The Transparencies and the Inversion of Forms Tests

THESIS

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CHAPTER I

INTRODUCTION

1.1 The Research Problem

The child likes to draw. It is a way to express himself through creative expression. The drawing of a child is much different from that of a grown-up.

"We know that everything the child does and to which he is exposed has some influence upon him. If the child in his creative work continuously attempts to relate all his experiences, such as thinking, feeling, perceiving (seeing, touching, and so on), to one another, it must also have a unifying effect on his personality"[1]

From the drawing we can study various stages of children's development. Two aspects of Form test will be emphasized here. They are the Transparencies and the Inversion of Forms Tests.

These tests have a double task: on the one side, to study in a more experimental way certain aspects of children's drawing, on the other hand, to study intellectual aspects

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[1] Viktor Lowenfeld, Your Child and his Art, A guide for parents, (New York: Macmillan Company, c 1955), p. 6

connected with perceptual activities."[1]

Frequently, the child finds it difficult to distinguish between what he knows to be present in an object and what he can see in this object. He may draw, for example, a house with transparent walls, or a woman with a transparent skirt according to his level of development and his logical method of expression. In other words: the child has to learn to distinguish between what is and what appears. The Transparencies Test has been designed to test this aspect of development.

The child also finds it difficult to distinguish between what he knows to be present in an object and how he sees its image. He may draw the image of a house with an upside down roof, or he may draw it as he sees it according to his level of development. The child has to learn to distinguish between what the object is and what the image is. The increasing mobility of perception is an important aspect of mental development. The Inversion of Forms Test attempts to measure this aspect of development by very simple designs.

The child's perception of reality is rigid. Grown up thinking requires that one is free from what he sees, because, in addition to what he actually sees,he always has to deal with what could be as a possibility. Small and big

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[1] Ernest E. Boesch, "Form Tests," Research Bulletin, Supplementary Document No. 1, p. 13

inventions in men's life have always been made possible by imagining things differently from what they look like.

1.2 The Significance of the Problem.

These two tests, the Transparencies and the Inversion of Forms Tests are devices for measuring some aspects of mental development. They form a part of the research programme of the International Institute for Child Study.[1]

"Individual differences in degree of mental acuity or intelligence can be explained to some extent in terms of certain inherent characteristics as these are influenced by environmental conditions. Except in special cases, however, it is difficult to isolate any one factor as the sole cause of mental status. Among the more generally accepted bases of differences can be included: health and physical development, sex and social and economic conditions."[2] We can say in another way that the mental development of an individual is based upon the kind of brain he is born with, the growth of his brain to maturity, and the way his brain has been modified during his interaction with his environment.[3]

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[1] see Ernest E. Boesch, Research - Plan 1956. (Bangkok: The International Institute for Child Study, c. 1956)

[2] Crow & Crow, Child Psychology, (New York: Barnes & Noble, Inc., c 1955), p. 61.

[3] Norman L. Munn, Psychology, (Boston: Houghton Mifflin Company, c 1956), p. 80

These two tests measure some aspects of mental development of Thai children. They will help in studying the understanding of the growth and development of the Thai children. If we study the surroundings and the data about the development of the children in different cultures, it will help us to advance our knowledge about the influence of environmental factors on the mental development.

Besides helping the whole group, we can help children individually. Those of low mental development can be taken aside for special education in line with their capacity to acquire mental development. Those of very high capacity can be selected for education in keeping with their capacity. Teachers may more wisely give guidance if they know a child's level of development.

1.3 The Sample

"The International Institute for Child Study has to concentrate the investigations in schools and cannot work, altogether, in more than four schools at the same time. For such a small number randomness has no meaning. We decided therefore to select our experimental schools in accordance with one variable which we considered to be of main importance for the variations in the educational situation in Bangkok: the socio - economic back-ground of the families. The criterion which was available for this purpose was the occupation of parents."[1]

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[1] Boesch, Research Bulletin, p. 3.

"From available schools, we selected two which seemed, at first sight, to represent more or less the socio-economic distribution of the Bangkok population. We decided to concentrate our first study on the first and fourth grade of the primary school. In addition we selected for group testing two other schools recommended by the Ministry of Education, which appeared to comprise a comparable group of children. We decided to study grades two and three in these two schools, thus getting the following distribution for the study:

School	Grade	examined
A	1 and 4	(boys and girls)
B	2 and 3	(boys only)
C	2 and 3	(girls only)
D	1 and 4	(boys and girls)" [1]

"It is interesting to examine the age range of all classes :

D_1 : 2 years

D_4 : 2 years (1 extreme case discarded)

C_2 : 3 years

B_3 : 3 years

A_1 : 4 years

C_3 : 4 years (1 extreme case discarded)

B_2 : 5 years

A_4 : 6 years

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[1] Boesch, Research Bulletin, pp. 4 - 5

School A has the highest, school D the lowest age range, while B and C are intermediate. If we study the income and the occupation of these groups, it shows that the socio - economic differences are accompanied by age differences."[1]

"Let us finally look at the class room totals :

D_4 : 24 children
D_1 : 32 "
C_2 : 32 "
B_3 : 35 "
B_2 : 38 "
A_1 : 39 "
C_3 : 42 "
A_4 : 45 "

Again, we see that school D has the most favorable situation while school A show the highest average number of children per classroom which suggests that teaching facilities are inferior in school A ."[2]

"As a conclusion we might say that school A corresponds most clearly to the economic distribution of the Bangkok population, but shows an age distortion which is of major concern to the research worker. School D shows

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[1] Boesch, Research Bulletin, p. 10

[2] Ibid., pp. 10-11

the most cohesive age - picture, but deviates strongly from the socio - economic distribution. School B and C in all respects seem to be intermediate, but still more closely to D than to A. School B and C seem at first view to be sufficiently similar for allowing us to combine them for obtaining a combined sex group."[1]

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[1] Boesch, Research Bulletin, p. 11

CHAPTER II

METHODS AND TECHNIQUES

2.1 The Background of these Tests

The Transparencies and the Inversion of Forms Tests are one part of the experimental techniques of the International Institute for Child Study. Altogether there are 21 tests. The testing began at the end of January 1957. We tested first in the third & fourth grades of four primary schools as mentioned in Chapter I. After finishing the experimental techniques in the third and fourth grades of those schools, we then tested the first and second grades. We had to test individually in the first grade. The period for testing was from 9:30 to 11:30. It was planned that subjects should not have two difficult tests together on the same day, or have too many tests on the same day either.

In the group tests, there was one experimenter and three assistants in one class room. The tester as well as the assistants was required to study the instructions so thoroughly that they all were quite familiar with the test. The assistants helped the tester in controlling the class, giving the material to and collecting the material from the subjects, and explaining the unclear parts to them. The material used was controlled to be the same for every class, for instance, a thick pink paper

size 14" x 9.5" was given to every child to place it under the answer sheet. The pencils were Lyra No. 2 and not shorter than 6 inches. The erasers were not allowed.

2.2 Procedure of the Transparencies Test.

In the Transparencies Test the assistants gave the answer sheet, a black pencil and a red pencil to every child. The top of the paper was used for writing the name, grade, school and date. The sentences in the answer sheet for the first to the fourth pictures were :

1. Draw a basket filled with six oranges.
2. Draw an orange, pierced through by a needle.
3. Draw an umbrella raised over a woman.
4. Draw with the red pencil over parts of the lines which cannot be seen in reality.

(see Appendix 1 p. 76)

In giving directions, the tester first told the class to write their names, grade, school and date on the top of the papers.

The explanations for the first picture were :

"Look at the first picture. There are a basket, seen from the front and six oranges. Suppose we put the six oranges in the basket. Draw the basket filled with the six oranges as you see them from the front. Draw it in the rectangle, pointed to by the arrow.

The time allowed is 1 minute.

For the second picture :

"Look at the next picture. You will see an orange and a long needle. Draw this orange as pierced through by the needle. Draw it in the rectangle, pointed to by the arrow."

The time allowed is 2 minutes.

For the third picture :

"The next picture is a woman standing with a raised umbrella to protect her from the sun. But the umbrella is not yet drawn. Draw an open umbrella in her hand."

The time allowed is 2 minutes.

For the next picture the tester drew on the blackboard a handbag and a purse in it as if the handbag were transparent. She showed the class her own handbag and purse, and then put the purse in her handbag and asked if the subjects saw her purse. The tester then pointed at the picture on the blackboard and said while drawing "So I draw with red chalk over the parts of the lines which cannot be seen in reality."

The experimenter then gave the instructions.

"Now look at your paper, you will see four pictures. They are a box; a girl wearing a skirt; a tree on the earth; and a man sitting in the house while in front of the house there is an earthen jar with a fish in it.

There are some parts in these pictures which cannot be seen in reality because something covers them up. Draw over those lines which cannot be seen in reality with the red pencil.

The time allowed is 4 minutes.

(see Appendix I p. 75)

2.3 Procedure of the Inversion of Forms Test.

In the Inversion of Forms Test the assistants gave the answer sheet, and a black pencil to every child and did the same as on the Transparencies Test. The sentences in the answer sheet were as follows :

1. Draw the image of the house as seen in the water.

2. Draw the image of the chair as seen in the mirror.

3. Draw the image of these three letters as seen in the mirror.

4. Draw on the right side the image of each pattern as seen on the mirror.

(see Appendix II P. 107)

The experimenter showed the class a mirror size 14" x 10" with a card drawn with this figure attached to it. The instructions were :

"Look here, you will see a figure on the card, the closed side is on the right, and the open side is on

the left. If I put it in front of the mirror. Wnere is the open side as seen in the mirror ? The right side. Quite right. What about the closed side ? The left side. Quite right. You will see that the image as seen in the mirror is inverted. If it is left in reality, it will be seen as right in the mirror. If it is right in reality, it will be seen as left in the mirror.

What do you see, if I put it like this ? (The experimenter put in the way that the open side is upward.) It is all right, the upside in the figure will be the downside as seen in the mirror, and the downside in the figure will be the upside as seen in the mirror.

We frequently see such images in water as we see them in the mirror. Now look at your paper, you will see a house standing by the still water. The water is like the mirror, and you can see the image in the water. Draw the image of the house as seen in the water."

The time allowed is one and a half minute.

"The second figure is the chair placed in front of the mirror. Draw the image of the chair as seen in the mirror in the rectangle.

The time allowed is one and a half minute.

"You will see the letters placed in front of the mirror. Draw the image of these letters as seen in the mirror in the rectangle."

The time allowed is two and a half minutes.

"The next figure is the patterns, which are formed by joining many points with lines. You will see many points on the right side, of the same number as those seen on the left side. (The experimenter pointed at them in the answer sheet.) If you look at the left pattern as seen in the mirror, what will you see? How do the lines join the points? Draw on the right side the image of each pattern as seen in the mirror."

The time allowed is four minutes.

(see Appendix II p. 105)

For the individual tests in Grade I, the experimenter used the same instruction, but instead of fixing the time, he recorded both the time for each picture and the behavior of the subjects.

CHAPTER III

THE RESULTS OF THE TRANSPARENCIES TEST

3.1 Data Summary & Findings

This test is divided into seven items. The task required of the subject is much different in each item. Each item, therefore, will have to be explained separately.

3.1.1 The drawing of the first picture, which we will call here item I, is the basket filled with six oranges. Ten qualitative criteria used for classifying the results are :

1. No transparency : Only a small part of the oranges emerges.

2. No transparency : Approximately a half of each orange emerges.

3. No transparency : The oranges are wholly aranged on the edge of the basket.

4. No transparency : Some of the oranges are floating above the edge of the basket, with others piling in different positions on top of them.

5. The six oranges are seen through the side of the basket. No orange emerges above the edge of the basket.

6. Some oranges are seen through the side of the basket; others emerge above the edge. None are in a floating position.

7. Some oranges are seen through the side of the basket, others emerge above the edge. All seem to be floating.

8. There are more than 6 oranges & they are all seen through the side of the basket.

9. There are less than 6 oranges & they are all seen through the side of the basket.

10. Incompletion.

(see the examples in Appendix I page 77-78)

The results of the classification according to the ten qualitative criteria are summarized in Table 16

Children's problems in this item are : transparency, spatial relationship and number.

In, category 1, there is only one response in B_2.(see Table 79) In category 2, the children of grade I cannot succeed, and the responses of D_4 have the highest percentage. The percentage of this category increases from grade to grade. In categories 1 & 2, the children can solve the problem of transparency, spatial relationship and number.

In categories 3 & 4, the children show clearly their failure in solving the problem of spatial relationship, but they can solve the problem of transparency and number.

TABLE 16. PERCENTAGE OF RESPONSES TO ITEM I

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	0	0	0	2.94	0	1.52	0	0	0	0	0	0	.41
2	0	0	C	5.88	9.37	7.57	3.13	13.16	8.57	6.06	38.10	18.52	8.54
3	5.00	12.50	7.14	0	0	0	12.50	5.26	8.57	6.06	14.29	9.26	6.10
4	10.00	18.75	12.50	0	3.13	1.52	12.50	0	5.71	3.03	0	1.85	5.28
5	70.00	50.00	64.29	52.94	68.75	60.61	56.25	65.79	61.43	66.67	28.57	51.85	59.76
6	5.00	0	3.57	11.76	12.50	12.12	3.13	2.63	2.86	6.06	9.52	7.41	6.50
7	0	0	0	5.88	6.25	6.06	12.50	5.26	8.57	6.06	4.76	5.56	5.28
8	10.00	6.25	8.93	11.76	0	6.06	0	5.26	2.86	3.03	0	1.85	4.88
9	0	6.25	1.79	5.88	0	3.03	0	0	0	3.03	4.76	3.70	2.03
10	0	6.25	1.79	2.94	0	1.52	0	2.63	1.43	0	0	0	1.22

Category 5 is the most popular response of every grade but D_4. A_1 has the highest percentage in this category. Category 6 is nearly the same as category 5. When we add the percentage of responses of category 5 to that of category 6, the percentages of responses decrease from grade to grade, with the exception of grade I, for which the test has been applied individually. In these two categories the children fail in solving the problem of transparency, but succeed in solving the problems of spatial relationship and number. The children who can solve only the problem of number in category 7 are rare.

The children who fail in solving the problems of transparency, spatial relationship and number give responses of categories 8 & 9. The percentage of responses decreases from grade to grade.

Very few responses --not more than one in each class-room belong to category 10. (see Table 79) None of the responses of grade 4 can be classified under this category.

The investigator classified the age of subject into 9 age-groups. There was much variation in the number of children in the various age-groups ranging from 3 to 89. The total number of subjects in each age-group are shown in Table 18

TABLE 18 TOTAL NUMBER OF SUBJECTS IN EACH AGE = GROUP

Age - group	No.
5/9- 6/8	9
6/9- 7/8	46
7/9- 8/8	89
8/9- 9/8	54
9/9-10/8	17
10/9-11/8	9
11/9-12/8	13
12/9-13/8	6
13/9-14/8	3

Because the lower & upper extremes in age are so relatively small in number, and in order to make the figures more nearly representative and easier to compare, the writer added the age-group 5/9-6/8 years to age-groun 6/9-7/8 years, and the age-groun 9/9-10/8 years up to 14/8 years, making four age-groups. The regrouping gives the following totals:

TABLE 19a TOTAL NUMBER OF SUBJECTS IN EACH REARRANGED AGE=GROUP

Age-group	No.
5/9-7/8	55
7/9-8/8	89
8/9-9/8	54
9/9-14/8	48

TABLE 19 b. PERCENTAGE OF RESPONSES TO ITEM I ARRANGED ACCORDING TO AGE

Type of Responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	0	0	1.85	0	0.41
2	1.82	3.37	24.07	8.33	8.54
3	5.46	4.49	7.41	8.33	6.10
4	7.27	7.87	1.85	2.08	5.28
5	65.45	68.54	37.04	62.50	59.76
6	3.64	5.62	11.11	6.25	6.50
7	3.04	4.49	7.41	6.25	5.28
8	5.46	5.62	5.56	2.08	4.88
9	3.64	0	3.70	2.08	2.03
10	3.64	0	0	2.08	1.22

The percentages of responses in category 2 increase with age except the 9/9-14/8 age-group. The 24.07 per cent of the 8/9-9/8 age-group are in category 2. It shows very much better than other age-groups.

Category 5 is the most popular response of every age-group.

3.1.2 The drawing of the second picture is the orange, pierced through by a long needle, which we will call here item II. It has been divided according to 7 qualitative criteria :

1. No transparency. The needle pierces through the orange. The pointed end of the needle can be seen and the other end is in front of the orange.

2. No transparency. The needle is partly through the orange. The pointed end is seen, but the other end of the needle is behind the orange.

3. No transparency. The needle does not run through the orange. The sharp end of the needle is not seen.

4. The orange is transparent; the whole needle which is put through it can be seen.

5. The orange is transparent; the needle is through it, but the sharp end is missing.

6. Ambiguous case

7. The needle and the orange are separated.

See the examples in Appendix I pp 81-82

TABLE 22. PERCENTAGE OF RESPONSES TO ITEM II

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	2.50	0	1.79	14.71	9.37	12.12	28.13	7.90	17.14	18.18	61.91	35.19	16.2
2	5.00	6.25	5.36	2.94	12.50	7.58	12.50	21.05	17.14	15.15	4.76	11.11	10.5
3	40.00	56.25	44.64	5.88	50.00	27.27	21.88	50.00	37.14	9.09	9.52	9.26	30.0
4	42.50	37.50	41.07	61.77	12.50	37.88	34.38	13.16	22.86	57.58	23.81	44.44	35.7
5	2.50	0	1.79	2.94	6.25	4.55	0	0	0	0	0	0	1.6
6	5.00	0	3.57	5.88	6.25	6.06	3.13	7.90	5.71	0	0	0	4.0
7	2.50	0	1.79	5.88	3.13	4.55	0	0	0	0	0	0	1.6

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The percentages of responses in category 1 increase with grade. It is the same in category 2 except D_4, since the percentage of responses of this group is also high in category 1.

Category 3 is the most popular for grade I & III The percentages of responses of two schools in the same grade are very different except grade IV.

Category 4 is the most popular for grade II & IV The percentages of responses of two schools in the same grade are also very different except grade I.

None of grade IV are in categories 5,6,7, only grades I & II are in these three categories. Grade III are in category 6, which is the ambiguous case. In category 6 we do not know whether the children understand transparency. The whole needle is in front of the orange, the sharp end is very near the bottom of the orange. We do not know what the children mean. May be the needle has pierced the orange as it is transparent, or the needle has not yet pierced the orange.

It is very interesting to look at the majority of these schools. The majority of A_1 is in 4 & 3 and D_1 is in 3 & 4. The majority of A_4 is in 4 & 1, and D_4 is in 1 & 4. The majority of B_2 & B_3 are in 4 & 1, and C_2 & C_3 are in 3 & 2.

In grades II & III the majority of the same school but different grade is more alike than the majority of the same grade but different school. As it was shown above the majority of school B is in categories 4 & 1, and the

majority of school C in categories 3 & 2.

TABLE 24 PERCENTAGE OF RESPONSES TO ITEM II
ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	7.27	14.61	20.37	25.00	16.26
2	3.64	11.24	12.97	14.58	10.57
3	34.55	35.96	33.33	10.42	30.08
4	43.64	26.97	29.63	50.00	35.77
5	3.64	2.24	0	0	1.63
6	1.82	8.98	1.85	0	4.07
7	5.45	0	1.85	0	1.63

The percentages of responses in categories 1 & 2 increase with age. Most of them are in categories 3 & 4, except the 9/9-14/8 age-group which are in categories 4 & 1.

Very few of them are in categories 5,6,7. There are only 2 subjects in the 8/9-9/8 age group, belong to categories 6 & 7. (see Table 84 a). None of the 9/9-14/8 age-group are in categories 5,6,7.

3.1.3. The drawing of the third picture is the raised umbrella which protects the woman from the sun. We will call this Item III. It has been divided according to 6 qualitative criteria:

1. Realistic: the drawing of an umbrella is as it appears, not as it is in reality. It. The upper part of the roof of the umbrella is represented by a curved line. The circumference of the roof is a continuous concave line for every space of two ribs. Sone parts of it which are hidden by the roof cannot be seen in this type of drawing.

2. Missed-realism : the drawing is nearly the same as the first criteria, but it has some mistakes. For instance, the circumference of the roof is represented by two straight lines, making an angle of about 135°.

3. Realistic intention but distorted : the drawing tried to be realistic but it was distorted. The umbrella is drawn as seen from the front, but the drawing is not in good proportion. For instance, two sides of the roof are not symmetrical,and the roof of the umbrella is rather flat. Some hidden parts of the handle are shown.

4. Intellectual realism : the drawing of the umbrella is as it is in reality, not as it appears.

The umbrella comprises two parts, a roof with ribs and a stick. A roof is represented by an oval or a circle, which has lines starting from the centre to the circumference, those lines are supposed to be the ribs. Some draw a stick beginning from the centre. Some draw it as if it had the end at the centre, and some part of it is hidden by the roof.

5. Eccentric : the drawing is nearly the same as intellectual realism. But the stick looks as if it begins from the edge of the roof not from the centre.

6. Schematic form : the drawing is something like one line or two narrow lines being attached to a broad area, which was intended to be the roof of the umbrella.

See the examples in Appendix I pp 85-86

TABLE 27. PERCENTAGE OF RESPONSES TO ITEM III

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Tota
	A	D	total	B	C	total	B	C	total	A	D	total	
1	0	0	0	11.76	0	6.06	3.13	7.90	5.71	33.33	57.14	42.59	12.6
2	5.00	6.25	5.36	14.71	9.37	12.12	25.00	15.79	20.00	27.27	9.52	20.37	14.6
3	30.00	31.25	30.36	58.89	28.12	43.94	40.63	42.11	41.43	18.18	19.05	18.52	34.5
4	12.50	18.75	14.28	8.82	34.38	21.21	28.13	26.36	27.14	15.15	4.76	11.11	19.1
5	17.50	25.00	19.64	5.88	25.30	15.15	0	5.26	2.86	6.06	9.52	7.41	10.9
6	35.00	18.75	30.36	0	3.13	1.52	3.13	2.63	2.86	0	0	0	8.1

None in grade I are in category 1. The percentages of responses of grade II are slightly more than those of grade III. Grade IV has the highest. Most of A_4 & D_4 are in this category.

The percentages of responses in category 2 increase with grade.

The percentages of responses in category 3 of grade II are slightly more than grade III, and grade I is the third, The lowest is in grade IV. Most of grades II & III are in this category and also D_1

The percentages of responses in category 4 increase with grade, except those of grade IV, most of which are in category 1.

The percentages of responses in category 5 decrease with grade, except grade IV, which have only 2 subjects more than grade III. (See Table 87)

Most of A_1 are in category 6. Very few of grades II & III and none of grade IV are in this category. The percentages of responses of grade I are the highest in this category.

TABLE 29 PERCENTAGE OF RESPONSES TO ITEM III ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	1.82	3.37	24.07	29.17	12.60
2	12.73	13.48	5.56	29.17	14.64
3	32.73	40.45	37.04	22.92	34.55
4	16.36	21.35	25.93	10.42	19.11
5	18.18	14.61	3.70	4.17	10.98
6	18.18	6.74	3.70	4.17	8.13

The percentages of responses in category 1 increase with age. It is the same in category 2 except the 8/9-9/8 age-group, since the percentage of responses of this group is also high in category 1.

The majority of the first three age-group is in category 3. The majority of the 9/9 - 10/8 age-group is in categories 1 & 2.

The percentages of responses in categories 5 & 6 decrease with the increase of age, except 9/9 - 14/8 age-group. But the number of subjects in the 9/9 - 14/8 age-group which belong to categories 5 & 6 are the same as those in the 8/9 - 9/8 age-group. There are 2 subjects in each category. (See Table 84 b)

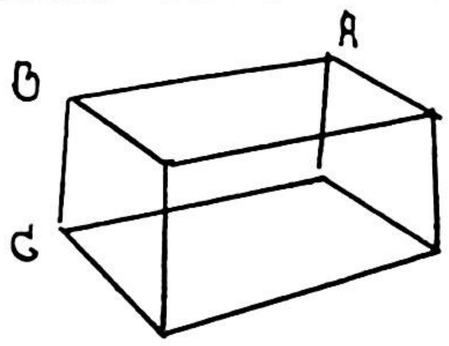
3.1.4. The next pictures are a paper box, a girl wearing a skirt, a tree standing on the earth, and a man sitting in a house. They will be called here item IV, V, VI, VII respectively.

Item IV has been divided according to 7 qualitative criteria :

1. Correct without lid : the lines, being hidden by the side of a box are drawn with red pencil. It is drawn as if it were a box without lid.

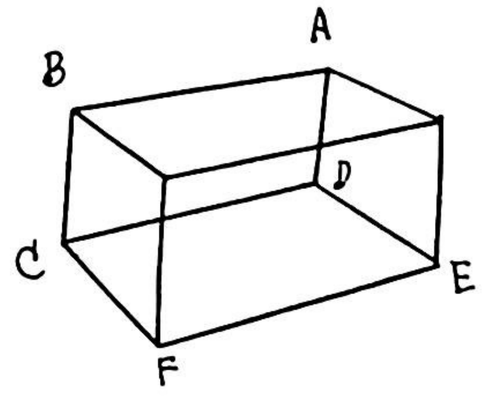
2. Correct with lid : it is drawn like category 1, but as if it were a box with a lid on it.

3. Partially correct : it is drawn as a box with a lid but having one unnecessary line. This line will be a line that is farther from the subject than other lines.



(Line AB or BC in the figure at left)

4. Attempt to solve : it is drawn as attempting to show one side or two sides of the box that are hidden. (Side ABCD and/or CDEF in the figure)



5. Wrong : the box is drawn on any lines, which do not show any lines or any parts, being hidden by other parts.

6. Drawn on every line.

7. No responses.

See the examples in Appendix 1 pp 88-89

The percentages of responses in categories 1 & 2 increase with grade, but the responses of grade II are slightly more than grade III, because C_2 is better than C_3 in category 1, and B_2 is better than B_3 in category 2.

The percentages of responses in categories 3 & 4 increase from grade to grade with the exception of the response of grade III which is slightly lower than that of grade II, because C_2 is better than C_3 in category 4.

The percentages of responses in category 5 decrease with the increase of grade except A_1.

The children who have the responses in categories

TABLE 32. PERCENTAGE OF RESPONSES TO ITEM IV

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	0	0	0	0	9.38	4.55	0	5.26	2.86	6.06	9.52	7.41	3.66
2	2.50	6.25	3.57	8.82	0	4.55	0	7.89	4.29	12.12	19.05	14.81	6.50
3	25.00	12.50	21.43	20.59	9.38	15.15	21.88	10.53	15.71	33.33	38.10	35.19	21.14
4	5.00	0	3.57	0	9.38	4.55	6.25	0	2.86	9.09	14.29	11.11	5.28
5	10.00	75.00	28.57	44.12	25.00	34.85	25.00	21.05	22.86	12.12	14.29	12.96	25.29
6	42.50	0	30.36	23.53	34.38	28.79	28.13	50.00	40.00	21.21	0	12.96	28.86
7	15.00	6.25	12.50	2.94	12.50	7.58	18.75	5.26	11.43	6.06	4.76	5.56	9.35

6 & 7 may have as their reasons that they cannot understand the instruction, or they can understand the instruction but do not know how to solve the problem, so they just draw on every line to pass the time or do not do anything. The children may not draw on any lines because of their carelessness. In these two categories the percentage of responses of grade I is the highest and grade IV is the lowest. Grade III is more than grade II.

The majority of A_1 draws on every line, and D_1 draws incorrectly. The majority of B_2 draws incorrectly and C_2 draws on every line. Most of grade III draw on every line, but most of grade IV are partially correct.

TABLE 33. PERCENTAGE OF RESPONSES TO ITEM IV ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	0	3.37	3.70	8.33	3.66
2	7.27	1.12	11.11	10.42	6.50
3	18.18	14.61	27.78	29.17	21.14
4	1.82	6.62	9.26	4.17	5.24
5	36.36	23.59	20.37	20.83	25.20
6	29.09	37.08	22.22	20.83	28.86
7	7.27	14.61	5.56	6.25	9.35

Category 1 is nearly the same as category 2. If we add the percentage of responses of category 1 to

that of ~~cat~~ category 2. The percentages of correct responses, increase from age to age with the exception of the 7/9-8/8 age-group. The percentages of responses in category 3 also increase from age to age with the exception of the 7/9-8/8 age-group, since most of them draw on every line. The majority of the 8/9-9/8 and 9/9-14/8 age-groups is partly correct.

Item V,VI,VII, pictures of a girl wearing a skirt, a tree standing on the earth and a man sitting in the house have been divided according to 4 qualitative criteria:

1. Correct : all parts of the lines which cannot be seen in reality are drawn with red pencil.

2. Lack of necessary line : some parts of the lines which cannot be seen in reality are still not yet drawn with red pencil. Every drawing which has no necessary lines even though having excess of unnecessary lines is included in this criteria.

3. Excess of unnecessary line : Not only parts of the lines which cannot be seen in reality are drawn with red pencil, but some parts of the lines which can be seen in reality are also drawn with red pencil.

4. Drawn on every line.

See the examples in Appendix I pp 92-96

TABLE 35. PERCENTAGE OF RESPONSES TO ITEM V

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	10.00	12.50	10.71	20.59	34.38	27.27	25.00	15.79	20.00	45.45	76.19	57.41	28.05
2	52.50	68.75	57.14	47.06	43.75	45.45	40.63	63.16	52.86	33.33	9.52	24.07	45.53
3	17.50	12.50	16.07	23.53	18.75	21.21	18.75	18.42	18.57	15.15	14.29	14.81	17.89
4	20.00	6.25	16.07	8.82	3.12	6.06	15.63	2.63	8.57	6.06	0	3.70	8.54

The percentages of responses in category 1 generally increase with grade, but the result of grade II is rather higher than grade III because of C_2.

In category 2 grade I ranks highest, grade IV lowest. C_2 is still better than C_3.

The percentages of responses in category 3 decrease with the increase of grade but grade I.

The percentages of responses in category 4 decrease with the increase of grade except B_3.

The majority of grade IV draws correctly, and the majority of the other grades draw with lack of necessary lines. Very few of them draw on every line.

TABLE 36. PERCENTAGE OF RESPONSES TO ITEM V ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	14.55	25.84	27.78	47.92	28.05
2	58.18	43.82	48.15	31.25	45.53
3	20.00	15.73	20.37	16.67	17.89
4	7.27	14.61	3.70	4.17	8.59

The percentages of responses in category 1 increase with age. The majority of the 9/9-14/8 age-group draws correctly. The majority of the other age-groups draw with lack of necessary lines. Very few of them draw on every line.

TABLE 37. PERCENTAGE OF RESPONSES TO ITEM VI

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	62.50	43.75	57.14	50.00	62.50	56.06	53.13	63.16	58.57	90.91	100.00	94.44	65.4
2	12.50	50.00	23.21	23.53	9.38	16.67	21.88	23.68	22.86	3.03	0	1.85	16.6
3	12.50	0	8.93	8.82	21.88	15.15	9.38	7.89	8.57	6.06	0	3.70	9.3
4	12.50	6.25	10.71	17.65	6.25	12.12	15.63	5.26	10.00	0	0	0	8.5

Item VI is the picture of a tree standing on the earth.

The percentage of responses in category 1 of grade III is slightly better than grade II, and grade II is also better than grade I with the exception of A_1. But grade IV is much better than grade III. All of D_4 are in this category.

In category 2 grade I has the highest percentage of responses, grade IV has the lowest. C_2 is much better than C_3, because many of them are in category 3.

The percentage of responses in category 4 of B_3 is slightly lower than B_2, and also C_3 is slightly lower than C_2. School B has more percentage of responses in this category than school C. None of grade IV are in this category.

Most of the subjects can succeed in Item VI except D_1. However the percentage of correct answers of D_1 is 44%.

TABLE 38 PERCENTAGE OF RESPONSES TO ITEM VI ARRANG D ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	54.55	55.06	72.23	89.58	65.45
2	23.64	20.22	16.67	2.08	16.67
3	7.27	12.36	9.26	6.25	9.35
4	14.55	12.36	1.85	2.08	8.54

The percentages of correct answers, the responses in category 1, increase with age. But those in category 2 decrease with the increase of age.

The percentage of responses in category 4, the tree being drawn on every line, of grade II is less than that of grade I. There is only one subject in each other age-group in this category. (See Table 100 a)

Item VII is a man sitting in the house, and in front of the house there is an earthen jar with a fish in it.

The percentages of correct answers, the responses in category 1, increase with grade.

The results of grades I & II & III in category 2 are nearly the same. But grade IV has the lowest percentage.

The percentage of responses in category 4 of grade I is more than those of grade II. None of grades III & IV belong to this category . (the figure being drawn on every line)

The majority of all subjects in every grade misses the necessary lines, since there are many lines to draw in this picture.

TABLE 40 PERCENTAGE OF RESPONSES TO ITEM VII

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	12.50	0	8.93	11.76	9.37	10.61	34.38	15.79	24.29	33.33	42.86	37.04	19.92
2	55.00	81.25	62.50	55.88	62.50	59.09	56.25	63.16	60.00	36.36	47.62	40.74	56.10
3	22.50	12.50	19.64	23.53	25.00	24.24	9.38	21.05	15.71	30.30	9.52	22.22	20.33
4	10.00	6.25	8.93	8.82	3.13	6.06	0	0	0	0	0	0	3.66

TABLE 41 PERCENTAGE OF RESPONSES TO ITEM VII ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	10.91	12.36	27.78	35.42	19.92
2	61.82	66.29	50.00	37.50	56.10
3	16.36	19.10	20.37	27.08	20.33
4	10.91	2.25	1.85	0	3.66

The percentages of correct responses increase with age, and also those of drawing with excess of unnecessary lines in category 3. The percentages of responses in category 4 decrease with the increase of age. None in the 9/9-14/8 age-group belong to this category.

The majority of every age-group, falling in cat 2 shows the lack of necessary lines.

3.2 The Scoring & Difficulties.

Each item has been discussed. Now, let us talk about the test as a whole and then compare the responses to each item. We will give them arbitrary scores according to their qualities.

TABLE 42 THE SCORING PLAN

Item	Category	Score
I	1, 2	3
	3, 4	2
	5, 6, 7	1
	8, 9, 10	0
II	1, 2	3
	3	2
	4, 5	1
	6, 7	0
III	1	4
	2	3
	3	2
	4	1
	5, 6	0
IV	1, 2	2
	3, 4	1
	5, 6, 7	0
V, VI,VII	1	1
	2, 3, 4	0

After giving them arbitrary scores, we will score all subjects on each item. The frequency of all subjects total scores arranged according to grade & school & age are shown in Tables 101, 102, 103, 104

The maximum score of each item is different, ranging from 1 to 4 as shown in Table 42. The number

TABLE 43 AVERAGE SCORES IN PERCENTAGE ON EACH ITEM ARRANGED ACCORDING TO GRADE & SCHOOL

Item	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
I	35.00	37.50	35.71	32.35	40.63	36.36	43.75	41.23	42.38	38.38	61.90	47.53	40.49
II	49.17	56.25	51.19	43.14	61.46	52.02	66.67	66.67	66.67	58.59	80.95	67.28	59.35
III	21.88	25.00	22.77	54.41	29.69	42.42	49.22	47.37	48.21	66.67	75.00	69.91	45.63
IV	17.50	12.50	16.07	19.12	18.75	18.95	14.06	18.42	16.43	39.39	54.76	45.37	23.37
V	10.00	12.50	10.71	20.59	34.37	27.27	25.00	15.79	20.00	45.45	76.19	57.41	28.05
VI	62.50	43.75	57.14	50.00	62.50	56.06	53.13	63.16	58.57	90.91	100.00	94.44	65.45
VII	12.50	0	8.93	11.76	9.38	10.61	34.38	15.76	24.29	33.33	42.86	37.04	19.92
Total	30.67	30.83	30.83	37.65	37.92	37.78	44.58	42.98	43.71	53.74	70.48	60.25	42.79

of total subjects in every group is different. So the writer tried to find the average scores of each group as if the maximum score of every item is 100. Now we get the average scores in percentage on each item as will be shown in Table 43

The total average scores in percentage for all the seven items increase from grade to grade. Those of the same grades except grade IV are almost equal. D_4 is much higher than A_4, and A_4 has the highest percentage.

The average scores in each item increase with grade. Grade III in items IV & V are the exception.

The average scores of each item show the ability in performing it. The rank order of the highest average scores is 1 and of the lowest is 7 for every class. The rank orders of each item for every class will be shown in Table 44.

TABLE 44 RANK ORDER OF EACH ITEM
ARRANGED ACCORDING TO CLASS.

Item	A_1	D_1	B_2	C_2	B_3	C_3	A_4	D_4	Total
I	3	3	4	3	4	4	6	5	4
II	2	1	3	2	1	1	3	2	2
III	4	4	1	5	3	3	2	4	3
IV	5	5.5	6	6	7	5	5	6	6
V	7	5.5	5	4	6	6	4	3	5
VI	1	2	2	1	2	2	1	1	1
VII	6	7	7	7	5	5	7	7	7

The rank orders of the various items in each class are not much different from those of all subjects.

TABLE 45 AVERAGE SCORES IN PERCENTAGE ON EACH ITEM ARRANGED ACCORDING TO AGE

Item	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
I	34.55	37.83	50.62	40.28	40.38
II	49.70	59.55	65.43	63.19	59.35
III	31.82	39.04	53.24	65.10	45.63
IV	17.27	14.61	33.33	35.42	23.37
V	14.55	25.84	27.78	47.92	28.05
VI	54.55	55.06	72.22	89.58	65.45
VII	10.91	12.36	27.78	35.42	19.92
Total	32.97	38.05	50.37	54.31	42.79

The total average scores(in percentage) for all the seven items increase with age.

The average scores on each item increase with age, except the 9/9-14/8 age-group in items I & II. The 7/9-8/8 age-group in item IV is also an exception

TABLE 46 RANK ORDER OF EACH ITEM ARRANGED ACCORDING TO AGE

Item	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
I	3	4	4	5	4
II	2	1	2	3	2
III	4	3	3	2	3
IV	5	6	5	6.5	6
V	6	5	6	4	5
VI	1	2	1	1	1
VII	7	7	6	6.5	7

The rank orders of the various items in each age-group are not much different from those of all subjects.

TABLE 47 CUMULATIVE PERCENTAGE DISTRIBUTION

OF THE TOTAL SCORE OF EACH GRADE

Score	Grade I			Grade II			Grade III			Grade IV		
	f	cumf	cumf%	f	cumf	cumf%	f	cumf	cumf%	f	cumf	cumf%
15	0	56	100.00	0	66	100.00	0	70	100.00	2	54	100.00
14	0	56	100.00	0	66	100.00	0	70	100.00	4	52	96.30
13	0	56	100.00	0	66	100.00	0	70	100.00	4	48	88.89
12	0	56	100.00	1	66	100.00	0	70	100.00	3	44	81.48
11	0	56	100.00	1	65	98.48	3	70	100.00	5	41	75.93
10	2	56	100.00	4	64	96.97	8	67	95.71	6	36	66.67
9	1	54	96.43	5	60	90.91	7	59	84.29	5	30	55.56
8	1	53	94.64	4	55	83.33	7	52	74.29	5	25	46.30
7	3	52	92.86	4	51	77.27	6	45	64.29	7	20	37.04
6	8	49	87.50	11	47	71.21	13	39	55.71	5	13	24.07
5	13	41	73.21	12	36	54.54	13	26	37.14	4	8	14.81
4	11	28	50.00	13	24	36.36	6	13	18.57	3	4	7.41
3	12	17	30.36	6	11	16.67	4	7	10.00	1	1	1.85
2	2	5	8.93	5	5	7.58	3	3	4.29	0	0	0
1	3	3	5.36	0	0	0	0	0	0	0	0	0

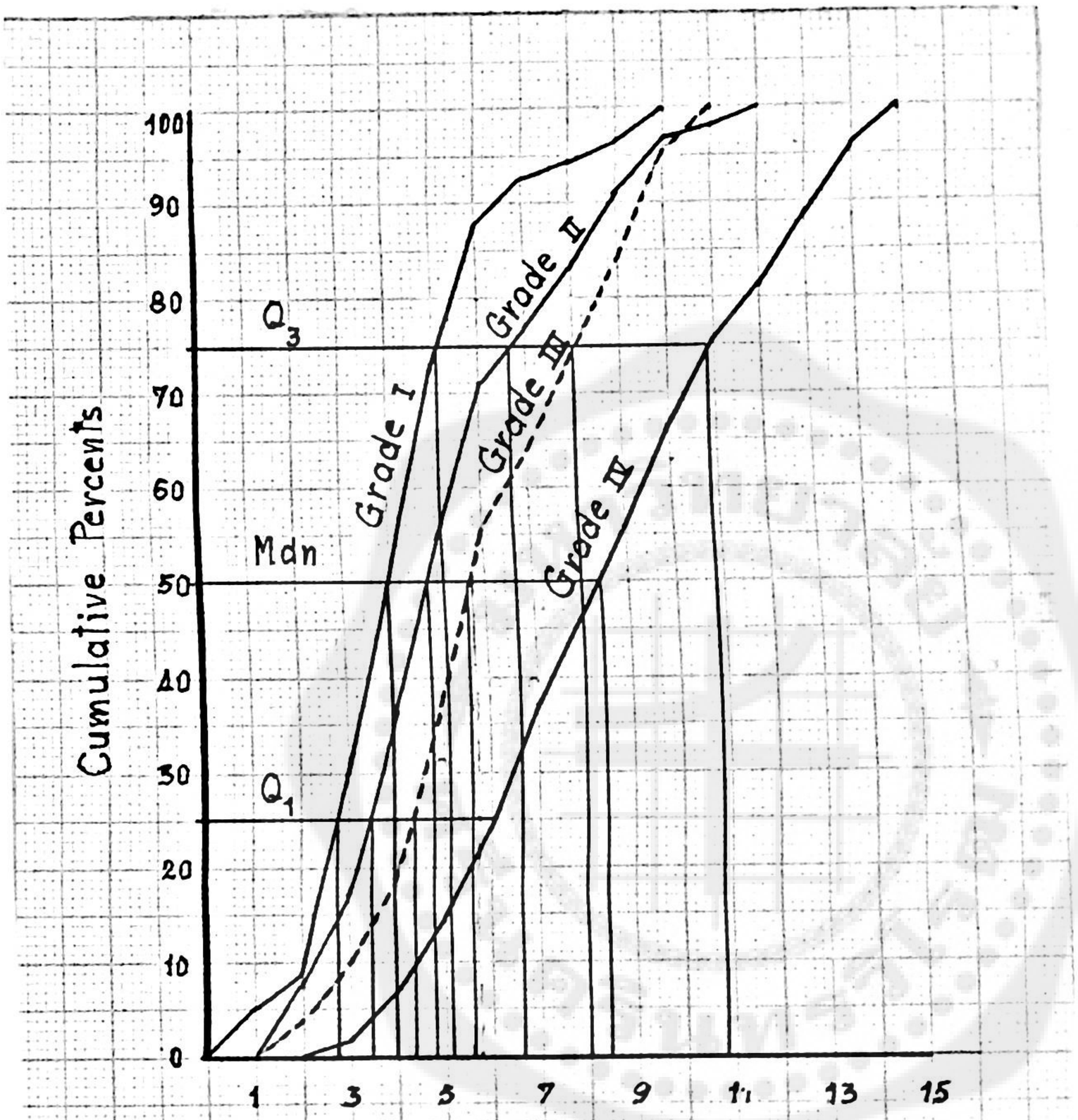


FIG 48. Ogives Representing Scores Made by Four Grade on The Tranparencies Test.

The higher grades' ogives in Fig. 48 lie to the right of the lower grades' ogives showing that the higher grades score higher than the lower ones. Differences in achievement between each grade are shown by the distances separating each curve at various levels. Grade IV is more different from grade III than grade II is different from grades I & III. The scores of 97 th. to 100 th. percentile of grade III a re lower than that of grade II.[1]

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[1] Henry E. Garrett, Statis tics in Psychology and Education, (New York : Longman, Green & Co. C 1 952) p. 87.

TABLE 50 CUMULATIVE PERCENTAGE DISTRIBUTION

OF THE TOTAL SCORE OF EACH AGE-GROUP

Score	5/9 - 7/8			7/9 - 8/8			8/9 - 9/8			9/9 - 14/8		
	f	cumf	cumf%	f	cumf	cumf %	f	cumf	cumf%	f	cumf	cumf%
15	0	55	100.00	0	89	100.00	2	54	100.00	0	48	100.00
14	0	55	100.00	0	89	100.00	3	52	96.30	1	48	100.00
13	0	55	100.00	0	89	100.00	0	49	90.74	4	47	98.92
12	0	55	100.00	1	89	100.00	0	49	90.74	3	43	89.58
11	2	55	100.00	1	88	98.88	3	49	90.74	3	40	83.33
10	1	53	96.36	6	87	97.75	8	46	85.19	5	37	77.08
9	3	52	94.55	5	81	91.01	5	38	70.37	5	32	66.67
8	3	49	89.09	4	76	85.39	5	33	61.11	5	27	56.25
7	2	46	83.64	9	72	80.90	2	28	51.85	7	22	45.83
6	5	44	80.00	19	63	70.79	8	26	48.15	5	15	31.25
5	12	39	70.91	16	44	49.44	9	18	33.33	5	10	20.83
4	12	27	49.09	13	28	31.46	5	9	16.67	3	5	10.42
3	9	15	27.27	10	15	16.85	3	4	7.41	1	2	4.17
2	4	6	10.91	4	5	5.62	1	1	1.85	1	1	2.08
1	2	2	3.64	1	1	1.12	0	0	0	0	0	0

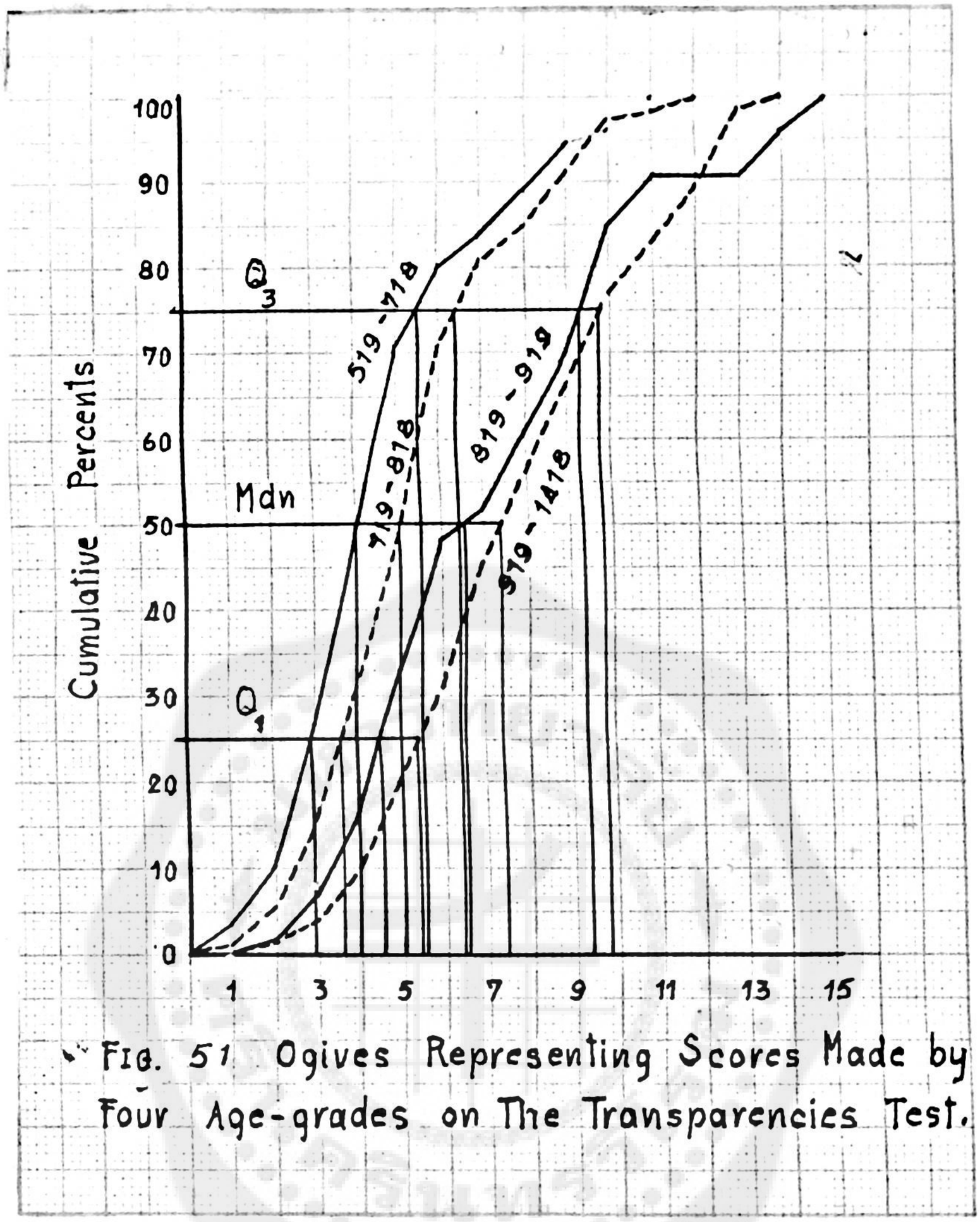


FIG. 51 Ogives Representing Scores Made by Four Age-grades on The Transparencies Test.

This figure shows that the higher age-group score higher than the lower ones, except the scores of 96 th. to 98th. percentile of the 7/9-8/8 age-group and 90 th. to 100 th. percentile of the 9/9-14/8 age-group.

CHAPTER IV

THE RESULTS OF THE INVERSION OF FORMS TEST

4.1 Data summary & Findings.

4.1.1 The drawing of the first picture is the image of the house, called here Item I. It has been divided according to 3 qualitative criteria

1. Correct : the house stands upside down in the water, the image of each house post and the house post of the original picture is in the same vertical line, but this point is not so important. The image of the upside down house succeeds in being classified to be a correct answer.

2. Partial inversion : Some parts of them show inversion of forms, but some of them do not. The house post and the wall are upside down, but the roof is not, or vice versa.

3. No inversion : there is no inversion of forms, the subject copies the original picture.

See the examples in Appendix II p.108

4.1.2 The second drawing is the image of the chair, called here Item II. Itscategories are :

1. Correct : the image of the chair shows inversion of forms. The back-rest is at the right side of the image, as it is at the left side of the original figure.

2. Copy upside down : the image of the chair

TABLE 53a. PERCENTAGE OF RESPONSES TO ITEM I

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	23.69	60.00	31.25	57.14	59.38	58.21	59.38	92.31	77.47	79.55	100.00	86.57	66.00
2	5.26	0	4.17	0	3.12	1.49	0	0	0	0	0	0	1.19
3	71.05	40.00	64.58	42.86	37.50	40.30	56.52	7.69	22.53	20.45	0	13.43	32.81

TABLE 53 b. PERCENTAGE OF RESPONSES TO ITEM II

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	10.53	20.00	12.50	42.86	50.00	46.27	53.13	38.46	45.07	72.73	73.91	73.13	46.64
2	15.79	0	12.50	0	9.37	4.48	0	20.51	11.27	6.82	0	4.48	7.91
3	73.68	80.00	75.00	57.14	40.63	49.25	46.88	41.03	43.66	20.45	26.09	22.39	45.45

is the upside down chair.

3. Copy original : the image is the same a s the original figure, the child fails to show inversion of forms.

See the examples in Appendix II p. 109

4.1.3 The third drawing is the three letters, called here Items III,IV,V respectively. They have been divided to 4 categories :

1. Correct : the image of the letter shows inversion of forms for all parts.

2. Partial Inversion : some parts of the same letter show inversion of forms, but some do not.

3. Copy upside down : the image of the letter is the same as the original figure, but it is upside down.

4. No inversion : the image is the same as the original letter.

See the examples in Appendix II p. 112

4.1.4 The fourth drawing is the image of three patterns, which are formed by joining many points with lines, called here Items VI, VII, VIII respectively. They have been divided to 4 categories :

1. Correct : the image of the pattern shows inversion of forms for all parts. The placing of the

TABLE 55 PERCENTAGE OF RESPONSES TO ITEM III, IV, V

ARRANGED ACCORDING TO GRADE & SCHOOL

Item & Category		Grade I			Grade II			Grade III			Grade IV			Total
		A	D	total	B	C	total	B	C	total	A	D	total	
III)	1	5.27	20.00	8.33	11.43	21.87	16.42	37.50	35.90	36.62	50.00	60.87	53.73	30.43
	2	2.63	0	2.09	2.86	15.63	8.96	6.25	0	2.82	20.46	13.04	17.91	8.30
	3	7.89	10.00	8.33	0	12.50	5.96	0	33.33	18.31	11.36	0	7.46	10.28
	4	84.21	70.00	81.25	85.71	50.00	68.66	56.25	30.77	42.25	18.18	26.09	20.90	50.99
IV)	1	2.63	0	2.09	8.57	21.87	14.93	18.75	15.38	16.90	29.55	43.48	34.33	18.18
	2	7.89	10.00	8.33	8.57	18.75	13.43	25.00	23.08	23.94	36.36	39.13	37.31	21.74
	3	7.89	10.00	8.33	0	9.37	4.48	0	30.77	16.90	11.36	0	7.46	9.49
	4	81.58	80.00	81.25	82.86	50.00	67.16	56.25	30.77	42.26	22.73	17.39	20.90	50.59
V)	1	2.63	10.00	4.17	8.57	21.87	14.93	34.38	25.64	29.58	31.82	47.83	37.31	22.93
	2	2.63	10.00	4.17	2.86	9.38	5.97	6.25	10.26	8.45	34.09	17.39	28.36	12.25
	3	7.89	10.00	8.33	0	9.38	4.48	0	30.77	16.90	13.64	0	8.94	9.88
	4	86.85	70.00	83.33	88.57	59.37	74.62	59.37	33.33	45.07	20.45	34.78	25.38	54.94

points joined by lines, in the image is considered an important aspect.

2. Partial inversion : the image shows inversion in some parts of the pattern, but does not in some parts, the points are not at the correct place even though the image shows inversion of form.This is considered to have partial inversion.

3. Copy original correct : the image is the same as the original figure. There is no inversion of forms.

4. Copy original wrong : the child does not show understanding of inversion of forms in the image. The image seems to be a copy, but the copy is different from the original

See the examples in Appendix II pp. 114-116

The different tables need little comment. They show, for all the items a steady progression with grade.

In the drawing of the image of the house only three persons show partial inversion.

If we look at the copy upside down responses in category 2 for item II and in category 3 for items III, IV, V at Tables 111 & 113 . We see that none in B_2, B_3, D_4 belong to these categories. C_3 has the highest percentage of upside down responses, and is relatively high. It is about 20% in item II, and 30% in item III, IV, V. It might be that the experimenter added some

TABLE 57 PERCENTAGE OF RESPONSES TO ITEM VI, VII, VIII

ARRANGED ACCORDING TO GRADE & SCHOOL

Item & Category		Grade I			Grade II			Grade III			Grade IV			Total
		A	D	total	B	C	total	B	C	total	A	D	total	
VI)	1	0	0	0	5.71	12.50	8.96	9.38	28.21	19.72	38.64	56.52	44.78	19.76
	2	0	0	0	5.71	15.63	10.45	15.63	10.26	12.68	20.45	13.04	17.91	11.07
	3	15.79	20.00	16.67	51.43	31.25	41.79	46.87	20.51	32.39	13.64	21.74	16.42	27.67
	4	84.21	80.00	83.33	37.15	40.62	38.80	28.12	41.02	35.21	27.27	8.70	20.89	41.50
VII)	1	0	0	0	2.86	3.13	2.98	18.75	20.51	19.72	29.55	39.13	32.84	15.02
	2	0	0	0	5.71	18.75	11.94	0	12.82	7.04	25.00	30.43	26.86	12.25
	3	13.16	30.00	16.67	42.86	34.37	38.81	50.00	28.21	38.03	25.00	21.74	23.88	30.44
	4	86.84	70.00	83.33	48.57	43.75	46.27	31.25	38.46	35.21	20.45	8.70	16.42	42.29
VIII)	1	0	0	0	0	0	0	3.12	0	1.41	4.55	0	2.99	1.19
	2	0	0	0	5.71	9.37	7.46	3.12	2.56	2.82	15.91	26.09	19.40	7.91
	3	2.63	0	2.08	14.29	18.75	16.42	40.64	35.90	38.03	20.45	56.52	32.83	24.11
	4	97.37	100.00	97.92	80.00	71.88	76.12	53.12	61.54	57.74	59.09	17.39	44.78	66.79

more explanation. If we look again at the instruction on p.12 , we will see that the exlanation for the image of the object being put in front of the mirror are : If it is left in reality, it will be seenas right in the mirror. If it is right in reality, it will be seen as left in the mirror. That for the image of the object being put on the mirror are : " The upside in the figure will be the downside as seen in the mirror, and the downside in the figure will be the upside as seen in the mirror." If the experimenter added some more explanation, for example; "Don't forget that the image as seen in the mirror is inverted. If it is left in reality, it will be seen as right in the mirror. If it is right, it will be left. The upside will be the downside, the downside will be the upside.". Some children may have been confused by the explanation. Even though the experimenter followed the instructions exactly, they still cannot differentiate between the image of the object being put in front of the mirror and that being put on the mirror. However the children had some idea about inversion of forms, but their concepts are vague.

Only three persons succeed in item VIII. (See Table 117) None in grade I succeed in drawing the image of three patterns. Those who understand inversion of forms will try to draw it. Some are correct, some are partly correct. Those who cannot understand try to

copy them.

This test shows us clearly the progression of grade.

TABLE 59a. PERCENTAGE OF RESPONSES TO ITEM I
ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	41.67	62.50	78.95	78.33	66.00
2	0	1.14	3.51	0	1.19
3	58.33	36.36	17.54	21.67	32.81

TABLE 59b. PERCENTAGE OF RESPONSES TO ITEM II
ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	31.25	31.82	57.89	70.00	46.64
2	2.08	12.50	7.02	6.67	7.91
3	66.67	55.68	35.09	23.33	45.45

TABLE 60 PERCENTAGE OF RESPONSES TO ITEM III,IV,V

ARRANGED ACCORDING TO AGE

Item Category		5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
III)	1	10.42	21.59	42.11	48.33	30.43
	2	2.08	5.68	7.02	18.33	8.30
	3	6.25	12.50	10.53	10.00	10.28
	4	81.25	60.53	40.34	23.33	50.99
IV)	1	6.25	13.64	26.31	26.67	18.18
	2	6.25	15.91	29.82	35.00	21.74
	3	4.17	12.50	8.78	10.00	9.49
	4	83.33	57.95	35.09	28.33	50.59
V)	1	6.25	19.32	31.58	33.33	22.93
	2.	2.08	5.68	15.79	26.67	11.25
	3	4.17	12.50	8.77	11.67	9.88
	4	87.50	62.50	43.86	28.33	54.94

TABLE 61 PERCENTAGE OF RESPONSES TO ITEMS VI,VII,VIII

ARRANGED ACCORDING TO AGE

Item Category		5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
VI)	1	2.08	10.23	31.58	36.67	19.76
	2	2.08	10.23	12.28	18.33	11.07
	3	39.58	29.54	26.32	16.67	27.67
	4	56.25	50.00	29.82	28.33	41.50
VII)	1	2.08	9.09	24.56	25.00	15.02
	2	2.08	6.82	14.04	2o.67	12.25
	3	35.42	30.68	28.07	28.33	30.44
	4	60.42	53.41	33.33	20.00	42.29
VIII)	1	0	1.14	0	3.33	1.19
	2	2.08	2.27	15.79	13.33	7.91
	3	8.33	22.73	38.59	25.00	24.11
	4	89.58	73.86	45.62	58.33	66.79

Tables 59 a-61 also show us the progression with age. One subject in the 7/9-8/8 age-group can succeed in item VIII, but none in the 8/9-9/8 age-group can. Looking at the percentages of copy upside down responses in category 2 for item II and in category 3 for items III,IV, V , we see that there is no sign of regular increase from one age-group to another, it fluctuates. Therefore we concluded that the high percentage

of responses in C_3 is due to the experimenter or the school more then to the increasing of age.

4.2 The Scoring & Difficulties.

We try to give each item arbitrary scores according to their qualities.

TABLE 62 THE SCORING PLAN

Item	Category	Score
I	1	2
	2	1
	3	0
II	1	2
	2	1
	3	0
III,IV,V	1	2
	2,3	1
	4	0
VI,VII,VIII	1	2
	2	1
	3,4	0

TABLE 63 AVERAGE SCORES IN PERCENTAGE ON EACH ITEM ARRANGED ACCORDING TO GRADE & SCHOOL

Item	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
I	26.32	60.00	33.33	57.14	60.93	58.96	59.38	92.31	77.46	79.55	100.00	87.57	66.60
II	18.42	20.00	18.75	42.86	54.69	48.51	53.13	48.72	50.70	76.14	73.91	75.37	50.59
III	10.53	25.00	13.54	12.86	35.94	23.88	40.63	52.56	47.18	65.41	67.39	66.42	39.72
IV	10.53	10.00	10.47	12.86	35.94	23.88	31.25	42.31	37.32	53.41	63.04	56.72	33.79
V	13.16	20.00	10.47	10.00	31.25	20.15	37.50	46.15	42.25	55.68	56.52	55.97	33.99
VI	0	0	0	8.57	20.31	14.18	17.19	33.33	26.06	48.86	63.04	53.73	25.30
VII	0	0	0	5.71	12.50	8.96	18.75	26.92	23.24	42.05	54.35	46.27	21.15
VIII	0	0	0	2.86	4.69	3.73	4.69	1.28	2.82	12.50	13.04	12.69	5.14
Total	9.21	16.88	10.81	19.11	32.03	25.28	32.81	42.95	38.38	54.26	61.41	56.72	34.54

Table 63 shows the increasing of the total average scores for all the eight items from grade to grade. The average scores in each item increase with grade except C_3 in item VIII. It is very interesting to compare the results of school B & school C at the same grade. Both grades of school C show higher ability than those of school B in the Inversion of Forms Test. School D is better than school A in both grades.

TABLE 64 RANK ORDER OF EACH ITEM ARRANGED ACCORDING TO CLASS

Item	A_1	D_1	B_2	C_2	B_3	C_3	A_4	D_4	Total
I	1	1	1	1	1	1	1	1	1
II	2	3.5	2	2	2	3	2	2	2
III	4.5	2	3	3.5	3	2	3	3	3
IV	4.5	5	4.5	3.5	5	5	5	4	5
V	3	3.5	4.5	5	4	4	4	6	4
VI	6	6	6	6	7	6	6	5	6
VII	6	6	6	7	6	7	7	7	7
VIII	6	6	6	8	8	8	8	8	8

The rank orders of the various items in each class are not much different from those of all subject. The test seems to show increased difficulty in every item with some exception.

TABLE 65 AVERAGE SCORE IN PERCENTAGE ON EACH ITEM ARRANGED ACCORDING TO AGE

Item	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
I	41.67	63.07	80.70	78.33	66.60
II	32.29	38.06	61.40	73.33	50.59
III	14.58	30.68	50.88	62.50	39.72
IV	11.46	27.84	45.61	49.17	33.79
V	9.38	28.41	43.86	52.50	33.99
VI	3.13	15.34	37.72	45.83	25.30
VII	3.13	12.50	31.58	38.33	21.15
VIII	1.04	2.27	7.89	10.11	5.14
Total	14.58	27.27	44.96	51.25	34.54

The total average scores for all the eight items increase with age.

The average scores on each item increase with age, except the 9/9-14/8 age-group in item I.

TABLE 66 RANK ORDER OF EACH ITEM ARRANGED ACCORDING TO AGE

Item	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
I	1	1	1	1	1
II	2	2	2	2	2
III	3	3	3	3	3
IV	4	5	4	5	5
V	5	4	5	4	4
VI	6.5	6	6	6	6
VII	6.5	7	7	7	7
VIII	8	8	8	8	8

The rank orders of the various items in each age-group are very much alike. The test seems to show increased difficulty in every item for every age-group. Item V is the exception for some age-groups.

TABLE 67 CUMULATIVE PERCENTAGE DISTRIBUTION

OF THE TOTAL SCORE OF EACH GRADE

Score	Grade I			Grade II			Grade III			Grade IV		
	f	cumf	cumf%	f	cumf	cumf%	f	cumf	cumf%	f	cumf	cumf%
16	0	48	100.00	0	67	100.00	1	71	100.00	2	67	100.00
15	0	48	100.00	0	67	100.00	0	70	98.59	5	65	97.01
14	0	48	100.00	2	67	100.00	4	70	98.59	6	60	89.55
13	0	48	100.00	1	65	97.01	2	66	92.96	5	54	80.59
12	0	48	100.00	2	64	95.52	1	64	90.13	5	49	73.13
11	0	48	100.00	1	62	92.54	6	63	88.73	5	44	65.67
10	1	48	100.00	2	61	91.04	3	57	80.28	3	39	58.21
9	0	47	97.92	5	59	88.06	4	54	76.06	6	36	53.73
8	1	47	97.92	2	54	80.59	2	50	70.42	5	30	44.78
7	1	46	95.83	1	52	77.61	6	48	67.60	5	25	37.31
6	3	45	93.75	0	51	76.12	10	42	59.15	5	20	29.85
5	1	42	87.50	8	51	76.12	5	32	45.07	4	15	22.39
4	1	41	85.42	9	43	64.18	6	27	38.03	4	11	16.42
3	5	40	83.33	0	34	50.75	2	21	29.58	2	7	10.45
2	7	35	79.92	15	34	50.75	10	19	26.76	3	5	7.46
1	2	28	58.33	1	19	28.36	1	9	12.68	0	2	2.98
0	26	26	54.17	18	18	26.86	8	8	11.27	2	2	2.98

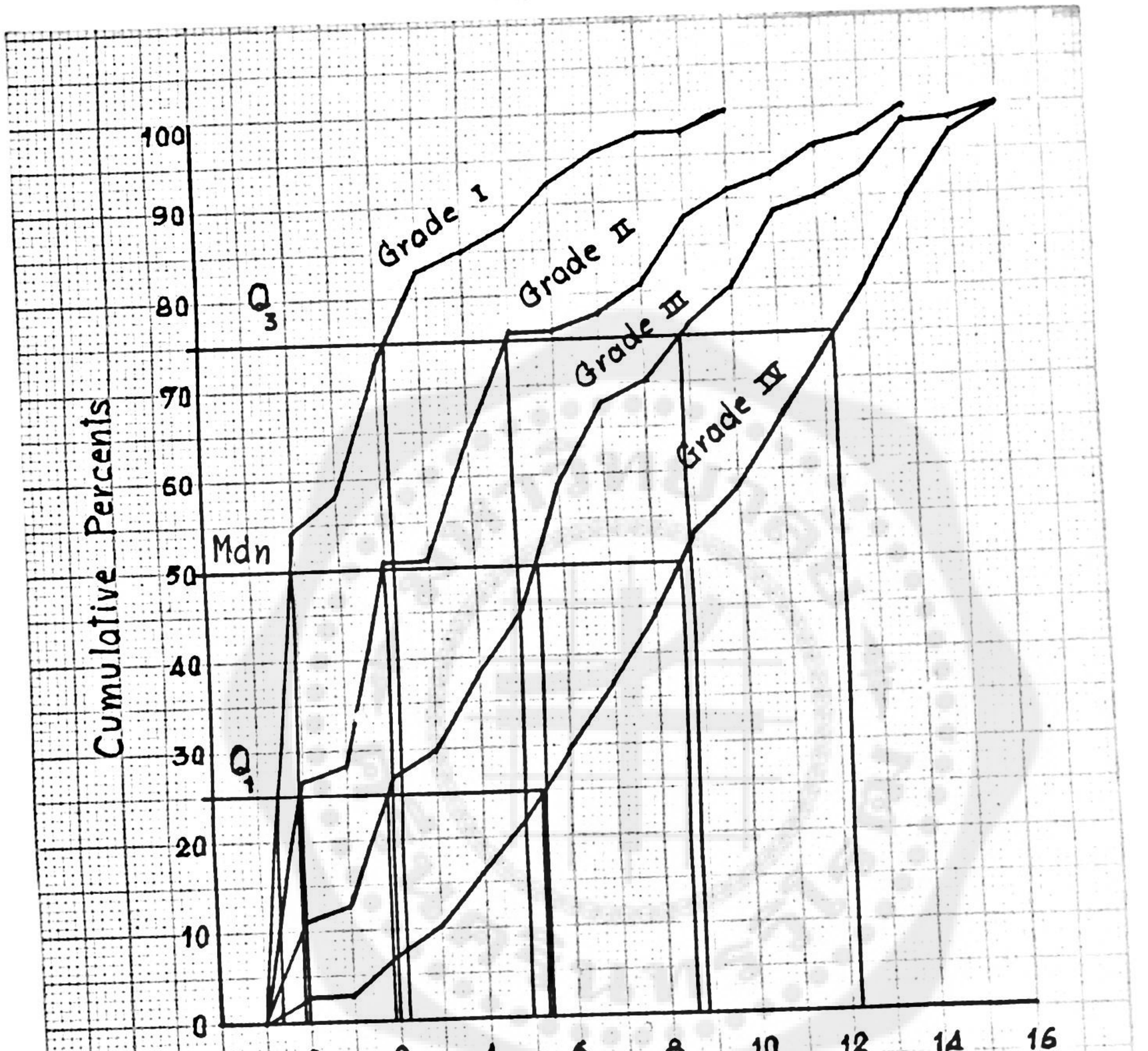


FIG 66 Ogives Representing Scores Made by Four Grades on The Inversion of Forms Test.

The higher grades ' ogives lie to the right of the lower grades' over the entire range, showing that the higher grades score consistently higher than the lower ones.

TABLE 69 CUMULATIVE PERCENTAGE DISTRIBUTION

OF THE TOTAL SCORE OF EACH AGE-GROUP

Score	5/9 - 7/8			7/9 - 8/8			8/9 - 9/8			9/9 - 14/8		
	f	cumr	cumf%	f	cumf	cumf%	f	cumf	cumf%	f	cumf	cumf%
16	0	48	100.00	1	88	100.00	0	57	100.00	2	60	100.00
15	0	48	100.00	0	87	98.86	2	57	100.00	3	58	96.67
14	0	48	100.00	3	87	98.86	5	55	96.49	4	55	91.67
13	1	48	100.00	1	84	95.45	4	50	87.72	2	51	85.00
12	0	47	98.92	2	83	94.32	2	46	80.70	4	49	81.67
11	1	47	98.92	1	81	92.05	5	44	77.19	5	45	75.00
10	1	46	95.83	3	80	90.91	2	39	68.42	3	40	66.67
9	0	45	93.75	6	77	87.50	3	37	64.91	6	37	61.67
8	1	45	93.75	3	71	80.68	2	34	59.65	4	31	51.67
7	0	44	91.67	2	68	77.27	5	32	56.14	6	27	45.00
6	0	44	91.67	9.	66	75.00	4	27	47.37	5	21	35.00
5	2	44	91.67	7	57	64.77	6	23	40.35	3	16	26.67
4	5	42	87.50	9	50	56.82	2	17	29.82	4	13	21.67
3	4	37	77.08	2	41	46.59	2	15	26.32	1	9	15.00
2	14	33	68.75	11	39	44.32	6	13	22.81	4	8	13.33
1	0	19	39.58	3	28	31.82	1	7	12.28	0	4	6.67
0	19	19	39.58	25	25	28 41	6	6	10.53	4	4	6.67

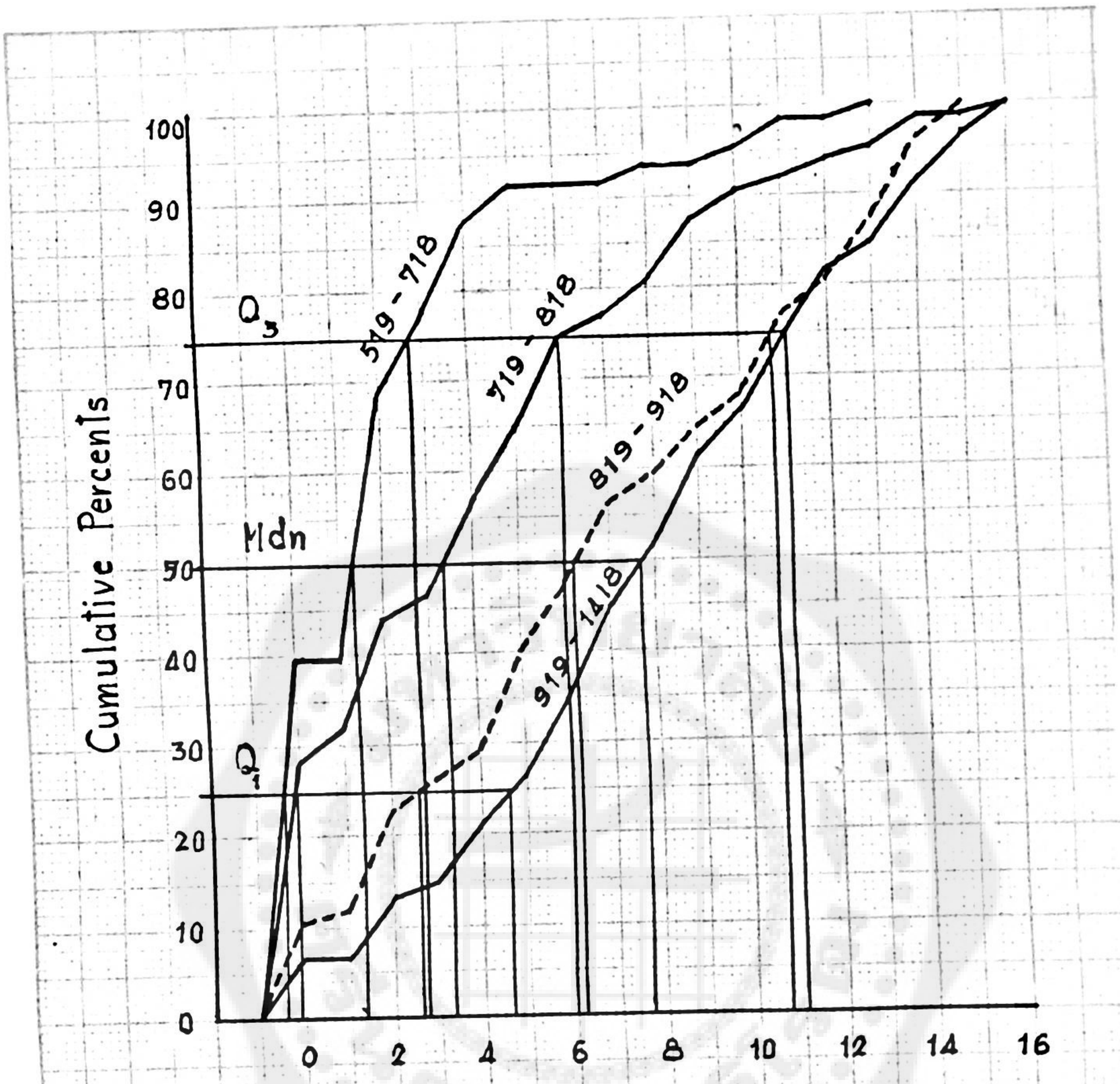


Fig 70 Ogives Representing Scores Made by Four Age-groups on The Inversion of Forms Test.

The figure shows that the higher age-group score higher than the lower ones. Differences in achievement between the 8/9-9/8 to the 9/9-14/8 age-groups are less than those of other age-group.

CHAPTER V

CONCLUSIONS

From a study of 246 children for the Transparencies Test and 253 children for the Inversion of Forms Test, the following conclusions concerning the concept of these two tests have been drawn :

The abilities to solve the problems of the Transparencies Test and the Inversion of Forms Test increase from grade to grade and from age to age.

To the young child, drawing is more nearly akin to talking to himself than to talking to others. It is a way to dramatize his ideas through making them visible. Children draw what they know rather than what they see. The little child does not care whether or not his pictures are beautiful, but he wants them to tell what he has in mind. Details do not trouble him; he goes straight for what is to him the main fact. So if he wants to draw a girl with skirt on, he draws the girl first and add the skirts afterward. The fact that the legs show through the skirt does not trouble him a bit. "The changes in children's drawings that take place from age to age as well as many of the children of the same age have been shown to be far more closely related to general intelligence than to special artistic talent in children under the age of ten or eleven years. Older and brighter children less

often omit essential parts of a drawing; they show a better sense of proportion; their idea of the relationship of different parts of a drawing to each other are more definite."[1] The Transparencies Test shows clearly the progression in drawing and understanding transparency from age to age.

The perception of difference of two forms depends upon the child's perceptual development. "Perception is as much a matter of the child's native equipment as sight or hearing. According to this point of view, the ability to perceive form, size, position and so on is chiefly a matter of innate neurological organization. Thurstone defined this perceptual abilities as an aspect of intelligence."[2] This aspect of intelligence is the first step in solving the problem of inversion of forms. The child who cannot differentiate between the forms of the original picture

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[1] Florence L. Goodenough, Developmental psychology, An Introduction to the Study of Human Behavior, (New York : D. Appleton-Century Company. C 1945)p. 405

[2] Leonard Carmichael, Manual of Child Psychology, (New York: John Wiley & Sons, Inc. C1946) pp.458-459

and that of the image, draws the original picture and supposes it to be the image of that picture. Some draw the image as the upside down picture, or the partial inversion; This is because of *their* understanding of spatial relations. Thurstone also defined this as an aspect of intelligence.[1] The Inversion of Forms Test shows chearly the progression in these two aspects of intelligence from age to age.

It can be concluded here that these two tests, The Transparencies Test and the Inversion of Forms' Test show the progression of the Thai children's mental development from year to year.

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[1] Leonard Carmichael, Manual of Child Psychology, (New York : John Wiley & Sons, Inc. C 1946) p. 459

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APPENDIX I

for

THE TRANSPARENCIES TEST

INSTRUCTION SHEET

INTERNATIONAL INSTITUTE FOR CHILD STUDY. BANGKOK

TRANSPARENCES.

Material : Sheet Transparences, pencils (black and red), stop-watch.

Instructions: เรียนชื่อ วัน และวันเกิดของตัวเองบนตัวกระดาษ

รูปที่หนึ่ง มีรูปกระจกอยู่ใบหนึ่ง เส้นต่างข้าง ๆ กันมีจุดประ ขอบอกว่าเราเอาเม็ดสีผสมในกระจก ให้เธอวาดรูปกระจกนี้ลงมาเต็มในรูปที่เหมือนกันที่เธอมองเส้นต่าง ๆ จากในรูปที่เหมือนที่ถูกครั้งนะ

เวลา ๑ นาที

ที่ถูกรูปต่อไป เธอจะเห็นต้น และเงียบ ๆ เหมือนหนึ่ง เราเอาเป็นเสียงตะโกนต้น ให้เธอวาดรูปต้นไม้เขียวเสียงตะโกนในรูปที่เหมือนที่ถูกครั้ง

เวลา ๒ นาที

รูปต่อไปนี้ผู้วิจัยเลือกระดาษกันแดดอยู่ แต่ว่าเขายังไม่ได้เรียนให้เธอวาดรูประดาษอยู่ในช่องเวลา

เวลา ๒ นาที

ผู้ทดสอบเรียกรูปกระเป๋าสีชมพูกระดาษ และกระเป๋าสีน้ำตาลอยู่ในน้ำด้วย เหมือนอย่างกับว่ากระเป๋าสีน้ำตาลอยู่ในน้ำ เรียกว่าผู้ทดสอบถูกระเป๋าสีน้ำตาลกระเป๋าสีน้ำตาลไม่ค่อยเรียกดู แล้วเก็บกระเป๋าสีน้ำตาลไว้ในกระเป๋าถือเลย และถามเด็กว่าเด็กจะเห็นกระเป๋าสีน้ำตาลไหม ผู้ทดสอบรู้ว่าคนกระดาษและผู้ทดสอบรู้ว่าเขา ถ้าอย่างนั้นครูจะเอาออกแล้วเรียนให้เห็นตามความเป็นจริงของไม่เห็นเลย และเรื่องอธิบายต่อไปว่า

ต่อไปเธอจะเห็นมีรูปอยู่สี่รูป คือรูปกองกระดาษ รูปผู้หญิงนุ่งกระโปรงรูปต้นไม้ที่มีผลอยู่บนดิน และรูปคนอยู่ในบ้าน หน้าบ้านมีโอ่งใส่น้ำ มีปลาตัวหนึ่งอยู่ในโอ่งนั้น ในรูปเหล่านี้ มีบางส่วนที่เราดูของจริง ๆ แล้วมองไม่เห็น เพราะว่ามีอะไรบังอยู่ ให้เธอเอาดินสอแดงลากเส้นให้ตามความจริงแล้ว เรามองไม่เห็น

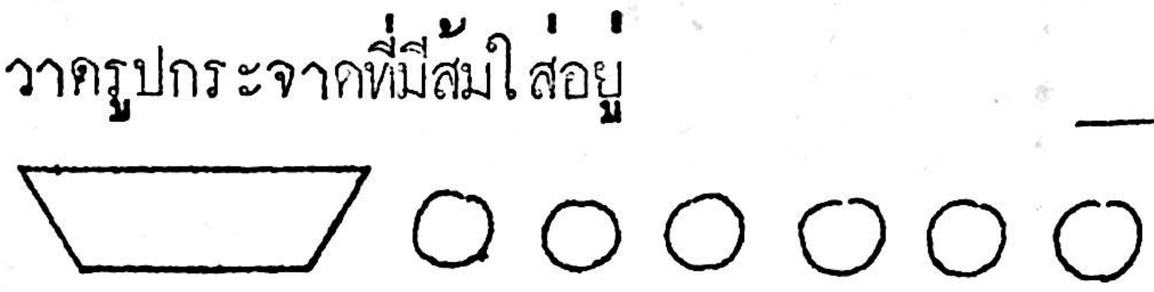
เวลา ๔ นาที

TRANSPARENCIES

ชื่อ..... ชั้น.....

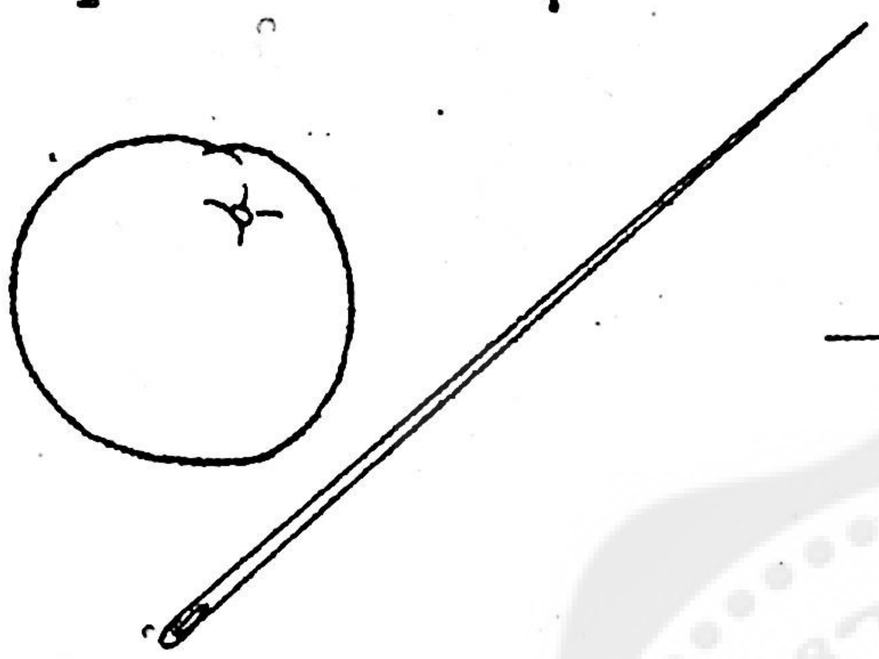
โรงเรียน..... วันที่.....

๑. วาดรูปกระจาดที่มีส้มใส่อยู่





๒. วาดรูปส้มมีเข็มเสียบทะลุ

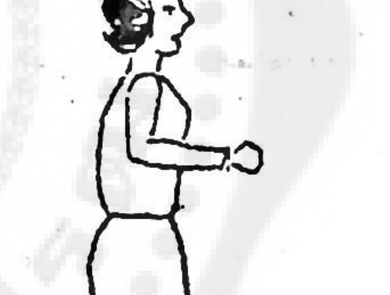


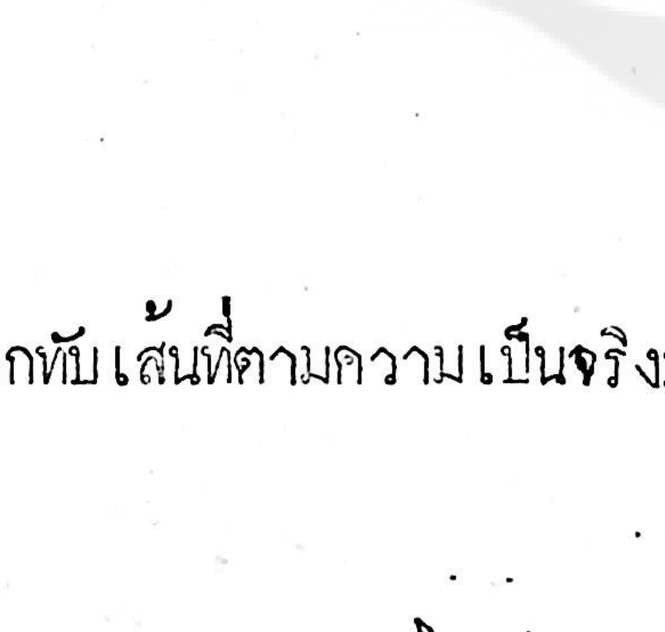


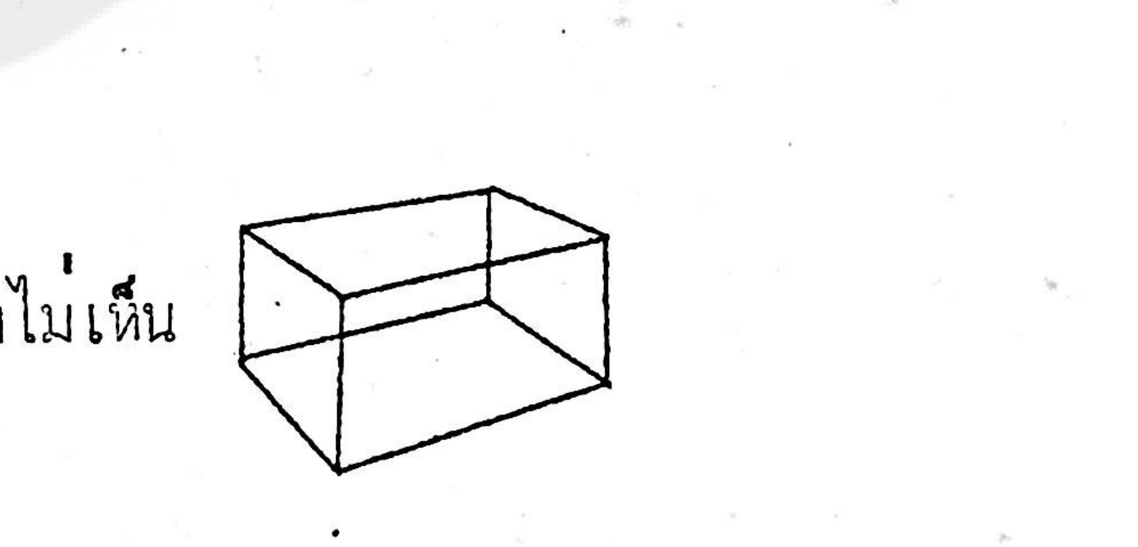
๓. วาดรูปร่มกางให้ผู้หญิงถือ



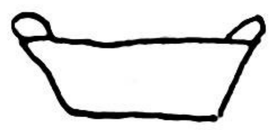
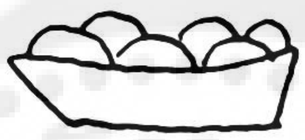
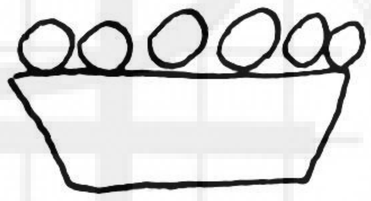
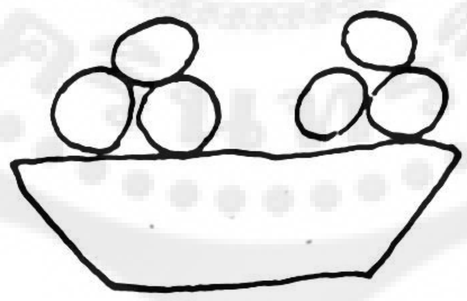
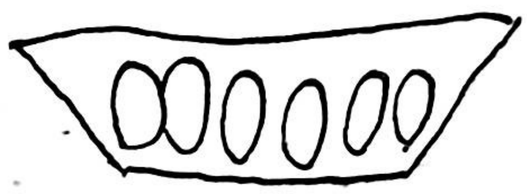
๔. ใช้ดินสอแดงลากทับเส้นที่ตามความเป็นจริงมองไม่เห็น







Examples of responses in item I

	Category	response
	1	
	2	
	3	
	4	
	5	

Examples of responses in item I (Cont.)

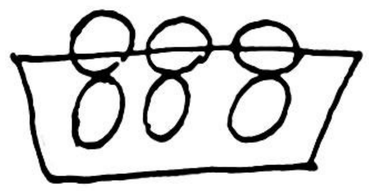
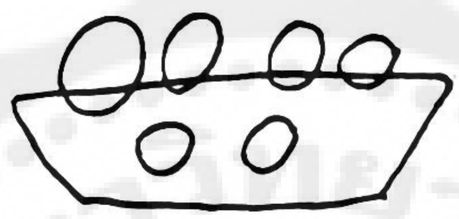
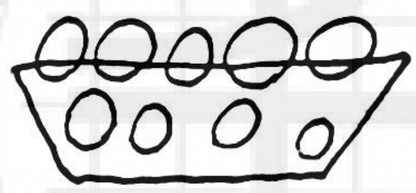
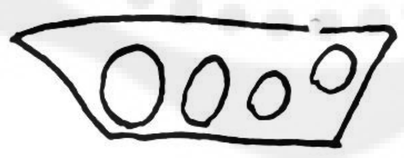
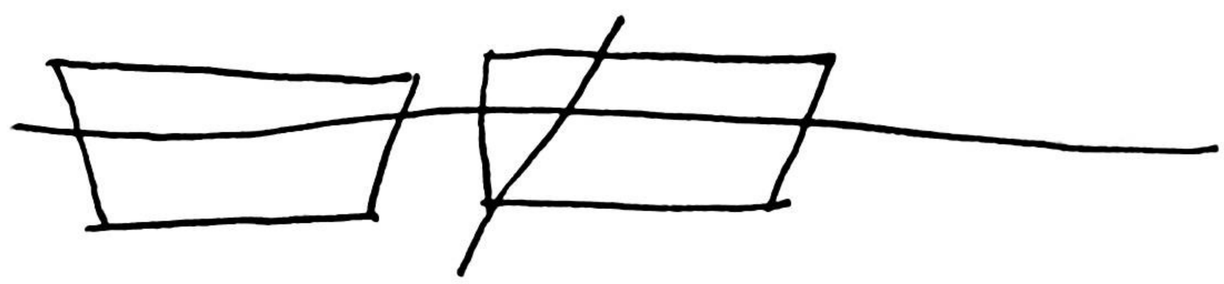
	Category	response
	6	
	7	
	8	
	9 9	
	10 10	

TABLE 79 FREQUENCY OF RESPONSES TO ITEM I

ARRANGED ACCORDING TO GRADE & SCHOOL

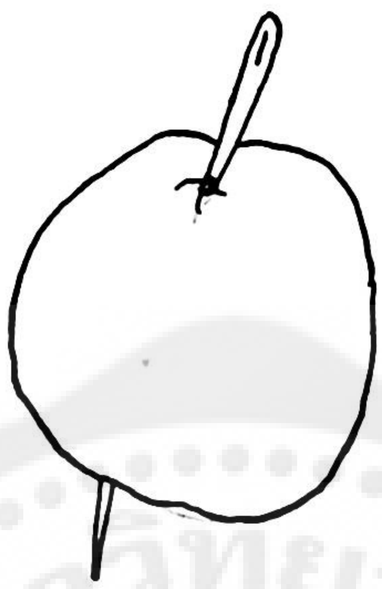
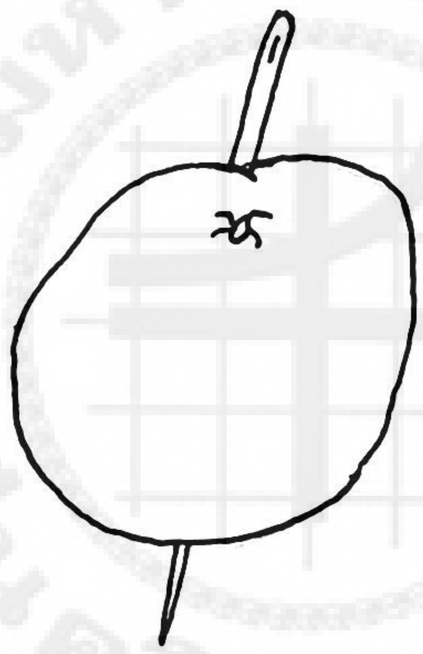
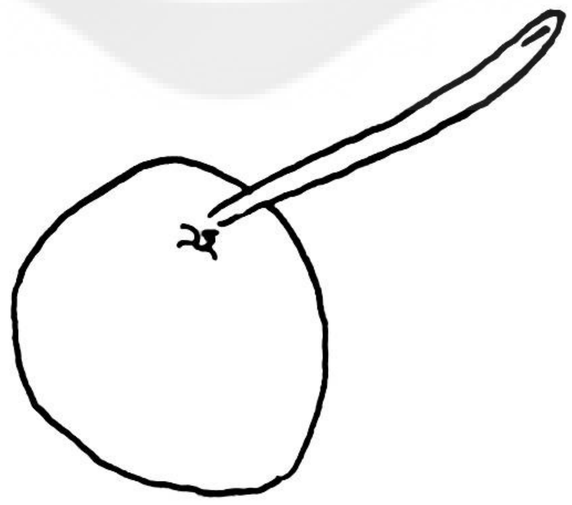
Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	0	0	0	1	0	1	0	0	0	0	0	0	1
2	0	0	0	2	3	5	1	5	6	2	8	10	21
3	2	2	4	0	0	0	4	2	6	2	3	5	15
4	4	3	7	0	1	1	4	0	4	1	0	1	13
5	28	8	36	18	22	40	18	25	43	22	6	28	147
6	2	0	2	4	4	8	1	1	2	2	2	4	16
7	0	0	0	2	2	4	4	2	6	2	1	3	13
8	4	1	5	4	0	4	0	2	2	1	0	1	12
9	0	1	1	2	0	2	0	0	0	1	1	2	5
10	0	1	1	1	0	1	0	1	1	0	0	0	3
Total	40	16	56	34	32	66	32	38	70	33	21	54	246

TABLE 80 FREQUENCY OF RESPONSES TO ITEM I

ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	0	0	1	0	1
2	1	3	13	4	21
3	3	4	4	4	15
4	4	7	1	1	13
5	36	61	20	30	147
6	2	5	6	3	16
7	2	4	4	3	13
8	3	5	3	1	12
9	2	0	2	1	5
10	2	0	0	1	3
Total	55	89	54	48	246

Examples of responses in item II

	Category	response
	1	
	2	
	3	

Examples of responses in item II (Cont.)

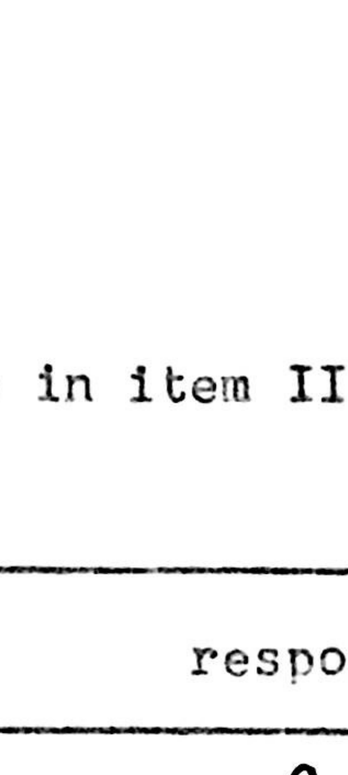
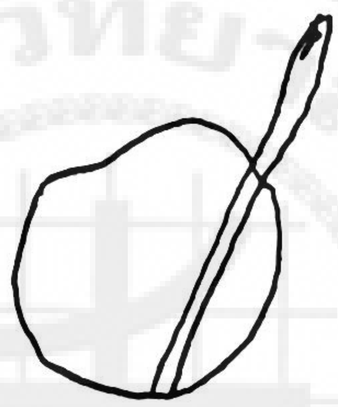
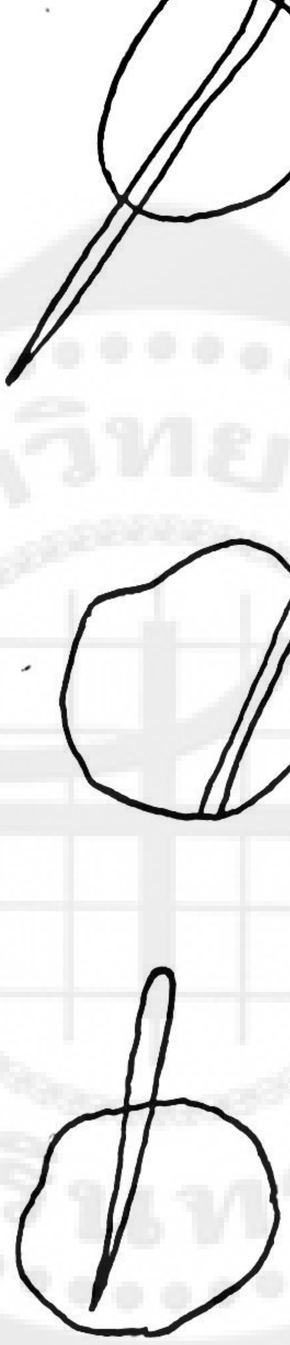
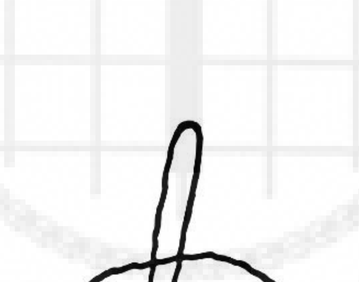
	Category	response
	4	
	5	
	6	
	7	

TABLE 83 : FREQUENCY OF RESPONSES TO ITEM II

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	1	0	1	5	3	8	9	3	12	6	13	19	40
2	2	1	3	1	4	5	4	8	12	5	1	6	26
3	16	9	25	2	16	18	7	19	26	3	2	5	74
4	17	6	23	21	4	25	11	5	16	19	5	24	88
5	1	0	1	1	2	3	0	0	0	0	0	0	4
6	2	0	2	2	2	4	1	3	4	0	0	0	10
7	1	0	1	2	1	3	0	0	0	0	0	0	4
Total	40	16	56	34	32	66	32	38	70	33	21	54	246

TABLE 84 a FREQUENCY OF RESPONSES TO ITEM II

ARRANGED ACCORDING TO AGE

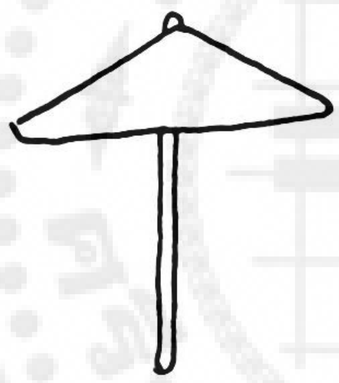
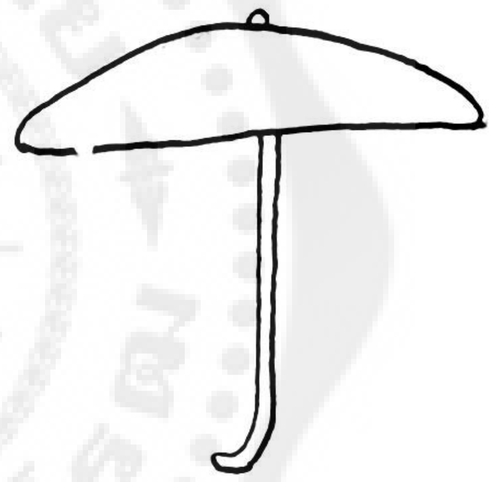
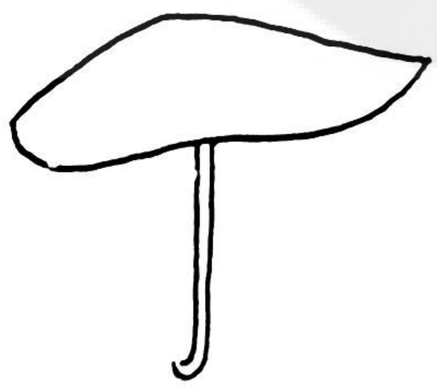
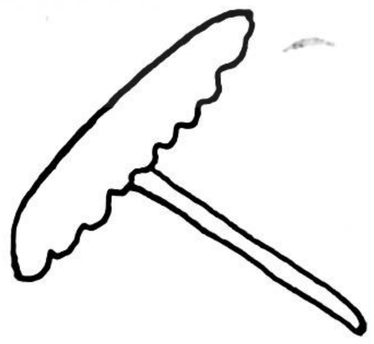
Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	4	13	11	12	40
2	2	10	7	7	26
3	19	32	18	5	74
4	24	24	16	24	88
5	2	2	0	0	4
6	1	8	1	0	10
7	3	0	1	0	4
Total	55	89	54	48	246

TABLE 84 b. FREQUENCY OF RESPONSES TO ITEM III

ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	1	3	13	14	31
2	7	12	3	14	36
3	18	36	20	11	85
4	9	19	14	5	47
5	10	13	2	2	27
6	10	6	2	2	20
Total	55	89	54	48	246

Examples of responses in item III

	Category	response
1		 
2		 
3		 

Examples of responses in item III (Cont.)

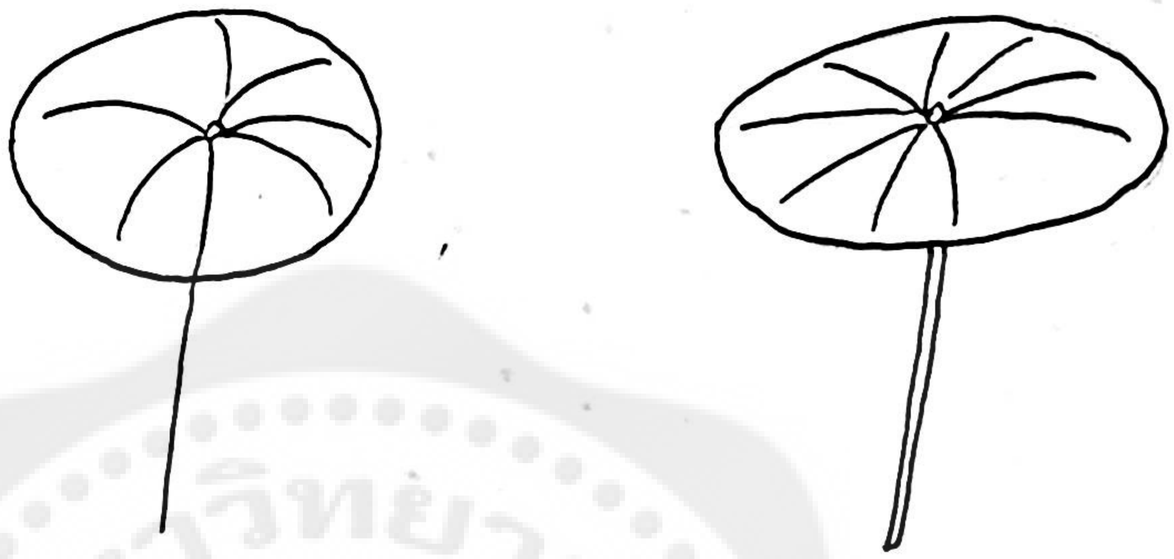
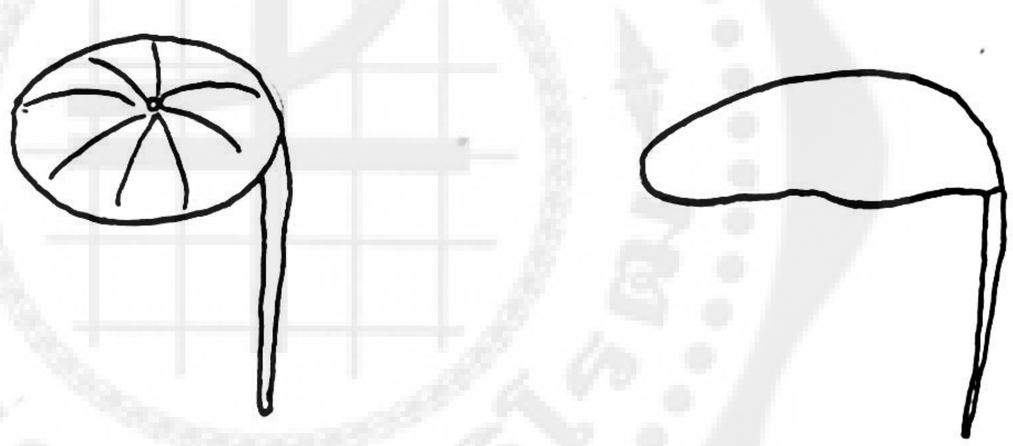
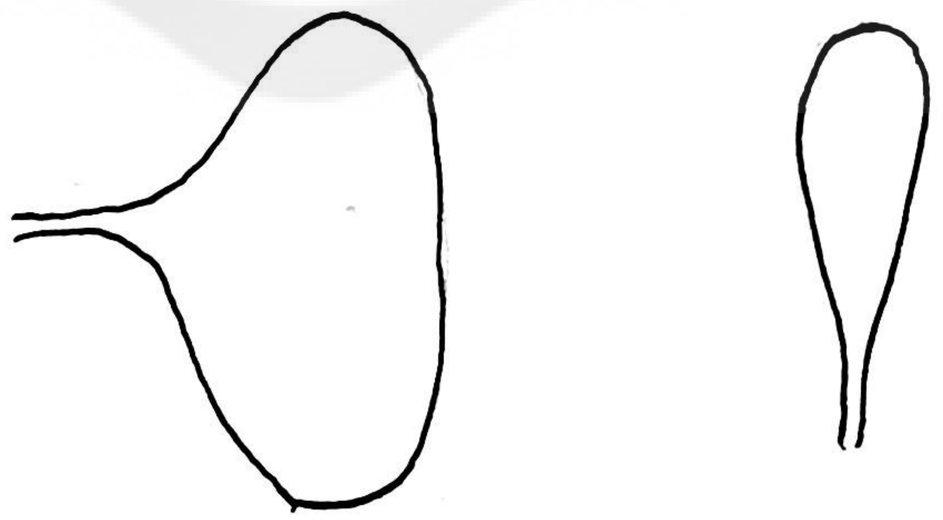
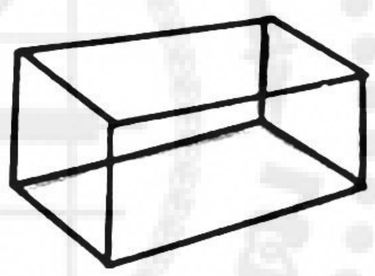
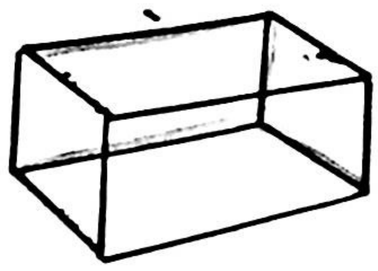
	Category	response
	4	
	5	
	6	

TABLE87 FREQUENCY OF RESPONSES TO ITEM III

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	Total	B	C	total	B	C	total	A	D	total	
1	0	0	0	4	0	4	1	3	4	11	12	23	31
2	2	1	3	5	3	8	8	6	14	9	2	11	36
3	12	5	17	20	9	29	13	16	29	6	4	10	85
4	5	3	8	3	11	14	9	10	19	5	1	6	47
5	7	4	11	2	8	10	0	2	2	2	2	4	27
6	14	3	17	0	1	1	1	1	2	0	0	0	20
Total	40	16	56	34	32	66	32	38	70	33	21	54	246

Examples of responses in item IV

	Category	response
	1	
	2	
	3	

Examples of responses in item IV (Cont.)

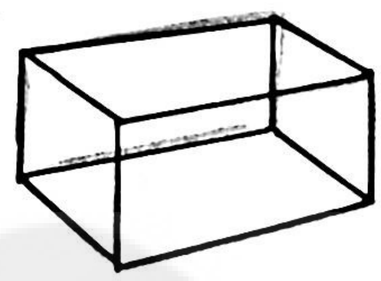
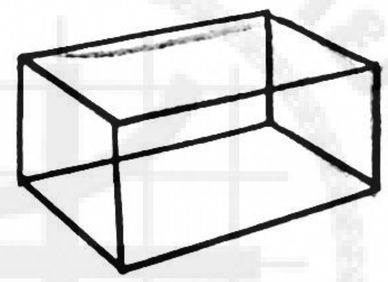
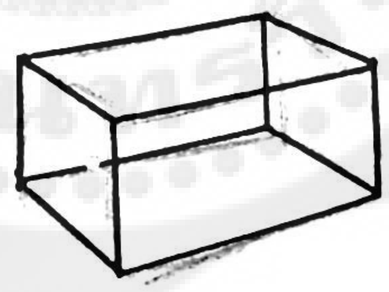
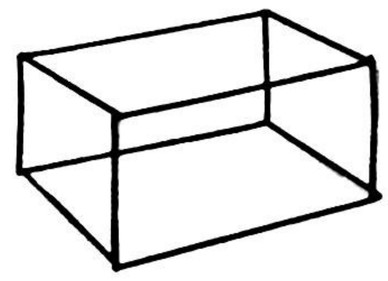
	Category	response
	4	
	5	
	6	
	7	

TABLE 90 FREQUENCY OF RESPONSES TO ITEM IV

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	0	0	0	0	3	3	0	2	2	2	2	4	9
2	1	1	2	3	0	3	0	3	3	4	4	8	16
3	10	2	12	7	3	10	7	4	11	11	8	19	52
4	2	0	2	0	3	3	2	0	2	3	3	6	13
5	4	12	16	15	8	23	8	8	16	4	3	7	62
6	17	0	17	8	11	19	9	19	28	7	0	7	71
7	6	1	7	1	4	5	6	2	8	2	1	3	23
Total	40	16	56	34	32	66	32	38	70	33	21	54	246

TABLE 91 a FREQUENCY OF RESPONSES TO ITEM IV

ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	0	3	2	4	9
2	4	1	6	5	16
3	10	13	15	14	52
4	1	5	5	2	13
5	20	21	11	10	62
6	16	33	12	10	71
7	4	13	3	3	23
Total	55	89	54	48	246

TABLE 91b. FREQUENCY OF RESPONSES TO ITEM V

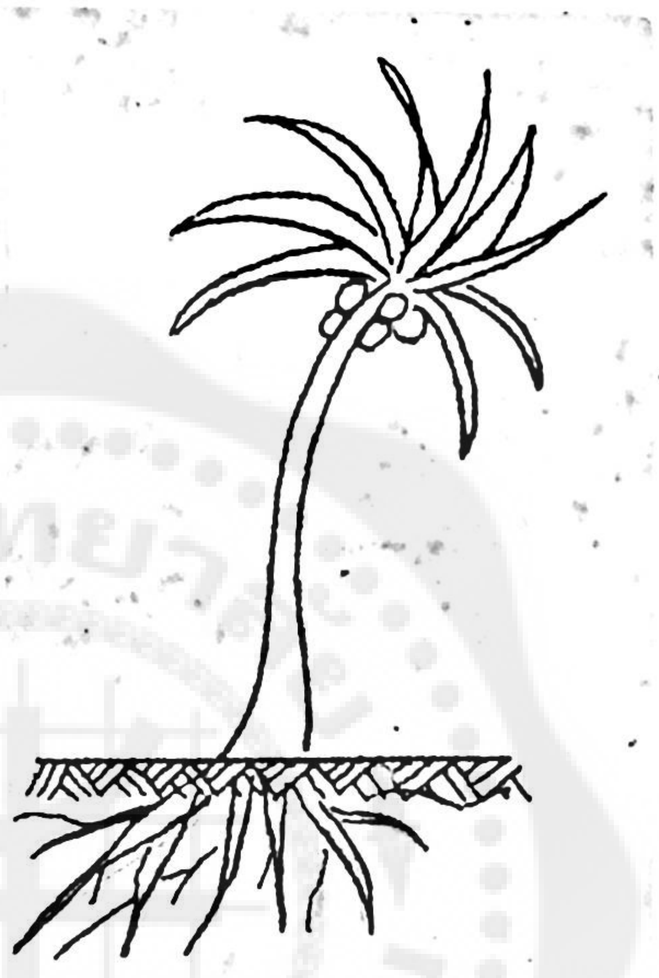
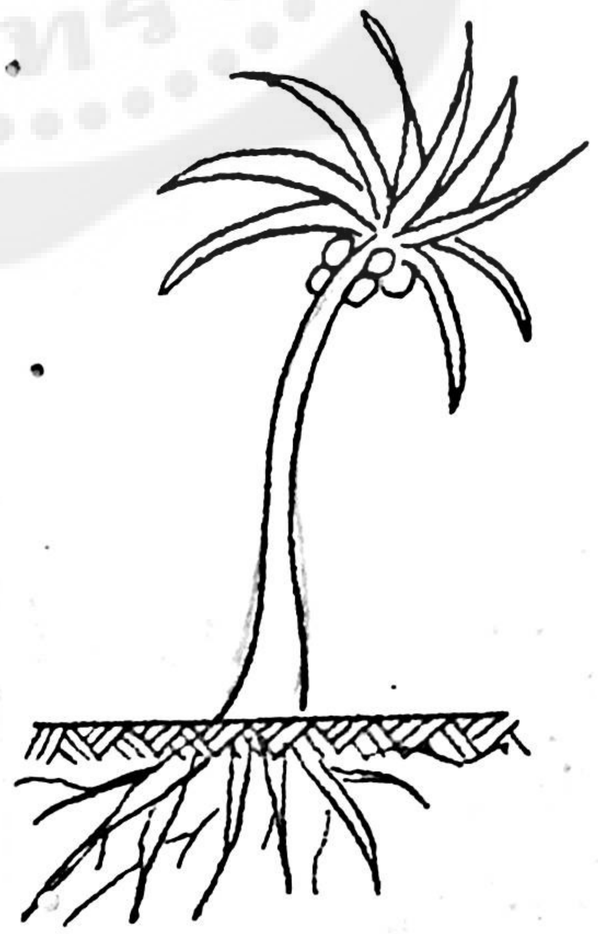
ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	8	23	15	23	69
2	32	39	26	15	112
3	11	14	11	8	44
4	4	13	2	2	21
Total	55	89	54	48	246

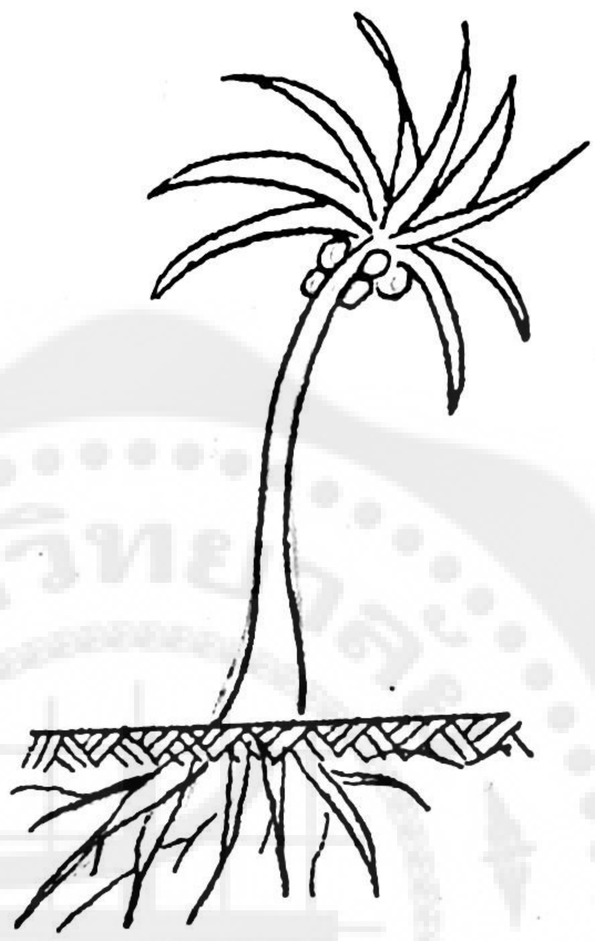
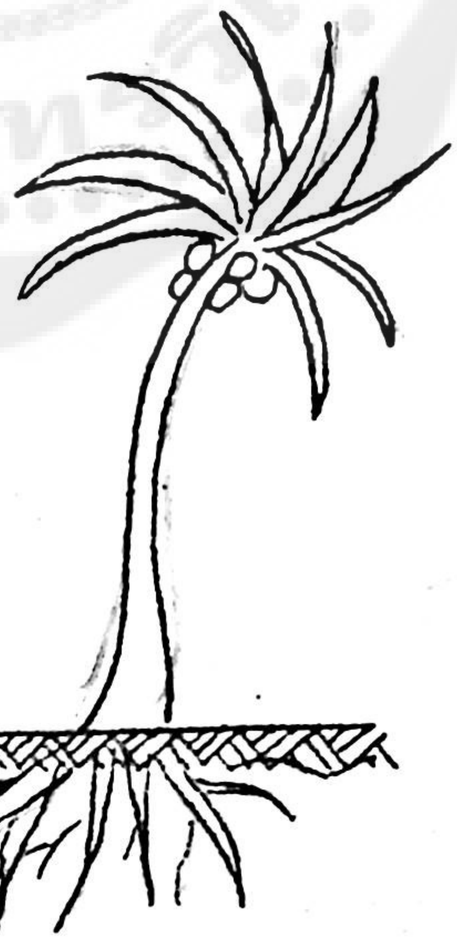
Examples of responses in item V

	Category	response
	1	
	2	
	3	
	4	

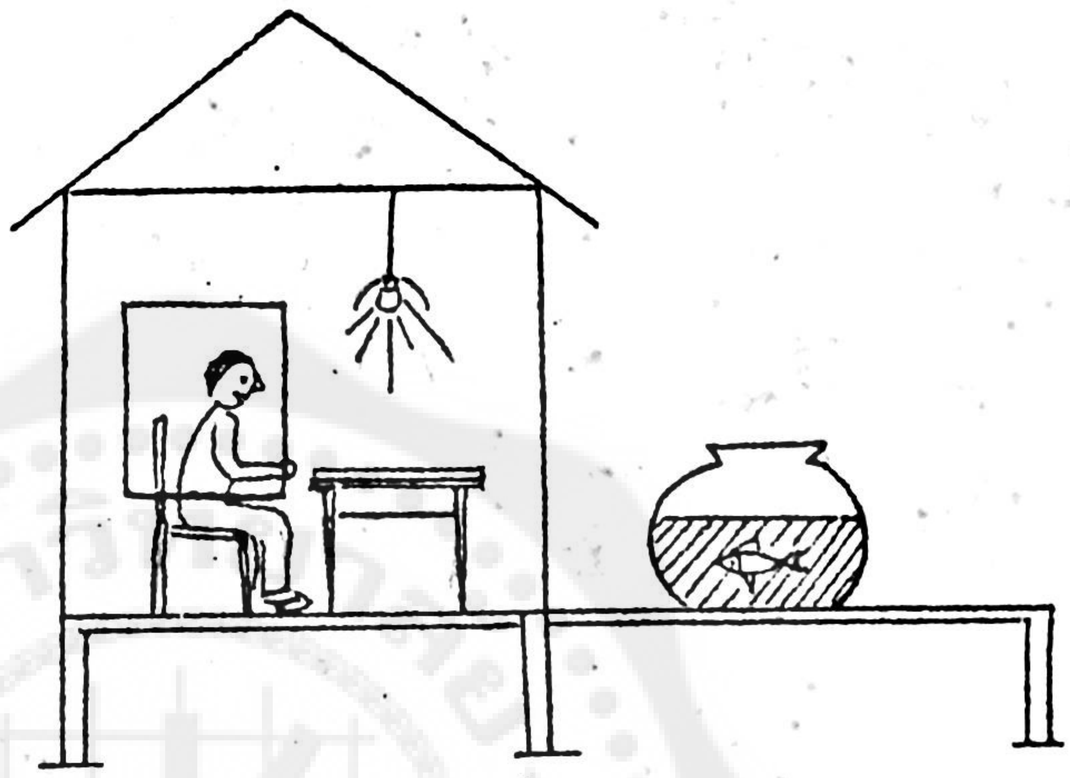
Examples of responses in item VI

	Category	response
	1	
	2	

Examples of responses in item VI (Cont.)

	Category	response
	3	
	4	

Examples of responses in item VII

	Category	response
	1	
	2	

Examples of responses in item VII (Cont.)

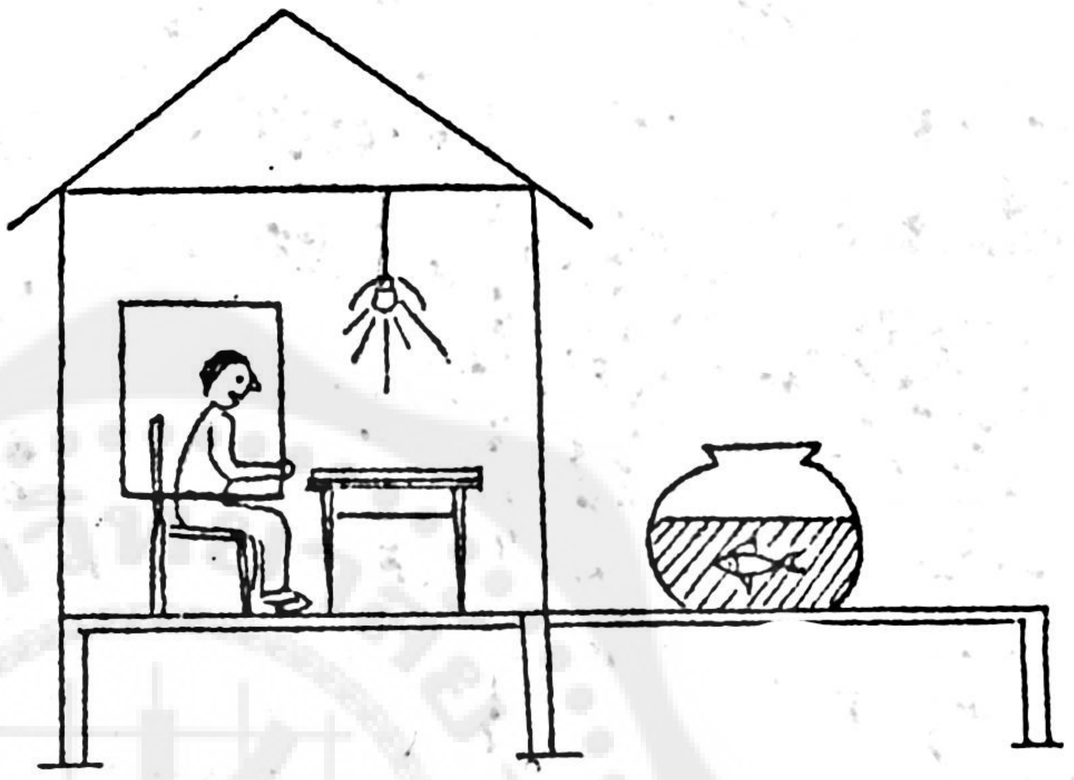
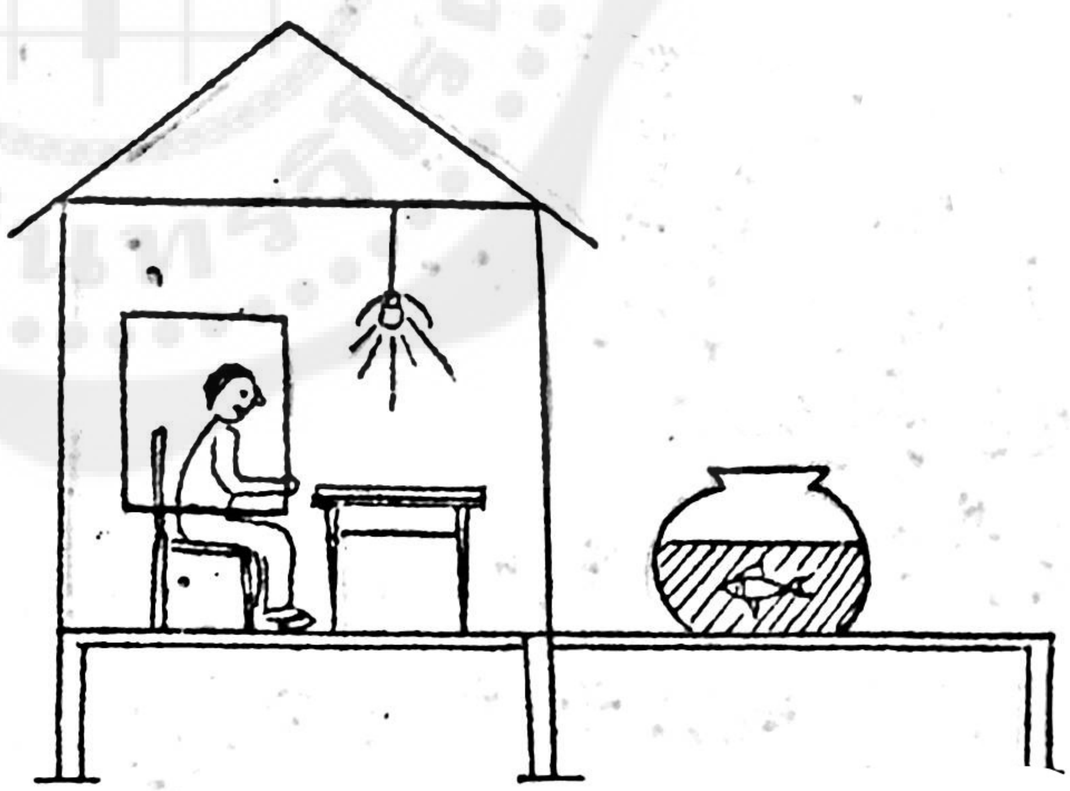
	Category	response
	3	
	4	

TABLE 97 FREQUENCY OF RESPONSES TO ITEM V

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	4	2	6	7	11	18	8	6	14	15	16	31	69
2	21	11	32	16	14	30	13	24	37	11	2	13	112
3	7	2	9	8	6	14	6	7	13	5	3	8	44
4	8	1	9	3	1	4	5	1	6	2	0	2	21
Total	40	16	56	34	32	66	32	38	70	33	21	54	246

TABLE 98 FREQUENCY OF RESPONSES TO ITEM VI

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	B	D	total	
1	25	7	32	17	20	37	17	24	41	30	21	51	161
2	5	8	13	8	3	11	7	9	16	1	0	1	41
3	5	0	5	3	7	10	3	3	6	2	0	2	23
4	5	1	6	6	2	8	5	2	7	0	0	0	21
Total	40	16	56	34	32	66	32	38	70	33	21	54	246

TABLE 99.FREQUENCY OF RESPONSES TO ITEM VII

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	5	0	5	4	3	7	11	6	17	11	9	20	49
2	22	13	35	19	20	39	18	24	42	12	10	22	138
3	9	2	11	8	8	16	3	8	11	10	2	12	50
4	4	1	5	3	1	4	0	0	0	0	0	0	9
Total	40	16	56	34	32	66	32	38	70	33	21	54	246

TABLE 100a . FREQUENCY OF RESPONSES TO ITEM VI

ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	30	49	39	43	161
2	13	18	9	1	41
3	4	11	5	3	23
4	8	11	1	1	21
Total	55	89	54	48	246

TABLE 100b. FREQUENCY OF RESPONSES TO ITEM VII

ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	6	11	15	17	49
2	34	59	27	18	138
3	9	17	11	13	50
4	6	2	1	0	9
Total	55	89	54	48	246

TABLE 101. SCORES OF ALL SUBJECTS ON EACH ITEM ARRANGED ACCORDING TO GRADE & SCHOOL

Item	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
I	42	18	60	33	39	72	42	47	89	38	39	77	298
II	59	27	86	44	59	103	64	76	140	58	51	109	438
III	35	16	51	74	38	112	63	72	135	88	63	151	449
IV	14	4	18	13	12	25	9	14	23	26	23	49	115
V	4	2	6	7	11	18	8	6	14	15	16	31	69
VI	25	7	32	17	20	37	17	24	41	30	21	51	161
VII	5	0	5	4	3	7	11	6	17	11	9	20	49
Total	184	74	258	192	182	374	214	245	459	266	222	488	1579

TABLE 102. SCORE OF ALL SUBJECTS ON EACH ITEM

ARRANGED ACCORDING TO AGE

Item	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
I	57	101	82	58	298
II	82	159	106	91	438
III	70	139	115	125	449
IV	19	26	36	34	115
V	8	23	15	23	69
VI	30	49	39	43	161
VII	6	11	15	17	49
Total	272	508	408	391	1579

TABLE 103 FREQUENCY OF TOTAL SCORE

ARRANGED ACCORDING TO GRADE & SCHOOL

Score	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
15	0	0	0	0	0	0	0	0	0	0	2	2	2
14	0	0	0	0	0	0	0	0	0	1	3	4	4
13	0	0	0	0	0	0	0	0	0	2	2	4	4
12	0	0	0	0	1	1	0	0	0	1	2	3	4
11	0	0	0	1	0	1	0	3	3	3	2	5	9
10	2	0	2	2	2	4	5	3	8	3	3	6	20
9	0	1	1	3	2	5	5	2	7	3	2	5	18
8	0	1	1	3	1	4	3	4	7	5	0	5	17
7	2	1	3	1	3	4	2	4	6	5	2	7	20
6	8	0	8	6	5	11	5	8	13	3	2	5	37
5	8	5	13	4	8	12	6	7	13	4	0	4	42
4	8	3	11	8	5	13	3	3	6	2	1	3	33
3	8	4	12	3	3	6	3	1	4	1	0	1	23
2	2	0	2	3	2	5	0	3	3	0	0	0	10
1	2	1	3	0	0	0	0	0	0	0	0	0	3
Total	40	15	56	34	32	66	32	38	70	33	21	54	246

TABLE 104. FREQUENCY OF TOTAL SCORE ARRANGED ACCORDING TO AGE

Scor	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
15	0	0	2	0	2
14	0	0	3	1	4
13	0	0	0	4	4
12	0	1	0	3	4
11	2	1	3	3	9
10	1	6	8	5	20
9	3	5	5	5	18
8	3	4	5	5	17
7	2	9	2	7	20
6	5	19	8	5	37
5	12	16	9	5	42
4	12	13	5	3	33
3	9	10	3	1	23
2	4	4	1	1	10
1	2	1	0	0	3
Total	55	89	54	48	246

APPENDIX II

for

THE INVERSION OF FORMS TEST

INSTRUCTION SHEET

INTERNATIONAL INSTITUTE FOR CHILD STUDY. BANGKOK

TEST INVERSION OF FORMS

Material: Sheet inversion of forms, pencil, stopwatch, mirror, small card (size post-card) with drawing:

Instruction: ผู้ทดสอบ เมื่อเธอจะเห็นรูป ๆ หนึ่ง มีด้านเปิดอยู่ทางขวา และมีด้านเปิดอยู่ทางซ้าย ก็ดูเอารูปนี้ไปวางข้าง ๆ กระจก เธอของดูว่าในกระจก ด้านเปิดจะอยู่ทางไหน? ทางขวาดังถูกแล้ว เธอก็เห็นได้ว่า เงาที่เราเห็นในกระจกจะกลับข้างกัน ของจริงเป็นทางซ้าย แต่ในกระจกเธอจะเห็นเป็นทางขวา และถ้าของจริงเป็นทางขวา เธอก็จะเห็นในกระจกเป็นทางซ้าย

ถ้ารูปเรขาคณิตบาง ๆ กระจกบางนี้ เธอจะเห็นเป็นอย่างไร (เอารูปวางให้เห็นส่วนเปิดนี้ในทางต่าง ๆ กัน) ขั้นนี้แล้ว ถึงนี้ข้างบนในรูปจะแสดงนี้ข้างล่างในกระจก และนี้ข้างล่างในรูปก็จะเป็นนี้ข้างบนในกระจก

เราเห็นเงาอย่างนี้ ๆ ไป เช่น เงาในกระจกหน้าบ้าน เงาที่เห็นในน้ำ ในกลอง หรือในกระจกนี้ ดูในกระจกนี้ดูเถิด ดูแรกเธอจะเห็นเป็นบ้านหันอยู่ทิศใดทิศหนึ่ง น้ำก็เหมือนกระจก และเธอก็จะเห็นเงาบ้านในน้ำได้ ลองเอารูปเก้าอี้เป็นเงาดูในน้ำกลองในรูปนี้ดู

เวลา ๑ นาที ๓๐ วินาที

ต่อไปเอารูปเก้าอี้วางอยู่ข้างกระจก ให้เธอเขียนลงในกระดาษว่ารูปเก้าอี้นี้เป็นเงาอยู่ในกระจกเป็นรูปอย่างไร

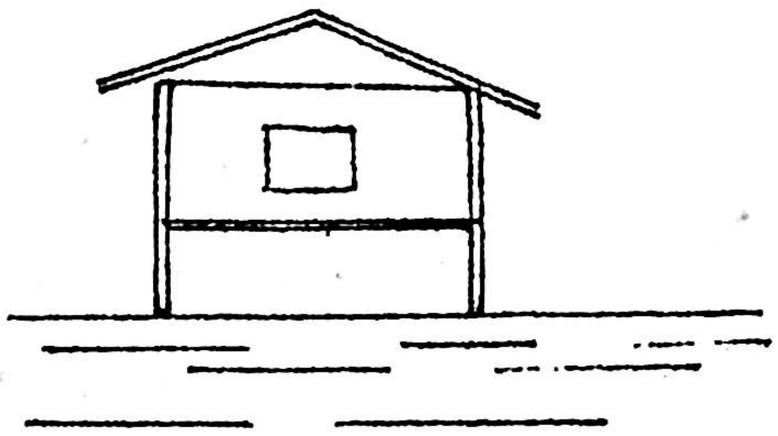
เวลา ๑ นาที ๓๐ วินาที

ในรูปสุดท้ายเธอจะเห็นตัวหนังสือต่าง ๆ อยู่ข้าง ๆ กระจก ให้เธอเขียนลงในกระดาษว่าเงาของตัวหนังสือเหล่านี้มองเห็นในกระจกเป็นอย่างไร

เวลา ๒ นาที ๓๐ วินาที

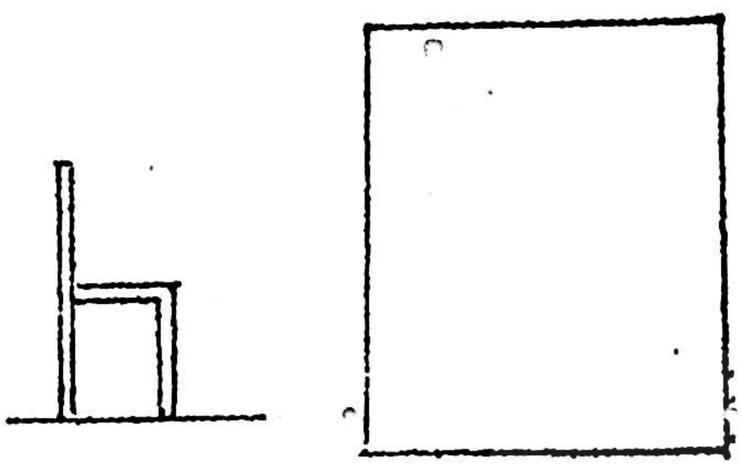
ถัดไปเป็นรูปจุดสาย ๆ จุด และมีเส้นจากกระหว่างจุดเป็นรูปต่าง ๆ ทาง
ขวาเขาจะเห็นจุดสาย ๆ จุด จำนวนเท่ากับทางกาสาย (ชี้ให้นักเรียนดูในกระกาะกำกับ) ถ้าเรามองดูรูปทางซ้ายในกระจก เราจะเห็นเป็นรูปอย่างไร เส้นระกากอจุดไหนบ้าง ลองจากกอจุดในทางขวาให้เหมือนกับเงาของรูปทางซ้ายที่เห็นในกระจก

เรา ๔ นาที

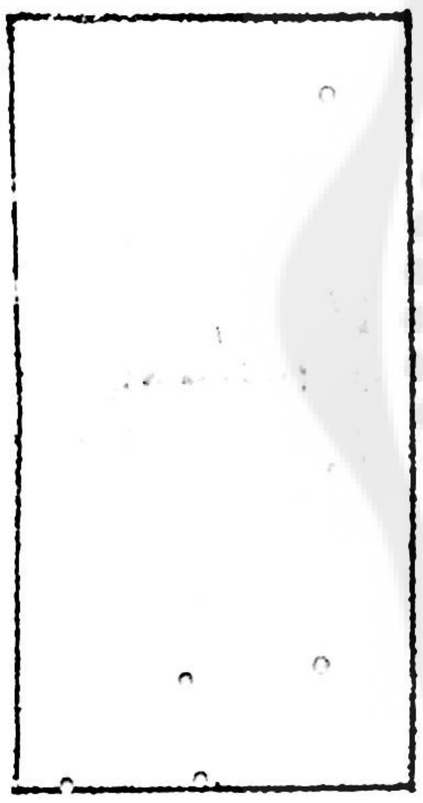


ชื่อ..... ชั้น.....

๑. เขียนรูปบ้านที่เห็นเป็นเงาอยู่ในน้ำ

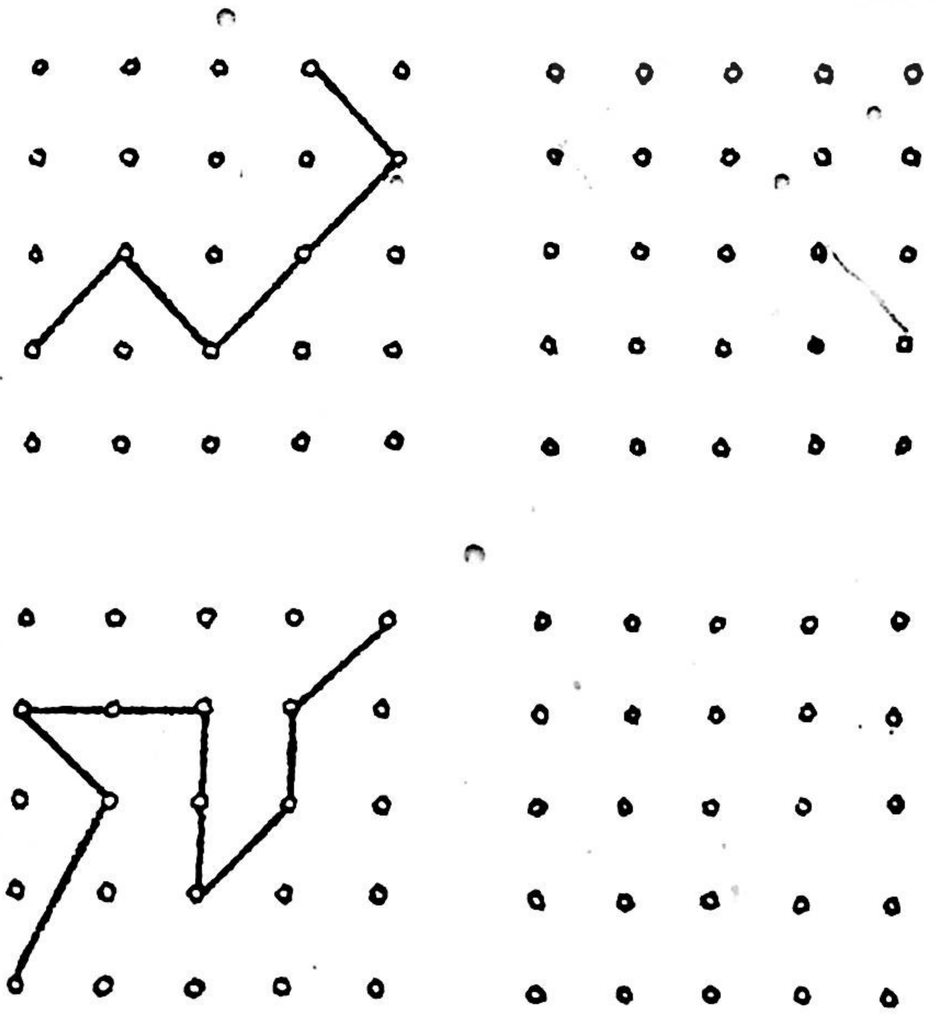


๒. เขียนรูปเก้าอี้ที่เห็นเป็นเงาอยู่ในกระจก



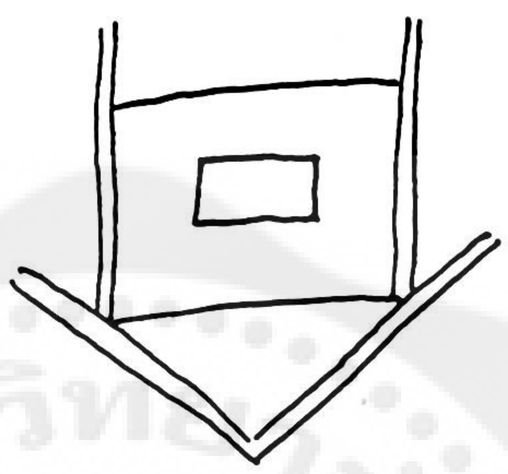
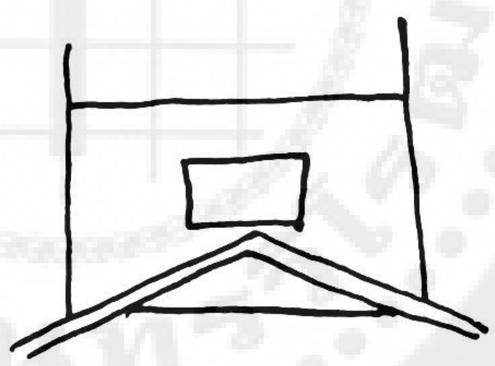
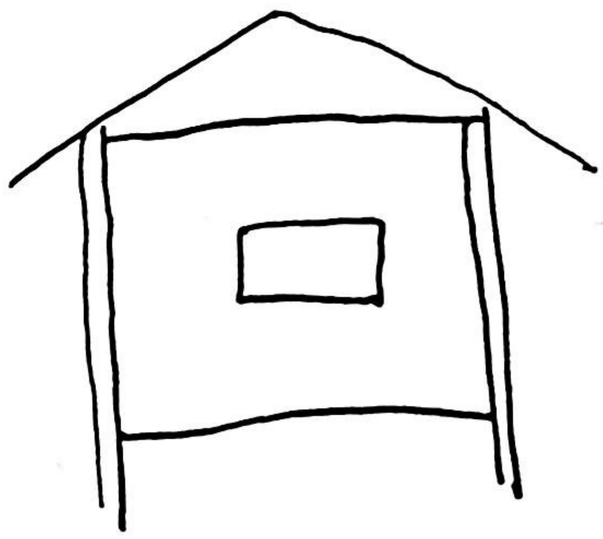
๓. เขียนตัวหนังสือเหล่านี้ที่เห็นเป็นเงาอยู่ในกระจก

ก ข ค ง



๔. เขียนรูปข้างซ้ายให้เหมือนกับที่เห็นเป็นเงาอยู่ในกระจก ลงในแบบข้างขวา

Examples of responses in item I

	Category	response
	1	
	2	
	3	

Examples of responses in item II

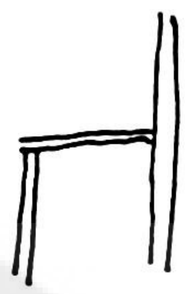
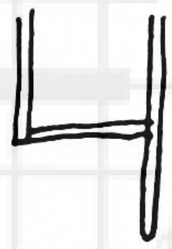
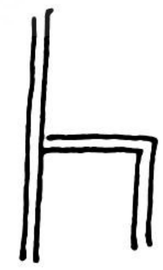
	Category	response
	1	
	2	
	3	

TABLE 11OFREQUENCY OF RESPONSES TO ITEM I

ARRANGED ACCORDGIN TO GRADF & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	9	6	15	20	19	39	19	36	55	35	23	58	167
2	2	0	2	0	1	1	0	0	0	0	0	0	3
3	27	4	31	15	12	27	13	3	16	9	0	9	83
Total	38	10	48	35	32	67	32	39	71	44	23	67	253

TABLE 111 FREQUENCY OF RESPONSES TO ITEM II

ARRANGED ACCORDING TO GRADE & SCHOOL

Type of responses	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
1	4	2	6	15	16	31	17	15	32	32	17	49	118
2	6	0	6	0	3	3	0	8	8	3	0	3	20
3	28	8	36	20	13	33	15	16	31	9	6	15	115
Total	38	10	48	35	32	67	32	39	71	44	23	67	253

Examp'es of responses in items III, IV, V

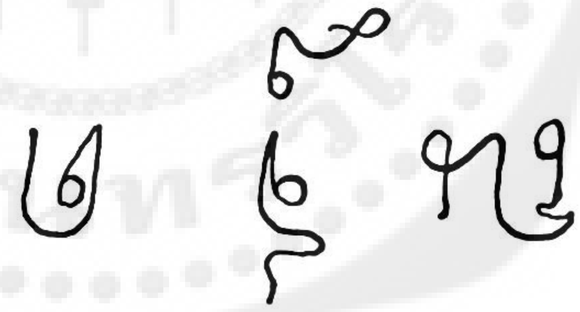
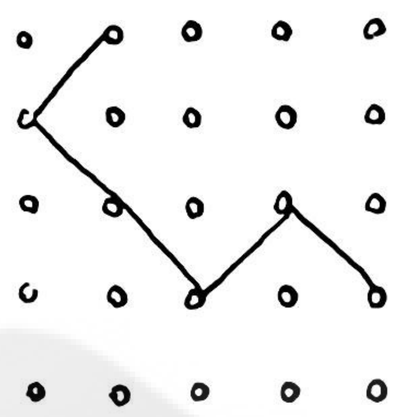
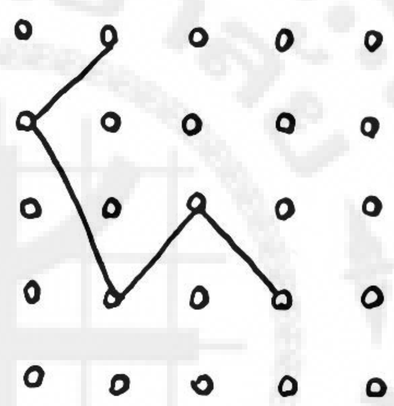
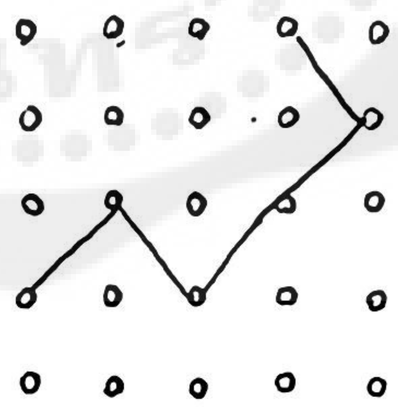
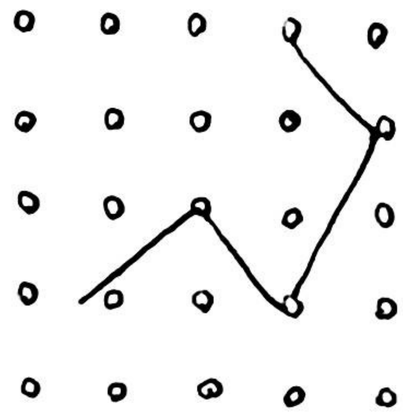
	Category	responee
	1	
	2	
	3	
	4	

TABLE 113 FREQUENCY OF RESPONSES TO ITEM III, IV, V

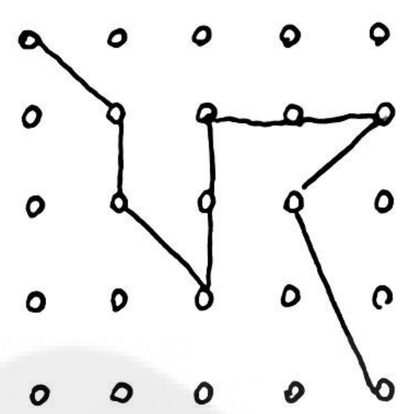
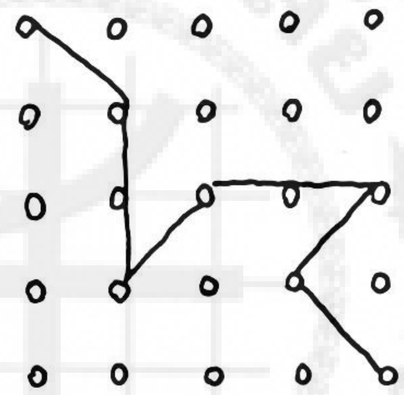
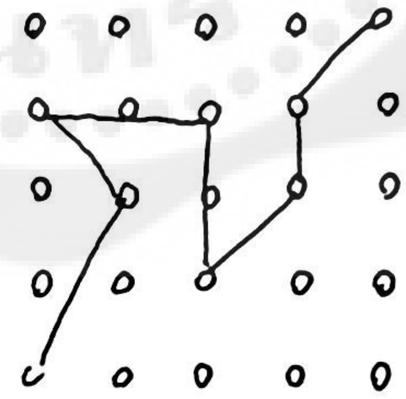
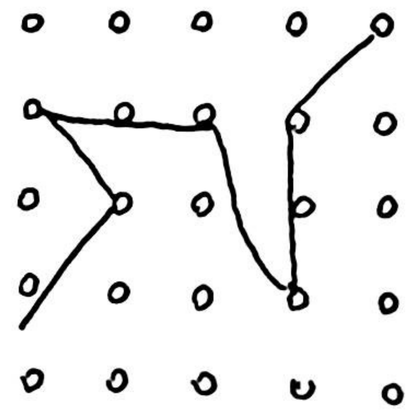
ARRANGED ACCORDGING TO GRADE & SCHOOL

Item & Category		Grade I			Grade II			Grade III			Grade IV			Total
		A	D	total	B	C	total	B	C	total	A	D	total	
III)	1	2	2	4	4	7	11	12	14	26	22	14	36	77
	2	1	0	1	1	5	6	2	0	2	9	3	12	21
	3	3	1	4	0	4	4	0	13	13	5	0	5	26
	4	32	7	39	30	16	46	18	12	30	8	6	14	129
IV)	1	1	0	1	3	7	10	6	6	12	13	10	23	46
	2	3	1	4	3	6	9	8	9	17	16	9	25	55
	3	3	1	4	0	3	3	0	12	12	5	0	5	24
	4	31	8	39	29	16	45	18	12	30	10	4	14	128
V)	1	1	1	2	3	7	10	11	10	21	14	11	25	58
	2	1	1	2	1	3	4	2	4	6	15	4	19	31
	3	3	1	4	0	3	3	0	12	12	6	0	6	25
	4	33	7	40	31	19	50	19	13	32	9	8	17	139
Total		38	10	48	35	32	67	32	39	71	44	23	67	253

Examples of responses in item VI

	Category	response
	1	
	2	
	3	
	4	

Examples of responses in item VII

	Category	response
	1	
	2	
	3	
	4	

Examples of response in item VIII

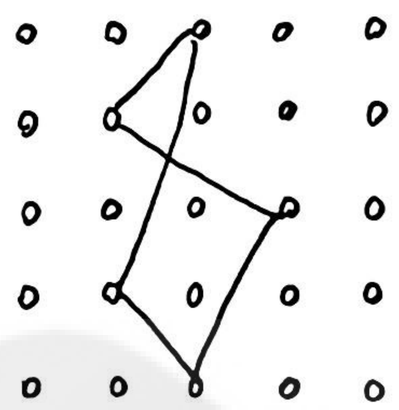
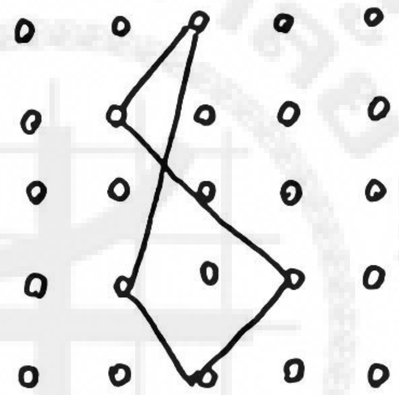
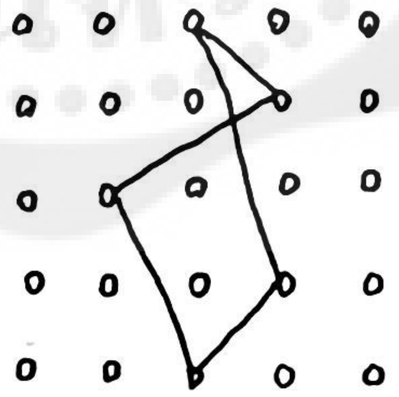
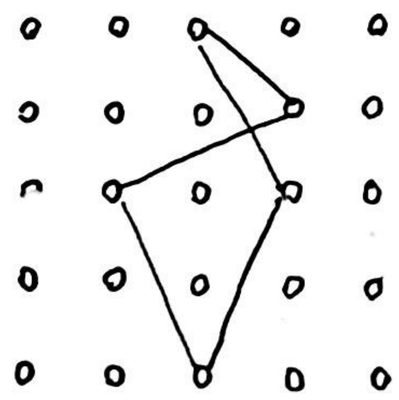
	Category	response
	1	
	2	
	3	
	4	

TABLE 117 FREQUENCY OF RESPONSES TO ITEM VI,VII,VIII

ARRANGED ACCORDING TO GRADE & SCHOOL

Item & Category		Grade I			Grade II			Grade III			Grade IV			Total
		A	D	total	B	C	total	B	C	total	A	D	total	
VI)	1	0	0	0	2	4	6	3	11	14	17	13	30	50
	2	0	0	0	2	5	7	5	4	9	9	3	12	28
	3	6	2	8	18	10	28	15	8	23	6	5	11	70
	4	32	8	40	13	13	26	9	16	25	12	2	14	105
VII	1	0	0	0	1	1	2	6	8	14	13	9	22	38
	2	0	0	0	2	6	8	0	5	5	11	7	18	31
	3	5	3	8	15	11	26	16	11	27	11	5	16	77
	4	33	7	40	17	14	31	10	15	25	9	2	11	107
VIII)	1	0	0	0	0	0	0	1	0	1	2	0	2	3
	2	0	0	0	2	3	5	1	1	2	7	6	13	20
	3	1	0	1	5	6	11	13	14	27	9	13	22	61
	4	37	10	47	28	23	51	17	24	41	26	4	30	169
Total		38	10	48	35	32	67	32	39	71	44	23	67	253

TABLE 118a. FREQUENCY OF RESPONSES TO ITEM I
ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	20	55	45	47	167
2	0	1	2	0	3
3	28	32	10	13	83
Total	48	88	57	60	253

TABLE 118b. FREQUENCY OF RESPONSES TO ITEM II
ARRANGED ACCORDING TO AGE

Type of responses	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
1	15	28	33	42	118
2	1	11	4	4	20
3	32	49	20	14	115
Total	48	88	57	60	253

TABLE 119 FREQUENCY OF RESPONSES TO ITEM III, IV, V

ARRANGED ACCORDING TO AGE

Item & Category		5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
III)	1	5	19	24	29	77
	2	1	5	4	11	21
	3	3	11	6	6	26
	4	39	53	23	14	129
IV)	1	3	12	15	16	46
	2	3	14	17	21	55
	3	2	11	5	6	24
	4	40	51	20	17	128
V)	1	3	17	18	20	58
	2	1	5	9	16	31
	3	2	11	5	7	25
	4	42	55	25	17	139
Total		48	88	57	60	253

TABLE 120 FREQUENCY OF RESPONSES TO ITEM VI, VII, VIII

ARRANGED ACCORDING TO AGE

Item & Category		5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
VI)	1	1	9	18	22	50
	2	1	9	7	11	28
	3	19	26	15	10	70
	4	27	44	17	17	105
VII)	1	1	8	14	15	38
	2	1	6	8	16	31
	3	17	27	16	17	77
	4	29	47	19	12	107
VIII)	1	0	1	0	2	3
	2	1	2	9	8	20
	3	4	20	22	15	61
	4	43	65	26	35	169
Total		48	88	57	60	253

TABLE 121 SCORES OF ALL SUBJECTS ON EACH ITEM ARRANGED ACCORDING TO GRADE & SCHOOL

Item	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
I	20	12	32	40	39	79	38	72	110	70	46	116	337
II	14	4	18	30	35	65	34	38	72	67	34	101	256
III	8	5	13	9	23	32	26	41	67	58	31	89	201
IV	8	2	10	9	23	32	20	33	53	47	29	76	171
V	6	4	10	7	20	27	24	36	60	49	26	75	172
VI	0	0	0	6	13	19	11	26	37	43	29	72	128
VII	0	0	0	4	8	12	12	21	33	37	25	62	107
VIII	0	0	0	2	3	5	3	1	4	11	6	17	26
Total	56	27	83	107	164	271	168	268	436	382	226	608	1398

TABLE 122 SCORES OF ALL SUBJECTS ON EACH ITEM

ARRANGED ACCORDING TO AGE

Item	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
I	40	111	92	94	337
II	31	67	70	85	256
III	14	54	58	75	201
IV	11	49	52	59	171
V	9	50	50	63	172
VI	3	27	43	55	128
VII	3	22	36	46	107
VIII	1	4	9	12	26
Total	112	384	410	492	1398

TABLE 123 FREQUENCY OF TOTAL SCORE ARRANGED

ACCORDING TO GRADE & SCHOOL

Score	Grade I			Grade II			Grade III			Grade IV			Total
	A	D	total	B	C	total	B	C	total	A	D	total	
16	0	0	0	0	0	0	1	0	1	2	0	2	3
15	0	0	0	0	0	0	0	0	0	3	2	5	5
14	0	0	0	0	2	2	1	3	4	3	3	6	12
13	0	0	0	1	0	1	1	1	2	1	4	5	8
12	0	0	0	1	1	2	1	0	1	3	2	5	8
11	0	0	0	1	0	1	2	4	6	3	2	5	12
10	1	0	1	1	1	2	1	2	3	3	0	3	9
9	0	0	0	0	5	5	3	1	4	5	1	6	15
8	0	1	1	0	2	2	1	1	2	3	2	5	10
7	1	0	1	1	0	1	1	5	6	5	0	5	13
6	3	0	3	0	0	0	1	9	10	3	2	5	18
5	1	0	1	2	6	8	1	4	5	2	2	4	18
4	1	0	1	6	3	9	3	3	6	3	1	4	20
3	2	3	5	0	0	0	1	1	2	1	1	2	9
2	2	5	7	10	5	15	6	4	10	2	1	3	35
1	2	0	2	0	1	1	1	0	1	0	0	0	4
0	25	1	26	12	6	18	7	1	8	2	0	2	54
Total	38	10	48	35	32	67	32	39	71	44	23	67	253

TABLE 124 FREQUENCY OF TOTAL SCORE

ARRANGED ACCORDING TO AGE

Score	5/9-7/8	7/9-8/8	8/9-9/8	9/9-14/8	Total
16	0	1	0	2	3
15	0	0	2	3	5
14	0	3	5	4	12
13	1	1	4	2	8
12	0	2	2	4	8
11	1	1	5	5	12
10	1	3	2	3	9
9	0	6	3	6	15
8	1	3	2	4	10
7	0	2	5	6	13
6	0	9	4	5	18
5	2	7	6	3	18
4	5	9	2	4	20
3	4	2	2	1	9
2	14	11	6	4	35
1	0	3	1	0	4
0	19	25	6	4	54
Total	48	88	57	60	253