

**MENTAL ASPECTS OF SCHOOL CHILDREN
WITH SPECIAL REFERENCE
TO THE MENTAL RANGE**

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MENTAL ASPECTS OF SCHOOL CHILDREN WITH
SPECIAL REFERENCE TO THE MENTAL RANGE

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CHAPTER I

MENTAL MEASUREMENTS IN EDUCATION

Introduction and Historical Setting

There are few, if any, more significant events in recent American educational history than the discussions which have recently taken place relative to methods of mental measurement. Typical of the methodical and comprehensive manner in which certain large-scale scientific efforts are carried on is the work of the Bureau of Curriculum Research of Teachers College, Columbia University. This Bureau reports that it has now on file 100,000 references and 30,000 courses of study with abstracts available for 60,000 educational articles published since 1910.¹

Only twenty-four years have elapsed since Binet devised his first crude series of intelligence tests, only twenty-one since he gave to the world the first real intelligence scale, and only nineteen since the first translation of Binet's method was published in America. Nowhere else has such extensive practical use been made of the tests or so much research been undertaken for their improvement. In prisons, juvenile courts, reform schools, and institutions for defectives their use has become well nigh universal.

But the movement has not stopped at this point. Far-seeing educational psychologists and school administrators early realized that the greatest value of mental tests would

¹Teachers College Record, (February, 1929), 413.

would be found in their use with school children. This use has grown to include the testing not only of backward or otherwise abnormal children, but also of the gifted and normal. Thousands of teachers have been trained in the use of many kinds of test procedure, and in many of the school systems all the children have been tested.²

Some discussion of the application of scientific measurement to what is usually called "the new education" or "progressive education", has appeared in the past year. Dr. Harold Rugg, who is known as an admirer of much of the work of progressive schools, nevertheless comments on the fact that:

Not one of these schools is conducting scientifically controlled experiments. Enthusiastic innovation, but not scientific study marks out the advances of the experimental school.³

There have been professional students in this field who, in advancing conclusions, put forth results which have proved erroneous.

Therefor they are receiving several severe attacks from critical thinkers.

This is a sample of fatalism, Mr. Bagley said, that is being drawn by some of the half knowledged psychologists, not from the fact that they have discovered, but from the assumptions that they have made.⁴

²Lewis M. Terman, Intelligence Tests and School Re-organization, 2, New York: World Book Co., 1922.

³Teachers College Record, (February, 1929), 413.

⁴William C. Bagley, Determinism in Education, 14, New York: World Book Co. 1926.

Even Professor John Dewey, who is favorably disposed toward the mental test movement, made the following warning at the 1928 meeting of the Progressive Education Association.

Even if it be true that everything which exists could be measured - if only we know how - that which does not exist cannot be measured. Moreover, said Professor Dewey, It is no paradox to say that the teacher is deeply concerned with what does not exist. For a progressive school is primarily concerned with growth, with a moving and changing process, with transforming existing capacities and experiences; what already exists by way of native endowment and past achievement is subordinate to what it may become, possibilities are more important than what already exists, and knowledge of the latter counts only in its bearing upon possibilities. The place of measurement of achievements as a theory of education is very different in a static educational system from what it is in one which is dynamic, or in which the on-going process of growing is the important thing.⁵

The human mind, as an object of experiment, is only a figure of real being, because our consciousness is not mind itself but only one product of mind. We must use carefully all results of experimental psychology, and we must avoid all impertinent conclusions. Educational methods are constructed on psychological facts derived from observation of certain pupils and educational purposes are determined by human ethics. This is an old Herbartian educational idea. Do not believe such simple educational conception.

Many professional students of mental measurement must be careful of their educational conclusions even more than their psychological conclusions, because the psychological facts which were discovered by the psychologists cannot cover

⁵Progressive Education, (July, August, September, 1928), 200.

all the educational field, nor can they cover all educational methods.

In arriving at conclusions in the field of mental measurements, there were involved some mistakes but the movement as a whole has succeeded in a very practical way. To interpret this movement as but another educational fad, destined to flourish awhile and then be forgotten, would be a serious mistake. The essential facts in the situation do not justify such a view.

Intelligence tests have demonstrated the great extent and frequency of individual differences in the mental ability of unselected school children, and common sense tells us how necessary it is to take such differences into account in framing curricula and methods, in the classification of children for instruction, and in their educational and vocational guidance. Today, a new-type examination movement has made remarkable use of mental measurements. The over-enthusiastic will gradually learn that not even the universal use of intelligence tests will bring us to an educational millennium. The children are more than intelligence, and education is more than the cultivation of intellectual abilities.

Thus far effort has been devoted chiefly to the improvement of the testing technique and to the investigation of the nature and range of individual differences. The results have shown convincingly that the schools of the future will have to take account of such differences, but we have

not shown how this can best be done.

School reform has lagged behind the advances of psychological science. This is, of course, inevitable. The problems involved are inherently very difficult and are of such a nature that various alternative methods of solution appear to be, from the point of view of theoretical considerations, almost equally plausible. Considerable time will have to elapse before final judgment can be rendered as to the relative value of the various possible methods of adjusting curriculum and methods to the individual differences of children.⁶

Lack of Uniformity in the Mental Ability of Grades and Classes.

What does "grade" mean? This is a very simple question, but the conventional conception of "grade" does not explain at all the essential facts of "grade" but only incidental facts. The class room, chronological age, and text books are not essential facts of grade. Until now we defined only on such unessential facts because we did not realize that the pupils differences of mental capacity and those anticipated developments and changes were of such great importance. But the movement of mental measurement taught those essential facts. The several studies of mental measurements have shown us the lack of uniformity in mental ability both in grades and classes.

The grade group which was determined on the basis of chronological age is the heterogeneous group in mental ability, for instance, 416 children, all of whom were twelve years

⁶Lewis M. Terman, Intelligence Tests and School Reorganization, 4, New York: World Book Co., 1922.

of age, were examined at the Institute for Juvenile Research, Chicago, by Luton Ackerson by the Binet Test.

Luton Ackerson found sixteen years mental range in these children. Table I is the result of that study.⁷

W. S. Gray studied about the quality of silent reading of 271 pupils in the eight grades of the Cleveland Schools and he discovered the large distribution of scores. The following Table II is the result of that discussion.⁸

Despite the small number of pupils involved, almost all these figures approximate, at least roughly, the "surface of normal distribution" which finds most of the pupils grouped about the central measure of quality of performance with a symmetrical attenuation of numbers of pupils above and below the central measures. The persisting recurrence of this distribution has itself been no unimportant factor in convincing the scientific educator of the need of recognizing differences found. If such distribution appeared only occasionally, we should feel much less moved to action.

Another factor is the increasing range of variation from grade to grade. The range is usually wider in the fifth grade than it is in the fourth, and wider in the sixth grade

⁷ Luton Ackerson; "The Mental Growth Curve for the Binet Test", The Journal of Educational Psychology, (November, 1929.)

⁸ Gray, William Scott. Studies of Elementary School Reading Through Standardized Tests. Supplementary Educational Monograph, No. 1, Vol. 116.

TABLE I

FREQUENCY DISTRIBUTION OF MENTAL AGES FOR TWELVE YEAR WHITE CHILDREN EXAMINED AT THE INSTITUTE FOR JUVENILE RESEARCH, CHICAGO

Mental Ages	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Number of Pupils	6	6	10	6	20	23	64	70	74	32	30	22	11	5	1	2

Total number of cases.....382

TABLE II

DISTRIBUTION OF SCORE FOR QUALITY OF SILENT READING OF 271 PUPILS IN THE EIGHT GRADES OF CLEVELAND, OHIO, PUBLIC SCHOOLS

Scores	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79
Number of Pupils	34	66	44	56	45	16	6	4

than it is in the fifth, etc. This tendency is partially checked in upper elementary grades by what is called "qualitative elimination" the tendency of the less capable pupils (and others doing poorer work) to drop out at or near the termination of the compulsory school period. The range of mental variation is usually wider in the fourth year than it is in the fifth year, and wider in the sixth year than it is

in the fifth year. This widening variability will be discussed in following chapters.

We have discussed the lack of uniformity in the mental ability of individuals, which were bounded by the grades and ages, now we wish to discuss the lack of uniformity in the mental ability of grades themselves.

Five first-grade classes in the vicinity of Stanford University tested by Dickson about the middle of the school year yielded the following median mental ages, stated in years and months; 5-10, 6-0, 6-0, 7-2, 7-8. That is, the best class had a median mental age more than two years above that of the poorest class. The best class possessed average second-grade ability, the poorest class about average kindergarten ability.

Seven receiving (first-grade) classes tested by Dickson in Oakland, California, gave the median mental ages 5-8, 6-2, 6-4, 6-4, 6-4, 6-6, and 7-0. On the other hand three first-grade classes in Horace Mann school gave the median mental ages as 7.4, 7.5, and 7-11.

These conclusions are very interesting, because they tell us that there is lack of uniformity in grades by place; for example the children of the Horace Mann school are superior to the children of the Oakland, California School, and even in the same school, there may be a lack of uniformity by grades.

In view of such facts as these just reviewed it is

obvious that the usual custom of standardizing educational tests in terms of grade performance has little to commend it. "Grade" means too little, or rather it means too many things to justify such a procedure. The grade concept lacks permanency; it is affected by all the shifting influences incident to such unstabilized and unstandardized educational systems as we find at present in the world. Age offers a far more satisfactory and permanent basis for norms of school achievement. It is beginning to be recognized that educational tests will have to be re-standardized in terms of age, means or medians.⁹

The lack of uniformity in the mental ability of grades naturally brings on movements of homogeneous grouping of pupils. But the writer does not feel concerned about this problem, because he is now studying only the situation of individual mental abilities. The writer does not think that the movement of homogeneous grouping is the single and inevitable road which opens on the discussion of lack of uniformity in the mental ability of grades, because our purpose is not to make uniformity in the mental ability of grades, but is a discussion of the great adaptability to individual needs and individual differences. The making of uniformity in the mental ability of grades has many weaknesses. We should not mix

⁹Lewis M. Terman, Intelligence Tests and School Re-organization, 7, New York: World Book Co., 1922.

the discussion of individual differences in grades with the discussion of homogeneous grouping.

Overlapping in Mental Ability.

Until now we have considered the different grades as groups of children of different abilities but this is a mistake. Many discussions of mental measurement are based on the overlapping of ability among children in the different grades.

Madsen's tests of 12,000 children bring out strongly the facts as regards the overlapping of ability among children in different grades. He also uses data to show the well-known fact that the older children in the given grades are duller and that the younger ones are the brighter. He shows for each grade facts similar to those which we give for grade IV, (Table III).

In this grade the youngest children have an average I.Q. of 142 and the oldest of 46. There is, of course, no criticism necessarily implied in this sort of distribution, provided the mental ages of the children are more or less equal. In the above distribution this is not the case. Turning the data into mental ages and considering age 8 as equivalent to 8 years and 6 months, and so on for the other ages, we get the facts which are presented in Table IV. Here again we see that the younger children of chronological ages 8, 9 and 10 are in absolute intelligence above the older

children of ages 11, 12, 13, and 14. If, as Terman says, a mental age of 10 should be the standard for grade IV, we might expect the I.Q. to be as shown in Table V for children of different chronological ages. A comparison of this ideal arrangement with the one actually found by Madsen shows much less difference in the spread of I.Q. for the different chronological ages.

Terman discusses this problem of overlapping on the heterogeneity in intelligence within a given grade and shows many sample distributions. He says:

The condition may be summed up by the statement that, in general, from 20 to 25 per cent of the pupils of a given grade have attained a mental age about as high as the median mental age of the next higher grade, while the lowest 20 to 25 per cent in the same grade are about as low in mental age as the median for the next grade below.¹⁰

In the above discussion we have seen that the different grades are not made up of groups of the same mental ability. Each grade has a large range of mental ability and there is much overlapping of mental ability. On the other hand, let us discuss the overlapping tendency of mental ability in chronological ages.

L. L. Thurston discovered children of the mentality of ten years who were from seven to seventeen years old according to chronological age.

¹⁰I. N. Madsen; "Intelligence as a Factor in School Progress", School and Society, XV, (March 11), 283-4.

TABLE III

THE AVERAGE INTELLIGENCE QUOTIENT AT THE CHRONOLOGICAL AGE FROM EIGHT TO FOURTEEN IN GRADE FOUR (MADSEN)

C. A.	8	9	10	11	12	13	14
I. Q.	142	107	86	62	56	59	46

TABLE IV

AVERAGE MENTAL AGE AT THE CHRONOLOGICAL AGE FROM EIGHT TO FOURTEEN IN THE GRADE FOUR

C. A.	8	9	10	11	12	13	14
M. A.	12.1	10.2	9.0	7.2	7.0	7.11	6.8

TABLE V

THE IDEAL ARRANGEMENT OF THE AVERAGE INTELLIGENCE QUOTIENT FOR THE CHRONOLOGICAL AGE IN THE GRADE FOUR

C. A.	8	9	10	11	12	13	14
I. Q.	118	105	95	87	80	74	90

TABLE VI

THE OVERLAPPING OF THE MENTAL AGE, FROM CHRONOLOGICAL AGE THREE TO SEVENTEEN YEAR CHILDREN AT THE INSTITUTE FOR JUVENILE RESEARCH, CHICAGO

Chron- ologi- cal Ages	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fre- quen- cy of M. A. of 10	0	0	0	0	3	4	21	45	49	74	80	63	56	30	14
Exam- ined Cases	64	95	148	191	256	294	353	359	354	382	416	484	383	273	156
Total.....	4208 cases														

TABLE VII

THE MENTAL AGE STANDARDS FOR THE DIFFERENT GRADES

Grades	Standard Mental Ages			Mental Ages at Mid-grades.
I	6-6	to	7-5	7 years
II	7-6	to	8-5	8 years
III	8-6	to	9-5	9 years
IV	9-6	to	10-5	10 years
V	10-6	to	11-5	11 years
VI	11-6	to	12-5	12 years
VII	12-6	to	13-5	13 years
VIII	13-6	to	14-5	14 years
H.S.I	14-6	to	15-5	15 years

In Table VI is given the partial result of L. L. Thurston's study. This study was carried out at the Institute for Juvenile Research, Chicago, and with the use of the Sanford-Binet tests. This report includes cases ranging in age from three to seventeen years. The total number of children which were examined was 4208. He found three children of the mental age of ten years who were seven years of age, and four children of the mental age of ten years who were eight years of age, etc.

There were fourteen children of the mental age of ten years who were seventeen years of age, and thirty children of the mental age ten years who were sixteen years of age. The total range was eleven years.

Tentative mental age standards worked out on the basis of 1936 Binet tests of California children are given in Table VII.

Now let us discuss the comparative study of Tables VI and VII.

Table VII indicates that the grade for children with mental age of ten years is the fourth or fifth. Table VI indicates that the mental age of ten year old children may be found to be all the way from the age of seven years to seventeen years. From these facts we arrive at the following conclusion.

If the fourth and fifth grade are determined by mental

age standards, there may be found very large variation of chronological ages, from seven years to seventeen years.

Leonard V. Koos said:

In a seventh grade group of only eighty-two pupils there were representatives of each age from eleven to seventeen, inclusive, showing a range of six years between the youngest and the oldest pupils.¹¹

The above is not an unnatural situation if we consider it from the point of view of mental ability, because if we want to make homogeneous ability groups, naturally such situations will happen with respect to chronological age. This is evident from L. L. Thurston's and Terman's discussions.

Leonard V. Koos continued:

Tables similarly constructed for school systems enrolling larger numbers of pupils in this grade discover ranges of seven, eight, and even nine years. It is shown later in discussing the nature of the child, that these great differences in chronological age are paralleled by comparable differences in measurements of physique, such as height, weight, lung capacity, and strength of grip. There are also wide differences in sex maturity of pupils of the same grade, so wide, indeed, that some pupils enrolled in the seventh grade of a single school have been sexually mature for three or four years, while at the other extreme will be found those who will not arrive at pubescence until two, three, or even four years have passed.¹²

This statement suggests to us that there are differences not only relative to mental ability but also in many

¹¹Leonard V. Koos. The Junior High School, p.37, New York: World Book Co., 1921.

¹²Ibid, p. 38.

other respects, namely, emotional, instinctive, moral, physical, etc. The object in educating children is not only to care for their intellectual development but also their personal and physical development. If this is true our intellectual homogeneous grouping becomes only a partial problem in education, and adaptation to individual needs and individual differences becomes a very complex and difficult problem.

Not wholly unrelated to the many efforts at individualization of teaching are the remedial periods and rooms which would be established with an array of other special groupings such as "adjustment room", "study coaches" and the like.

We find in table VI that they who are of the mental age of ten years range from seven to seventeen years chronologically. This group of children is homogeneous in mental ability, but it is not a homogeneous group in other kinds of abilities and conditions, for example, interest, instinct, will power, physical self-control, and dependability are somewhat independent of intelligence.

Suppose these children of the mental age of ten years enrolled in the fourth grade, their mental ability may be adapted to the curriculum of fourth grade, because the mental age standard for fourth grade is ten years, according to Table VII, but this group is a decided heterogeneous in other abilities and conditions. This group may include from the

first grade to the ninth or the tenth grade in other abilities, according to Table VII, because the majority of seven year children are first grade in their mental age, and eight year children are second grade in their mental age, etc.

CHAPTER II

THE RANGE OF MENTAL AGE IN THE FIRST GRADE

The Problem

The problem of the range of mental capacity which appears in some grades has been considered only in part. However, this problem is a most important one in the field of modern educational investigation because one of the chief motives behind the modern educational reorganization has been adaptation to individual needs and individual differences. The specific question, which the facts presented in this investigation may partially help to answer, is: "What is the character of the individual range of mental capacity which appears in first grade children?"

The Methods

The writer has found very reliable materials for this investigation in the report by Professor Paul V. Sangren.

Four examiners who had had considerable experience in giving both group and individual intelligence tests administered tests with the aid of the teachers to four groups of first grade children of training schools of Western State Teachers College, Kalamazoo, Michigan, according to the following plan:

Test	When Given
Stanford Revision of Binet	November 1st to December 15th, 1926.
Otis Group Intelligence Scale Primary examination Form A	January 2nd, 1927.
Rhode Island Intelligence Test Form A	January 2nd, 1927.
Detroit First Grade Intelligence Test. Form A	January 3rd, 1927.

Test	When Given
Kingsbury Primary Group Intelligence Scale, Form A	January 3rd, 1927.
Pressey Primary Classification Scale, Form A	January 3rd, 1927.
Haggerty Intelligence Examination Delta 1.	January 4th, 1927.
Pintner-Cunningham Primary Mental Test, Form A	January 4th, 1927.

Since the Stanford-Binet test was given from one-half to two months earlier than the group tests it was necessary to bring the mental ages of the pupils on the Binet Test up to the date of January 3rd. This was handled statistically by assuming that the intelligence quotients of pupils would remain constant and that the pupils would have made a sufficient increase in Binet Mental age to Maintain the same intelligence quotient.¹

The Results

Table VIII shows the distribution of mental ages in first grade pupils. This table is furnished from Sangren's investigation. Table VIII shows also the median mental age, the median chronological age, and the standard deviations of the distribution of mental ages.

We can guess that the group of children included in this investigation is a normal group of first grade children so far as may be judged from the central tendency of the different distributions of mental ages which are somewhere between 84 and 89 months. Furthermore, the median chronological

¹Paul V. Sangren, "Comparative Validity of Primary Tests", The Journal of Applied Psychology, (August, 1929).

age of the group is 83 months, which would be exactly normal according to the generally accepted age-grade standards for school children. A number of very interesting facts appear from a study of Table VIII which may be summarized as follows:

The Mental Ranges from Several Tests.-- There are large ranges of mental ages as determined by each intelligence test. In the case of Pressey Primary Scale, for example, the mental ages of the group vary from 48 to 128 months. On the Otis Group Intelligence Scale Primary Examination, the mental ages vary from 64 to 127 months.

We can find the largest range of mental ages on the Pressey Primary Classification Scale that varies about 79 months. The shortest range of mental ages is determined by the Haggerty test, but even the shortest range varies from 60 to 107 months, that is about 48 months.

The Mental Range in Each Quartile.-- The quartile ranges of mental ages, in months, of first grade pupils in terms of the eight intelligence tests have been indicated in Table IX.

There are very interesting ranges of mental ages, for example, in the case of the Pressey Primary Scale, the first quartile range is twenty-seven months, the second quartile range is twelve months, the third quartile range is fifteen months, and the fourth quartile range is twenty-eight months. The ranges of the two middle quartile sections are almost

TABLE VIII (Continued)

THE DISTRIBUTION OF THE MENTAL AGES OF THE FIRST GRADE PUPILS IN THE TERMS OF THE VARIOUS INTELLIGENCE TESTS

	Tests							
	Pressy	Otis	Pint-ner-C	Hag-C gerty	Kings-bury	De-troit	Rhode Island	Binet
Median M.A.	86.8	96.0	93.8	83.8	85.9	89.5	83.8	86.8
P.E.	1.14	1.00	0.71	0.66	1.13	1.72	0.94	0.67
Median C.A.	83	83	83	83	83	83	83	83
Standard D	6.88	14.85	10.48	9.81	16.72	10.68	13.88	9.93
Whole Range	48-127	64-127	52-111	60-107	56-135	56-103	24-91	60-111
First Q Range	48-74	64-84	52-86	60-75	56-72	56-81	24-74	60-79
Second Q Range	75-86	84-95	86-93	75-83	72-85	81-89	74-83	79-85
Third Q Range	86-100	95-109	93-99	83-89	85-99	89-94	83-86	85-91
Fourth Q Range	100-127	109-127	99-111	89-107	99-135	94-103	86-95	91-111
Middle 50 Range	75-100	84-109	86-99	75-89	72-99	81-94	74-86	79-91

TABLE IX

THE QUARTILE MENTAL RANGES, IN MONTHS, OF THE FIRST GRADE PUPILS IN THE TERM OF VARIOUS INTELLIGENCE TESTS

Ranges	Tests								Aver.
	Pressy	Otis	Pint-ner-C	Hag-C gerty	Kings-bury	De-troit	Rhode Island	Binet	
First Q	27	21	35	16	17	26	51	20	26.6
Second Q	12	12	8	9	14	9	10	7	10.1
Third Q	15	14	7	7	15	6	4	6	9.3
Fourth Q	28	19	13	19	37	10	6	21	19.1
Middle 50	26	25	13	15	28	14	13	13	18.4

equal and the range of the first and the fourth quartile sections are also nearly equal. These conform to the regular appearance of the normal curve. The range of the middle fifty per cent is twenty-six months and this range is almost equal with the first on fourth quartile. This is a very interesting fact.

The above explanation can be repeated in the seven other Intelligence tests with a few exceptions. Even in some exceptions, if we consider the ranges of the middle fifty per cent and the average of the first and fourth quartiles, there is approximate equality. The range of the middle fifty per cent taken twice is almost equal to the sum of the first and the fourth quartiles.

In comparing the ranges of the first quartile range and the fourth quartile we find them almost equal as has been already illustrated, but, if we consider more thoroughly we find that there is one regular tendency, namely that the first quartile range is almost always a little bit larger than the quartile range. This is true in six cases out of eight.

On the average, the range of the first quartile of mental age is 26.6 months and the range of the fourth quartile of mental ages is 19.1 months. There is about 7.5 months difference. The range of second quartile of mental ages is 10.1 months and the range of the third quartile of mental ages

is 9.3 months. There is only 0.8 months difference, in this case.

The range of the middle fifty per cent of mental ages is 18.4 months. This differs about 0.7 months with the range of the fourth quartile, and it differs about 8.2 months with the range of first quartile of mental ages.

The average range of the middle fifty per cent is 18.4 months ranging about one and one-half years, and the range of the bipolar fifty per cent is 45.7 months ranging about four years. The average total range is 64.1 months, thus ranging is about five and one-half years.

The Rate of Mental Range in Each Quartile,-- Table X shows the rates of the ranges of the first quartile, the second quartile, the third quartile, the fourth quartile, and the bipolar fifty per cent which was determined by the middle fifty per cent range.

Table X shows the rates for each of the quartile ranges and the bipolar fifty per cent ranges compared with the middle fifty per cent ranges.

The rates of bipolar fifty per cent ranges compared with the middle fifty per cent ranges are somewhere from 1.60 to 4.31. The rate between the bipolar fifty per cent and the middle fifty per cent have been indicated by following average rate.

It may be that this average rate is the regular rate of the bipolar fifty per cent compared with the middle fifty per cent. On this point we bring forth evidence in the following chapter with much more data.

The rates of bipolar fifty per cent are somewhere over 2.00 except in one case, the eight. It means that the range of the middle fifty per cent is almost always below the half of the range of the bipolar fifty per cent. If there are two year ranges of middle fifty per cent, there are four year ranges of bipolar fifty per cent. This is the conclusion to which we come, based on the above facts which appeared in some of the first grades under our observation.

The Rate Of The Mental Ranges In Each Section.-- The quartile ranges, by month, of the first grade pupils, in terms of the various intelligence tests, have been determined by the rates for their average chronological ages, as in Table XI.

These are very interesting. In the case of the Pressey Primary Scale, for example, the rate of the range of the first quartile for the chronological age is thirty-three per cent; the rate of the range of the second quartile for the same chronological age is fourteen per cent; the rate of the range of the fourth quartile for this chronological age is thirty-four per cent, and these total rates are ninety-four per cent.

The rate of the whole range of mental ages, in the

case of the Pressey Primary Scale, for the average chronological age is ninety-six per cent. In other words, there are almost the same number of months in both the whole range and the average chronological age. If there are, for example, first grade pupils of six or seven years, there may be almost six or seven years difference of mental age between the most gifted child and the most feeble-minded child.

Even the smallest range which appeared on the Haggerty Intelligence Test had fifty-eight per cent of the rate or over a half range for chronological ages. There are three or four years difference of mental age among the six and seven year old pupils of the first grade.

Summary.-- The ranges of the mental ages in the three first-grade classes of the Horace Mann School in 1925 were 33 months, 38 months, and 45 months. Here the ranges within the same school are not large, but the first grade of this school as a whole is enormously superior (special) to the first grade as a whole in most other school systems.

Dickson found the ranges of mental ages of 30 months, 32 months, 36 months, 38 months, 38 months, 42 months and 42 months in seven first-grades.

In Palo Alto the ranges found within three first-grade classes were 28 months, 38 months and 76 months. (See Table XII). Within three second-grade classes, 57 months, 59 months, and 38 months; within two third-grade classes, 78 months, and 54 months. (These were also found in Palo Alto).

TABLE X

THE RATES OF THE MENTAL RANGES IN THE FIRST QUARTILE, THIRD QUARTILE, FOURTH QUARTILE, AND THE BIPOLAR 50 PER CENT WHICH WERE DETERMINED BY THE MIDDLE 50 PER CENT RANGE

Rates	Tests								
	Press-ey	Otis	Pint-ner-C	Hag-gerty	Kings-bury	De-troit	Rhode Island	Binet	Aver.
First	1.04	0.84	2.69	1.07	0.63	1.86	3.85	1.54	1.69
Second	0.46	0.48	0.62	0.60	0.52	1.64	0.71	0.54	0.57
Third	0.58	0.56	0.54	0.47	0.56	0.43	0.29	0.46	0.49
Fourth	1.08	0.76	1.00	1.27	1.39	0.71	0.46	1.62	1.04
Bipolar 50	2.12	1.60	3.69	2.34	2.02	2.57	4.31	3.16	2.73
Middle 50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

TABLE XI

THE RATES OF THE RANGES IN THE FIRST QUARTILE, SECOND QUARTILE, THIRD QUARTILE, FOURTH QUARTILE, MIDDLE 50 PER CENT; AND THE WHOLE WHICH WERE DETERMINED BY THE AVERAGE CHRONOLOGICAL AGE

Rates	Tests								
	Press-ey	Otis	Pint-ner-C	Hag-gerty	Kings-bury	De-troit	Rhode Island	Binet	Aver.
First Q	0.33	0.24	0.42	0.19	0.20	0.31	0.61	0.24	0.31
Second Q	0.14	0.14	0.10	0.11	0.17	0.11	0.12	0.08	0.12
Third Q	0.18	0.17	0.08	0.08	0.18	0.07	0.05	0.07	0.11
Fourth Q	0.34	0.23	0.16	0.23	0.45	0.12	0.07	0.24	0.23
Middle 50	0.31	0.30	0.16	0.18	0.34	0.17	0.16	0.16	0.22
Bipolar 50	0.67	0.47	0.58	0.42	0.65	0.43	0.78	0.48	0.56
Whole	0.96	0.77	0.72	0.58	0.96	0.58	0.82	0.63	0.75

The range for Proctor's first-year high school pupils was practically seven years. The ranges disclosed by the National Intelligence Tests in grades 3 to 8 of Vallejo, California, were in most cases over 4 years for any given grade.

Terman said:

Summarizing in the typical first-grade class the dullest pupil is likely to have a mental age of 4 or 4-1/2 years, the brightest a mental age of 8 or 8-1/2. If we lump a dozen first-grade classes together, the range is ordinarily from 3 or 3-1/2 years to 10 or 10-1/2. Similarly, a dozen third-grade classes may range from mental age 7 to mental age 13. Fifth-grade classes range from the mental age of 8 to the mental age of 16, and the eighth-grade classes range from the mental age of 10 to a point about as high as any intelligence scale will measure.²

In one term there were 1776 failures reported in the various elementary grades of the California schools. The teachers were asked to tabulate the causes of the failure under the following headings: (1) irregular attendance, (2) ill health, (3) mental condition, (4) disciplinary causes, (5) environmental causes, (6) administrative causes. A summary of this report of the teachers shows that low mentality, irregular attendance, and poor health, in the order mentioned, are believed to be the leading causes of failure.

The failure of 48 per cent was attributed to low mentality, 28 per cent to irregular attendance, 11 per cent to poor health. These three causes are closely related. Irregular attendance is often due to low mentality; also poor health

²Lewis M. Terman, The Problem, 8, New York: World Book Co., 1922.

and low mentality are frequent partners in causing school trouble. In any event, there is general agreement among teachers that the difference in mental level is the chief cause of trouble in the average classroom. More than 50 per cent of the failure is attributed to the fact that the child is asked to do work beyond his capacity. Mental tests given to nearly 30,000 children in Oakland prove conclusively that the proportion of failures due chiefly to mental inferiority is nearer 90 per cent than 50 per cent.³

The above explanation indicates that the cause of school troubles is mostly on account of low mental ability, but we also see other factors which are involved. If there are 1776 failures in the Oakland Schools, there are also about the same number of superior children. If the present school systems or present teaching methods can not help the failures, the present school systems and present teaching methods are not of the right calibre for superior children, because present school systems and teaching methods are prepared only for middle-class children mentally. Then the troubles for feeble-minded children become the troubles for superior children.

This problem is not a small problem in educational history, because future civilizations must be built on the

³Virgil E. Dickson. Classification Of School Children According to Mental Ability, 33.

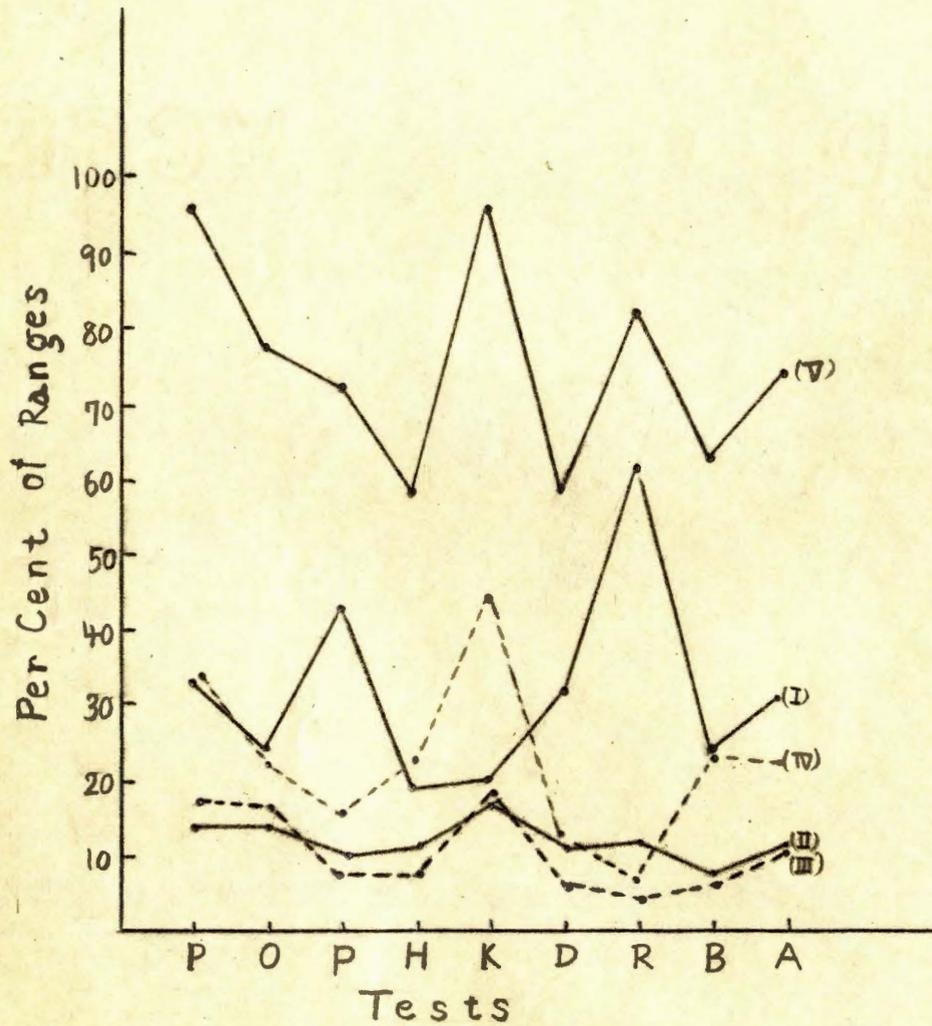
preparation for the diversified duties of democratic society by giving full recognition to individual capacities and individual training.

Criticism Of The Tests.--The comparative validity of the various intelligence tests which were used in this study will be of interest.

The Sanford-Binet, Otis Primary, Rhode Island Primary, Haggerty Delta 1, Pressey Primary, Pintner-Cunningham Primary, Detroit First Grade, and Kingsbury Primary Intelligence tests were applied to 100 first grade children of the training schools of Western State Teachers College, Kalamazoo, Michigan, and those tests were studied by Paul V. Sangren in the terms of such factors as: the nature of the distributions of mental ages and intelligence quotients, the conformance to central tendencies, whole and partial correlations with independent or partially independent measures of intelligence, deviations of mental ages and intelligence quotients of tests taken singly or in pairs from the mental ages and agreement of single test with three-fold sectioning of pupils in terms of criteria employed. The results of above investigations may be summarized as follows.

Perhaps one of the most significant findings of this study is that it corroborates the previously discovered fact (a) judgment of the validity of a test in terms of any single criterion is unsafe (b) a test may be highly valid in one re-

Figure 1.- The per centages of the mental ranges of the first quartile (I), second quartile (II), third quartile (III), fourth quartile (IV), and the whole (V) which were determined by the average chronological age.



spect, but quite the reverse in another, (c) the validity of an intelligence test is always a matter of degree and (d) the perfectly valid test has not yet been constructed.

There is practically always a marked variation in the extent to which the different tests agree with any accepted criterion of validity in the intelligence tests. It is often true that the test which appears highly valid in terms of one criterion may appear very inferior in terms of another criterion. Thus, it is found that the Otis Primary and Stanford-Binet correlate highly, although the mental age and intelligence quotients obtained by pupils on the two tests differ very markedly.

While the results of this study do not enable one to state with certainty what is the comparative validity of the various group intelligence test applied, the writer does feel that, for the group tested and in terms of the criteria employed, he would be justified in listing tentatively the tests in order of their comparative validity approximately as follows:

1. Haggerty Intelligence Examination, Delta 1.
2. Pressey Primary Classification Scale, Form A.
3. Pintner-Cunningham Primary Mental Test, Form A.
4. Detroit First Grade Intelligence Test, Form A.
5. Otis Primary Mental Examination, Form A.
6. Kingsbury Primary Intelligence Scale, Form A.
7. Rhode Island Intelligence Test, Form A.

The findings of this study may have little direct bearing upon the comparative validity of the intelligence tests applied when other groups of primary children, such as second or third grade pupils, are used as subjects or when other criteria of validity are employed. In the interest of thoroughness and accuracy the study should be carried to cover other groups of children and other criteria of validity in intelligence tests.⁴

⁴Paul V. Sangren, Comparative Validity of Primary Intelligence Tests.

CHAPTER III

THE RANGES OF THE MENTAL AGES WITHIN GIVEN CHRONOLOGICAL AGES

The Problem and the Method

In the preceding chapter we found that the range of mental ages within the first grade was very large. In this chapter we wish to discuss the range of mental ages in children of three, four, five, six and seven chronological years. The writer has used in this investigation very reliable data, that reported by L. L. Thurston of the Juvenile Research Institution of Chicago, which was written under the following title "The Mental Growth Curve For The Binet Test".

Table XII which is titled "The Distribution of the Mental Age of three, four, five, six and seven chronological years, who have been given the Stanford-Binet Test at the Juvenile Research Institution, Chicago" was furnished from the above data under my supervision. This Table XII is the fundamental material in this discussion.

A proviso should be added as follows: The original data of this table included from three year to seventeen year children, but only the first five years have been used here because each part of the data discusses the same fact.

The range of mental ages within three, four, five, six, and seven years was studied in the terms of such factors as: (1) The distribution of mental ages of three, four, five, six, and seven years; (2) Each quartile range in months of the three, four, five, six and seven years; (3) Rate of the

mental range of the first quartile, second quartile, third quartile, fourth quartile, and the bipolar 50 per cent which was determined by the middle 50 per cent range; (4) The rate of the mental ranges of the first quartile, second quartile, third quartile, fourth quartile, the middle 50 per cent and the bipolar 50 per cent which was determined by the chronological age.

The Results

The Distribution of the mental ages.--Table XII shows the distribution of childrens' mental ages in three, four, five, six and seven year chronological ages. A number of very interesting facts appear from a study of Table XII which may be summarized as follows:

There are more mental ranges than the ranges given in the grades which were considered in the preceding chapter. In the cases of three year children, for example, the mental ages vary from 0-2 months to 54-56 months without any gap of three months distribution intervals. In the cases of four year children, the mental ages cover from 2-5 months to 81-83 months, with only three gaps of three months distribution intervals. In the cases of five year children, their mental ages range from 6-8 months to 99-101 months. In the cases of six year children, there is 105 months' mental range which covers from 6-8 months to 108-110 months. In the cases of seven year children, there are very large mental ranges

which vary from 12-14 months to 135-137 months, thus, the whole range is about 126 months.

If we change these monthly mental ranges to yearly ranges we find that the three chronological year children have over four and one-half years mental range. In the case of four year children the mental range is near to seven years. In the case of five year children the mental range is just eight years. In the case of six and seven year children the mental ranges are about nine and over ten and one-half years.

We can say on the basis of the above facts that the ranges in the groups which were divided by the chronological ages are larger than their own chronological ages. This conclusion is probably true until their mental progress comes to its maximum. We have many reports which prove this conclusion.

The mental range in each section.--The quartile ranges of mental ages in the three, four, five, six and seven year children, in the terms of the Stanford-Binet Test have been indicated by Table XIII.

Table XIII shows several interesting ranges of mental ages. In the case of three year children, for example, the mental range of the middle fifty per cent covers a two year scale, and the bipolar fifty per cent of mental range is nearer three years. The first and fourth quartile ranges

are each almost one and one-half years, while the second and the third quartile ranges are either above or below one year.

As usual the first quartile and the fourth quartile, or the second quartile and the third quartile, are equal. We must keep in mind that the above facts are regarding three year children.

In the case of four year children, the middle fifty per cent range is two and one-half years and the bipolar fifty per cent range is over four years. The first and fourth quartile ranges are about two years, the second and third quartile ranges are one or one and one-half years. As usual the middle two quartiles are smaller than the bipolar two quartiles.

In the five year children, the middle fifty per cent range is three months less than three years, and the bipolar fifty per cent range is three months over five years. The range of the first quartile is nearly two and one-half years. The second and third quartile ranges are a little over one and one-half years. The fourth quartile range is two months less than three years.

In the six year children, the middle fifty per cent and the bipolar fifty per cent show a remarkable difference. The former shows just a two year range, the latter shows nearly a seven year range. The second and third quartile ranges are just the same with the three year children, but

TABLE XII

THE DISTRIBUTIONS OF THE MENTAL AGES OF THE CHILDREN WHO HAVE BEEN GIVEN THE STANFORD-BINET TESTS AT THE INSTITUTE FOR JUVENILE RESEARCH, CHICAGO.

Mental Ages (Month)	Chronological Ages				
	3	4	5	6	7
0-2	3				
3-5	1	1			
6-8	4	3	2	2	
9-11	2	2	1	0	
12-14	5	2	6	2	2
15-17	2	0	2	3	
18-20	3	5	5	4	3
21-23	2	4	0	1	1
24-26	2	9	8	1	3
27-29	6	2	4	0	7
30-32	8	4	7	9	
33-35	1	3	3	1	6
36-38	7	12	3	5	6
39-41	6	2	5	1	5
42-44	2	4	5	7	
45-47	2	2	2	4	3
48-50	3	12	8	6	11
51-53	1	3	4	3	12
54-56	4	9	11	6	
57-59		1	9	8	8
60-62		6	18	12	10
63-65		2	8	12	11
66-68		4	12	14	
69-71		1	7	15	25
72-74		1	6	22	19
75-77		0	1	8	17
78-80		0	7	20	
81-83		1	0	7	22
84-86			2	8	10
87-89			0	2	
90-92			1	3	21
93-95			0	0	18
96-98			0	0	8
99-101			1	3	9
102-104				1	
105-107				0	3
108-110					1
111-113					1

Continued

TABLE XII (Continued)

THE DISTRIBUTIONS OF THE MENTAL AGES OF THE CHILDREN WHO HAVE BEEN GIVEN THE STANFORD-BINET TESTS AT THE INSTITUTE FOR JUVENILE RESEARCH, CHICAGO

Mental Ages (Month)	Chronological Ages				
	3	4	5	6	7
114-116					
117-119					3
120-122					1
123-125					1
126-128					1
129-131					
132-134					1
135-137					1
Total	64	95	148	191	256
Median	30	38	53	67	75
Whole					
Range	0-56	3-83	6-101	6-110	12-138
First Q					
Range	0-16	3-26	6-34	6-52	12-59
Second					
Q Range	16-30	26-38	35-53	53-67	59-75
Third					
Q Range	30-39	38-56	53-67	67-76	75-98
Fourth					
Q Range	40-56	56-83	68-101	76-110	98-138

the first and the fourth quartile ranges are nearly three or four years.

In the seven year children, the largest ranges are the middle fifty per cent and the bipolar fifty per cent.

The middle fifty per cent range is almost three and one-half years; the bipolar fifty per cent range is about

TABLE XIII

THE MENTAL RANGES, IN MONTHS, OF THE THREE, FOUR, FIVE, SIX, AND SEVEN YEAR CHILDREN IN THE TERMS OF THE BINET TEST

Ranges (Month)	Chronological Ages				
	3	4	5	6	7
First Q	17	24	29	47	48
Second Q	15	13	19	15	17
Third Q	10	19	15	10	24
Fourth Q	17	26	34	35	41
Middle 50	24	31	33	24	40
Bipolar 50	34	50	63	82	89

seven and one-half years. The first quartile range is just four years, and the fourth quartile range is nearly three and one-half years. The second and third quartiles are from one and one-half years to two years.

The middle fifty per cent ranges, in each year, are from 24 to 40 months. The difference between the smallest middle fifty per cent range and the largest middle fifty per cent range is eighteen months. On the other hand, the bipolar fifty per cent ranges, in each year, are from 34 to 89 months. The difference between smallest bipolar fifty per cent range and largest bipolar fifty per cent range is 55 months.

From above observations we arrive at the following conclusion: The changes of the middle fifty per cent ranges are smaller than the changes of the bipolar fifty per cent ranges in several chronological years. This is a very important conclusion, because in education the changes of these different characteristics, in terms of middle and bipolar fifty per cent, demand a change in the curriculum.

If we consider the range of the first quartile, the range of seventeen months is the lowest, and the range of forty-eight months is the highest. There are three first quartile ranges that range from seventeen months to forty-eight months. The seventeen months' range is about a one and one-half year range, and the forty-eight months' range is just a four year range. On the other hand, the lowest range of the fourth quartile is seventeen months, and the highest range of fourth quartile is forty-one months. The former is about one and one-half years and the latter is about three and one-half years. The scales of change of the first and the fourth quartile ranges are almost equal.

The lowest range in the second quartile is thirteen months, and in the third quartile, the range of ten months is the lowest. The highest range in the third quartile, the range of twenty-four months is the highest range. The scale of change in the second quartile is just one-half year, but the scale of change in the third quartile is a little more than one year.

TABLE XIV

THE RATES OF THE MENTAL RANGES IN THE FIRST QUARTILE, SECOND QUARTILE, THIRD QUARTILE, FOURTH QUARTILE AND THE BIPOLAR 50 PER CENT WHICH WERE DETERMINED BY THE RANGE OF THE MIDDLE 50 PER CENT

Rates of Ranges	Chronological Ages				
	3	4	5	6	7
First Q	.77	.77	.88	1.96	1.20
Second Q	.62	.42	.58	.62	.42
Third Q	.42	.61	.45	.42	.60
Fourth Q	.77	.81	1.03	1.50	1.02
Middle 50	1.00	1.00	1.00	1.00	1.00
Bipolar 50	1.45	1.61	1.91	3.42	2.72

In the first and fourth quartiles, the scale of change was from three and one-half years to about four years, but the scale of change in the second and the third quartiles was from one-half year to a little over one year.

There are some regular tendencies of change in the mental ranges but these facts will be discussed in a following chapter.

The rate of the mental range in each section (1).-- Table XIV shows the rate of the ranges of the first, second, third, fourth quartiles, and the bipolar fifty per cent against the ranges of the middle fifty per cent.

The rates of the first quartiles are from .77 to 1.96. The rates of the fourth quartiles are from .77 to

1.50, and the rates of the bipolar fifty per cent are from 1.45 to 3.42. In the cases of six and seven year children, the rates of the first quartile ranges versus the middle fifty per cent ranges are above 100; in the three cases of three, four, and five year children, the rates of the first quartile ranges versus the middle fifty per cent ranges are below 100.

Three cases out of five, in the fourth quartiles, the rates of ranges are above 100, but out of two cases in five, the rates of ranges are below 100.

The rates of the second quartiles and the third quartiles are from .42 to .62. Out of three cases in five, in the second quartile, the rates of ranges are above .50, and out of two cases in five they are below .50. On the contrary, out of two cases in five, in the third quartiles, the rates of ranges are above .50, and out of three cases in five they are below .50.

The differences of the rates in the bipolar fifty per cent are not small. These rates are indicated from 1.45 to 3.42. There is a difference of 1.97.

The rate of the mental range in each section (2).-- The rates of each of the quartile ranges, the bipolar fifty per cent ranges, the middle fifty per cent ranges and the ranges as a whole have been compared with each chronological age. Table XV shows these rates.

In case of three year children, the whole range is

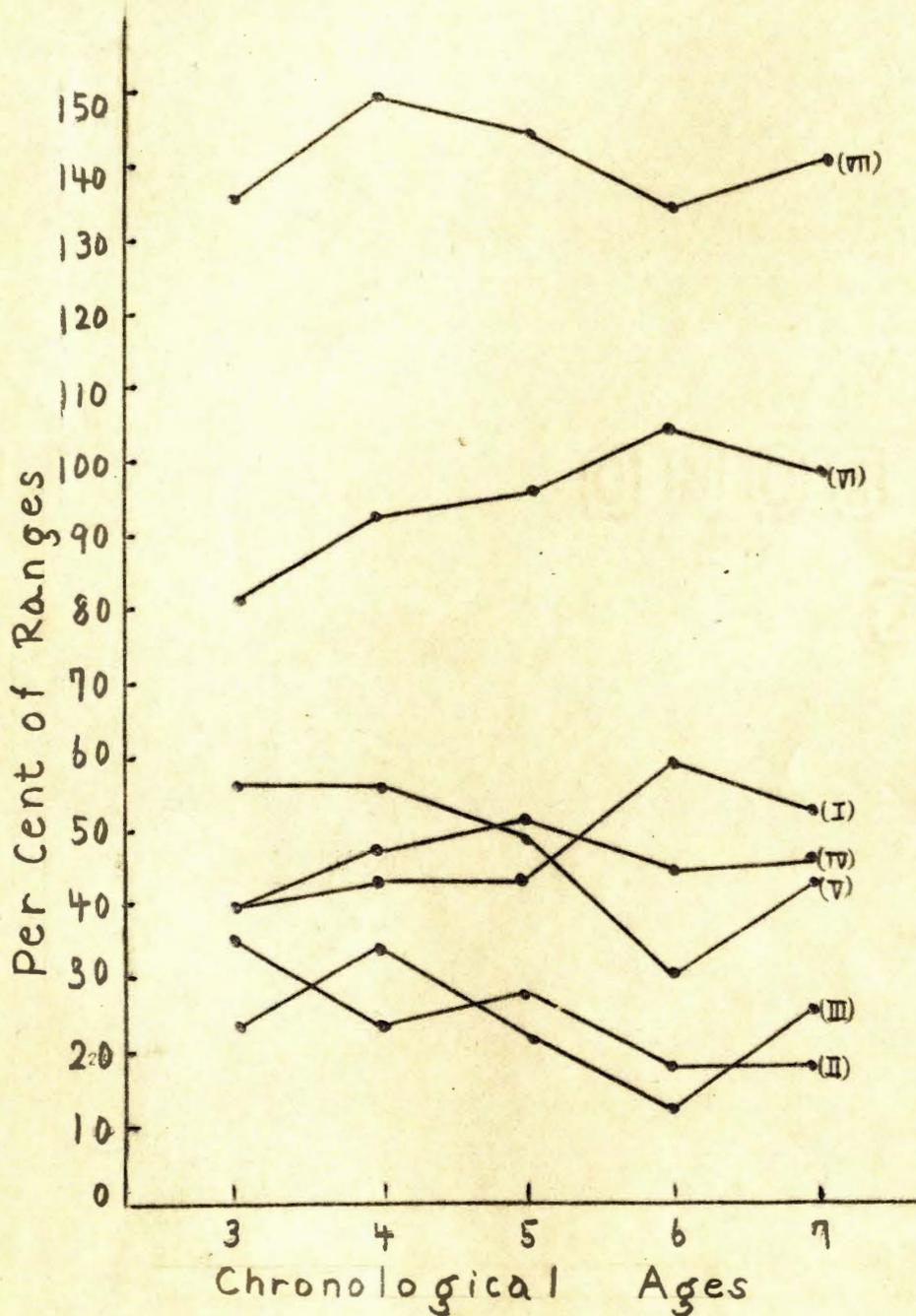
136 per cent for its average chronological age, the rate of the bipolar fifty per cent range is 81 per cent and the rate of the middle fifty per cent range is 57 per cent. There is a difference of 24 per cent between the middle and the bipolar fifty per cent ranges. The first and fourth quartile ranges are equal, viz., each range is 40 per cent for the average chronological age of this group. The rate of the second quartile range of this group is 36 per cent, and the rate of the third quartile range is 24 per cent for the average chronological ages. The rate of the second quartile range is 12 per cent larger than the rate of the third quartile range.

In the case of four year children, the rate of the whole range is 150 per cent for the average chronological age. The rate of the bipolar fifty per cent is 93 per cent and the rate of the middle fifty per cent range is 57 per cent. Forty-three per cent is the difference of the above two rates. The rate of the first quartile range is 44 per cent and the rate of the fourth quartile range is 48 per cent for their chronological ages. There is only a 4 per cent difference. The rate of the second quartile range is 24 per cent and the rate of the third quartile range is 35 per cent. The rate of the third quartile range is 35 per cent larger than the rate of the second quartile range. This rotation between the rates of the second and the

third quartile is just contrary. In this group the rate of the bipolar fifty per cent is 93 per cent as already mentioned. It means that the range of the bipolar fifty per cent in the case of four year children is almost the same as their chronological ages. As already mentioned the range of the middle fifty per cent is over 50 per cent in chronological ages. This fact tells us that the range of the middle fifty per cent covers half of its chronological age. These tendencies in the bipolar and the middle fifty per cent ranges are almost the same as the same tendencies in three year children.

In groups of three and four year children, the rate of the whole range is 145 per cent for its chronological age. The rate of the bipolar 50 per cent range is 96 per cent; this rate tells us that the bipolar 50 per cent range is just the same as its chronological age. The rate of the middle 50 per cent range is 50 per cent for its chronological age. This fact tells us that the range of the middle 50 per cent is just half of its chronological age. The range of the first quartile is 44 per cent and the range of the fourth quartile is 52 per cent of their chronological ages. Two bipolar quartile ranges are nearer half of their chronological ages. The rate of the second quartile range is 29 per cent and the third quartile range is 52 per cent for their average chronological ages. The sum of the rates

Figure 2.- The rates of the mental ranges in the first (I), second (II), third (III), fourth (IV) quartiles, the middle 50 per cent (V), the bipolar 50 per cent (VI), and the whole (VII) which were determined by the chronological ages.



of the second and the third quartiles is just the same as the rate of the fourth quartile range. The rates of each quartile, middle 50 per cent, bipolar 50 per cent and the whole range are very nearly similar to the cases of three or four year children.

In the case of the six year children, the rate of the whole range is 135 per cent for its chronological age. This rate is just the same as the rate of the three year children. The rate of the bipolar 50 per cent is 105 per cent for its chronological age; in other words the bipolar 50 per cent range is a little more than its chronological age. The difference of the rates between the rate of the five year childrens' bipolar 50 per cent is only 9 per cent. The rate of the middle 50 per cent is 31 per cent for its average chronological age. This is a very small rate within the three, four, five, six and seven year childrens' groups. Even this very small rate of middle 50 per cent ranges means about two years in mental range. The rates of the first and the fourth quartile ranges are 60 and 45 per cent and the rates of the second and the third quartile ranges are 19 and 13 per cent for their chronological ages.

In the group of seven year children, the rate of the whole range for its average chronological age is 145 per cent. This is nearly the rate of the five year childrens' rate of the whole range.

TABLE XV

THE RATES OF THE MENTAL RANGES IN THE FIRST QUARTILE, SECOND QUARTILE, THIRD QUARTILE, FOURTH QUARTILE, MIDDLE 50 PER CENT, THE BIPOLAR 50 PER CENT, AND THE WHOLE WHICH WERE DETERMINED BY THE CHRONOLOGICAL AGE

Rates Of Ranges	Chronological Ages				
	3	4	5	6	7
First Q	.40	.44	.44	.60	.53
Second Q	.36	.24	.29	.19	.19
Third Q	.24	.35	.23	.13	.29
Fourth Q	.40	.48	.52	.45	.46
Middle 50	.57	.57	.50	.31	.44
Bipolar 50	.81	.93	.96	1.05	.99
Whole	1.36	1.50	1.45	1.35	1.41

The rate of the bipolar fifty per cent is 99 per cent. This rate is almost the same as the five year childrens' rate, and the rate of the middle fifty per cent range is 44 per cent. This is a very small rate compared with other similar rates, except the five year childrens' rate. The rates of the first and the fourth quartiles are a little over or a little below the rate of the fifty per cent range. The rate of the second quartile is 19 per cent, and the rate of the third quartile is 27 per cent of their chronological ages. The middle fifty per cent range is a little smaller than half of the bipolar fifty per cent range.

The rate of the whole range of mental ages counting several years in chronological ages is from 135 per cent to 150 per cent. There is a difference of only 15 per cent between the smallest and the largest rate. The above facts are very important because educational troubles, in the present systems, increase according to the progress of children's intellectual range, and the increase of other mental and physical elements. We may say that children have many independent elements, mentally or physically, which are also very important with respect to educational objectives. Even if we made the intellectual homogeneous group, this group is still a heterogeneous group in other mental and physical elements.

We have considered the ranges of mental ages in the first grade in the preceding chapter, and we found that the ranges have from 50 to 100 per cent for their average chronological ages. In this chapter, we find the range of mental age to be nearly one and one-half that of its chronological age. The comparative discussion between these two ranges brings to our attention very interesting facts showing that the range of children grouped in class rooms is smaller than the range of the children grouped only by chronological age. For example, take the first grade children; their average chronological age of 83 months had a 50 - 90 per cent range; on the other hand, children in the six and seven year group had 135 - 141 per cent range for their chronological age.

Then we may say that the present class room children have been selected more homogeneously than the age-grouped children.

The bipolar fifty per cent range is from 81 to 105 per cent. Four out of five are above 90 per cent in range. This percentage suggests to us that the ranges of the bipolar fifty per cent in age-grouped children is nearly the same as that of their chronological ages.

The seven year children's group, for example, may have nearly a seven year mental range in its bipolar fifty per cent.

The middle fifty per cent ranges are from 31 to 57 per cent. Three cases out of five are above 50 per cent. These facts tell us that the range of the middle fifty per cent in age-grouped children is nearly the same as half of its chronological age.

The five year children's group, for example, has a mental range of nearly two and one-half years in their middle fifty per cent group.

The rates of the first quartile ranges are from 40 to 60 per cent for their chronological ages. The rates of the second quartile ranges are from 19 to 36 per cent for their chronological ages. There are remarkable differences between the first quartile and the second quartile; the latter is just one-half of the former.

The relation of the first quartile range and the

second quartile range to the fourth quartile range and the third quartile range is almost equal. The rates of the third quartile ranges are from 13 to 35 per cent for their chronological ages, and the fourth quartile ranges are from 40 to 52 per cent of their ages.

In the three groups of children of the ages of four, five, and six years, each quartile range is over one year except in one case. Each first quartile range and each fourth quartile range is over two years without any exception.

Suppose that the seven year children's group is a first grade group, which would be regular age-grade; and see how many are in the range per cent in each quartile, middle fifty per cent, bipolar fifty per cent and in the whole. We will find that there is a very large range in the middle fifty per cent group; that the range for the seven year group is 44 per cent or three and one-half years of mental range. The bipolar fifty per cent range is 99 per cent for the seven years; in other words there are seven years of mental range. The whole range is 141 per cent for seven years; in other words there are more than eleven years of mental range.

Let us consider the intellectual homogeneous grouping. If we have made the homogeneous group by the middle fifty per cent of the seven year children of chronological age, this group has a three and one-half year mental range.

This middle fifty per cent group can be divided into four different groups by the mental "Year-Unit". Such facts are very important in practical education.

If we consider the whole mental range in the group of children of seven years, we may find that the group will be divided into twelve different groups by the mental "Year-Unit".

The nature of these rates of mental ranges for chronological ages are suggested in figure 2, which shows graphically each group of three, four, five, six and seven year children.

CHAPTER IV

THE PROGRESS OF THE MENTAL RANGES WITHIN GIVEN AGES

The Problem

The problems with which this study has to deal may be stated in the following questions.

1. The mental range within given years.
2. The progress curve of the lower and upper limits and also first, middle, and third quartile points.
3. The study of the ranges in each quartile, middle fifty per cent and the bipolar fifty per cent.
4. The study of the rate of range.
5. The mental identity between certain connected years.

In the preceding chapter we discussed the range of mental ages within the given grades and the given chronological ages, and then we found the degrees of the mental ranges, and the character of the ranges in each quartile, middle fifty per cent, bipolar fifty per cent, and the ranges as a whole were observed carefully. In this chapter we wish to discuss the progress of these mental ranges taken year by year. Here also we will discuss the variations of the character of each quartile range, each middle fifty per cent range, each bipolar fifty per cent range and the mental identity between certain connected years.

The Methods

We have used, in this study, two very reliable distribution tables which were furnished by Charles Leonard Odom.

¹Odom, C. L. "A Study of the Mental Growth Curve with Special Reference to the Results of Group Intelligence Tests", The Journal of Educational Psychology, XX, (Baltimore, Md.,

Worwich & York, Inc., (November 1929).

TABLE XVI

DISTRIBUTIONS OF SCORES IN THE DEARBORN
SCALE, SERIES II DATA ON SCHOOL CHILDREN
IN MASSACHUSETTS TOWNS

Scores	Chronological Ages									
	7	8	9	10	11	12	13	14	15	16
0-4	13	9	3	3					2	
5-9	46	31	13	2	3			1		
10-14	57	42	24	10	3	1	1	1		
15-19	47	58	40	10	9	3	4	1		
20-24	33	52	40	20	6	7	7	0		
25-29	22	52	43	24	13	8	10	1	1	
30-34	6	40	61	34	17	14	3	5	1	
35-39	5	50	55	44	16	16	3	8		
40-44	2	30	43	45	26	14	17	5	3	2
45-49	0	19	42	35	31	29	10	8	3	2
50-54	2	16	22	26	40	36	22	11	4	3
55-59		9	24	38	30	34	18	7	8	2
60-64		5	14	34	42	32	26	16	8	2
65-69		2	16	31	47	33	32	9	8	4
70-74		0	9	19	38	29	37	21	9	4
75-79		0	6	13	27	30	22	27	15	5
80-84		2	5	21	26	38	30	22	13	3
85-89		0	3	14	29	20	32	24	29	7
90-94		1	6	6	20	16	24	32	27	10
95-99				1	18	18	25	36	17	15
100-104				1	6	26	32	32	28	10
105-109				1	6	22	31	23	34	18
110-114				0	5	14	22	29	26	16
115-119				1	1	9	21	30	28	35
120-124				2	3	7	18	19	33	18
125-129					2	8	10	20	28	16
130-134					1	4	18	9	25	22
135-139						1	10	14	20	12
140-144						1	18	12	11	17
145-149						1	1	7	13	16
150-154						1	1	6	6	4
155-159							2	4	2	4
160-164									1	2
Total	233	418	469	435	465	472	507	440	403	249
Total number of cases	4,074									

The first data concern the Dearborn Scale and were gathered in small Massachusetts towns. The second data are the results of the Illinois Group Intelligence Scale which was given to the children in the elementary Schools of Chicago, Ill. The Dearborn Scale was given to 4,074 pupils, and the Illinois Group Intelligence Scale was given to 3,637 pupils.

This study may be helped by the distribution table which was prepared by L. L. Thurston, and which has been used already in the preceding chapter (see Table XIII).

The Results

After the careful study of table XVI and many other data, Charles Leonard Odom summarized as follows;

1. The mental growth curve is shown generally to be negatively accelerated when plotted from the results of group intelligence tests. Occasionally a curve will be slightly positively accelerated, Occasionally a curve will approximate a straight line.

2. Absolute variability increases as chronological age increases. This statement holds in the case of every test scaled in this study.

3. The ability of children to score on group intelligence tests does not stop growing before the age of seventeen and very likely not until a later age.

4. Further investigation is necessary to discover the upper limit for intelligence growth; studies should be made in which adequate representation is maintained at the higher ages and where the factor of selection is eliminated. Such a study might be one in which a large number of children are tested at an early age and retested annually until the growth curve reaches a level.

The mental ranges within given years.--Table XVII, which was taken from table XVI, shows the mental ranges for

seven year to sixteen year old children.

We can see, Table XVII, the range of intelligence score in each chronological age group. The range of the mental test score of children seven years is from 0 - 54; the range of the mental test score for children of eight years is from 0 - 94; the score-range for children of nine years is just the same as that of the children of eight years, etc. In the group for ten year children, the lowest score-interval is 0-4, and the highest score-interval is 120 - 124. In the group for children of eleven years, the lowest score-interval is 5 - 9, and the highest score-interval is 130-134, etc. The score for children of 12 years covers 144 points, and children of thirteen years have a score that covers 149 points, and so on. In the fourteen year children, the interval of 5 - 9 is the lowest interval, and the interval of 155 - 159 is the highest interval among the children of fourteen years.

The variation of the mental ranges to each year are as follows:

seven years	- 54 points
eight years	- 94 points
nine years	- 94 points
ten years	-124 points
eleven years	-129 points
twelve years	-144 points
thirteen years	-149 points
fourteen years	-154 points
fifteen years	-164 points
sixteen years	-124 points

If we arrange each year in order of the length of

TABLE XVII

THE RANGES OF MENTAL TEST SCORES IN SEVERAL YEARS
ON SCHOOL CHILDREN IN MASSACHUSETTS TOWNS

Ages	Score Intervals		Whole Ranges	
	lower	higher	intervals	points
7-7, 11	0-4	50-54	0-54	54
8-8, 11	0-4	90-94	0-94	94
9-9, 11	0-4	90-94	0-94	94
10-10, 11	0-4	120-124	0-124	124
11-11, 11	5-9	130-134	5-134	129
12-12, 11	10-14	150-154	10-154	144
13-13, 11	10-14	155-159	10-159	149
14-14, 11	5-9	155-159	5-159	154
15-15, 11	0-4	160-164	0-164	164
16-16, 11	40-44	160-164	40-164	124

mental range, it becomes as follows; seven, eight and nine, ten and sixteen, eleven, twelve, thirteen, fourteen, and fifteen. This is the progression of mental ranges in the order of their chronological ages with only two exceptions.

Now if we account for the differences of mental ranges between the connected years, they become as follows:

seven	-(40)-eight	twelve	-(5)-thirteen
eight	-(0)-nine	thirteen	-(5)-fourteen
nine	-(30)-ten	fourteen	-(10)-fifteen
eleven	-(15)-twelve	fifteen	-(40)-sixteen

There is a progression of score which is from 5 to 40 except in two cases of eight - nine and fifteen - sixteen.

Let us repeat for the sake of discussion Table XIII. This tells us that the progress of the mental range in three, four, five, six and seven year children is very remarkable. In the groups of three, four, five, six, and seven year children, the length of the mental ranges are as follows:

three years	-	58 months
four years	-	81 months
five years	-	96 months
six years	-	106 months
seven years	-	129 months

The length of the mental range increases with the chronological age without any exception. If we notice the differences of mental ranges between two connected years, they become as follows:

three	-	(23 months)	-	four
four	-	(15 months)	-	five
five	-	(10 months)	-	six
six	-	(23 months)	-	seven

The differences of mental ranges are from 10 months to 23 months.

From the above observations, we will say that the ranges of the mental capacity of children increases yearly with the increase of their chronological age. These points we will discuss in the following pages with more detail.

The progress-curves of the lower and upper limits, and also first, middle and third quartile ranges.--In the preceding pages we observed that the progress of "mental

range" is continued until children reach the age of fifteen at least. Table XVIII will show these facts. The lowest points in these mental test scores, in the nine cases out of ten, ranged from 0 to 10. The lowest points in the seven, eight, nine, ten, and fifteen year children are zero. Out of four cases in ten, the lowest points were five or ten. In the "sixteen year" children's group, the lowest point is forty.

The character of the point of zero has no question. The character of the point of five means the average ability of three year old children. The point of ten is the middle score of five year old children. The point of zero is the lowest point of seven, eight, nine, ten, and fifteen year old children's score. The point of five is the lowest point of eleven, and twelve year old children's score. The point of ten is the lowest point in thirteen and fourteen year old children's score. The lowest point of fifteen year old children's score is forty. This point, which may be chance, is lower than the middle score of the ten year old children, and it is near the average of nine year old children's score.

On the contrary, the highest point in each year is from 54 to 164. There is a difference of 110 points between the highest point of the seven year old children and the highest point of the sixteen year old children. The highest point of the seven year old children is larger than that of

TABLE XVIII

THE SCORES OF LOWER, UPPER, MIDDLE, FIRST QUARTILE,
AND THIRD QUARTILE IN THE DEARBORN SCALE, SERIES II
DATA ON SCHOOL CHILDREN IN MASSACHUSETTS TOWNS

Ages	Scores				
	lower	Q1	Middle	Q3	Upper
7-7 , 11	0	9	15	21	59
8-8, 11	0	16	26	38	99
9-9, 11	0	24	36	48	99
10-10, 11	0	35	48	65	124
11-11, 11	5	48	64	80	134
12-12, 11	10	53	71	93	154
13-13, 11	10	65	86	109	159
14-14, 11	5	77	97	116	159
15-15, 11	0	89	108	126	164
16-16, 11	40	102	118	133	164

the middle score of the ten year old children. The highest point of the eight year old children is near the mid-point of the fourteen year old children. The highest point of the ten year old children is like the mid-score of the seventeen year old children.

The highest point of the twelve year old group is equal with the mid-score of the twenty or twenty-one year old group. The highest point of the twelve and the thirteen year old group is the upper limit of intelligence growth.

There is a remarkable difference between the growth of the lowest points and the growth of the highest points. It may be summarized as follows: The feeble-minded child reaches a stage of mental arrest early compared to the normal child, the gifted child continues to grow intellectually after the normal child has stopped.

Rudolf Pintner said:

It shows a hypothetical growth curve for superior, normal, and inferior intelligence, with the suggestion that the curve for inferior mentality stops rising at an earlier age than that of normal mentality, and that curve for superior mentality continued to rise for a longer period. There seems to be no doubt that the intelligence growth of the feeble-minded begins to slow up at an earlier age than that of the normal child.²

We wish to discuss in more detail the lowest points of mental test scores of children of various ages. This point is a very important one for our discussion of mental range.

As we have mentioned, we cannot find any progression of the lower points. This fact adds a proviso to the common belief of psychologists as our data will show. The mental growth curve for the feeble-minded mentality reaches a stage of mental arrest comparatively early, and its growth rate is very small. On the other hand the growth curve for those

²Rudolf Pintner. Intelligence Testing, 68, New York: Henry Holt & Co., 1923.

TABLE XIX

THE SCORES OF LOWER, UPPER, MIDDLE, FIRST QUARTILE,
AND THIRD QUARTILE IN THE ILLINOIS INTELLIGENCE
SCALE A DATA ON CHILDREN IN THE CHICAGO PUBLIC
SCHOOLS

Ages	Scores				
	lower	Q ₁	Middle	Q ₃	Upper
8-8, 11	10-20	31	39	50	90-99
9-9, 11	0-10	33	41	56	90-99
10-10, 11	0-10	333	43	59	140-149
11-11, 11	0-10	42	52	72	150-159
12-12, 11	0-10	46	65	84	150-159
13-13, 11	0-10	49	70	90	180-189
14-14, 11	0-10	50	70	87	150-159
15-15, 11	0-10	49	70	87	170-179

of superior mentality continue to rise for a longer period with a larger growth rate. Note Table XVII and XVIII.

One boy fifteen years old got his mental score in the interval of 0 - 5. In the case of sixteen year old children, the lowest score-interval was 40-44, but this is only an incidental condition, because we often have in mentality one or two year old children in the group of chronologically aged sixteen or seventeen year old children. Thurston found, for example, in the case of 156 children of seventeen years, that one boy had a mental age of one year. He also found in

the same group that three children had the mental age of two years.³

We may say, according to these examples, that the lowest mental score in each of these years is smaller by ten points, as can be seen by Table XIX.

Let us try to interpret the lowest intervals. Table XIX is the result of the Illinois Group Intelligence Scale which was given to children in the Chicago Public Schools.

We can not see each lowest point because the original data shows only the lowest interval. The lowest intervals of nine, ten, eleven, twelve, thirteen, fourteen, and fifteen year children are 0 - 10 without one exception.

The mental progress of most feeble-minded children is exceedingly small.

Several years progress of the mid-point of the mental test score is indicated by Tables XVIII and XIX.

In Table XVIII there is shown a regular progress of the mid-point scores. The difference of mid-point scores between the connected two years is from seven to sixteen points. Six cases out of nine, the progress of the mid-point scores is ten, eleven, or twelve points. There is no limitation of the mental growth until the cases of sixteen year children.

³L. L. Thurston. "The Mental Growth Curve For The Binet Test", The Journal Of Educational Psychology, XX, (November, 1929), 517.

Rudolf Pintner said about the progress of mental curve as follows:

From birth to five years there is the most rapid increase in intelligence. The annual increments are larger than during any other five-year period. During the next period from five to ten the growth is not so great but is still steady and measurable. During the next five-year period the growth becomes smaller and smaller, and many psychologists assume that a fourteen-year-old level on the Binet Scale is the level attained by the average adult. Some assume that the sixteen-year-old level is the average adult level. At present it is customary to assume the fourteen-year-old level in view of general results of mental testing in the Army, where it was found that the average recruit had a mentality about equal to a mental age of 13.8 on the Standord Revision.⁴

The comparative study of the facts of Table XVIII and Pintner's conclusion for the mental growth curve suggests that the nature of mental tests is different in each case.

We have observed in Table XVIII that the straight lined progress had been continued until the cases of sixteen year children. There is some contradiction between Table XVIII and Pintner's conclusion. But this contradiction may be explained as follows:

It is obvious that the rate of growth exhibited by the increase in scores of a test depends, not merely upon the actual development of the children, but also upon the character of the test itself. The aspect of the test which is probably the important one in determining the increase in the scores up to the age of maturity is its difficulty.

⁴Rudolf Pintner. Intelligence Testing, 66, New York: Henry Holt & Co., 1923.

We could not find the culmination period of the mid-point score in the Dearborn Scale, but we could find the culmination period of the upper score in the same scale. We can guess, by the growth curve of the upper score, that the most gifted children may reach the highest mental level when they become thirteen or fourteen years old, but normal children may continue their mental progress until they reach to the highest mental level. (See Table XVIII).

The above two conclusions do not agree with the general scientific theory of mental growth rate in normal and superior children. This theory was explained in the beginning of this chapter.

Let us discuss the culmination period according to Table XIX.

The culmination period cannot be found in the lowest point as has been already mentioned. The culmination period in the first quartile point is thirteen years. The culmination period in the mid-point is the same as the first quartile point. The culmination period in the third quartile is also thirteen years. The culmination period in the upper point is thirteen years. There is no difference in the culmination periods in any cases except the lower point.

The highest and the lowest points in each year are separated from the middle score, but these upper and lower scores are connected without any gaps. The highest point

and the lowest point are connected by the law of distribution, step by step from the central distribution to the bipolar minimum steps. The most superior and most inferior child is a being which is separated from the average pupil but without any gap. The discussion of the highest point and the lowest point is not only a very much separated and rare child's study, but it is also the study of children who are connected with those children who are most superior or most inferior.

The natures of the mental growth curves are suggested by figures III and IV. They show graphically each quartile and the lowest interval and the highest interval.

The study of the range in each quartile, each middle fifty per cent and each bipolar fifty per cent.--Figures III and IV suggest to us some nature of the range of the middle fifty per cent and the bipolar fifty per cent.

After many studies, Freeman summarized the variability in intelligence in succeeding ages as follows:

The facts seem to show that in most cases the scores of single tests have a somewhat increased variability with age, but that the coefficient of variability remains constant. In the case of group tests, however, the variability does not increase but remains constant. If the coefficient of variability were calculated, it would decrease. Our conclusion upon the evidence thus far presented, then, is that the variability in the scores of children from age to age remains relatively constant.⁵

⁵F. N. Freeman. "Mental Test", New York: Mifflin Co., 1927.

Figure 3.- The mental progress curve from the Dearborn Scale.
The lowest interval (I). The highest interval (V). The First quartile point (II). The third quartile point (IV). The mid-point (III).

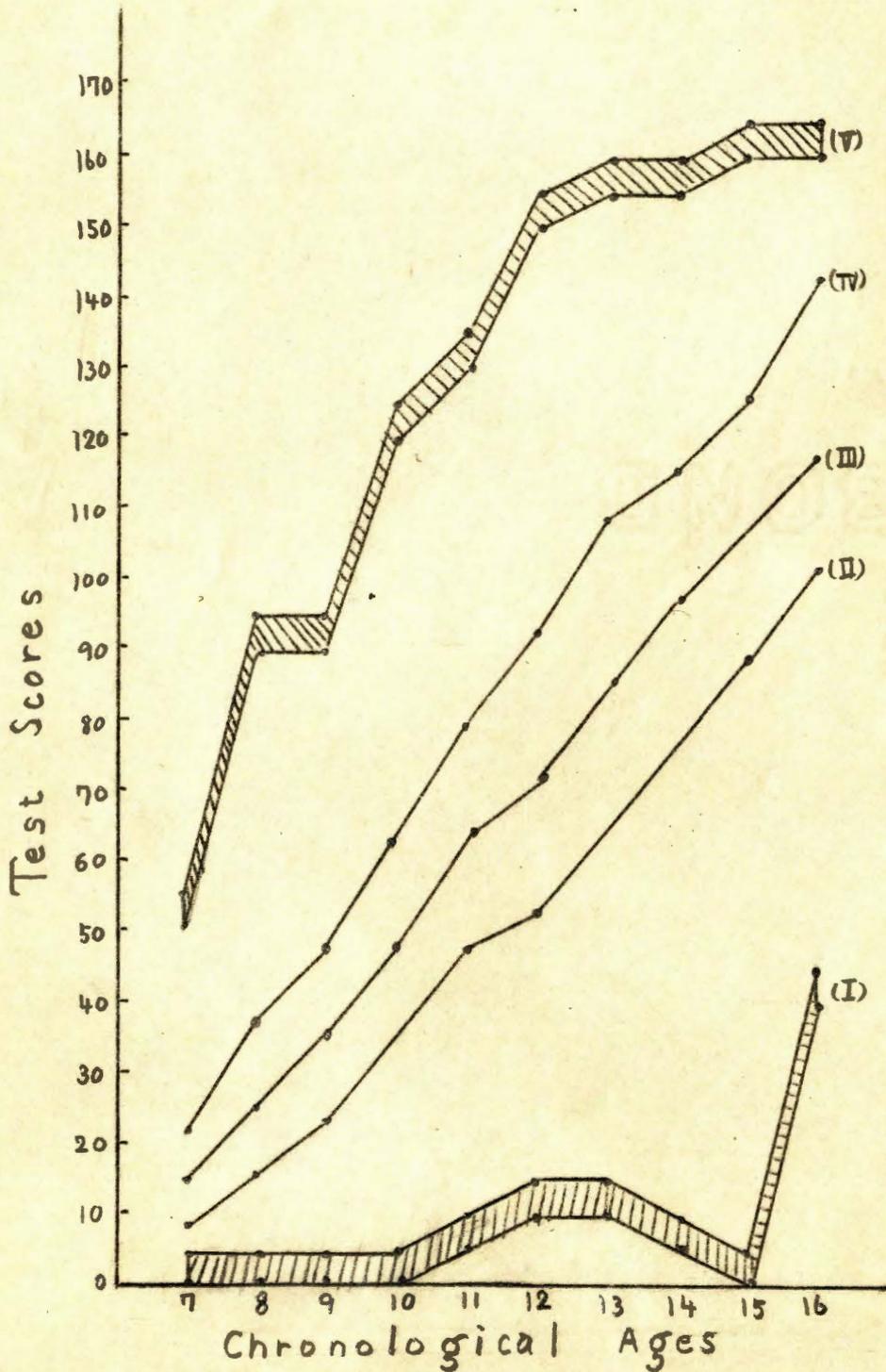
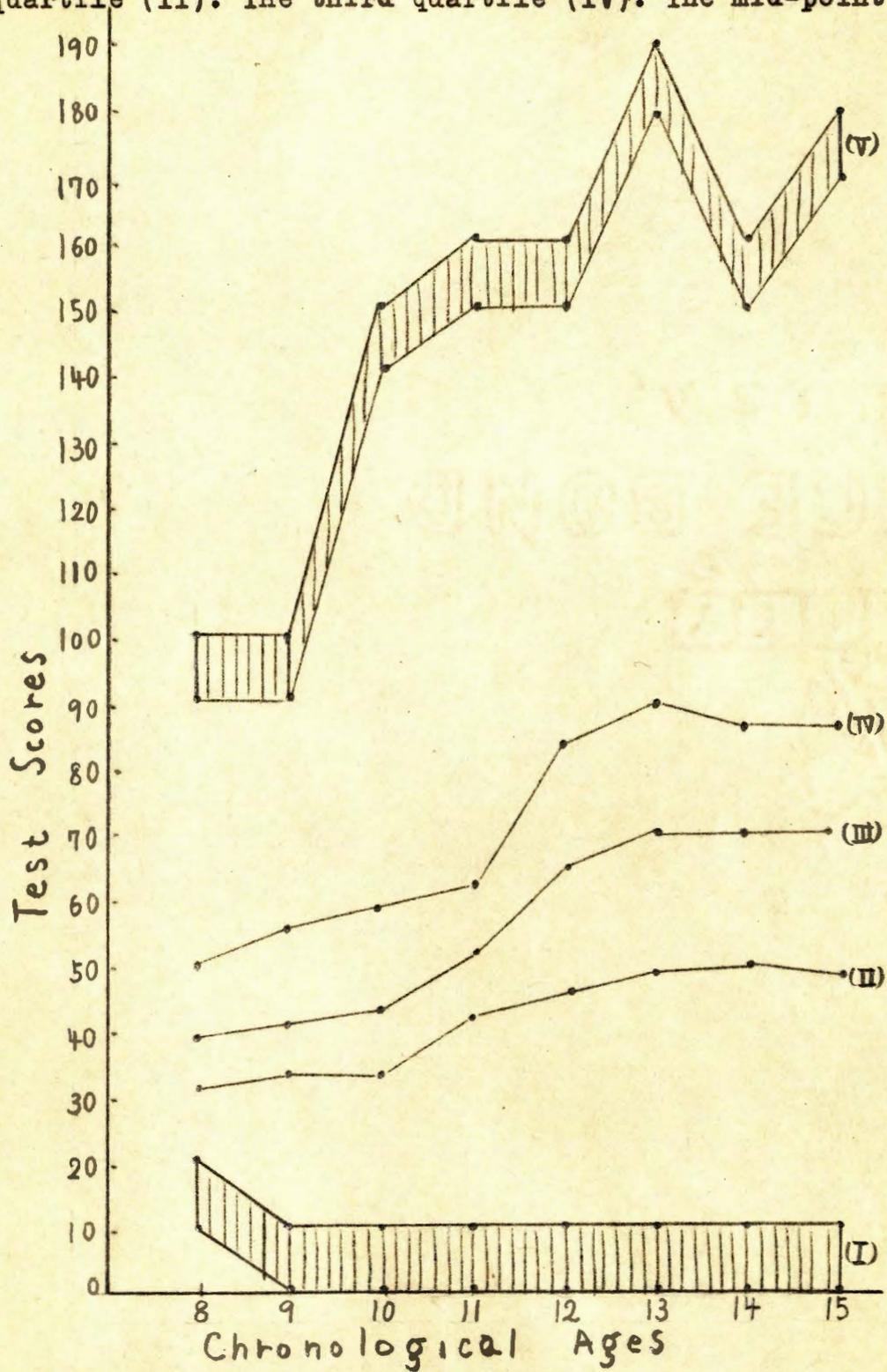


Figure 4.- The mental progress curve from the Illinois Intelligence Test. The lowest interval (I). The highest interval (V). The first quartile (II). The third quartile (IV). The mid-point (III).



The above assumption tells us that the curve of inferior mentality stops rising at an earlier age than that of a normal mentality, and that the curve of superior mentality continues to rise for a longer period than that of normal mentality.

The above suggests to us something of the progress of the mental range as to age. Let us discuss this point by referring to Table XX.

Table XX was taken from Table XVIV. It shows the first quartile range, second quartile range, third quartile range, fourth quartile range, middle fifty per cent range, bipolar fifty per cent range and the whole range of the test scores.

Table XXI was taken from Table XIX. It shows also each quartile range, the middle and bipolar fifty per cent ranges, and the whole range of the test scores.

Figures V and VI show graphically the character of the growth curve in each quartile, middle and bipolar fifty per cent range, and the range taken as a whole.

In Table XX the range of the first quartile gradually increases year by year. The first quartile range of seven year children is ten points, the first quartile range of eight year children is seventeen points, etc. There is a regular progression until the fifteenth year. The difference between the smallest range and the largest range is 80 points. The smallest range comes in that of the seven

TABLE XX

THE MENTAL RANGE IN EACH QUARTILE, EACH MIDDLE-FIFTY PER CENT, AND EACH BIPOLAR FIFTY PER CENT IN THE DEARBORN SCALE, SERIES II DATA ON SCHOOL CHILDREN IN MASSACHUSETTS TOWNS.

Ranges On Score							
Ages	First Q	Second Q	Third Q	Fourth Q	Mid- 50	Bip- 50	Whole
7-7, 11	10	7	7	39	14	49	60
8-8, 11	17	11	13	62	24	79	100
9-9, 11	25	13	13	52	26	79	100
10-10, 11	36	14	18	66	32	102	125
11-11, 11	44	17	17	55	34	99	130
12-12, 11	44	19	23	62	42	106	140
13-13, 11	56	22	24	51	46	107	150
14-14, 11	73	21	20	44	41	117	155
15-15, 11	90	20	19	39	39	129	165
16-16, 11	60	17	16	32	33	95	125

year children's range, and the largest range is the fifteen year children's range.

The range of the second quartile in Table XX increases little by little with the years until the thirteenth year. After the thirteenth year, the range of the second quartile decreases bit by bit with the years. The range of the seven year children is seven points, and the range of the eight year children is eleven points, etc. The seven

TABLE XXI

THE MENTAL RANGE IN EACH QUARTILE, THE MIDDLE-FIFTY PER CENT, AND THE BIPOLAR-FIFTY PER CENT IN THE ILLINOIS INTELLIGENCE SCALE A DATA ON CHILDREN IN THE CHICAGO PUBLIC SCHOOLS

Ages	Ranges On Score						
	First Q	Second Q	Third Q	Fourth Q	Mid- 50	Bip- 50	Whole
8-8, 11	22	9	12	50	21	72	90
9-9, 11	34	9	16	44	25	78	100
10-10, 11	34	11	17	91	28	135	150
11-11, 11	43	11	21	78	32	121	160
12-12, 11	47	20	20	76	40	133	160
13-13, 11	50	22	21	100	43	150	190
14-14, 11	51	21	18	73	39	124	160
15-15, 11	50	22	18	93	40	143	180

year children's range is the smallest and the thirteen year children's range is the largest. There is a difference of fourteen points.

The range of the third quartile is almost the same as that of the second quartile range. The seven year old children have the smallest range, and the thirteen year old children have the largest range. The former is seven points and the latter is twenty-four points. After thirteen, the range decreases little by little with the years, but until the thirteenth year, there is an increase with the years.

The fourth quartile range has a larger scale than the other three ranges. In eight years, for example, there is a sixty-two point range. The topping of the scale rises from eight years. After twelve years, the range becomes gradually smaller. The largest fourth quartile range is sixty-six points, and the smallest fourth quartile range is thirty-two points. There is a difference of 34 points. The sixteen year old children have the smallest fourth quartile range, and the next smallest one is that of seven year old children.

The range of the middle fifty per cent increases yearly. The middle fifty per cent range of year seven is fourteen points, and the range of the middle fifty per cent of eight year children is twenty-four points, etc. The increase rate is continued until thirteen years, and after thirteen years the range decreases little by little. The largest range of the middle fifty per cent is forty-six points and the smallest range of the middle fifty per cent is fourteen points. The former is by seven year children, the latter is by thirteen year children. There is a difference of 34 points.

The difference between the smallest bipolar range and the largest bipolar range is eight points.

Year seven has the smallest bipolar fifty per cent range and year fifteen has the largest bipolar fifty per

cent range. The increase rate of the bipolar fifty per cent range is continued from seven to fifteen, and there are few exceptions.

In the bipolar ranges, the smallest one is sixty points, and the largest one is one hundred and twenty-six. The former is taken from year seven and latter is taken from year fifteen.

The whole range increases with the years. This increment is continued until the age of fifteen. The rate of increase is above five points except in one case. The whole range of year seven is sixty, and the whole range of year fifteen is one hundred and sixty-five. There is a difference of one hundred and five points. If we translated these points to mental years, one hundred and five points may become ten or eleven years. Then the difference of the whole mental range between seven and fifteen year children is ten or eleven years.

The average increasing rate per year is nearly one and one half years.

Table XXI shows each quartile range, each middle-fifty per cent range, each bipolar-fifty per cent range, and all of the ranges as a whole in the Illinois Intelligence Scale of the children of the elementary schools of Chicago.

The first quartile range of eight year children is twenty-two points. The first quartile range of nine year

children is thirty-four points, etc. There is progression until the age of fourteen. But the age of thirteen may be a culmination period because after thirteen there is progress of only one point. This point is not the same as the result of the Dearborn Scale. The smallest range is twenty-two points, and the largest range is fifty-one points. There is a difference of twenty-nine points.

The smallest range of the second quartile is nine points, and the largest range is twenty-two points. There is a difference of thirteen points. The differences of the ranges under eleven years are very small, and the differences of the ranges from twelve to fifteen years are also small. The culmination period is therefore probably from twelve to thirteen years. This result is just the same as the result of the Dearborn Scale.

In the third quartile, the mental range of eight year children is eleven points, and nine year children's mental range is sixteen points, etc. The smallest range appears in that of eight year old children, and the largest range appears in that of eleven and thirteen year old children. There is a difference of nine points. The culmination period appears in eleven year children. This is two years earlier than the result given by the Dearborn Scale.

The range of the fourth quartile is very large. Even the smallest range is almost as large as the largest

one of the quartile. The fourth quartile range of eight year children is fifty points and the range of the fourth quartile of children of nine years is forty-four. There is the decrease of six points. The largest range of the fourth quartile is a hundred points, and the smallest range of the fourth quartile is forty-four points. There is the difference of fifty-six points. The topping of the changing rate of the fourth quartile range begins from the ten year group. This is two years later than the result of the Dearborn Scale.

The middle fifty per cent range in eight year children is twenty-one, and the range of the middle fifty per cent in nine year children is twenty-five, etc. There is a regular progress from eight to thirteen years. This point agrees with the results of the Dearborn Scale. The difference of the middle fifty per cent ranges between eight year children and thirteen year children is seventy-eight points. The former is nearly one half of the latter.

The bipolar fifty per cent range, in eight year children, is seventy-two points; and the bipolar fifty per cent range in nine year children is a hundred points, etc. The culmination period comes in the year "thirteen". This point agrees with the result of the Dearborn Scale. The difference between the largest range and the smallest range is just one hundred points.

The culmination period in the whole range appears in the thirteenth year. This point agrees with our former discussion. The regular progress is continued from the eighth to the thirteenth year. The difference between the smallest range and the largest range is just a hundred points.

TABLE XXII

THE RATE OF THE MENTAL RANGE-SCORE OF EACH QUARTILE, MIDDLE FIFTY PER CENT, BIPOLAR FIFTY PER CENT, AND WHOLE WHICH WAS DETERMINED BY THE MID-SCORE IN THE DEARBORN SCALE SERIES II DATA ON SCHOOL CHILDREN IN MASSACHUSETTS

Ages	Rates Of Range-Scores						
	First Q	Second Q	Third Q	Fourth Q	Mid- 50	Bip- 50	Whole
7-7, 11	67	47	47	260	93	327	400
8-8, 11	65	42	50	238	92	304	385
9-9, 11	69	36	36	133	72	214	278
10-10, 11	75	29	37	137	67	212	260
11-11, 11	68	27	27	86	53	155	203
12-12, 11	62	27	32	87	58	149	204
13-13, 11	65	26	28	59	53	124	174
14-14, 11	75	22	22	45	42	120	159
15-15, 11	83	19	18	36	36	119	153
16-16, 11	53	14	13	27	28	80	106

Figure 5.- The Progress Curve of the mental range from the Dearborn Scale. The First Quartile Range (I). The Second Quartile Range (II). The Third Quartile Range (III). The Fourth Quartile Range (IV). The Middle Fifty Per Cent Range (V). The Bipolar Fifty Per Cent Range (VI). The Whole Range (VII).

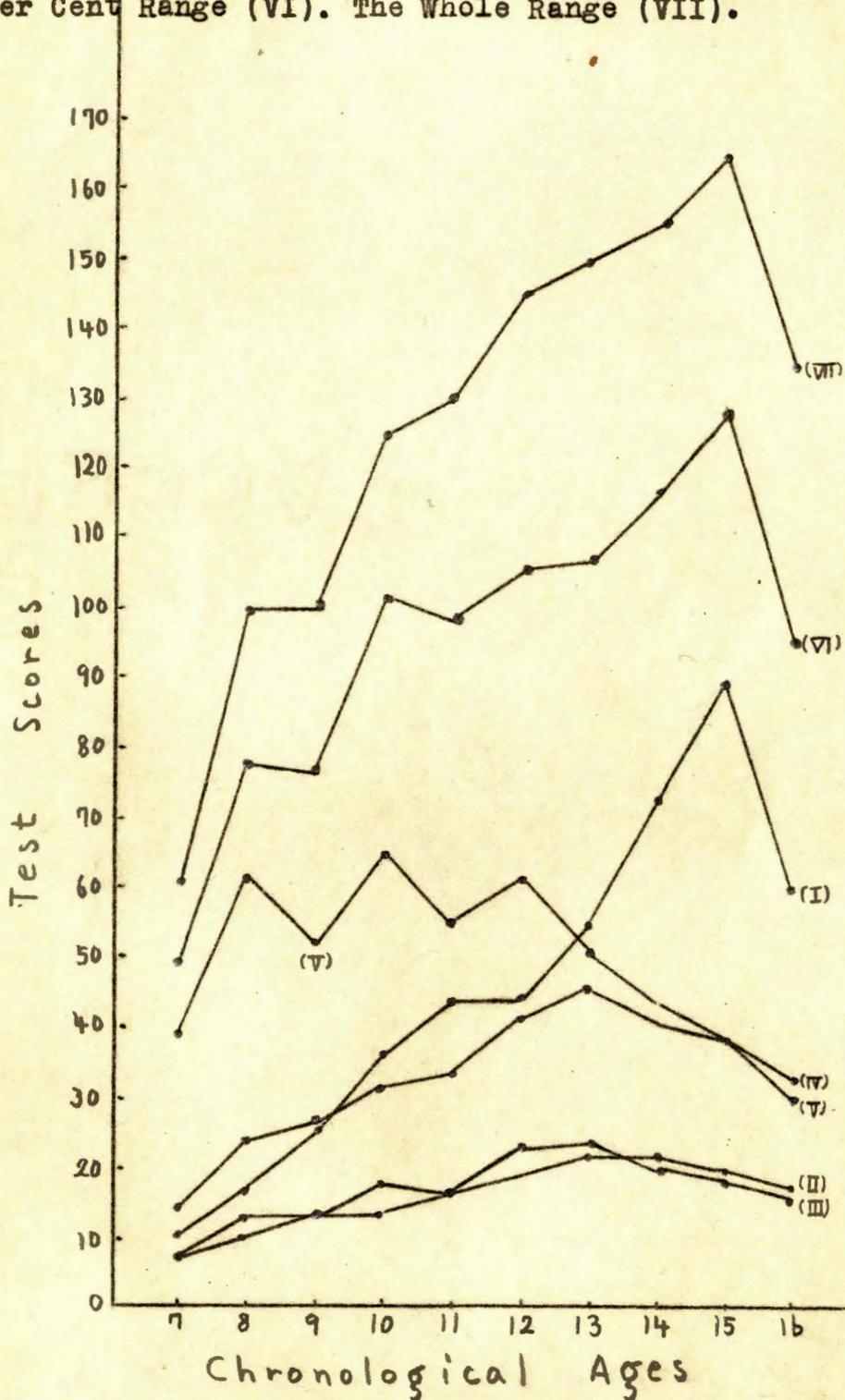


Figure 6.- The Progress Curve of the mental range from the Illinois Scale.
The First Quartile Range (I). The Second Quartile Range (II).
The Third Quartile Range (III). The Fourth Quartile Range (IV).
The Middle Fifty Per Cent Range (V). The Bipolar Fifty Per Cent Range (VI).
The Whole Range (VII).

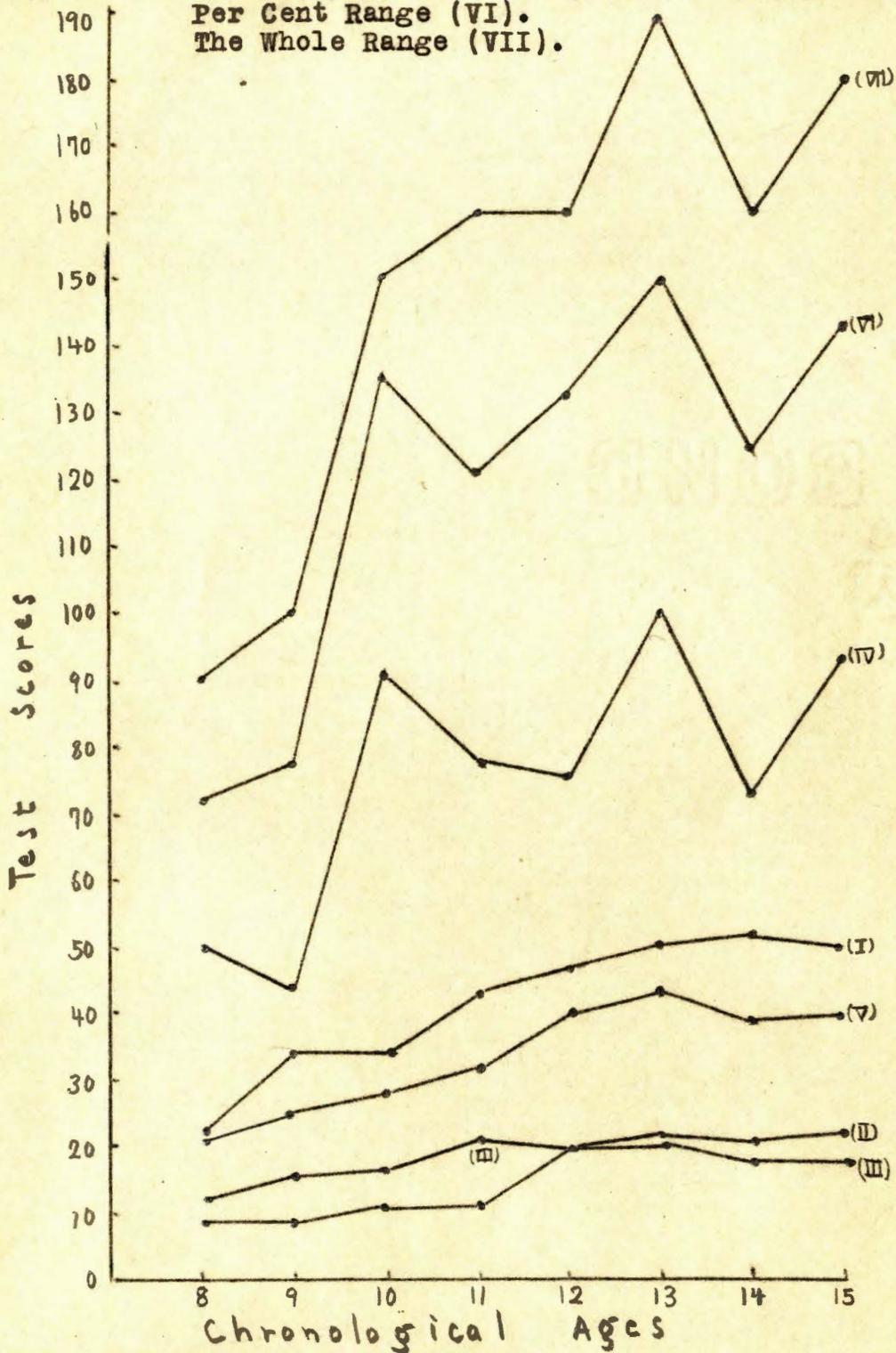


Figure 5 and Figure 6 are furnished from Table XX and XXI. These figures show graphically the comparative size of each range.

The ranges of the second quartile and the third quartile are smaller than any other ranges. The ranges of the second quartile and the third quartile have no large change. From this character of the range of the two middle quartiles many psychologists interpret the constancy of intelligence quality. The curves of the second quartile range and the third quartile range are almost alike. This is low compared with the regular statistics.

The comparative study of the range curves of the first quartile and the fourth quartile suggest to us that the ranges of the first quartiles are usually smaller than the ranges of the fourth quartiles. The range curve of the first quartile shows nearly a straight line, but the range curve of the fourth quartiles shows a topping line. This

Out of three cases in eighteen the range of the middle fifty per cent is smaller than the range of the first quartile, but these two range curves are almost similar in both tests.

There are large gaps between the range curve of the middle fifty per cent and the bipolar fifty per cent. The former is about one-third of the latter. This point is the same in both tests.

The range curve of the whole is affected by the range rate of the fourth quartile and the first quartile. This range curve then shows a topping line in its latter period. But in the Dearborn Scale the whole range curve growth is nearly a straight line until the scale of the fifteen year old children; in the Illinois Scale the whole range curve growth is almost a straight line until the range of the thirteen year children.

TABLE XXIII

THE RATE OF THE MENTAL RANGE-SCORE OF EACH QUARTILE, MIDDLE FIFTY PER CENT, BIPOLAR FIFTY PER CENT, AND WHOLE RANGE WHICH WAS DETERMINED BY THE MID-SCORE IN THE ILLINOIS INTELLIGENCE SCALE
A DATA ON CHILDREN IN THE CHICAGO PUBLIC SCHOOLS

Ages	Rates Of Range-Scores						
	First Q	Second Q	Third Q	Fourth Q	Mid- 50	Bip- 50	Whole
8-8, 11	56	23	31	128	54	185	231
9-9, 11	83	22	39	110	61	190	246
10-10, 11	79	25	40	212	67	214	250
11-11, 11	83	21	40	150	62	233	308
12-12, 11	72	31	31	118	62	205	247
13-13, 11	71	31	30	143	61	214	271
14-14, 11	73	30	26	104	56	177	228
15-15, 11	71	31	26	173	57	207	257

The study of the rates of ranges.--The rate of each quartile range, each middle fifty per cent range, each bi-

polar fifty per cent range, and each whole range was determined by the middle score of each age. This discussion corresponds to the former discussion of the rates between the mental range of each year and the range of its chronological age.

The rate of the range-score of each quartile, each middle fifty per cent range-score, each bipolar fifty per cent range-score, and each whole range-score for its middle score was indicated by Table XXII.

In the case of seven year children, the rate of the first quartile range-score is 67 per cent, for the middle-score of this group; and the rate of the second quartile range is 47 per cent for the same middle-score, etc.

The rate of the first quartile range-score, in seven year old children was 67 per cent for its middle-score. The rate of the first quartile-score in the eight year old children is 65 per cent for its middle score, etc.

If we arrange each year, in the first quartile-range rates, in order of the size of each mental range-rate, it becomes as follows: fifteen, fourteen and ten; nine, eleven, seven, eight and thirteen; twelve and sixteen. This is not the decrease or the increase of mental range-rate in order of their chronological ages. The toppings of the rates were continued from seven years to sixteen years.

The topping of the rates is only in this case.

Most of the other range-rates decrease with their chronological ages. For example, in the rates of the second quartile, the rate of the ranges increase with their years, except in one case where the same level was kept.

The rates of the whole ranges also decrease with their chronological ages except one case in ten. The largest rate of the whole range is 400 per cent and the smallest rate of the whole range is 106 per cent. The former is in the group of seven year children, the latter in the group of sixteen year children.

We will discuss each rate of the range-score for each middle point of group scores according to the results of the Illinois Intelligence Scale A Data on children in the Chicago Public Schools. Table XXIII shows this rate.

In the case of eight year children, the rate of the first quartile range-score is 56 per cent for the middle-score of this group, and the rate of the first quartile range-score, in nine year children, is 83 per cent for their middle-score, etc.

In the case of eight year children, the rate of the first quartile range-score is 56 per cent. In the same group, the rate of the second quartile range-score is 23 per cent, etc.

The rates of the range-scores are almost constant in all cases. This is a different point from the former data

except in the cases of the rates of the first quartile range-scores.

In the above data of two cases of the rates of range-scores, the smallest whole range-rate is 106 per cent and the largest whole range-rate is 400 per cent. The whole range-rate of 106 per cent means that the difference between the most feeble-minded child's mental test score and the most gifted child's mental test score is almost the same with the mid-point of the mental test scores of their age-group. In other words, the difference in mental years between the most feeble minded child and the most gifted child in their age-group, is almost equal with their chronological ages, because the middle score of the mental test of age groups indicates their chronological ages. By the same reasoning the whole range-rate of 400 per cent means that the difference between the most gifted child and most feeble-minded child is nearly four times that of their chronological age.

Then we will say that the range of mental age, in age-groups, is the same with the chronological age of this group, or it is larger than the chronological age of this group.

Figure 7 shows graphically the rate of each middle fifty per cent, each bipolar fifty per cent, and each whole range-score for each mid-point of mental test score.

Figure 7.- The rate of the mental range in each middle fifty per cent, bipolar fifty per cent, and each whole in the Dearborn Scale (Solid line) and in the Illinois Scale (Broken Line).

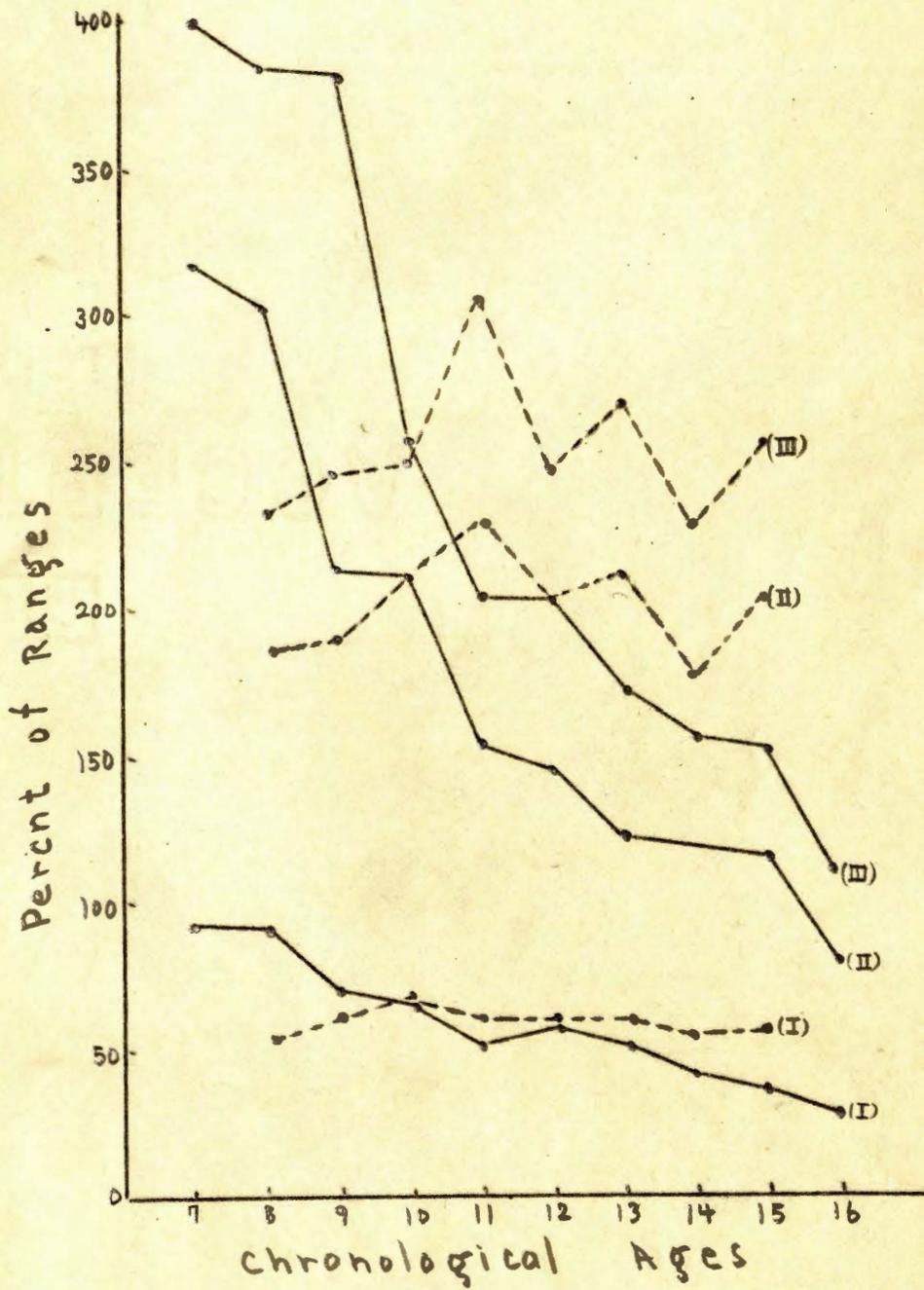
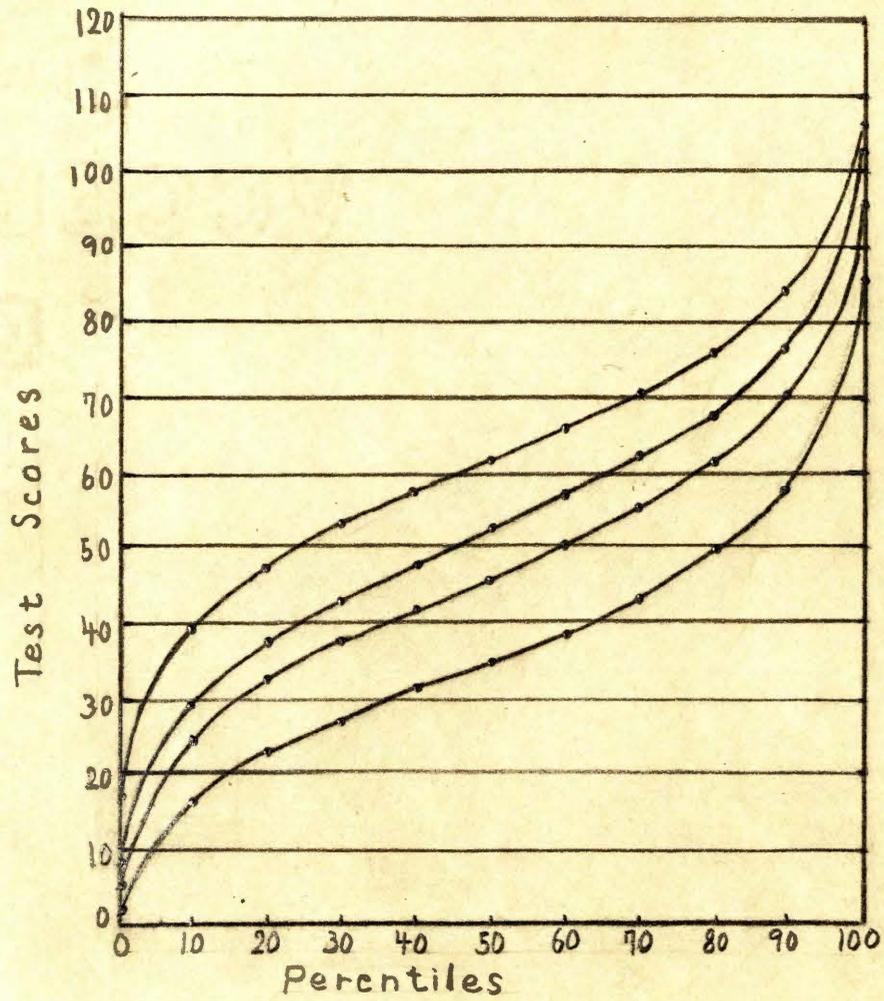


Figure 8.- The percentile graph of the Miller test scores.



The mental identity between certain connected years.-
Figure 8 is the Percentile Graph of the Miller test scores
in seven, eight, nine, and ten year children's groups.⁴

In the case of seven year old children, the ten per cent score is 17, the twenty per cent score is 23, etc.

In the points of ten per cent, the score of seven year children was 17, the score of eight year children was 25, and the score of nine year children was 29, etc.

There are many interesting facts. For example, the ten per cent score of eight year children is equal with the seven per cent score of nine year children. The twenty per cent score of eight year children is equal with the thirteen per cent score of nine year children. Their mental identity may express itself as follows:

Ten Years	Nine Years
100 per cent.....	-----
99 per cent.....	100 per cent
90 per cent.....	95 per cent
80 per cent.....	90 per cent
70 per cent.....	83 per cent
60 per cent.....	78 per cent
50 per cent.....	69 per cent
40 per cent.....	60 per cent
30 per cent.....	53 per cent
20 per cent.....	39 per cent
10 per cent.....	23 per cent
0 per cent.....	2 per cent
-----	0 per cent

⁴Miller, W.S., "Miller Mental Ability Test", New York: World Book Co., (1926), 13.

When the upper one per cent scores of ten year children were omitted the remaining scores of ten year children were involved in the scores of nine year children. On the contrary, when the lower two per cent scores of nine year children were omitted, the remaining ninety-eight per cent scores were involved in the score of ten year children. That is to say, when the upper one per cent scores of the ten year children and the lower two per cent scores of nine year children were omitted, both age-groups of nine and ten years become equal ability groups.

In the cases of seven and eight year children, these mental identity groups may be expressed as follows:

Eight Years	Seven Years
100 per cent.....	-----
99 per cent.....	100 per cent
90 per cent.....	97 per cent
80 per cent.....	93 per cent
70 per cent.....	88 per cent
60 per cent.....	81 per cent
50 per cent.....	74 per cent
40 per cent.....	63 per cent
30 per cent.....	57 per cent
20 per cent.....	42 per cent
10 per cent.....	25 per cent
0 per cent.....	2 per cent
-----0 per cent

When the upper one per cent scores of eight year children were omitted, the scores of all eight year children were involved in the scores, of seven year children. On the contrary, when the lower two per cent scores of nine year children were omitted, the remaining scores were involved in the scores of eight year children. This is just the same with the cases of nine and ten year children.

Because there is the difference of the density of scores in the interval of 70 - 80 of the Miller test scores, there are 2.5 per cent scores of seven year children. But in the same interval there are 6 per cent scores of eight year children. In the interval of 30 - 40 of the Miller test scores, there are 7 per cent scores of ten year children, but in the same interval, there are 14 per cent scores of nine year children.

CHAPTER V

THE PROGRESS OF MENTAL RANGE WITHIN GIVEN GRADES

The Distribution of the Mental Ages and the Intelligence Quotients within given grades.

Pupils belonging to the same school grade are found to differ widely with respect to mental age. Differences of as much as two or three years are common and extreme differences of five or six years are by no means infrequent. These large individual differences result in a large degree of overlapping with respect to mental age.

In figure 9 we have represented graphically the distribution of pupils showing that there are a few pupils classified in the eighth grade whose mental age is below the average for the fourth grade and that there are pupils in the fourth grade whose mental age is above the average for the eighth grade.¹

It is worth re-emphasizing that such increased variation as there is from grade to grade obtains despite the qualitative selection which has already been referred to. The nature of this selection is suggested in Figure 10, which shows graphically for one school system, enrolling in all about fifteen hundred pupils, the percentage distributions of intelligence quotients of pupils in three groups of grades,

¹B. R. Buckingham, "The Illinois Examination", 22, Bloomington, Illinois, The Public School Publishing Co., (1920).

namely, (1) the fourth, fifth, and sixth; (2) the seventh, eighth and ninth; and (3) the tenth, eleventh, and twelfth. These groupings correspond to what are termed (1) intermediate, (2) Junior high school, and (3) Senior high school grades. The shift of the distributions toward the higher intelligence quotients in the advanced grades of system is unequivocal. Qualitative elimination may be illustrated as follows. In the random sample of 117 such pupils the intelligence quotients for only 10 were at or above 100, and for only two were above 110. It should be clear that, if the secondary school offsets the selective influences, as achievement to be inferred from the junction of retention as accepted, its task of recognizing individual differences will be almost correspondingly increased.²

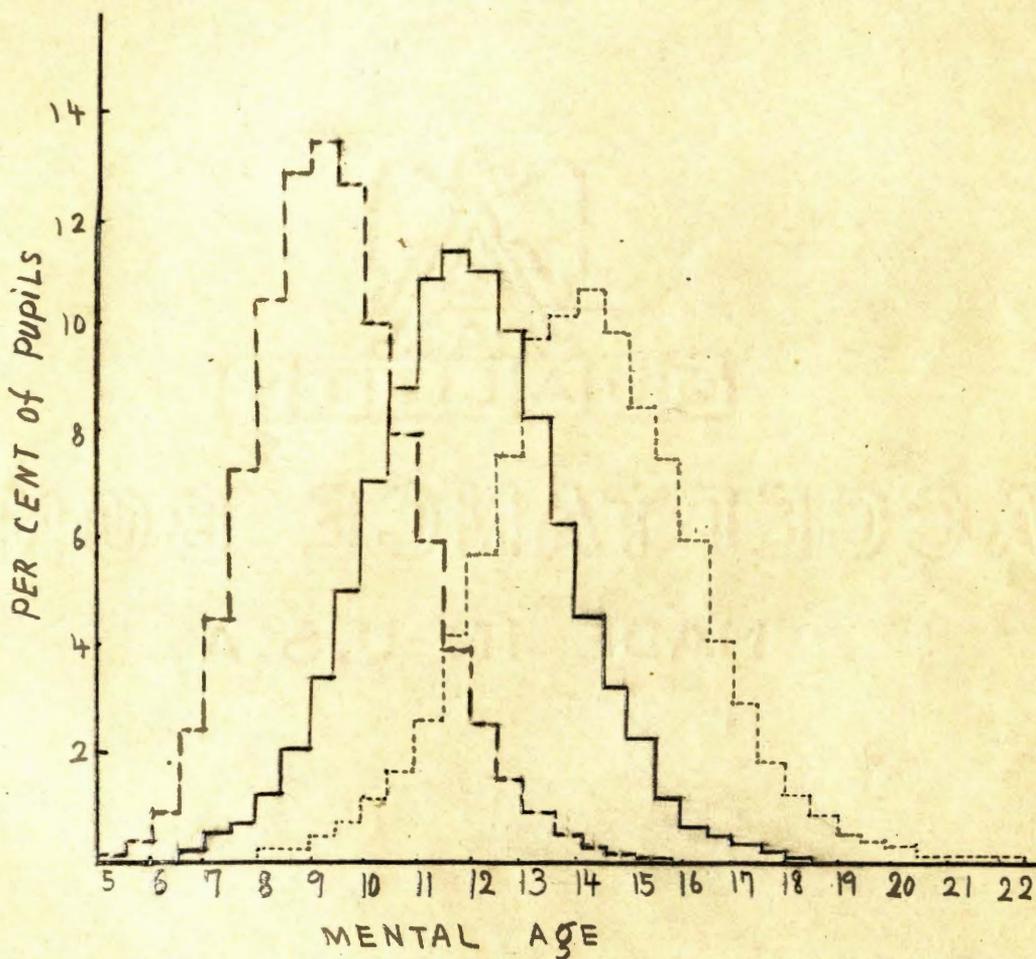
The Mental Ranges within Given Grades.

Another factor showing the urgency of recognizing individual differences is the expanding range of variation as we proceed from grade to grade. The range is usually wider in the sixth grade than it is in the fifth, and wider in the seventh grade than it is in the sixth, etc., as we have already mentioned. This tendency is partially checked in upper elementary grades by what is called "qualitative elimination". The tendency of the less capable pupils (and

²T. Grin Powers. "Instructional Outcomes in Junior High Schools", 72.

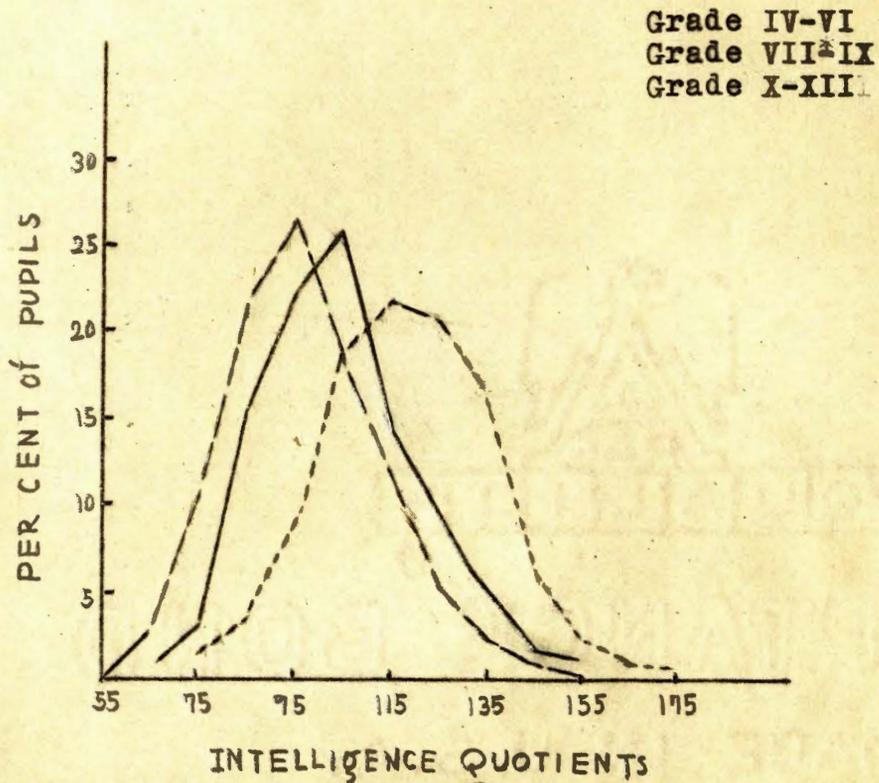
Figure 9.- Distribution of pupils with respect to mental age for Grades IV, VI, VIII.*

Grade IV
Grade VI
Grade VIII



*This figure was furnished the writer by Dr. B. R. Buckingham and Dr. W. S. Monroe.

Figure 10.- Percentage distributions of intelligence quotients of pupils enrolled in grades (IV-VI), grades (VII-IX) and grades (X-XIII) in the Austin, Minnesota, public schools, 1921-1922.



*Computed from Mervin G. Neale's "Studies of Instruction in the Austin, Minnesota, Public Schools", Bulletin of the University of Minnesota, Educational Monograph, No. 2, p. 91.

others doing poor work) to drop out at or near the termination of the compulsory school period. The widening variability is illustrated in the measures of intelligence presented in Table XXIV, which, besides reporting the Median (middle) scores, cites the upper and lower quartiles and the difference between these two points in the distributions. Data are presented for grades IV to VIII and grade XII. Those for grades IX, X, and XI are omitted because the numbers of pupils represented were much smaller. The range of the middle 50 per cent, the simple measure of variability here used, may be seen to increase from grade to grade, slackening somewhat between grades VII and VIII, but enlarging again somewhere between this point and the last high-school grade. Increasing variability from the seventh grade upward is shown also in Table XXV, the exception being a shrinkage between the last two high-school grades.³

³Leonard V. Koos. "The Junior High School", Ginn & Co. New York: (1927), 42.

TABLE XXIV

THE LOWER QUARTILE, MEDIAN, AND THE UPPER QUARTILE TEST SCORES, AND THE RANGES OF THE MIDDLE 50 PER CENT OF THE TEST SCORES FOR THE PUPILS IN THE GRADES IV TO VII AND IN THE GRADE XII (MYERS MENTAL MEASURE)*

Measures	Grades					
	IV	V	VI	VII	VIII	XII
Lower quartile	25.7	31.2	26.1	38.5	44.1	47.4
Median	33.6	38.6	43.6	47.8	52.4	63.0
Upper Quartile	40.8	47.2	52.5	56.3	62.0	73.9
Range of Middle 50 per cent	15.1	16.0	16.4	17.8	17.9	26.5

*Computed from distributions of scores presented in "Measuring Minds - and Examiner's Manual to Accompany the Myers Mental Measure", pp. 23-24.

TABLE XXV

THE FIRST QUARTILE, MEDIAN, AND THE THIRD QUARTILE TEST SCORES, AND THE RANGES OF THE MIDDLE 50 PER CENT OF THE TEST SCORES FOR THE PUPILS IN THE GRADES VII TO XII (TERMAN GROUP TEST OF MENTAL ABILITY).*

Measures	Grades					
	VII	VIII	IX	X	XI	XII
Lower Quartile	51	69	81	98	112	122
Median	68	89	104	122	128	147
Upper Quartile	88	112	128	147	163	167
Range of Middle 50 per cent	37	43	47	49	51	47

*Computed from distribution of scores presented in "Manual of Directions for Terman Group Test of Mental Ability" for grades VII to XII, p. 9.

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