General Stores	8
Canteen	16
First Aid	1
Reception and Offloading	6
Drivers	5
Police	9
Gardeners	12
Cleaning Squad, Handymen and Wood boys	23
Experimental Bay	6
Body Jig Bay	23
Body Line	28
Paint Shop	56
Electrical Line	4
Trim Line	12
Chassis Line	8
Body Mount	4
Seat Pulling	15
Final Finish	26
Oil and Grease Ramp	22
Total	334

Author De Ridder J C
Name of thesis An investigation into educational and occupational differences in test performance on a battery of adaptability tests designed for Africans 1956

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