PRIMITIVE FORMS OF RESPONSE TO THE MATRICES TEST.

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I. Problem and Method.

Recent work on the psychology of intelligence and thinking suggests that perceptual types of intelligence tests are inadequate for dealing with psychiatric cases, young children, old people, mental defectives, and primitive peoples. The argument is that, in these groups, intellectual processes have either deteriorated from or failed to develop to that level with which most perceptual intelligence tests are concerned. The methods of scoring also assume that the correct answers are always reached in the same way, but this is by no means always the case, as Goldstein and Scheerer (1941, p. 14) have pointed out. The studies of Werner (1948), Piaget (1951), Goldstein (1940), Hanfmann and Kasanin (1942), Rapaport (1951), Moursy (1952) *et al.* show convincing evidence that cognition can take place at different "levels." The exact determination of the number, nature, and scope of the different levels remains a task for the future, since the present situation is confused, to say the least.

The present study was undertaken in order to see whether or not the Matrices test might reasonably be applied to "primitive" individuals as a test of their immediate capacities for observation and clear thinking. The word "primitive" will be used to characterize the disordered thinking of psychiatric cases, the immature thinking of young children, the deteriorated thinking of old people, the simplicity of mentally defective thinking, and the magical and superstitious thinking of primitive peoples. Readers are referred to Werner's book, *The Comparative Psychology of Mental Development* (1948), for a detailed account of "primitive" thinking. The "primitive" group dealt with in the present study consists of thirty-five middle-aged and elderly psychiatric cases; so the findings should not be uncritically applied to other groups.

Readers will know how important it is to get accurate assessments of present intellectual capacities, and will, therefore, see the significance of the questions: "Does the Matrices test give an unambiguous measure of the intellectual capacities of 'primitive' individuals?" and, "Does it take into account the possibility that the 'primitive' intellect may not operate like that of the normal adult?" The quotations set out below are taken from *Guide to Using Progressive Matrices* (1938), (Raven, 1950, pp. 1 and 2). They give some idea of the purpose of the test:

"Progressive Matrices (1938) is a test of a person's capacity at the time of the test to apprehend meaningless figures presented for his observation, see the relations between them, conceive the nature of the figure completing each

system of relations presented, and, by so doing, develop a systematic method of reasoning."

" Young children, mentally defective persons and very old people are not expected to solve more than the problems in Sets A and B of the scale and the easier problems of Sets C and D, where reasoning by analogy is not essential. After they can no longer solve the problems, they may still choose the correct answer by chance."

The basis of the Matrices test is the " noegenesis " described by Spearman (1927, 1932). The assumption is that " g " is qualitatively the same in everyone and varies only in amount. It is true, however, that different mental operations are involved, such as comparison, grouping, analogy, etc., and later developments of the Matrices test have taken these into account (Raven, 1950, p. 4), even to the extent of admitting that the development and decline of mental activities with age may vary in kind and amount. I doubt if such a conclusion could be made to fit Spearman's theory. Further information about the construction of perceptual intelligence tests is given in articles by Penrose and Raven (1937), and Raven (1939). Readers will need to refer frequently to the Progressive Matrices (1938), Raven (1938).

Doubts about the effectiveness of the Matrices test arose during a pilot-inquiry into the relations holding between age and intellect. Tests of reaction-time, intelligence, memory-span, vocabulary, deterioration and conceptualization were administered to a group of psychiatric cases. The reason for choosing this particular kind of group was that the E expected intellectual changes due to age to show up clearly in abnormal S's.

The S's were drawn from two mental observation wards. The E tested every S between the ages of 40 and 80 years who was capable of co-operating and understanding the test instructions ; there were only two refusals. There were 35 S's altogether, with an average age of 61 years, s.d. 11.3. The 16 males had an average age of 54 years ; in this group there were 2 seniles, 8 paranoid states, 3 depressives, and 3 organics. The 19 females had an average age of 66 years ; in this group there were 6 seniles, 2 paranoid states, 9 depressives, and 2 organics. The seniles had an average age of 72 years, depressives 62 years, organics 56 years, and paranoid states 54 years. That this group was definitely " primitive " was shown by the psychiatric condition of the S's and by their performance on other tests.

The Progressive Matrices (1938) was administered individually to each member of the experimental group. S's were encouraged to explain their reasons for choosing one answer rather than another. There was no time limit, and the test was continued only up to the point where an individual was getting consistently wrong answers. S's were allowed, of course, to tackle the easier problems in each of the five sets.

Three hypotheses guided the collection and treatment of the data :

(i) The Matrices test cannot be used effectively with very young children, old people, psychiatric cases, mental defectives, and primitive peoples. The reason for this is that the kind of observation and clear thinking or intelligence tested by the Matrices is a highly developed form of abstract, objective, logical, relational thinking, whilst the intelligence of these primitive groups is of a

qualitatively different kind—a lower order of concrete, subjective, alogical, global thinking.

(ii) Certain primitive forms of thought may operate in an S's selection of the correct answers to the problems in the Matrices test, i.e., he selects the right answers for the wrong reasons, thus giving a false picture of his intellectual capacities when only his total score is taken into account. Conversely, he may choose the wrong answers for reasons which are perfectly good at lower levels of thought.

(iii) (*a*) The Matrices test does not prevent the operation of certain primitive forms of thought, and, in failing to recognize this fact, (*b*) the Matrices test scoring system does not take into consideration certain important intellectual processes.

The balance of evidence for and against these hypotheses indicates, in a general way, four things: (i) the usefulness and limitations of Spearman's theory of cognition, (ii) the usefulness and limitations of the "levels" theory of cognition, (iii) the applicability of the Matrices test to primitive groups, and (iv) the kind of investigation best calculated to throw light on the fate of the intellect in old age.

II. Results.

(i) *Quantitative.*—The average Matrices raw-score was 21·31, s.d. 9·2, with the majority of S's falling in the 50–26 percentile group, i.e., slightly below average. The distribution of total scores is otherwise normal. The product-moment r between age and Matrices score was —·46, significant at the 5 per cent. level. This supports the assumption that intellectual decline would show up clearly in abnormal S's. The other product-moment r's conform to the expected pattern for intellectual decline, i.e., the r between age and W.B. vocabulary score was —·22, not significant at the 5 per cent. level, but in the expected direction. The r between Matrices score and W.B. vocabulary score with age held constant was + ·38, and between Matrices score and age with vocabulary held constant — ·42, both significant at the 5 per cent. level.

The average scores for Sets A, B, C, D, and E were 9·22, 5·77, 3·26, 2·65 and ·34 respectively. This corresponds fairly well with the expected scores for individuals averaging a total score of 21, i.e., according to Table II in *Guide to Using Progressive Matrices* (1938) the expected scores are 8, 6, 4, 2, and 1 respectively.

Concerning scatter, Raven (1950, p. 8) says, "If a person's score on one of the sets deviates by more than 2, his total score on the scale cannot be accepted at its face value as a consistent estimate of his general capacity for intellectual activity. For general purposes the total score appears to be relatively valid even when discrepancies of more than 2 points occur in the break-up." The total scatter scores of the experimental group ranged from 1 to 10, with an average of 4·51, s.d. 2·2. There was no significant r between scatter and either age or Matrices score. Seven S's had a deviation of more than 2 points on one of the sets, but this appeared to be unrelated to any other part of their performance.

So far, then, there is nothing to suggest that this group is anything more than slightly below average in intelligence. A closer analysis of the results, however, brings to light a number of peculiarities.

Table I shows, for each problem in each set, the number of people solving it, not solving it, and not attempting it. The diagonal strokes indicate what

TABLE I.

	Problem.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Set A :												
Total right .	35	35	32	32	35	33	27	27	26 /	20 /	6	17
,, wrong .	0	0	3	3	0	2	8	7	8	14	28	17
No attempt .	0	0	0	0	0	0	0	1	1	1	1	1
Set B :												
Total right .	33	29	26	24	26 /	16	17	19 /	3	5	3	1
,, wrong .	0	4	7	9	6	16	13	11	25	20	17	17
No attempt .	2	2	2	2	3	3	5	5	7	10	15	17
Set C :												
Total right .	31 /	22	15	11	12 /	4	8	5	4	1	1	0
,, wrong .	2	11	17	19	15	16	7	6	6	7	6	6
No attempt .	2	2	3	5	8	15	20	24	25	27	28	29
Set D : . . .												
Total right .	27 /	12	11	8	11 /	6	6	5	4	1	2	0
,, wrong .	6	18	16	9	1	6	3	4	1	4	0	3
No attempt .	2	5	8	18	23	23	26	26	30	30	33	32
Set E :												
Total right .	/ 3	5	3 /	0	1	0	0	0	0	0	0	0
,, wrong .	24	10	7	4	2	1	1	1	1	1	1	1
No attempt .	8	20	25	31	32	34	34	34	34	34	34	34

appear to be sharp changes in the trend of scores. Whether or not these apparently sharp changes are statistically significant is not known.

Table II shows, for each problem in each set, the number of S's choosing the correct alternative, and the numbers choosing other alternatives. The italic figures indicate the number of S's choosing the correct alternative.

Table III shows the percentage of choices for each answer position in each set, with separate totals for A + B (six alternatives) and C + D + E (eight alternatives).

The results set out in Tables I, II and III suggest that :

(i) The problems steadily increase in difficulty, but the trend is broken at two or more points in each set by sharp stepwise increases ; this is shown by a sharp decline in the number of successes. The gradually increasing difficulty of the problems in each set suggests a gradually increasing need for "g," whilst the stepwise increases suggest either an inadequate grading of the problems or a need to operate at qualitatively different intellectual levels.

(ii) The distribution of wrong answers is not what one would expect if the wrong alternatives are all equally unfitted to complete a matrix, i.e., wrong answers to any one problem are not randomly distributed but tend to cluster on particular alternatives.

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TABLE II.

	Problem.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Set A :												
Alternative 1	–	–	*32*	–	–	–	1	–	*26*	–	3	3
,, 2	–	–	–	*32*	–	–	–	*27*	–	–	–	4
,, 3	–	–	3	1	–	*33*	–	2	–	*20*	1	2
,, 4	*35*	–	–	2	–	1	6	2	–	2	11	*17*
,, 5	–	*35*	–	–	–	–	1	–	5	–	*6*	1
,, 6	–	–	–	–	*35*	1	*27*	3	3	12	13	7
Set B :												
Alternative 1	–	–	*26*	–	*26*	4	7	1	17	9	3	1
,, 2	*33*	3	6	*24*	2	7	1	4	–	6	9	6
,, 3	–	1	1	–	–	*16*	1	4	1	*5*	4	3
,, 4	–	–	–	5	–	2	1	1	*3*	–	*3*	2
,, 5	–	–	–	2	4	1	*17*	1	7	3	–	*1*
,, 6	–	*29*	–	2	–	2	3	*19*	–	2	1	5
Set C :												
Alternative 1	–	2	3	3	–	5	2	5	3	2	*1*	1
,, 2	1	*22*	4	3	–	3	–	2	1	2	2	–
,, 3	1	7	*15*	4	5	3	–	–	–	–	1	3
,, 4	–	–	1	6	6	*4*	3	1	–	2	2	–
,, 5	–	–	1	1	–	3	*8*	–	–	–	1	–
,, 6	–	2	4	2	–	–	1	–	2	*1*	–	–
,, 7	–	–	4	–	*12*	–	–	2	*4*	–	–	1
,, 8	*31*	–	–	*11*	4	2	1	1	–	1	–	1
Set D :												
Alternative 1	3	–	3	2	–	2	–	–	*4*	–	–	–
,, 2	–	5	3	1	–	–	–	–	–	*1*	–	–
,, 3	*27*	8	*11*	–	1	2	1	–	–	–	–	–
,, 4	1	*12*	8	2	–	–	1	5	–	–	–	1
,, 5	1	–	–	2	–	1	6	3	1	3	*2*	–
,, 6	–	2	1	1	–	6	–	–	–	–	–	–
,, 7	–	3	1	*8*	–	1	1	–	–	–	–	2
,, 8	1	–	–	1	*11*	–	–	1	–	1	–	–
Set E :												
Alternative 1	11	1	1	–	*1*	–	–	1	–	–	–	–
,, 2	1	1	–	–	–	–	–	–	–	1	1	–
,, 3	3	3	2	3	–	–	–	–	–	–	–	1
,, 4	6	2	1	–	–	–	–	–	–	–	–	–
,, 5	2	2	–	–	–	–	–	–	–	–	–	–
,, 6	–	*5*	2	–	–	–	–	–	1	–	–	–
,, 7	*3*	1	1	–	2	–	1	–	–	–	–	–
,, 8	1	–	*3*	1	–	1	–	–	–	–	–	–

TABLE III.

	Sets.						
	A.	B.	C.	D.	E.	A+B.	C+D+E.
Position 1	16·0	27·0	11·5	8·5	23·0	21·5	14·0
,, 2	15·0	29·0	17·0	5·5	6·0	22·5	10·0
,, 3	15·0	10·5	17·0	30·5	18·0	12·5	22·0
,, 4	18·0	5·0	11·0	18·0	13·5	11·5	14·0
,, 5	12·0	10·5	6·0	11·5	6·0	11·0	8·0
,, 6	24·0	18·0	5·5	6·0	12·0	21·0	8·0
,, 7	—	—	10·0	10·0	12·0	—	11·0
,, 8	—	—	22·0	10·0	9·5	—	13·0

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(iii) The distribution of answers among the various positions is not what one would expect if the positions are representing right and wrong answers equally well, i.e., certain answer positions are preferred more than others.

(ii) *Qualitative.*—The peculiarities found in the trend of scores and the distribution of wrong answers require an explanation, but first of all we need to know why S's choose certain answers rather than others—a problem that mental testers have neglected. The following descriptions of the way the S's in this experiment approach the Matrices problems are based on comments and explanations given by them during their attempts to solve the problems. An examination of this kind of qualitative data helps us to answer such questions as: What kind of information, as displayed in the Matrices problems, do these S's consider relevant? Do these S's approach the problems in the way described by the *Guide*? Do these S's ever select the right answers for the wrong reasons, or give "reasonable" explanations for wrong answers? Is it possible to infer whether the intelligence of these S's is capable of abstract, objective, logical, relational thinking, or limited to concrete, subjective, alogical, global thinking?

(*a*) The explanations given in response to the problems of Set A show that the S's can perceive simple perceptual figure-ground relationships, and can grasp the relationships of number, position, size, identity, direction and shape which are embodied in the patterns. On A7 S's find it relatively easy to trace out with their fingers the pattern which completes the gestalt; on A9 and A10 most of the S's who fail choose an answer which is the reverse of the correct one; on A11 and others failures are due to the inability of S's to combine two relationships in a single pattern, their proneness to fall back on the response of "matching" an answer with part of the matrix when faced with a difficulty, and to the similarity of the alternative solutions, which causes a certain amount of "mental dazzle."* On A12 attention focuses on the "area" or "shape" of the parts enclosed by the wavy lines—this is an interesting example of the way in which abstract relations (of position) can be grasped in a primitive global way.† There is a tendency for the S's to be dominated by the figure (black lines) and to neglect the ground (white lines).

Typical explanations are: "Two borders like the pattern, and this line meets down here," A7, iv. "Number iv has the black lines, but the spaces are better in number vi"; "All the others are out of it," A7, vi. "Same width of lines towards the end'; "Other black parts are too big"; "Same as that one (i.e., part of the matrix)"; "Shaped like a lighthouse—this one," A11, iv or vi. "Seems to come to a point"; "White in the centre and at the ends"; "If it were turned round it would be like this (left-hand) side of the pattern," A10, vi. "Parallel lines are wider here"; "On the same side of the page (i.e., as alternative vi)"; "Similar to that part," A12, vi.

(*b*) The explanations given in response to the problems of Set B show that S's are able to grasp relationships of opposition, similarity, part-whole, direc-

* Katz (1951), Ch. 22, "Connective Inhibition and Mental Dazzle in Thought Processes."

† "The matrix is relationally concrete in comparison with the concept" (Hearnshaw, 1951, p. 319).

tion, absence and size.* A sharp drop in the trend of scores occurs on problem 6, where the task shifts from the completion of continuous patterns or patterns made up of discrete elements to the use of simple analogies. It is possible that by the time they are attempting these slightly more difficult problems many S's have become "mechanical"† in their use of matching as a way of solving problems.

Typical explanations are: "Same as that," B5, v; B6, ii and i; B7, i; "Two diamonds and one gate," B9, v; "Corresponds with blank diamond," B11, iv; "Makes it equal—four pieces," B4, ii; "It's a letter 'L' the other way round," B5, i; "Like a reflector—got to shade the light that way," B8, ii; "Bring the black marks to the bottom," B8, vi; "Would embody all three"; "Has the whole pattern in itself," B12, vi.

(*c*) On Set C, S's are able to perceive changes in the relative size, number, and position of parts of the matrix. Most of the errors are due to the inability of S's to use analogy, to combine two or more relationships at the same time, and to their use of the "matching" response. An interesting point to note here is that although the S's can easily see numerical relationships embodied in simple perceptual patterns, as in the Matrices test, yet they are unable to manipulate numbers and arithmetical processes satisfactorily in their symbolic form on the Rashkis Number Matrices (Rashkis, 1947).

Typical explanations are: "Three there, then six, then nine spots," C3, iii; "They go bigger like a flight of planes," C2, ii; "This would join on to any one to complete it," C5, iii; "The numbers go three, six, then seven—seven comes after six," C3, vii; "It would look nice," C5, vii; "It works in all the spots," C11, iv; "It finishes the pattern off," C12, iii.

(*d*) A sharp drop in the number of correct answers to D2 shows up an important characteristic of primitive thinking; the attention of the S's focuses on the similarity of the items in the matrix, and they definitely attempt and sometimes succeed in their efforts to group them correctly; D1 is an example of a rigid, global grouping, such as one often sees in the performance of psychiatric cases on the Weigl-Goldstein-Scheerer, Colour-Form, sorting test, and most S's choose the correct answer; from D2 onwards, however, the matrices show mixed groups, and many S's find it impossible to abstract the common properties of the parts and serialize the differences.

Those S's who succeed on the problems of Set D focus their attention on the operation of grouping, and give such explanations as: "Three of each," D3, iii, "Three dots, three bows, three crosses," D2, iv; "They each have a cross," D2, iv; "To make three crosses, and this one is different from the other two," D4, vii. Of those S's who fail, several try to group but do so incorrectly, whilst the remainder fall back on "matching." Typical explanations are: "One, two, three (indicating the matrix)—four," D2, iii; "Identical with any one of those three," D3, iv; "To match these two (indicating parts of the matrix)—I wouldn't spoil another man's work; if he had a small one so would I," D8, v; "The others would be odd or are already on the board," D3, ii.

* From C6 onwards the answers and explanations refer to those S's getting relatively high scores.

† Luchins (1942).

The need to combine two kinds of groups in D4 causes another sharp break in the trend of scores, but the wrong answers are randomly distributed. Oddly enough, D5 is solved more often than D4; the only reason I can put forward for this anomaly is that in D4 S's have a choice of five possible answers (involving either a cross or a square), whereas in D5 their choice is limited to three (involving either a star or dots).* Another sharp drop in the trend of scores for this set occurs at D6, where two groupings are needed—one patterned and one mixed. On the last three problems S's get an impression of variety and oddity; their errors are due largely to the faulty combination of elements, and matching. Typical explanations are: "All the others are in (the matrix); it's like a wireless or a loudspeaker," D8, iv. "None of these are in the pattern," D10, v.

(*e*) On Set E, S's are dominated by the operation of grouping, and on E1 most S's choose alternative iv, and explain: "Corresponds with this line"; "Same as these two"; "Makes it three"; "Loving kisses—put the other one there"; "Legs of Man." The slight recovery in the trend of scores at E2 is due to the global qualities of the correct answer: "All different patterns worked into one"; "Embodies leaves, dots and circles"; "Completes the sort of flower"; these explanations refer to alternative vi. E4 marks another drop in the number of successes, and once again this is related to a change in the type of problem; hitherto S's have been required to combine and group; they are now required to separate and subtract. Alternative iii enables some of the S's to solve the problem on the basis of apparent symmetry, and they explain that it "corresponds with the first one (of the matrix)" or "matches that corner." The explanations for E5 illustrate the way some S's are dominated by a particular "set": two S's group the curves with the dots because "It is the same pattern as the bottom line and has four dots" or "The curves are similar" and so choose alternative vii.

The qualitative data outlined above show that these S's often pay attention to those aspects of the Matrices problems that the normal person considers relevant, and work out answers to the problems in the way described in the *Guide*, i.e., S's perceive the fundaments of the patterns and the relations between them, and it is possible to infer from their explanations the operations of noegenesis. At other times, however, S's give responses based on personal associations, simplified and concrete ideas, global impressions, reversals of pattern, and the mechanical "matching" of an alternative answer with a part of the matrix; S's often approach the problems in a sensori-motor way—by touching, pointing, and tracing. Subjects show an inability to shift from one idea to another, and to hold two aspects of the same pattern in mind at the same time; they tend to work from the alternative answers to the matrix rather than from the matrix to the answers; they often fail to shift to the new kind or level of mental operation required at certain stages of the test. For the most part, such primitive approaches to the Matrices problems end in failure as judged by logical standards, but the explanations given by the S's for their wrong choices are not all equally absurd.

* This kind of thing makes item-analysis very difficult.

III. Explanation.

The foregoing analysis of qualitative data and the quantitative results set out in the tables suggest that there are at least three factors determining the answers that a person chooses when he attempts to solve the problems set by the Matrices test. These factors are (i) the position of the alternatives with respect to the matrix and with respect to each other, (ii) the kinds of figures offered as possible solutions to the problems, and (iii) the psychological processes at work in the individual. The phrase " by chance " quoted from the *Guide* implies that apart from the intellectual operations described in the quotations, no other factors, intellectual or otherwise, are influencing the S's choice of answers. We shall see the error of this implication.

(*i*) *Positional dominance of alternatives.*—Miller and Raven (1939) investigated the influence of the positions of alternative answers, with respect to the matrix, on the choice of answers to perceptual intelligence tests. In a verbal or perceptual mental test, where the right answer has to be chosen from a fixed number of possibilities, the problem will be solved by chance in a certain number of cases. The first experiments showed that choices were more evenly distributed when the alternatives were placed below the matrix than when they were placed at the side. When the possible answers were placed at the right-hand side of the matrix the S's preferred the ones on the left, i.e., the ones near the matrix, near the centre of attention ; the strength of preference decreased towards the right, but the one on the extreme right was often preferred.

The second group of experiments showed that Central-School girls preferred position 2 most, then 3, 5, 1, 6 and 4 in that order. The authors say that these tendencies persisted for Central-School girls irrespective of the amount of attention required to solve the problem, but this did not appear to be so for the Infant-School children. When the matrix above arrested their attention, the Infant-School children chose figures near the space to be filled ; when it did not arrest their attention, they chose alternatives placed near themselves on their right-hand side (positions 5 and 6).

In experiment IX, where eight possible answers were presented, the same tendencies appeared : S's chose alternatives on the right of the group more frequently than on the left ; and those alternatives from the upper line more frequently than from the lower ; the preference for the right-hand side was more marked than the preference for the upper line.

The results of the present inquiry, as set out in Table III, show that for Sets A and B combined the preferred positions were 2, 1, and 6, each of which received about 22 per cent. of the choices, whilst positions 3, 4 and 5 each received about 11 per cent. These results agree with those of Miller and Raven only in respect of position 2. In Sets C, D, and E combined the preferred positions were 3, 1 and 4, 8, 7, 2, 5 and 6 in that order ; so that these results are in general agreement with those of Miller and Raven. Taking wrong choices alone, the preferred positions for Sets A and B combined are 6, 1, 2, 4, 5 and 3 in that order, which confirms the first analysis ; similarly, the preferred positions for Sets C, D and E combined are 3, 1, 4, 2, 5, 7, 6 and 8 in that order, which confirms the dominance of the top line of alternatives over the bottom line, but not the dominance of the right-hand side over the left-hand side.

A partial solution to these contradictions lies in a further comment by Miller and Raven to the effect that the frequency with which an alternative is chosen depends partly upon its own position and partly upon the relative positions of the other figures shown with it; if a familiar figure such as a repetition of part of the matrix is placed near the centre of attention, less effort appears to be made to search elsewhere for the right answer. The upshot of this discussion is that S's tend to choose alternatives from the top line rather than from the bottom line, and possibly from the right-hand side rather than the left-hand side, but a preference for first and last alternatives cuts across these other preferences.

There is nothing in Spearman's theory of cognition to account for constant positional errors of the type described above; the "levels" theory can, however, offer a tentative explanation. Miller and Raven say that S's usually observe the matrix and group of alternatives as a whole, and we can infer from the results of their second series of experiments that increasing age up to maturity brings with it an increasing ability to separate out the main parts of the perceptual and cognitive field. Whether children choose alternatives from the upper or lower line depends upon whether their attention is centred by objective perceptions or subjective efforts, i.e., they are both "bound by outer-world stimuli" and "egocentric" in their thought and action. Their boundedness to outer-world stimuli takes the form of an inability to analyse the situation into its component parts or to re-structure it; their egocentricity takes the form of using their bodies as reference points and being dominated by the spatial and temporal proximity of their environment. As age increases up to maturity not only do we find that people are better able to discriminate between self and environment, but also that they are better able to free themselves from the compelling influence of both—they can consider, suspend judgment and action, change their minds, and so on.

In the present inquiry the preference of psychiatric S's for the upper line of alternatives suggests that "boundedness to outer-world stimuli"* is a later development and a higher form of primitive thought than "egocentricity."† The gestalt phenomenon of "closure" may also have something to do with the dominance of the top line. Werner (1948) has shown the importance of the body-schema in the development of primitive concepts of space and number; so that the preference for the right-hand group of alternatives, where this is not due to the factors mentioned above, may be due to the sensori-motor dominance of the right-hand side of the body in right-handed people‡; moreover, this tendency might be exaggerated by the fact that the part of the matrix which has to be completed is always on the right-hand side of the page. The preference for the first and last of a number of alternatives cannot be adequately explained, but it can be seen as another example of the dominance of boundary areas commonly found in studies of learning and perception.

(*ii*) *Figural dominance of alternatives.*—The "amount of attention" an

* Goldstein and Scheerer (1941).
† Piaget (1951).
‡ This hypothesis could be tested easily by analysing the performance of left-handed children, keeping all other factors constant.

alternative receives depends partly on its position and partly on the attitude of the S; if the attitude of the S is predominantly primitive, i.e., concrete, global, or physiognomic, then those figures which can be grasped in a primitive way will be chosen more often than those which are abstract and "meaningless." For example, S's say, "Reminds me of a jellyfish," B10, i; "Square one—like a window," B11, ii; "To get the bull's-eye," D3, i. If one examines the choices made in particular problems, one sees that on no problem of the Matrices test do primitive S's give consistently concrete or physiognomic interpretations. With global responses this is not the case: on B12, vi, and possibly C10, iv, C11, iv, and E2, vi, there is a slight tendency for S's to choose answers which clearly portray the total qualities of the matrix, and to explain, "It would embody all three"; "Has the whole pattern in itself," B12, vi; "All the patterns in the one space," C10, iv.

Certain types of alternatives are chosen irrespective of position. Miller and Raven give the following analysis for their experiment VIII with Central-School girls:

TABLE IV.

Description of alternative.	Designation.	Per cent. frequency of choice.
Correct figure	A	17·5
Symmetrical figure	B	12·5
Part of the matrix	C	26·7
Asymmetrical figure	D	12·4
Another part of the matrix	E	20·0
Simple figure which resembles the correct one	F	10·9

They explain, "When the matrix presented was difficult to comprehend, there was a tendency to choose a figure which repeated part of the matrix. The strength of this tendency varied according to the position of the figures. In other words, if a C alternative is in a favoured position such as number iii, it will be chosen more frequently than if it is in an unfavoured position such as number iv."

The descriptions of the various types of alternatives given by Miller and Raven, however, are not clear, and I have preferred a different system for describing them. In the present analysis the following frequencies were obtained:

TABLE V.

Description of alternative.	Designation.	Per cent. frequency of choice.
Correct figure	A	61·0
Part of the matrix	C	24·0
Simple or distorted figure like the correct one	F	4·0
Relatively unrelated figure	G	1·0
Global figure	H	6·5
Similar to part of the matrix reversed or distorted	I	3·5

Such an analysis suggests that, apart from correct answers, which are mainly determined by eductive processes and positional factors, S's are likely to choose in order of preference: first, a part of the matrix; second, a figure embodying all or several features of the total matrix; third, a figure similar

to the correct one ; fourth, a figure similar to some part of the matrix, usually a distortion of it ; and fifth, very infrequently, an unrelated figure. This analysis is not conclusive because it is somewhat arbitrary, certain classifications overlap, and the possible types of alternatives may not be exhaustively described.

28 per cent. of the correct answers to the Matrices test reproduce exactly a part of the matrix, the remainder produce new parts. Taking Sets A and B together, 50 per cent. of the correct answers are reproductive rather than eductive, and it is small wonder that primitive S's become mechanical in their response of matching an alternative with part of the matrix. It is difficult, if not impossible, to classify adequately those answers which are really eductive —the reason is that they can be seen from different points of view, e.g., C1 can be seen as a problem requiring an answer in terms of grouping, analogy, or order. There are 432 possible answers to the 60 Matrices problems ; the percentage falling into each of the categories A, C, F, G, H and I are 14, 34, 6, 9, 15 and 22 respectively. This clearly shows that the composition of alternative answers to the Matrices test is biased in favour of those alternatives portraying a part of the matrix.

Taking Sets A and B alone, and presuming for the sake of simplicity that the types of alternatives are equally represented for each problem, the expected and observed percentage frequencies of choice are as follows :

TABLE VI.

	Designation.					
	A.	C.	F.	G.	H.	I.
Expected per cent. frequency of choice . .	16	20	10	21	5	28
Observed per cent. frequency of choice .	69	19	5	1	4	2

We find, naturally, that the correct answers are chosen much more frequently than would be expected if chance alone were operating, whilst all the other types of alternatives are chosen less frequently. However, the proportions of obtained to expected frequencies are high for types G and I, and low for types C, F, and H. If we compare the observed frequencies of choice in Table V with the frequency of occurrence of different kinds of alternatives for the 432 possible answers, we get similar results. We must conclude, therefore, that factors other than chance and position are operating in the preferences of S's for answers of the type C, F or H, i.e., part of the matrix, a simple or distorted figure like the correct one, or a global figure. This conclusion may alter the significance of the findings of Miller and Raven (1939), Eysenck (1945), and Pinkerton and Kelly (1952), because the different kinds of alternative answers are unequally represented on the Matrices test and are weighted in favour of those portraying a part of the matrix. Moreover, the unequal representation of certain kinds of alternatives does not allow fine distinctions to be drawn between adult normal, pathological, and children's thinking.

(iii) *Cognitive factors.*—The Matrices test is based on Spearman's theory of intelligence. The basic mental processes described by him are (*a*) the

apprehension of one's own experience, (*b*) the eduction of relations, and (*c*) the eduction of correlates. These processes can be plainly inferred from the behaviour and explanations of the S's in this inquiry, e.g., " Has there to be two of these and two of these ? (indicating the black, and lined triangles). If it has to complete the pattern in the best way, then it has to be like this (indicating alternative v) because of the reverse shape,"* B7, v ; " The number of lines up and down (meaning horizontal and vertical) increase with each one," C4, viii ; " Number i is the only one that will go—it has the two double lines," A8, i ; " This is less than this (indicating parts of the matrix) and the same here (indicating position i)," E5, i.

The point we now have to decide is whether noegenesis is the only kind of mental process operating in the performance of these primitive S's. Spearman shows in theory how his principles apply to conceptualization, judgment, reasoning, memory and imagination, but criticisms of such a universal application of noegenetic principles have been made by Hearnshaw (1951). Spearman's theory makes allowances for certain kinds of errors in thinking, but these are very inadequately described : there are those errors due to obscurity (ignorance and variable error), those due to illusion (constant error, associative reproduction, and wishful thinking), and those due to both obscurity and illusion (confusion). The explanations given by the S's in this inquiry show that there are errors of other kinds, indicating, perhaps, the presence of other cognitive processes.

(a) *Global responses*, e.g., " Number i is more complete in itself than any of them," C9, i ; " It completes the picture—all these parts (indicating the matrix) are different parts of that one (indicating position vii)," E7, vii. In these and other cases the S's are aware of the constituent parts of the matrix, but are unable to educe a correlate and fall back on a syncretic or global solution.

(b) *Concrete responses*. e.g., " This is a letter ' A ' (triangle with a dot) and this (position ii) is a letter ' B ' to match it," C9, ii ; " This (position ii) is the same size and everything : if things are too big, like a piece of wood, you can always take some away. There are none the same size ; so it will be odd, or you will have to make one (by paring it down)," C2, ii. Such examples of concrete perception and thinking are commonly found among psychiatric conditions—they are said to be disruptive forces which impair abstract thinking.† This seems to be true for schizophrenia at least, but in other groups it is possible for certain primitive forms of thought and behaviour to compensate for an impaired abstract attitude.‡

(c) *Mechanization of response*.—In all probability " matching " would be regarded by Spearman as a constant error due to an illusion of equality or

* The S who gave this explanation was by no means always so logical ; she gave a number of very primitive responses.

† Cf. Goldstein (1940), and Hanfmann and Kasanin (1942).

‡ Welford (1951) has explained how compensations occur in skilled activities when abilities are impaired. Compensatory mechanisms are well known in physiology and psychoanalysis, and in both these fields such mechanisms occasionally fail to stay as compensatory devices and become, as it were, autonomous, thus disrupting normal functions. It is quite possible, therefore, that the intellectual life of an individual involves mechanisms which normally compensate him for impaired abilities, but occasionally become dominant over and disruptive of his normal intellectual activities.

symmetry, and a limited span of apprehension, or explained, perhaps, by reference to the law of retentivity of dispositions, according to which, " cognitive events by occurring establish dispositions which facilitate their recurrence."* But it is possible to explain " matching " in terms of rigidity or mechanization of response, since in the early problems of Sets A, B, C and D solutions are parts of the incomplete matrix, whereas in later problems they are not. In primitive S's the " set " for " matching " built up in the first three or four problems remains fixed in spite of its inappropriateness to later problems.†

(d) *Inability to explain.*—One or two S's get correct answers but cannot give an explanation. This suggests an impairment of the abstract attitude, since S's cannot " account for acts and verbalize the account."‡ But more often the inability of S's to explain is concerned with problems they cannot solve—they cannot explain what their difficulty is, whereas a normal adult can.

(e) *Sensori-motor responses.*—Many S's point with their fingers and trace out the shape of the pattern which completes the matrix. If S's were not allowed to behave in this way their errors would increase ; this is the reason for having form-board tests. Using a form-board not only brings the problem down to a concrete level, but, in making the S use his hands, it also helps him to concentrate. In the present inquiry (where the test was in booklet form) a number of S's made the peculiar error of finding the required pattern by tracing, but then choosing the wrong alternative even if both were adequately traced.

(f) *Physiognomic responses*, e.g., " Number vi for the poetry and thickness of the rhyme (line)," A9, vi. Only one S gave such responses.

(g) *Subjective responses*, e.g., " But it all depends on what you want," B5, i ; " Number i—you need one with a diamond on top, but it's haphazard, a mere matter of choice," C8, i. I have found that explanations of this kind are quite frequent even among normals, particularly artistic individuals. They would, presumably, be classed by Spearman as errors due to conative or associative tendencies, and we would, no doubt, agree.

(h) *Fluid responses*, e.g., " Any one will go in—4, 5, 6 or 7," C3, vi ; " It (position i) would be entirely different—making four different ones," B11, i. The clearest example in this inquiry was, " I'm lost in a fog here. I can't find it on here (i.e., he cannot find one like alternative vii). It's a variety of a picture," D6, vii. One S gave the following classical example of fluidity of response combined with concreteness : " Might be a fallen flower with the petals falling off. There is no pattern—just a piece of bent wire, clockwork, a broken propeller, Morse code, shorthand-typist. Several of these (alternatives) would fit in ; the pieces drawn together would make a vase, and this (alternative vi) could be the main switch—one button for six lights," E2, vi. Note the global response at the end of this explanation. Many S's choose an answer by finding the " odd man out," i.e., an answer which does not appear in the pattern at all. Fluidity of response is a characteristic of primitive thinking which is, in a way, the opposite of rigidity ; it refers to a cognitive instability or, as Werner (1948) would call it, " lack of centralization."

* Spearman (1932, p. 271).
† Cf. Luchins (1942).
‡ Goldstein and Scheerer (1941, p. 4).

(i) *Avoidance of reality*.—On very rare occasions an S will want to alter the test conditions, e.g., "But as a picture you would have to turn it upside-down," D2, iii; "It (alternative vi) would be alright if it were turned round," A10, vi. One finds this kind of response more often associated with other tests, e.g., a schizophrenic performance on the Vigotsky test. Another technique for avoiding reality is the concern for fine detail; this response is more likely to be brought out by a projective test. In this inquiry S's gave such explanations as, "Has little pieces on the ends," C2, ii. A number of S's try to find slight differences in the sizes and shapes of the frames containing the alternative answers.

The responses described above are typical of primitive levels of thinking and are found on tests other than the Matrices. The efficiency of the Matrices test is due partly to its minimal stimulation of primitive forms of thought. A point to be emphasized is, however, that primitive forms of thought can play a part in an S's performance on the Matrices test; so that it is impossible, without his explanations, to say whether his answers are based on noegenetic operations or not. What seems certain is that noegenetic and primitive levels of thought can coexist in the same person.

We may summarize this section by saying that the results obtained from this group of S's must be explained not only by reference to noegenetic principles and chance, but also by reference to (i) positional factors in the way the matrices and alternative answers are displayed, (ii) figural factors in the kind of alternatives from which the S has to choose an answer, and (iii) cognitive factors of a primitive kind which seem to operate either to compensate an individual for an intellectual deficit or to disrupt his normal thinking.

IV. Discussion.

(i) *Implications for Spearman's theory of cognition*.—The foregoing examples of primitive thinking are sufficient to show that the basic cognitive processes described by Spearman are by no means the only ones discernible in intellectual activities. This limitation of Spearman's theory probably arises from the fact that the theory is based on the intellectual performances of normal adults and older children, and fails to take into account the developmental aspects of intelligence and its breakdown in pathological conditions. The theory fails to account adequately for errors made in thinking, and can be criticized sharply for its explanations of conceptualization, grouping, and judgment. The truth is that Spearman's theory has been exploited systematically only in the field of factorial-analysis; so that if the quantitative principles and anoegenetic processes, also described by Spearman, were exploited, particularly in the fields of psychopathology and developmental psychology, the theory might take on a new lease of life.

(ii) *Implications for the "levels" theory of cognition*.—The results of the present inquiry suggest a number of interesting possibilities:

(*a*) The types of primitive thought that I have exemplified—global responses, concreteness, mechanization or rigidity (matching), inability to explain, sensori-motor behaviour, physiognomic responses, subjectivity (egocentric

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and affective thinking), fluidity, and avoidance of reality seem, from a clinical point of view, to be distinct forms of response. It is likely, too, from the way many separate fields of cognitive psychology are converging on each other, that most of the primitive forms of thought have been detected; hence future research should aim at making more precise the concepts that are now only vague.

(*b*) Again, from a clinical point of view, there seems to be all the difference in the world between the adaptive efficiency of an S who searches systematically for an answer which is "odd man out" and that of an S who is content to match or search for fine details or give concrete responses. Sensori-motor, syncretic and global responses seem to be the most effective forms of primitive thought, then come rigidity, fluidity and concreteness, whilst what are to all intents and purposes merely the last remnants of a lost intellect seem to come lowest in the hierarchy—physiognomic responses, subjectivity, inability to explain, and avoidance of reality.

(*c*) Certain primitive forms of thought, particularly sensori-motor responses and mechanization are common to all the S's of this inquiry, whilst global and concrete responses are common to a large number. Other primitive forms of thought appear to vary with age, intelligence, and psychiatric type: it is quite easy to trace the gradual loss of higher intellectual capacities with increasing age and to trace the emergence first of higher and then of lower forms of primitive thought; the same kind of thing occurs, naturally enough, as we move from the higher to the lower grades of intelligence; the number of S's in this inquiry was too small to show any definite differences in primitive thought between the various psychiatric types, but it is likely that such differences exist.

(*d*) There appear to be differences between individuals in their susceptibility to various kinds of primitive thinking. One S looks at A5 and asks, "Is that Jupiter or Mars?," but selects the right answer. On A4, she says, "Spot (indicating alternative iv) the winner (indicating alternative ii)"; such primitive puns were not frequent in this inquiry!! During any lull in the conversation she returns to her paranoid theme of persecution. She oocasionally searches among the answers for one which does not appear in the matrix, but rarely matches her answer with part of the matrix. Another S often fluctuates between two or more answers, saying to herself, "Yes it is, no it isn't." She tries hard, and changes her mind often when I ask her why she chooses a particular answer. She gives no concrete responses, and usually matches a part of the matrix next to the empty space. A third S gives slow but adequate explanations, and uses small details as a guide, e.g., "It (alternative iii) is white in the centre and at the ends," A10, iii. Like a number of other S's he can trace correctly the shape required on B4, but chooses the wrong answer. He often points and traces with his finger when he is unable to explain in words. He thinks hard and for a long time before explaining. A fourth S gives very quick and good explanations, but occasionally fails to examine a problem closely, and says, as I check him, "Oh, you have to think about these things—I thought they were elementary." Sometimes he just blusters his way out of an explanation, saying, "It's obvious—there's no other choice." He gives

only the merest suggestion of concrete and subjective tendencies, viz., " Hour-glass fingers—inclined to the right and the left ; but it's a mere matter of choice," E3, iii. The S otherwise focuses sharply on the problem conditions.

(iii) *Implications for the Matrices test.*—As far as may be seen from the present inquiry, success on the Matrices test is largely dependent on the intact operation of such higher mental processes as awareness of experience, eduction of relations and correlates, simple and complex grouping, and the application of abstract principles of order. The Matrices test does not stimulate primitive forms of thinking as much as, say, Block-Sorting or Proverbs ; nevertheless, primitive thought occasionally plays a part in the choice of correct answers ; these are the forms which seem to be highest in the hierarchy—sensori-motor, syncretic (simple associative), and global responses. A further bias enters into the test because of its inadequate exclusion of positional and figural factors, and its tendency to encourage mechanization of response, especially in the early part of the test.

The paradox between the fact that the S's in this investigation exhibited primitive forms of response and the fact that the Matrices test still gives valid measures of their intelligence can be resolved by taking the Matrices scores as measures of their " abstract intelligence,"* which can, it appears, coexist with certain primitive forms of thought or lower levels of intelligence. These primitive forms or levels of thought, with the exception of those mentioned in the last paragraph, do not contribute to an S's score on the test, and seem only to interfere with higher thought processes in certain extreme pathological conditions, such as schizophrenia. Primitive forms of thought in the less grossly disordered individual seem to act in a compensatory sort of way—allowing him some sort of adjustment and release of tension but of an inferior kind. A similar process of " primitivation " can be discerned in the thinking of normal people faced with difficult problems—they tend to think in images, take concrete examples, try to alter the conditions of the problem, and so on.

The Matrices test seems to tap not only the higher forms of primitive thinking but also intellectual processes which are not adequately accounted for by the theory of noegenesis. I will mention briefly three possibilities :

(*a*) The operation of " grouping," particularly complex grouping, is not fully explained by Spearman's theory, but plays a part in the Matrices test, particularly Set D.

(*b*) In spite of the test's lack of confusing detail, " abstraction of the relevant relations " is definitely involved, particularly in the more difficult problems. This refutes a criticism which is often made against the test—that all the relations are relevant, therefore an important intellectual operation (abstraction) is not being tested.† The clearest example is E12, where the positions of the loops either on the circles or with respect to each other are irrelevant to the solution of the problem. This is not to say, of course, that a judicious use of irrelevant detail in the more difficult problems might not make the test more discriminating at higher intellectual levels.

* " . . . this combination of noegenesis together with abstractness does satisfy the G-loadings *almost* perfectly " Spearman and Wynn Jones (1950, p. 69).

† Hearnshaw's criticism (1951, pp. 318–319) notwithstanding.

(*c*) The Matrices test does, but to a very limited extent, tap " the ability to learn from experience." This, however, is in the form of latent learning and not organized or insightful learning. It is a mistake to assume that most people become aware of the problems in each set as variations on a single theme. Again, this is not to say that the introduction of some kind of knowledge of results might not have a corrective influence on S's who are prone to become " mechanized " in their responses.

If the above possibilities are found to be true, it would follow that the Matrices test is not as limited as the theory on which it is based, since it caters for intellectual activities not adequately encompassed by that theory. Even so, there are a number of ways in which the test might be improved: (*a*) by the standardization and simplification of positional and figural factors in the way the problems are displayed (including the use of different positions for that part of the matrix which has to be completed); (*b*) by weighting the alternative answers in terms of their " reasonableness," and so making the test more discriminating at the lower levels of intelligence; (*c*) by introducing knowledge of results to offset any possible mechanization of response; and (*d*) by introducing irrelevant detail in order to make the test more discriminating at the higher levels of intelligence.

(iv) *Implications for research into intellectual decline.*—The kind of investigation best calculated to throw light on intellectual decline during late maturity and old age is one which will show (*a*) the breakdown of noegenetic and other higher forms of cognition, (*b*) the increasing reliance upon and disruptive influence of primitive forms of thought, (*c*) the final deterioration through lower and lower levels of primitive thought, (*d*) the changes which possibly take place in the structure and hierarchical organization of both noegenetic and primitive forms of thought, and (*e*) the concomitants of primitive thinking and intellectual decline.

V. Summary and Conclusions.

Recent work on intellectual development and the pathology of thinking suggested the possibility that intelligence tests do not tap certain primitive levels of thinking, and so do not measure effectively the intelligence of immature and deteriorated individuals. An examination of the performance of thirty-five middle-aged and elderly psychiatric cases, therefore, was expected to show that the Matrices test was inapplicable to this group of S's (and possibly inapplicable to other primitive groups). It was argued that the breakdown of noegenetic processes and the operation of primitive forms of thought in these S's distorts their performance on the Matrices test; the test fails to prevent the operation of primitive thinking, and the scoring system does not take this fact into account. The Progressive Matrices (1938) was administered individually, and S's were encouraged to explain their choice of answers.

The quantitative results suggested a number of conclusions: (*a*) The test problems steadily increase in difficulty, but the trend is broken at two or more points in each set by sharp stepwise increases, indicating either an inadequate grading of the difficulty of the problems, or a need for the S's to shift to a higher level of intellectual activity. (*b*) The distribution of wrong answers is not

what one would expect if the alternative answers other than the correct one are all equally unfitted to complete the matrix. (*c*) The distribution of answers among the various positions is not what one would expect if the positions are representing right and wrong answers equally well.

The qualitative results suggested that the S's often paid attention to those aspects of the Matrices problems that the normal person considers relevant, and worked out answers in the way the *Guide* describes, i.e., the S's perceived the fundaments of the pattern and the relations between them, and it was possible to infer from their explanations the operations of noegenesis. At other times, however, the S's gave responses based on personal associations, sensori-motor impressions, simplified and concrete ideas, global impressions, reversals of pattern, and the mechanical " matching " of an alternative answer with a part of the matrix. Subjects showed an inability to shift from one idea to another, and to hold two aspects of the same pattern in mind at the same time ; they tended to work from the alternative answers to the matrix, rather than from the matrix to the answers ; they often failed to shift to the new kind or level of mental operation required at certain stages in the test.

In order to explain these results we need to consider three factors influencing an S's choice of answers. The first factor is the way S's are influenced by a preference for the top line of alternatives rather than the bottom line, for alternatives on the right-hand side rather than the left-hand side, and for the first and last alternatives rather than those in between. These preferences can possibly be explained in terms of the " egocentricity " and " boundedness to outer-world stimuli " characteristic of deteriorated, and immature individuals. The second factor is the way S's are influenced by a preference for answers which portray a part of the matrix, a simple or distorted figure like the correct one, or a global figure. These preferences can possibly be explained in terms of other characteristics of deteriorated and immature individuals, viz., the tendency to give responses based on habit rather than insight, to make errors in the application of ideas, and to fail to analyse a complex whole into its constituent parts. The third factor is the way the S's are influenced by what appear to be primitive forms of thought acting in either compensatory or disruptive ways. Thus, in addition to noegenetic forms of thought, which characterize the thinking of normal people, the S's in this inquiry showed various kinds and amounts of alogical behaviour, such as global and concrete responses, mechanization of response, inability to explain their performance, sensori-motor, egocentric and affective behaviour, fluidity of ideas and avoidance of reality.

On the whole the results do not suggest that the Matrices test is ineffective when used on primitive S's, provided the test is regarded as a test of " abstract " intelligence. The Matrices score, however, gives only a crude picture of the total intellectual organization of primitive S's, and needs to be supplemented by data from other tests. In certain instances, S's choose the right answer for the wrong reasons, especially when positional, figural and primitive cognitive factors conspire to produce this result ; but the Matrices test keeps the successful use of primitive forms of thought down to a minimum, and even the forms that do intrude belong to the higher primitive levels.

The findings have four main implications: (*a*) Spearman's theory does not adequately account for the performance of primitive S's on the Matrices test, but this inadequacy and others might be removed if the quantitative principles and anoegenetic processes were exploited in the fields of psychopathology and developmental psychology. (*b*) There is a limited number of separate primitive forms of thought which seem to be arranged in a hierarchy. The kind and amount of primitive thinking seems to vary with age, intelligence, and psychiatric type, and there seem to be marked individual differences. (*c*) The Matrices test is not limited to testing noegenetic processes, but covers a wide range of intellectual activities which cannot be comfortably accommodated to Spearman's theory. The Matrices test might be made more discriminating at all levels of intelligence by the weighting of alternative answers, the introduction of some kind of knowledge of results, and by the use of irrelevant detail in the more difficult problems. The influence of positional and figural factors could also be reduced. (*d*) Future research into the problem of intellectual decline with age should consider the breakdown of higher and the emergence of lower levels of thought, changes in intellectual organization, the concomitants of deterioration, and should compare the intellectual life of different kinds of primitive groups with one another.

The balance of evidence points to the need for a synthesis of the levels and neogenetic theories of cognition, since both the precision of the noegenetic and the scope of the levels theory are required if we are to have an adequate theory of intelligence and thinking.

References.

EYSENCK, M. D., "A Study of Certain Qualitative Aspects of Problem-solving in Senile-dementia Patients," *J. Ment. Sci.*, 1945, **91**, 337–345.

GOLDSTEIN, K., *Human Nature in the Light of Psychopathology*, 1940. Cambridge, Mass.: Harvard Univ. Press.

Idem and SCHEERER, M., "Abstract and Concrete Behaviour," *Psychol. Monog.*, 1941, **53**, 239.

HANFMANN, E., and KASANIN, J., "Conceptual Thinking in Schizophrenia," *Nerv. Ment. Dis. Mon. Ser.*, 1942, **67**, N.Y.

HEARNSHAW, L. S., "Exploring the Intellect," *Brit. J. Psychol.*, 1951, **42**, 315–321.

KATZ, D., *Gestalt Psychology*, 1951. Methuen.

LUCHINS, A. S., "Mechanization in Problem-solving," *Psychol. Monog.*, 1942, **54**, 6.

MILLER, F. M., and RAVEN, J. C., "The Influence of Positional Factors on the Choice of Answers to Perceptual Intelligence Tests," *Brit. J. Med. Psychol.*, 1939, **18**, 35–39.

MOURSY, E. M., "The Hierarchical Organization of Cognitive Levels," *Brit. J. Psychol.* (Stat. Sec.), 1952, **5**, iii, 151–180.

PENROSE, L. S., and RAVEN, J. C., "A New Series of Perceptual Tests," *Brit. J. Med. Psychol.*, 1937, **16**, Pt. 2, 97–104.

PIAGET, J., *Play, Dreams, and Imitation in Childhood*, 1951. London, Heineman.

PINKERTON, P., and KELLY, J., "An Attempted Correlation between Clinical and Psychometric Findings in Senile-arteriosclerotic Dementia," *J. Ment. Sci.*, 1952, **98**, 411, 244-255.

RAPAPORT, D. (Ed.), *Organization and Pathology of Thought*, 1951. Oxford Univ. Press.

RASHKIS, H. A., "Three Types of Thinking Disorder," *J. Nerv. Ment. Dis.*, 1947, **106**, 6, 650–670.

RAVEN, J. C., *Progressive Matrices, Sets A, B, C, D, and E*, 1938. H. K. Lewis & Co.

Idem, "The R.E.C.I. Series of Perceptual Tests," *Brit. J. Med. Psychol.*, 1939, **18**, Pt. I, 16–34.

Idem, *Guide to Using Progressive Matrices* (1938), 1950. H. K. Lewis & Co.

SPEARMAN, C., *The Nature of "Intelligence" and the Principles of Cognition*, 1927. MacMillan.

Idem, *The Abilities of Man*, 1932. MacMillan.

Idem and WYNN JONES, LL., *Human Ability*, 1950. MacMillan.

WELFORD, A. T., *Skill and Age*, 1951. Oxford Univ. Press.

WERNER, H., *Comparative Psychology of Mental Development*, 1948. Follett.