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A TEST OF MEMORY IN SCHOOL CHILDREN.

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The experiments described below were made to test the memory of children at different periods of school life, and to determine what appeals to the different senses and to the sympathies of children at different ages. For the purpose of the test, the following story, designed to appeal about equally to different senses and faculties, was written by Dr. Hall, and divided for examination as here indicated.

James | Mack | ten years old, | a farmer's son | dreamed |
that his father | and mother | died | very poor | and left him
nothing | but 37 cents, | a loaf of bread | and a Bible. | The
day after the funeral, | he had | to take these, | leave | his
home | and his school, | and go out alone | into the wide
world. | It was Sunday, | and a lame, | crooked, | little, |
old | woman, | with a red | shawl | on her head, | said: "Please
give me your Bible." | He did. | Soon he met | three | boys |
who looked | so hungrily | at his bread, | (so) that | he gave
it. | Then came | a ragged, | black | beggar | with a stub |
pipe, | one | leg | and a crutch, | and into his hat | James |
dropped | all | his money. | To a blind | schoolmate | with no
cap, | James | gave his. | To an half | naked, | sickly, | fiddler
| boy | with a lean | monkey, | he gave | his coat | and pants. |
At night, | in a woods | he found | a lost | baby, | naked, |
crying, | and as it was dark, | took off | his last | garment, | to
wrap around it. | Made a | big | bed | of oak | leaves, | crept
in | with the baby | and hugged it | to keep it warm. | Then as
he lay | looking up | into the sky | he said: | "Dear | God, |
what can I do | more?" | It was just the perfect | hush | of
midnight, | save | the hoot of an owl | and the distant | bark of
a dog. | Just then | the moon | peeped out | behind | a pinkish |
cloud, | and right under it | appeared | an angel | child, | which
he thought | was his dead | sister | Mabel's | face | smiling. |
There seemed | a sweet | perfume, | a hand | touched | his
head | and a gentle | voice | from the cloud said: | "This is

the Christ | child." | James | awoke. | It was Christmas | morning, | and by his bed | Santa Claus | had put | a silver dollar | a box of candy, | a bottle | of cologne, | a music box, | a loaf | of frosted cake, | a fur | tippet | and a gilt Bible | full | of colored | pictures.

The story contains 324 words, and is divided into 152 parts, which will be called "terms" for convenience. In this division of the story, it was sought to have as many terms as there were distinct facts or ideas. Tests were made in the following schools of Worcester: Woodland Street, Downing Street, Oxford Street, Winslow Street, and Salisbury Street grammar schools; both High Schools, English and Classical, and in one department at Clark University. The test was also made in a class of thirty at Miss Aiken's school, Stamford, Conn. The grammar schools where the tests were made were among the best in the city. The experiment was begun in the third grade and carried on through the fifth, seventh, and ninth grades of the grammar school and the second and fourth years of the high school. Enough over one hundred papers were secured from each of these six grades to leave fifty from girls and fifty from boys after a few had been cast out which indicated abandonment of effort or lack of effort. Where more than fifty were found, they were taken in order of occurrence until fifty had been used, and the remainder was not taken into account. Twenty papers from the University students and thirty from Miss Aiken's school were studied. The total number of papers examined was 700.

No small effort was made to avoid disturbance and to have the same conditions for all; and the pupils were encouraged to make the best possible effort. The test was made in the grammar schools in the afternoon; but as the high schools have only one session a day, the test was made in them after two hours of continuous work. If fatigue causes any considerable change in memory, it was thought that this plan made the conditions about the same as in the grammar schools. In all the schools of the city the reading was done by Miss Lesure of the Worcester State Normal School. When a room was entered preparatory to making the test, the pupils were told that they were to be given a memory test, in which a story would be read, which would take three minutes. They were requested to give the best possible attention and told that the same test had been, or would be, made in other grades and in other schools. The pupils were instructed neither to give nor receive aid, to write on sheets of paper previously placed on their desks as soon as the reading was finished, and to hand the papers to their teacher as soon as they had written all they remembered of the story. The attention and efforts of the

pupils were very satisfactory, except in one room and in a few individual cases. No unsatisfactory papers were taken into consideration.

In Miss Aiken's school the story was read at 9.30 A. M., by Mrs. Hart, a lady not connected with the school. The department at the University was given the test at 8 P. M., at a meeting of the Philosophical Club. Otherwise the conditions for these groups were the same as for the others.

In the seventh grade an additional test was made in which the pupils read for themselves. It was made the same hour in the day and, as far as possible, under the same conditions as those where the story was read to them. Type-written copies of the story were placed on each desk, with the printed side down, together with blank sheets of paper. At a given signal the pupils turned the papers over and were given three minutes to read them. This was sufficient time to read the story at a slow rate. Many commenced a second reading, and some probably read the entire story twice in this time. At a second signal they turned the papers back again and commenced writing. Fifty papers, twenty-five from girls and twenty-five from boys, were examined; and in estimating the results the numbers were multiplied by two to give a base of one hundred, as in case of the others.

The test was not merely one of word memory, nor was it a test in reproducing the thread of the story. A rigid adherence to either plan would in part have defeated the end sought. In the first case would have been the difficulty that many synonyms were used expressing the same idea, which could not be said to be lost from memory. In the second case, if strict adherence to the order of the story had been required, many papers would have been thrown out, changing the entire nature of the results. As our language is rich in its variety of expression for the same thought, or nearly the same, and every gradation down to where identity is completely lost, it was necessary to adopt a more or less arbitrary standard of acceptance. All terms which fell below this standard were not counted; but an attempt was made to maintain, as nearly as possible, the same standard in the study of all the papers. Sometimes a sentence would be so constructed that it would contain only one term that could be counted. In such a case the term was not counted, unless it retained its original meaning and was of such a nature as to indicate that it had its origin in the story. For example: "On his way he met a woman." In this sentence the word "woman" would be considered as so much of the story reproduced. In a number of cases synonyms were counted as the original, as in the sentence: "James dreamed that his parents died." "Parents"

was credited for both father and mother. "Please give me your Bible" was usually rendered "Asked for his Bible." And this form was accepted as correct. Exact terms were required in a number of cases, as in "beggar," "dropped," and in case of proper names. If substitutes had been freely accepted for "beggar" and "dropped," the nature of the sentence shows they would have been counted about as often as the term: "his money."

Few papers of any length adhered to the original order of the story. Few got the leading characters in their correct order, while their characteristics and acts were more or less confused in all. Some did not get the idea that the story was a dream. Others would have the subject go to sleep and dream after he made the bed of leaves or even later. It was a common occurrence to have the money given to the boys, or to the woman, and the bread to the beggar, or the angel said: "This is the Christ Child." In descending from the higher to the lower grades there was a decided tendency to increase the number of words used to express the same number of ideas.

Table I gives the number of times each term of the story was remembered in the different grades. The first six columns represent the grades indicated, and the numbers are based on one hundred papers, fifty from boys and fifty from girls. The boys and girls are grouped together because there were no striking differences between them except in the amount of the story remembered, which will be mentioned later. The table is self-explanatory. For example, by reference to the first number in the third grade column, it can be seen that 85 pupils remembered the word "James," and it is to be inferred that 15 failed to remember it. The next number, 27, in the same column shows the number who retained the word "Mack." Thus the table shows the per cent. as well as the actual number of pupils who remembered each term. The columns for the University and Miss Aiken's school were raised to a base of one hundred for comparison. The last column gives the average per cent. of the 600 grammar and high school pupils who remembered each term of the story. Thus the entire table is on a base of one hundred.

The test was only partially successful in determining what was expected. The appeal to the sympathies and senses was not sufficient to warrant any general conclusion in this direction. No difference between girls and boys in this respect was found. But other important results were obtained. One of the most striking facts brought out was the early age at which children reach approximately their maximum memory power. The boys in the second year of the high school remembered 43%, the highest per cent. for boys. The next highest was 42% in

TABLE I.

	3d Grade.	5th Grade.	7th Grade.	9th Grade.	2d Year, H. S.	4th Year, H. S.	7th Grade. Self-Reading.	University.	Miss Aiken's School.	Av. for first six columns.
James	85	76	90	91	93	93	92	75	93	88
Mack	27	56	80	81	93	89	92	85	93	71
ten years old	20	20	28	58	68	69	50	50	57	43
a farmer's son	17	28	40	54	55	55	70	60	52	41
dreamed	70	85	89	87	84	84	87	65	100	83
that his father	79	90	92	85	94	78	92	85	93	86
and mother	89	97	95	95	93	91	94	90	100	93
died	92	97	99	96	95	93	98	95	100	95
very poor	19	22	25	30	28	40	40	30	47	27
and left him nothing	76	96	93	98	87	88	86	80	100	90
but 37 cents,	35	78	93	89	89	85	76	75	87	78
a loaf of bread	73	93	96	95	99	97	96	90	100	89
and a Bible.	64	78	94	94	95	93	96	90	100	83
The day after the funeral	29	36	50	57	50	48	58	45	43	45
he had	13	37	38	23	31	30	46	25	47	28
to take these,	6	15	21	29	28	27	14	25	20	21
leave	21	34	40	36	35	30	62	45	27	32
his home	18	24	32	29	26	24	54	50	23	27
and his school,	13	15	16	15	17	20	38	15	10	16
and go out alone	21	43	48	42	68	48	36	35	53	46
into the wide world.	26	55	57	62	68	60	46	45	67	52
It was Sunday,	10	10	23	33	32	32	16	20	30	23
and a lame,	10	15	12	21	29	24	10	15	33	18
crooked,	10	10	23	29	31	39	20	35	47	23
little	3	3	5	9	13	15	12	35	37	7
old	41	66	84	74	85	59	74	80	90	67
woman,	58	81	90	91	95	92	94	90	93	84
with a red	20	20	24	40	37	43	34	40	63	30
shawl	23	21	24	45	35	46	34	30	57	32
on her head said,	14	18	19	34	21	29	18	15	37	22
"Please give me your Bible."	44	73	87	81	85	79	88	65	71	77
He did.	41	70	90	88	90	89	84	70	80	76
Soon he met	21	39	56	44	62	39	48	45	50	43
three	21	34	39	38	42	26	30	30	37	34
boys	33	72	78	73	66	59	78	35	70	63
who looked	22	52	58	61	59	46	72	7	70	49
so hungrily	22	54	68	83	77	66	72	50	77	61
at his bread	9	35	33	30	53	30	40	25	50	31
(so) that	1	16	18	20	27	24	20	25	33	15
he gave it.	49	78	89	93	90	89	82	80	100	74
Then came	0	3	1	1	3	0	0	0	7	1
a ragged	10	5	18	27	23	18	6	10	23	16
black	8	12	12	26	22	24	14	15	17	17
beggar	20	42	44	50	57	67	44	60	57	48
with a stub	1	3	3	18	14	14	10	10	17	8
pipe,	5	4	7	21	21	15	10	25	20	12
one	6	20	34	29	39	27	18	15	20	27
leg	7	24	38	34	43	33	22	40	37	31
and a crutch	10	18	32	30	20	31	20	25	23	23
and into his hat	23	40	37	36	36	34	32	30	70	34
James	4	5	16	15	5	9	0	15	30	9
dropped	10	27	28	21	29	21	28	15	50	20

TABLE I. Continued.

	3d Grade.	5th Grade.	7th Grade.	9th Grade.	2d Year, H. S.	4th Year, H. S.	7th Grade. Self-Reading.	University.	Miss Aiken's School.	Av. for first six columns.
all	8	19	17	27	32	27	14	10	43	21
his money.	45	80	92	86	90	89	82	70	90	90
To a blind	10	24	34	33	27	26	16	20	43	25
schoolmate	11	21	26	36	43	36	18	40	53	28
with no cap	19	31	43	44	46	37	58	35	50	36
James	1	4	8	10	7	4	0	5	7	5
gave his.	13	44	62	70	70	66	66	65	80	55
To an half	8	26	37	27	18	18	14	10	47	22
naked	10	28	36	27	23	20	16	10	53	23
sickly	0	0	5	3	5	2	12	0	7	2
fiddler	3	17	25	28	27	17	48	15	23	19
boy	17	41	48	37	36	30	46	30	50	35
with a lean	2	10	17	26	24	18	20	15	37	15
monkey	5	19	29	38	29	23	40	20	50	24
he gave	21	50	79	76	77	78	64	80	97	62
his coat	23	48	76	75	75	79	58	75	87	62
and pants.	19	60	73	71	74	75	54	70	80	62
At night,	7	21	33	28	29	32	28	25	23	26
in a wood	44	80	89	96	96	91	86	100	93	82
he found	29	48	62	78	80	82	58	75	73	63
a lost	6	18	10	11	8	7	8	5	13	10
baby,	57	88	100	99	99	96	86	95	100	90
naked,	18	50	64	64	68	57	48	70	77	53
crying,	15	23	25	26	26	18	30	30	13	21
and as it was dark	4	8	13	24	25	30	10	15	37	17
took off	28	49	68	58	63	57	34	65	90	55
his last	27	57	78	75	81	71	62	80	80	64
garment,	30	74	83	77	93	73	64	80	87	70
to wrap around it.	40	62	81	83	79	77	60	75	93	70
Made a	28	58	72	77	65	64	58	50	71	60
big	1	2	3	11	4	16	3	5	13	5
bed	30	60	73	77	68	65	58	55	80	62
of oak	11	37	37	59	40	45	30	15	50	37
leaves	33	62	79	84	76	76	68	70	90	68
crept in	26	51	67	72	76	64	40	75	90	59
with the baby	22	42	45	49	48	40	26	40	57	41
and hugged it	18	35	53	69	78	63	32	65	87	51
to keep it warm.	14	41	63	75	81	65	32	60	80	54
Then as he lay	1	3	4	11	11	9	2	5	17	6
looking up	9	22	31	33	44	34	20	40	60	30
into the sky	7	17	26	24	44	26	18	30	50	24
he said,	4	25	43	36	36	28	18	35	53	28
"Dear	3	16	18	22	35	30	16	35	50	22
God,	13	30	51	46	56	43	32	45	70	37
what can I do	12	27	52	53	49	46	32	50	70	41
more?"	4	22	50	45	58	43	20	50	70	38
It was just the perfect	0	0	0	(3)	11	2	0	0	13	2
hush	0	0	9	16	25	22	0	25	20	11
of midnight,	0	3	18	16	30	25	4	35	23	15
save	0	0	10	12	20	16	0	25	23	9
the hoot of an owl	4	3	12	15	21	15	6	35	17	6
and the distant	1	2	5	5	7	5	0	5	10	4

TABLE I. Concluded.

	3d Grade.	5th Grade.	7th Grade.	9th Grade.	2d Year. H. S.	4th Year. H. S.	7th Grade. Self-Reading.	University.	Miss Alken's School.	Av. for first six columns.
bark of a dog.	7	3	8	7	12	8	4	15	20	7
Just then	0	6	4	14	11	8	0	10	13	7
the moon	12	22	22	38	43	42	24	60	43	31
peeped out	11	20	21	31	31	33	18	55	43	26
behind	2	11	13	27	22	25	8	25	27	17
a pinkish	3	15	13	22	29	31	10	0	57	18
cloud	10	25	29	40	47	47	22	50	67	33
and right under it	0	3	3	12	14	12	4	55	30	7
appeared	1	3	7	15	41	31	4	15	30	17
an angel	12	44	54	62	58	56	46	60	60	51
child	0	3	1	2	13	13	0	30	17	5
which he thought	17	38	41	49	51	56	52	60	70	41
was his dead	4	20	28	29	36	51	26	55	67	25
sister	16	43	55	59	70	73	54	65	80	52
Mabel's	7	25	33	34	56	53	28	25	53	34
face	5	15	26	31	35	43	24	30	33	26
smiling.	2	6	3	5	9	8	10	0	17	5
There seemed	0	1	0	1	4	2	0	0	3	1
a sweet	0	1	0	5	3	6	0	0	10	2
perfume,	0	3	2	9	9	6	0	5	20	4
an hand	2	13	15	20	21	14	8	25	27	14
touched	8	18	19	27	28	24	20	25	37	21
his head	7	15	12	18	20	20	18	20	27	21
and a gentle	0	1	0	5	1	3	0	0	0	1
voice	4	9	10	27	25	33	10	35	40	18
from the cloud said	1	2	3	4	9	9	4	5	10	4
"This is the Christ	12	28	42	59	57	76	36	85	77	45
child."	11	20	39	51	48	72	30	85	77	40
James	0	4	15	20	21	26	4	35	23	14
awoke.	19	62	77	84	88	90	56	90	67	70
It was Christmas	31	56	62	69	74	74	72	60	80	61
morning,	19	37	57	64	51	77	48	60	90	50
and by his bed	2	29	32	51	63	70	22	60	80	40
Santa Claus	33	36	52	57	40	48	50	50	67	44
had put	21	25	34	46	35	39	38	40	57	33
a silver dollar,	22	56	72	76	76	74	52	60	83	63
a box of candy,	29	31	55	46	42	40	48	20	43	40
a bottle	10	18	21	19	26	32	28	25	30	21
of cologne,	8	9	13	16	26	31	26	20	27	19
a music box,	7	27	21	24	34	21	16	20	30	22
a loaf	9	14	13	13	30	25	16	20	20	25
of frosted cake,	19	42	50	57	66	54	36	45	77	47
a fur	1	8	20	33	35	33	2	20	43	23
tippet	4	14	31	40	42	38	12	35	50	28
and a gilt Bible	26	51	68	62	67	67	52	55	93	55
full	0	3	6	12	16	21	0	0	37	10
of colored	7	6	17	20	26	24	10	10	43	16
pictures.	8	12	20	22	26	28	14	10	47	18
Total for whole story,	2655	4693	6005	6408	6871	6493	5122	6048	7812	5526

the ninth grade, while the seventh grade made 37%, one per cent. less than that for the fourth year of the high school. Under these conditions it seems that boys reach their maximum memory power early in the high school period. The girls remembered 43% in the seventh grade and each high school grade remembered 47%. As a whole, so far as the grades ran parallel, the girls remembered 4% more of the story than the boys, and no decline of memory power was discovered in the girls. 37% of the whole story was the average remembered by all grades. This may seem a very low per cent., but it must be kept in mind that the story is a very hard one to memorize. The highest average attained by any grade was 52%, the amount remembered by a class of 30, in Miss Aiken's school, of the average age of sixteen. This high per cent. is perhaps due to special memory training¹ given to the class. The girls on an average had been in the school for two years.

The office of a word in a sentence determined largely how well the word was remembered. This fact is clearly shown in all the grades. The essentials of sentences were usually remembered, while accidentals faded out inversely in proportion to their importance and number.

It is surprising to note the irregularity of the average for the terms of a sentence. Some terms are remembered, while others closely connected are forgotten. The average of the five terms for all classes in the sentence: "To a blind" "school-mate" "with no cap" "James" "gave his," is in order of the terms, 25, 31, 45, 5 and 60. But the most surprising fact is the regularity with which all classes remember a given term, equally well, comparatively speaking. Trace the line of figures for each term in the above sentence across table I, and it will be found that no grade makes any considerable variation from the figures representing the average.

The first table shows the memory for the terms of this story as a function of the age and grade of the pupil. It is interesting, also, to study the strength of memory as a function of the place of the words in the story. For the latter purpose the story was divided into three equal parts, and the total number of words remembered in each part by the different grades calculated. The results are shown in the first three lines in table II. The results are given separately for boys and for girls; hence, as there were fifty of each grade, and 152 terms in the story, the highest possible total would be 51x50, or 2,550. Again, the story was divided into eight equal parts, and the total number of terms remembered in each of these parts by the different

¹ Miss Aiken's system of training is given in her book entitled: *Methods of Mind Training*.

grades calculated. The results with this eight-part division of the story are given in the lower part of the table. Here the highest possible total would be 19x50, or 950. The last vertical column of figures in table II gives the average per cent. of

TABLE II.

	3d Grade.		5th Grade.		7th Grade.		9th Grade.		12th yr. H. S.		4th yr. H. S.		7th Grade. Self-reading.		Miss Alken's School.	Univer- sity.	Average per cent. remembered by all grades.
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys			
I.	731	708	1042	1014	1293	1208	1282	1328	1412	1296	1851	1187	1202	1166	1425	1134	46
II.	407	375	855	824	1197	1050	1149	1195	1242	1194	1194	973	814	898	1461	1035	38
III.	258	186	540	418	730	527	861	693	939	788	1048	740	596	446	1020	855	27
I.	432	414	511	526	625	599	625	617	665	595	643	589	614	656	642	562	61
II.	236	213	394	355	503	425	495	473	546	502	517	404	534	380	556	397	45
III.	118	130	241	232	304	295	303	364	343	324	309	311	256	248	391	273	29
IV.	173	131	332	343	455	423	428	462	443	428	428	383	356	426	505	397	40
V.	168	178	376	344	500	439	501	515	520	519	518	405	334	292	647	448	44
VI.	52	50	135	104	229	152	267	212	324	270	324	187	130	134	318	283	21
VII.	63	33	169	96	214	131	256	199	272	255	348	240	202	136	344	292	21
VIII.	155	120	279	257	400	321	437	374	480	385	506	380	288	240	538	350	36
Per cent. remembered by grades.	18	17	32	30	43	37	44	42	47	43	47	38	36	33	52	39½	37

terms remembered in each part of the story by all grades. The line of figures at the bottom of the table shows the per cent. of the whole story remembered by the grades under which the numbers are written.

The first third of the story was remembered better than the second third by all grades with one exception. The second third of the story was remembered better than the last third without exception. The relative difference for the three parts is much greater in the lower grades than in the higher ones. The lowest grade remembered about one-third as much of the last part of the story as of the first, while the fourth year high school remembered 70% as much of the last third as they did of the first. The marked difference in the seventh grade, where the pupils read for themselves, is probably due to their reading the first part twice. The per cent. remembered by all in the three-part division was successively 46, 38 and 27. Practically the same ratio is sustained by all grades. Had the table been divided into four equal parts, the per cents would have been successively 52, 34, 31, and 28. When the eight-part division is considered, the same regular decline of memory in each successive part no longer appears. The first eighth, however, was remembered better by all grades, with one exception, than any other part; and the fifth was remembered better in all cases than any succeeding part. It was expected that the first part would be remembered best, but it could not be anticipated that the curve would take the course that it did. The largest part of the falling off is probably due to fatigue, but not all. The subject matter, the arrangement and length of sentences, and the manner of presentation, all had their influence. But these modifying conditions explain the irregularity of the falling off rather than its cause.

It seemed from the returns, that the memories of some pupils act spasmodically. They remember a portion with a considerable degree of accuracy; then they pass on for some distance without getting anything. Others touch, as it were, only the "high places," and so continue through the whole story. Some with a limited power of reproduction bring out the least expected points. A considerable number remember the first part of the story quite well and remember very little in the latter part. Here fatigue seemed quite clear.

In considering the causes of the variation in the eight-part division, it may be said that the mind is in an unfatigued and in an expectant mood at the beginning. The first sentence is an impressive and important part of the story. Hence the first eighth was remembered quite well. The second part, beginning with "go out alone" and ending with "at his bread," contains rather a striking feature, but it contains so many modifiers

that it possibly is not remembered as well as might be expected. In the third part we have one complete sentence and five terms from two others, only one of which is an essential. The entire sentence concerning the "beggar" is largely made up of accidental modifiers, and as no substitutes were accepted for "beggar," "James" and "dropped," it is not strange that this part is remembered poorly. The fourth part begins with "James" "gave his" followed by a sentence containing striking modifiers, and concludes with "crying" in a sentence which could not fail to awaken renewed interest. The fifth part is remembered better, probably owing to the subject matter and its manner of presentation. The sixth and seventh parts beginning with "God" and ending with "James" are probably low on account of fatigue, and the fact that the subject matter did not come within the range of sense experience. The last eighth makes quite a generous appeal to the senses, and for the greater part contains familiar subject matter. It would be remembered also, because it was the last. Doubtless this would not have been remembered so well had something more followed. Inspection of the eight-part table shows that the per cent. remembered by all for the different parts, has a corresponding order of value in the numbers for each grade. (See Table II.)

The relative retention of the different terms in memory is shown by the following: Four terms were remembered on an average by at least 90% of the pupils; 12 by 80%; 20 by 70%; 33 by 60%; 41 by 50%; 60 by 40%; 77 by 30%; 108 by 20%, and 130 by 10%.

Table III shows what terms appealed most, and what least, to memory. It gives the actual number of pupils who remembered the terms mentioned, i. e., it is on a base of fifty, except the columns for the University and Miss Aiken's class, have one hundred for a base. The first 16 terms are the only ones in the entire story remembered by as many as 75% of all. It is noteworthy that ten of these are in the first sentence. Three are in the second eighth of the story, two in the third eighth, and one in the fourth eighth. The next ten terms are the best examples of terms remembered about equally well by all grades, and not by a large number in any grade. The three terms: "It was Christmas," "Santa Claus," and "box of candy," all come near the end of the story; and it is worthy of note that nearly all in the third grade who remembered anything in the last part of the story remembered these terms. The fifth grade differed but little from the third in this particular. The same cannot be said of any of the higher grades. This was probably due to the fact that these words appealed most to sense association. Next in the table are given eleven terms, no one of which was remembered by more than 7%. For the

TABLE III.

	3d Grade.		5th Grade.		7th Grade.		9th Grade.		2d Year, H. S.		4th Year, H. S.		7th Grade, Self-Reading.		Miss Alken's School.	
	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	%	%
James Mack dreamed that his father and mother died and left him 37 cents a loaf of bread and a Bible. woman	44	41	41	35	45	45	47	44	48	45	45	48	44	48	75	93
"Please give me your Bible."	11	16	28	28	42	38	43	38	46	47	42	47	46	46	85	93
He did.	34	36	46	39	46	43	43	44	41	43	45	39	48	48	65	10
he gave it. (bread).	41	38	44	46	46	46	41	44	46	48	40	38	48	44	85	93
his money.	45	44	49	48	48	47	47	48	47	46	48	43	48	46	90	100
baby	47	45	49	48	49	50	49	47	47	48	48	45	50	48	95	100
very poor crying	40	36	50	46	45	48	49	49	46	41	43	45	42	44	80	100
It was Christmas Santa Claus box of candy	16	19	38	40	46	47	43	46	45	44	42	43	38	38	75	87
James (dropped) lost	37	36	48	45	48	48	47	48	49	50	47	50	50	46	90	100
the hoot of an owl bark of a dog, smiling.	35	29	42	36	49	45	48	46	50	45	46	47	50	46	90	100
Then came James (gave his cap). sickly	31	27	45	36	48	42	47	44	49	46	47	45	48	46	90	93
Then as he lay	26	18	39	34	47	40	42	39	44	41	41	38	48	40	65	71
It was just the perfect and the distant	22	19	37	33	47	43	46	42	49	41	43	46	44	40	70	80
There seemed a sweet perfume and a gentle from the cloud	23	26	38	40	47	42	45	48	46	44	44	45	44	38	80	100
37 cents {	24	21	40	40	47	45	45	41	45	45	45	44	38	44	70	90
dropped {	31	26	43	45	50	50	49	50	49	50	46	42	44	44	95	100
	9	10	16	6	15	10	15	15	17	11	24	16	22	18	30	47
	9	6	11	12	13	12	15	11	14	12	12	6	10	20	30	13
	18	13	32	24	33	29	35	34	38	36	38	36	36	60	80	
	18	15	14	22	23	29	34	23	21	19	25	23	36	14	50	67
	16	13	17	14	26	29	21	25	24	18	24	16	32	16	20	43
	2	2	2	3	9	7	6	9	3	2	6	3			15	30
	3	3	8	10	2	8	4	7	6	2	3	4	6	2	5	13
	3	1	2	1	8	4	8	7	14	7	11	4	6		5	10
	2	5	2	1	6	2	4	3	8	4	5	3	4		15	20
	2		3	3	3		1	4	4	5	5	3	4	6		17
			2	1		1		1	3							7
	1		3	1	5	3	2	8	4	3		4			5	7
				3	2		3	1	4	2			4	8		7
		1	2	1	3	1	6	5	6	5	4	5		2	5	17
		1	2		3	2	2	1	9	2	1	1				13
				3	2	3	2	4	3	5					5	10
			1				1	3	1		2					3
				1			3	2	1	2	4	2				10
		2	1	1	1	1	6	3	4	5	4	2			5	20
		1				5			1	2	1					
	1		1	1	1	2	3	1	2	7	5	4	2	2	5	10
37 cents {	16	19	38	40	46	47	43	46	45	44	42	43	38	37	75	87
dropped {	24	21	10	8	4	3	5	4	4	3	4	3	10	6	15	13
	7	3	14	13	15	13	15	6	11	18	9	12	14	14	15	50
	17	18	26	26	31	29	30	35	33	28	32	30	16	16	45	20

last two terms in the table, "37 cents" and "dropped," are given first the number who remembered them, and then the number who substituted some synonym. If these synonyms

had not been reckoned as errors, these two terms would have stood high on the list remembered.

It is interesting to see that the four terms: "mother," "died," "and left him," and "baby," were the only terms remembered by ninety per cent. The twelve terms remembered by eighty per cent. were "James," "dreamed," "that his father," "and mother," "died," "and left him," "a loaf of bread," "and a Bible," "woman," "his money," "in a wood," and "baby." Forty-one terms were remembered by fifty per cent. of all. These terms written in a story, with enough added to connect them, read as follows, the parts supplied being printed in italics:

"James" "Mack" "dreamed" "that his father" "and mother" "died" "and left him nothing" "but 37 cents," "a loaf of bread" "and a Bible." *He went out* "into the wide world." *An* "old" "woman" "asked him for his Bible." "He gave it." *Then* "gave his bread" *to some* "hungry" "boys" *and* "he gave" *away* "his money," "his cap" *and* "his coat" "and pants." "In a wood" "he found" "a naked" "baby," *and* "took off" "his last" "garment" "to wrap around it;" "made" "a bed" "of leaves," "crept in" "and hugged the baby" "to keep it warm." *Then he saw* "an angel" *that looked like* "his sister," *and when he* "awoke," "it was Christmas" "morning," *and he found near him a* "silver dollar" "and a gilt Bible."

A story made up in a similar manner from one hundred and eight terms, embracing all terms remembered by 20%, reads as follows: "James" "Mack" "ten years old," "a farmer's son" "dreamed" "that his father" "and mother" "died," "very poor," "and left him nothing" "but 37 cents," "a loaf of bread" "and a Bible." "The day after the funeral" "he had" "to take these," "leave" "his home" "and go out alone" "into the wide world." "It was Sunday" *and a* "crooked," "old" "woman" "with a red" "shawl" "on her head, said:" "Please give me your Bible." "He did." "Soon he met" "three" "boys" "who looked" "hungrily" "at his bread." "He gave it" *and met a* "beggar" "with one" "leg" "and a crutch" *and* "into his hat" "dropped" "all" "his money." "To a blind" "schoolmate" "with no cap" *he* "gave his." "To a half" "naked" "boy" "with a monkey" "he gave" "his coat" "and pants." "At night" "in a wood" *he saw* "a baby" "naked," "crying," "took off" "his last" "garment" "to wrap around it." "Made a" "bed" "of oak" "leaves," "crept in" "with the baby" "and hugged it" "to keep it warm." "Looking up" "into the sky" "he said:" "Dear" "God" "what can I do" "more?" "The moon" "peeped out" *from* "a cloud,"

and "an angel" *was seen* "which he thought" "was his dead" "sister" "Mabel's" "face." *Some one* "touched" "his head" *and said*: "This is the Christ" "child." *He* "awoke." "It was Christmas" "morning" "and by his bed" "Santa Claus" "had put" "a silver dollar," "a box of candy," "a bottle of cologne," "a music box," "a loaf" "of frosted cake," "a fur tippet" "and a gilt Bible."

Apart from the errors in spelling, in understanding the words, etc., the errors may be classed as errors of omission, insertion, substitution, and misplacement. In the higher grades, in general, the part remembered was nearest the exact reproduction, while parts left out were clear omissions. The terms most frequently omitted are clearly indicated by table I. Insertion was due to imagination. In different grades it frequently seemed that memory retained a vague notion of what had been given and imagination supplied the forgotten part from experience of a similar nature. The purest form of imagination was found in the third grade.

Substitution occurred most frequently where words used in the story had approximate synonyms in the child's vocabulary. Displacement occurred most frequently in the order of the personages mentioned, and where modifiers in one instance seemed well adapted in another. The misplaced parts, when so recognized, were not counted as errors in making out the results.

All degrees of inaccuracy were found in the paper, from mere failure to understand a word, to pure products of imagination. For example, James Mack became John Mack, Tommy Mack and Henry Mark; again, James Back, Baker, Brock, Shaw, Brown, Dean, Hall; and in some cases was abbreviated to Ned, Fred, Jack or Willie. According to some of the more imaginative ones: "James was a rich boy and died poor." "The farm was very small." "Now was his chance to go into the wide world to seek his fortune." "He met a blind girl," again, "a poor negro witch." He "begged his prayer-book;" exclaimed, "Thank the Lord all my things are gone;" "brought the baby into the stump of a tree;" "made a nest of grass." "The sun was streaming full into the window." "Nothing was heard but the rustle of the leaves," "save the sound of some bird in the distance." "As he was near the woods he did not care much." "He flew to the woods." "He had a thought come into his head that his father were dead." Christmas gave special opportunity for play of the imagination. "He awoke and found some pictures which he spent the rest of his days looking at." "He dreamed that Santa Claus had brought him a loaf of bread, a glass of wine, a Bible, a new hat, a new pair of drawers, a new waist, a box

of candy and 37 cents." "In his stockings was a box of candy, a silver dollar, a frosted cake and a beautiful Bible with many colored pictures." Again, "Christ gave him a silver dollar," a "Bible full of choicest candies." He found "A gold silk Bridle."

No one paper can be said to be typical in all respects. The story, as remembered by 20% or 50%, gives the terms best remembered. Four papers, however, are appended as illustrative. The first two are among the poorest from the third grade. Both are quite imaginative. One retains some idea of the latter part of the story, while the other does not.

"James Mack, 10 years old, dream that his mother was dead. And James Mack had a brother named John Mack. James Mack was sick the day Christmas. And Santa Clase came down throw the chimble, and gave him a loaf of cake and a box ful of candy, and a rattle. All the boys gave him some pressents She gave him a dolar. He had a grate many pressents."

"James Mack was a little boy who was poor he lived in a country where were people who were naughty and there was aagle came and saw all this and told on them. They thought that they would be good."

The two following versions show how much was remembered by those who succeed best. The first contains 115 and the second 127 terms, as counted. The second was the best paper in all examined.

James Mack, ten years old, dreamed one night that both his parents died and left him alone in the world, with 37 cents, a loaf of bread, and a bible.

The day after the funeral, he took these and went out into the wide world. It was Sunday, and an old crooked woman with a red cape, said, "Give me your bible." He did so. Then he met three boys, who looked so hungrily at the loaf of bread that he gave that to them. He saw an old black beggar, and dropped all his money into his cap. A poor blind school mate of his had no cap, and James gave him his. Soon he met a poor Italian boy, who had a fiddle and a lean monkey. He took off his coat and pants and gave to him. He went into the woods and there he found a baby, all naked and cold. As it was dark, he took off his only remaining garment and wrapped around it. Then he made a bed of oak leaves, crept in with the baby, and hugged it to keep it warm.

It was just the soft hush of midnight, the stars were shining overhead, and James lifted his eyes and said, "Dear God, what can I do more?" Just then the moon arose above a pinkish cloud, and underneath appeared an angel. He thought the face was that of his dead sister, Mabel, who was smiling at him. A hand was laid on his shoulder and a voice said, "It is the Christ child."

He awoke. It was Christmas morning, and Santa Clause had left at his bed-side, a silver dollar, a box of candy, a gilt bible, a frosted cake, a bottle of perfumery, and a music box.

James Hack, ten years old, a farmer's son dreamed that his father and mother died, leaving him alone and very poor, with thirty-seven cents, a loaf of bread and a Bible. The day after the funeral he had to go out, friendless and poor, into the wide world. A crooked, lame little old woman with a red shawl said, "Give me your Bible." He did so. Farther on, two boys gazed so hungrily at his bread that he gave it. Then came a black ragged beggar with a stump pipe, a wooden-leg, and a crutch. Into his hat James dropped all his money. To a blind schoolmate without a cap, he gave his. To a poor thin half-naked organ-boy with a lean little monkey he gave his coat and pants. About night-fall he entered a wood where he found a little baby, almost naked, and as it was quite dark he took off his last garment to wrap around it. Then he made a soft bed of the leaves of the oak and slipped into it with the baby, hugging it close to keep it warm. As he lay there looking up into the sky he said "Dear God, what more can I do?" It was the quiet hush of midnight and there was no sound, except the barking of a dog. Just then the moon came out from behind a pinkish cloud, and just below it appeared the face of an angel-child. James thought it was the face of his sister Mabel who had died. There seemed to be a soft perfume, then a touch on his head and a voice said: "This is the Christ child."

James awoke. It was Christmas morning and Santa Claus had left beside his bed a silver dollar, a box of candy, a bottle of cologne, a music-box, a loaf of frosted-cake and a gilt Bible full of colored pictures.

The story as written for the test, did not aim at literary form, but a difficult story for memorizing was desired, containing elements that would appeal more or less to children of all the different grades. It is noteworthy that a considerable number of those who got an intelligent understanding of the story improved upon its literary form. The two papers just given are conspicuous examples.

Résumé.—For a story like the one employed and under the conditions described above, the maximum memory power is reached at a relatively early age. The boys in the third grade remembered only 17% of the story. In the ninth grade they remembered 42%, and in the high school about 40%. From this it seems that memory power for the boys culminates about the beginning of the high school period. The girls made a rapid increase from 18% in the third grade to 43% in the seventh grade, and 47% in the high school. The class in Miss Aiken's school remembered 52%. This high average is probably due to special training, not usually given in public schools.

The office of a term in the sentence, and the number of like terms employed, determined how well a given term was remembered. It may be said that sentences, as wholes, were remembered inversely in proportion to their length and the number of non-essentials contained. Of the sixteen terms remembered by 75%, eleven are in the first sentence, and not one in the last half of the story. About two-thirds of the 41 terms remem-

bered by 50% are in the first half of the story. The decline of memory for the successive parts of the story is shown by the per cents for the three-part division of the story. They are successively 46, 38, and 27. A four-part division would give 52, 34, 32, and 28. Much of the falling off is doubtless due to fatigue, but some of it is due to changes in subject matter, as can be seen in table I, where sudden variations are found in the amount remembered. A decline of memory from the first to the last of the story was found in all grades, but the rate of decline was not the same in all.

The growth of memory is more rapid in case of girls than boys, and here the figures suggest a coincidence with the general law that the rapid development incident to puberty occurs earlier in girls than in boys. No other appreciable difference between the memory of boys and that of girls is apparent, except that the girls remembered 4% more of the story than the boys, and the girls in higher grades showed a better retaining power for the latter part of the story.

It is surprising how few remembered some terms in a sentence, while other terms in the same sentence were remembered by a large number. There seemed to be marked similarity of apperception in all the different grades; for any term remembered by a large or small number in one grade, was remembered by approximately the same number in every other grade. No part of the story, nor any term, other than those elsewhere mentioned made a noticeable appeal to any grade, which did not in like manner appeal to all the other grades.

The writer takes this opportunity to thank Dr. Hall and Dr. Burnham for counsel in this work, and Supt. Carroll, Miss Lesure, of the Normal School, and others connected with the schools of Worcester, as well as Miss Aiken, of Stamford, Conn., for their aid in making the tests.

APPENDIX.

Another mode of presenting the result of similar tests is the following:

The number above the line shows how many out of one hundred sixth grade children remembered the terms of the following story in a memory test.

<u>30</u>	<u>98</u>	<u>75</u>	<u>36</u>	<u>86</u>	<u>8</u>	<u>36</u>	<u>77</u>
A young man worked years to carve a white marble statue							
<u>70</u>	<u>67</u>	<u>38</u>	<u>7 (until it was finished</u>				
of a beautiful girl. She grew prettier than any one had							
<u>substituted by 1)</u>				<u>23</u>	<u>5</u>		
ever been. He began to love the statue so well that							

³⁴one ²⁸day ¹⁸he ¹³said ¹³to ¹³it: ¹⁸I ¹³would ¹³give ¹³everything
two-thirds substituted "I wish"
¹²in ⁵⁸the ⁷⁶world ⁷⁶if ⁷⁶you ⁷⁶would ⁷⁶be ⁷⁶alive ⁷⁶and ⁷⁶be ⁷⁶my ⁷⁶wife.
instead.
¹¹Just ⁶²then ⁶⁰the ⁹clock ⁹struck ⁹twelve, ⁹and ⁹the ⁹cold ⁹stone
⁴⁰began ⁵²to ³⁶grow ³⁶warm, ³⁶the ³⁶cheeks ³⁶red, ³⁶the ³⁶hair ³⁶brown,
³⁴the ⁵⁸lips ⁷⁷to ⁷⁷move, ⁷⁷she ⁷⁷stepped ⁷⁷down, ⁷⁷and ⁷⁷he ⁷⁷had ⁷⁷his ⁷⁷wish.
⁴⁸They ³²lived ⁷⁶happily ⁸⁶together ⁹for ³¹years ³¹and ³¹three ³¹beautiful
⁷⁶children ⁸⁶were ⁹born. ³¹One ³¹day ³¹he ³¹was ³¹very ³¹tired ³¹and ³¹grew
⁶⁵so ²⁵angry, ⁸⁷without ³⁶cause, ³⁶that ³⁶he ³⁶struck ³⁶her. ³⁶She ³⁶wept,
⁶²kissed ⁶²each ⁵³child ⁶³and ⁶³her ⁶³husband, ⁶³stepped ⁶³back
⁴⁹upon ²⁶the ¹⁷pedestal ³and ³slowly ³grew ³cold, ³pale ³and ³stiff,
¹²closed ²³her ¹³eyes, ²²and ²²when ²²the ²²clock ²²struck ²²midnight
⁵⁵she ³was ⁸a ³⁴statue ¹⁵of ¹⁵pure ¹⁵white ¹⁵marble ¹⁵as ¹⁵she ¹⁵had ¹⁵been
¹⁵years ²⁹before, ²⁹and ²⁹could ²⁹not ²⁹hear ²⁹the ²⁹sobs ²⁹of ²⁹her ²⁹husband
²⁸and ²⁸children.