MEMORY OF THE FEEBLE-MINDED.

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"MEMORY is the knowledge of an event or fact, of which we meantime have not been thinking, with the additional consciousness that we have thought or experienced it before. " Memory depends on retention and recall, which are phenomena of the law of habit. Retention depends upon purely physical conditions. Matter retains to a certain extent an impress made upon it. A nerve which has been faradized retains some effect of that action for it will be more easily faradized a second time. Retention, then, is a result of the physical condition of the brain. In order that an impression should affect the brain, it must endure a certain length of time, depending on the impressibility of nerve tissue. With the feeble-minded this is a variable quantity. With most of them, an impression must be repeated many times in order that it may be recalled. This is in part due to lack of nerve impressibility. The maximum of impressibility is found among those men who remember everything and anything without seemingly any effort. Lack of nerve impressibility is found in cases of amentia, that is, among those children who have never been able to learn anything from experience and exhibit only remnants of instinctive actions.

In recall we have a re-excitation of the impression. A nerve excitation can exist longer than a stimulus, as we see in the phenomena of after-image. These depend upon the continued excitation of the ganglion cells. In a higher sphere we have the phenomena of primary memory, where a mental impression may continue for some time and then fade out; the impression of constricted clothing may exist some hours after removal, and a person can recall a question shortly after its asking which at the time seemingly made no impression. But in order to have true memory the impression must have been absent from consciousness. However, a repetition of the impression does not constitute memory. In the first place, the memory image differs from the real image; it is less vivid and does not have the wealth of detail of the original. We see this when we look at a flower and then shut our eyes and call up an image of the same. In memory, in addition to the picture, we have the revival of associations, the recall of related circumstances and the fact that we have experienced these conditions, and the feeling of reality. The memory picture and its associations constitute the facts of memory. The associatons of the memory picture account for the fact that a repetition of the experience will not cancel the first memory of it, since in these they differ. However, a great number of experiences will do this, for after we have seen a rose a great many times, we can not say that we remember that it is a rose for no definite experience is called up by it. The associations are

not determined by the memory picture alone but by the whole brain state, as James has pointed out.

Looking at the physical side of these processes we find that it is not necessary at the present time to show that mental functions are brain functions, consequently a defect in the first means defect in the second. All sensory and motor functions have localized centers in the brain,—projection centers, for they are all directly connected with their appropriate end-organs. These projection centers, by means of associations fibers are brought into connection with the remaining regions of the cortex. A nerve excitation at the sensory end-organ is propagated to the projection center, and the mental side of the nerve discharge there is a sensation. Thence the nerve discharge is propagated through the association fiber to other regions of the brain or the conception center, and there arise in the mind preceptions and memory proper. The child sees a lighted candle and the visual center is excited; on account of previous experience, a nervous discharge is propogated to the touch, and possibly to the pain centers, and then also to the naming center and the child has a perception of the candle. Later, a knowledge of its use as gained by experience will give added content to the perception. Derangements in this scheme will give certain defects of memory, as will be shown later.

The importance of instinct in the formation of perceptions, and consequently, as influencing memory has not been duly emphasized. Instincts are "inherited actions or the bases of actions which were advantageous to our ancestors, the accompanying feeling being our emotion, and the same as our ancestors experienced in the performance of the action." Consequently, there are duly formed brain-paths ready in a young child's brain. So when a perception center has been excited by a stimulus, these paths produce various associations in the conception center with consequent perception and movement. A great number of our first preceptions are instinctive; in fact, they fo;m the basis of our mental life. Among imbeciles these paths by virtue of disease or mal nutrition are impervious or non-existent resulting in various degrees of defect from total lack of perception up. Bases of instinctive action which are or have not been detrimental to the race, we can expect to still exist in the brain, although the organs necessary for their performance may have been lost in the struggle for existence. That this is true is shown by the existence of the pineal gland and the infundibulum. The diseased condition of the higher centers in the idiot and imbecile might uncover some of these vestigial bases of action, and so cause the imbecile to exhibit mental states which pertained to the ancestors of our race but among normal people are inhibited by the higher brain centers. At any rate we can expect absent or irregular brain paths in the brains of idiots and imbeciles.

Ability to attend, in this connection, means ability "to impress

something on the memory." Lack and defect of attention is charactristic of imbeciles; in fact one writer has classified them on this basis. But in order to attend to a thing", this thing must develop in our minds. Look at a word in an unknown alphabet; it will not remain at the center of attention for it has no associates; it does not develop. Such is the condition of the lower grades of the feeble-minded in regard to common affairs of life. Here as above, instincts give us our primary objects of attention and all of our acquired attentive states are built up from these. Consequently, failure of memory through lack of attention results from the absence of cerebral bases of associaton.

The higher mental processes, if not possible without, are at least greatly aided by language. It gives a concrete base upon which the more subtile and abstract notions can crystalize, and no important mental advancement can be made without it. In amentia there is no perception and no memory, and consequently no language, neither is there ability to understand language. In idiocy we find the first rudiments of language, the expression of a few words, perhaps, and the comprehension of simple sentences, the most obvious early results of perception and memory. However, we find remnants of the various stages of the evolution of language of the race. First we find those whose language consists of exclamations and gestures, not being able to form and use names. Next we find those who can use names but usually a very limited number. Then we have those who can use nouns, verbs and pronouns, leaving out qualifying and connecting words. Lastly, we find those who make use of complete sentences, but in all the range is limited, becoming more so as we descend the scale. This explained by the conditions discussed above.

Ireland finds feeble-minded children deficient in memory as well as in other mental faculties, for "in their minds every species of mental operation is performed, though on a small scale."

Complete absence of memory is found in amentia. Here are grouped those children who have not been able to learn anything from experience. Their mental life consists chiefly of sensations and emotions. All of the senses may be active or one or more of them may be absent. No association seems to be present, and consequently, no perception. The more fundamental instincts are present; they eat, sit, and some can walk and climb. Rocking motions are frequently present. They do not attend to the calls of nature, and a few give indications of a higher class in making use of a spoon. They do not understand language and are heedless of danger. They do not show that they appreciate the different tastes of sugar and quinine. Sense stimulation still produces with them some instinctive reaction, showing that the sense still exists, but there are no associations and consequently there is no true memory. Possibly the inertia of the brain tissue may be so great that it will not retain impression.

In idiocy we find memory, as shown by the fact of the child being able to understand language, that is, concerning the more simple things, and learning to do simple operations. In imbecility and feeble-mindedne.ss greater powers of memory and mind are shown, as will be discussed in the tests later on.

Galton tested the memory span of several idiot girls in the Earlswood Asylum. "By memory span is meant the limit of the power of the memory to reproduce from a single hearing or seeing, immediately and without error, a succession of figures, or letters, etc." The girls were able to read and write a little. For nine girls the memory span ranged from two to five for figures. Six other girls were tested and gave results ranging from two to six.

Mr. G. E. Johnson has made a similar series of tests upon the feeble-minded children at Waltham, Mass. Of the seventy-two children tested, the average was 5.3, which is 1.3 less than the average for normal children for eight years as determined by Mr. Jacobs. Comparing his results with those found by Mr. Bolton, he finds that the results for "all the feeble-minded children fall far below those of normal children." The results of his tests show, he says, "that the feeble-minded fall considerably below normal children in memory span, but the memory span is so good in some cases, and the average so high, that we are led to conclude that the degree in which feeble-minded children fall below normal children is not commensurate with the degree in which the feeble-minded fall below normal children in intelligence. Moreover, it is evident that the deficiency in attention and will power, so proverbial in the feeble minded child, would tend to cause the memory span to be lower than that which a normal child of equal physiological retentiveness of memory would have. Hence, we may conclude that weakness of memory, physiologically speaking, is not a prominent factor in feeble-mindedness. As a rule, the memory span increases with intelligence

In testing the association time orally, Mr. Johnson found that the average time for thirty children, whose average was 13.3 years, was 5.35 seconds, maximum 10.7, minimum 2.7. Ten normal boys with the same test gave an average of 2.61 seconds, maximum 3.47, minimum 2.06. He finds that their association habit is characterized by "simple objectivity and great slowness." In fact, the paths seem often to be "wormed out."

In order to test the visual memory of our children the author made use of form, color and letters. For the first, ten forms were cut from card board, the more common geometrical forms as well as some irregular ones being chosen. Two sets were made, one for the child and one for the experimenter. For the color tests, ten colors were selected from Bradley's colored papers, the endeavor being made to get them as unlike as possible, and affixed to cards. For the last test, paper letters

mounted upon cards were used, the consonants being chosen so as to exclude syllable formation. The child being ready for the experiment, a set of forms, colors, or letters were arranged before him on the table; five of the same series were then shown to him by the experimenter for two seconds as indicated by a metronome, then they were covered from view and the child was required to select the same five as he remembered them from the sets of objects before him, the order of selection being disregarded. Five trials of each sort were made, and the number of correct selections noted. The results were as follows:

	FORM	COLOR	LETTERS
Girls 26	2.3	2.4	2.5
Boys 25	2.5	2.3	2.7

Thus, out of five objects these were the average number correctly remembered. The ages of the children ranged from fifteen to thirty, and we think that we are not wrong in expecting almost perfect answers to our tests from normal people of the same age. The memory error for five objects of our children is:

	FORM	COLOR	LETTERS.
Girls	2.7	2.6	2.5
Boys	2.5	2.7	2.5

Grouping- the children according to mental ability, as estimated by their teacher. A being the brighest, we have:

		FORM	M. V.	COLOR	M. V.	LETTERS	M. V.
Boys	A	3.3	0.6	3.2	0.5	4.1	0.5
	B	2.!)	0.3	3.0	0.4	3.2	0.4
	C	2.5	0.6	1.7	0.9	1.8	1.0
Girls	A	2.9	0.4	3.1	0.5	3.6	0.7
	B	2.4	0.4	2.5	0.5	1.8	0.8
	C	1.!)	0.7	2.0	1.2	2.2	1.6

Interpreting the mean variation as the uncertainty of memory, and deducing- the memory error from the other columns, we see that the error and uncertainty of memory increase with mental dullness. In regard to the influence of the knowledge of the names on the memory of the objects, we find that the average number of names known by each child is:

		FORM	COLOR	LETTERS
Boys	A	4.5	6.6	10
	B	3.5	5.0	7.8
Girls	A	4.1	8.6	10
	B	2.0	2.0	1.0

This shows a slight influence in colors and letters with the girls.

The tests so far having to do with visual memory, we next took up for consideration the auditory memory. To this end, we made use of the following tests. First a series of nonsense syllables were made, endeavoring to get some as free from association as possible. These

were read to the child at the rate of one per second, five making one **test. Next** were selected groups of six associated words, which were likewise read to the child at one per second. He was required to repeat them immediately, and both the words remembered and the number of associations were noted. Lastly, groups of sentences were selected from their school readers. These were of various lengths from five to thirty-five words. They were read to the child at the rate of a word per second and he was required to repeat it immediately. The number of words correctly remembers was noted. The results were as follows:

	SYLLABLES	WORDS	ASS'N	SENTENCES
Boys	2.1	3.9	1.8	10
Girls	2.1	3.7	1.9	12

The small number of associations and the large number of words is very noticeable. Chance we consider to be excluded by the method of work of the children.

Grouping our results according to the mental ability of the children we have:

		SYL.	M. V.	WORDS	M. V.	ASS'N	M. V.	SENT.	M. \
Boys	A	3.0	0.4	5.0	0.2	2.S	0.4	15	3
	B	2.1	1.1	4.0	0.6	1.6	0.7	12	6
	C	1.6	**0.8**	3.1	0.9	1.4	0.6	7	3
Girls	A	2.5	0.7	4.2	0.6	2.2	0.6	16	5
	B	2.1	1.5	3.5	1.8	2.1	1.2	10	5
	C	0.9	0.5	3.3	0.6	1.3	0.6	5	2

Here, as above, we find the error and uncertainty of memory increase with the mental dullness. These tests in auditory memory seemed easier to perform than those for visual memory, for four girls and two boys graded C. while being able to perforin the auditory tests, could not do the visual tests. Grouping the results to show the average number remembered in each way, we have:

	AUDITORY	VISUAL
Boys	2,6	2.4
Girls	2.6	2.5

This shows practically no difference. Vet five girls and two boys said that they remembered by "looks," and seven girls and nine boys by "name." However, we have seen some influence from the knowledge of the names in the visual tests.

The same children were given a test on the memory of muscular movements. A graduated rod was fixed on suitable supports and two adjustable stops or rings were placed on the rod so that any distance could be set off by them. Three distances were used; ten, thirty and fifty centimeters. In performing the test, the child was seated so that one of the stops on the rod was in front of him, the the other stop was set at the required distance; with eyes shut, the child then moved the

index finger of his right hand from one stop to the other and then back. The outer stop was then removed and he was required to move his hand over the original distance as he remembered it. In the first series this was done immediately, then after a wait of ten seconds, then of twenty seconds. The results for 100, 300 and 500 millimeters were as follows:

	0 sec.	M.V.	10 sec.	M.V.	20 sec.	M.V.
Boys 17	108	8.1	8.1	10.2	144	19.6
Girls 17	108	7.7	113	15.2	108	14.5
Boys	311	16.5	279	23.6	271	27.6
Girls	287	17.8	282	21.8	277	24.7
Boys	490	18.7	463	33.2	447	31.8
Girls	476	18.1	457	22.4	456	23.1

The averages found by Scripture for the same distances:

0 sec.	M.V.	10 sec.	M.V.	20 sec.	M.V.
—1.0	0.9	-3.1	1.1	—0.1	1.2
-|-to 2.8	to 1.3	-|-to 2.8	to 1.7	-to 4.0	to 1.9

Comparing these results from normal people with the ones we have given, we find the memory error of the feeble-minded to be from two to ten times the normal, and the uncertainty of memory to be from five to fifteen times the normal. The memory error, as with normal people, increases with increased distance while the uncertainty steadily increases. Grouping the results according to mental ability, we have, for 100, 300 and 500 millimeters:

	O sec.	M.V.	10 sec.	M. V.	20 sec.	M.V.
Boys A	102	6.1	104	10.3	104	13.9
B	107	9.5	111	11.7	140	19.8
C	110	8.9	121	8.4	196	26.2
Girls A	107	7.6	115	16.4	103	11.9
B	115	12.6	100	6.0	144	33.8
Boys A	305	17.2	282	25.4	26S	28.1
B	297	10.3	259	21.5	305	24.6
C	320	23.3	298	24.0	355	31.8
Girls A	291	14.2	280	22.4	274	25.8
B	273	35.7	297	16.8	302	17.0
Boys A	497	15.3	473	46.8	419	31.9
B	483	20.9	429	30.5	455	40.5
C	489	18.9	493	20.2	470	21.3
Girls A	484	16.8	458	23.1	455	24.2
B	430	24.1	448	17.0	465	15.2

As a rule the error and uncertainty of memory decrease with intelligence, the results showing some variations probably due to the number examined.

Our results show a great increase in the error and uncertainty of memory among the feeble-minded, both auditory, visual and muscular. This memory error may be due either to a rapidly fading or to a dull memory image. A rapidly fading image, other things being equal, means a rapid nerve activity. But this is contrary to all our ideas of the imbecile. He is dull, slow and immobile; his speech and ideation is slow as is shown by the slow association time; his reaction time is much slower than normal, as we have shown heretofore. Consequently, a simple rapid fading of the image will not explain all the facts.

A dull memory image can be due to an inactive central element or to lack of association. A rigid central element, as a consequent of rigid brain tissue would need strong and prolonged stimulation in order to produce an adequate impression. Therefore, ordinary stimulation produces defective impression which means imperfect retention. Furthermore, the feeble-minded person requires a stronger sense stimulation than the normal, as we have shown in our researches upon the senses of the feeble-minded. The same is observed in their pleasure and in their daily actions. So we regard feeble-minded persons as subnormal in the physiological retentiveness of memory. Again, a rigid brain tissue would under ordinary circumstances be conducive to a rapid fading of the memory image.

However, by strong stimulus and prolonged impression the image may become fixed. This explains the fact that the feeble-minded are creatures of habit. They dislike the unusual. This is particularly true of the lower grades. Any change of their daily routine, such as change of place of sleeping or of eating at the table, is met by remonstrance. The brain paths are fixed, and the new ones either can not be made or are made with such difficulty that the change is disagreeable to them. Consequently, the formation of proper habits with this class of children is of the first importance; this applies particularly to habits of person and daily care.

Defective association will produce a defective and inexact memory image. Deficiency in association has been shown above. This can also be explained by brain rigidity and defect resulting in impervious and lacking brain paths. Thus would also be explained imperfect recall and the high uncertainty of memory.

In the memory tests given above, the child was always asked the names of the forms, colors and letters, to see if he could name them or if he had names for them. The general results of this questioning have been indicated above. But in addition to this we have found, especially among the lower grades, a name difference; that is, they did not apply the names to particular objects. This was true of five boys and four girls. Thus colors would suggest color names, but the individual color would not suggest its proper name. In fact, there seemed

to be a general association, and in one case the colors did not even suggest color names. This is in part, no doubt, explained by sense dullness and the consequent lack of discrimination as indicated above; they need a greater sence stimulus and a greater difference for proper appreciation. Consequently there is a lack of secondary association paths which differentiate the color sensations and unite them to a particular naming center, so all the color sensations arising in the sensation center are associated with all the color names in the naming center, the particular one arising depending, probably, on local conditions. Some of the brighter children, when they did not know a letter, wouldsay so, showing a higher differentiation in the associative tracts, In investigations on the localization of cerebral function it is found that on stimulating a certain cortical area in an animal like a cat or dog a complex movement of a number of muscles will take place; higher in the animal scale stimulation of a definite area will cause a more simple movement, limited, perhaps to one muscle; thus showing that in the higher animals the individual muscles are represented in the cortex, while in the lower animals it is only groups of muscles that are so represented. Such conditions might result in the idiot brain when the areas due to later racial experience have been destroyed by means of defective nutrition or disease.

This brain rigidity is due principally to diseased conditions, for rarely if ever do we find cases which we can consider as arrested development for they show the irregularity and complexity of processes which result from diseased conditions Exhausted conditions of the brain, especially in their less acute stages, show similar states of rigidity and loss of association. Our accidental cases are those whose condition is the result of disease in early life, and the congenital cases we can explain either by disease or malnutrition of the embryo because of the imperfect condition of the mother from mental or physical stress; hence the starving of the areas corresponding to the higher mental processes, hence their defective and irregular development.

The continued study and collection of cases of aphasia is teaching us a more definite cerebral localization; thus our memory images of words, letters, figures and position and places seem to be localized in certain definite areas. This leads us to the notion that every memory image is separately located in the brain. Hence in diseased conditions some would be destroyed while others would be left. This would explain the difference in ability of our children; they remember one kind of images better than another. Some can be be taugt to read and write and others only some kinds of work. In our experiments we found some that could perform the muscular tests that could not do the others; the same was found true of the auditory tests.

Pedagogically these tests may give us some indication as to the most advantageous methods of teaching a child, as well asthe line in which he will work the best results.

SPECIAL SCHOOLS FOR SPECIAL CHILDREN.

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AS early as November, 1892, the Minister of Public Education in Berlin published an order, refering to the fact that, in several cities of the Kingdom of Pussia, the local school authorities had arranged for separating from the majority of pupils, children intellectually slow and dull, but otherwise normal and by no means to be confounded with idiots, by establishing either special schools for them or separate classes in large school houses. He particularly emphasized the consideration that the pupils to be selected for this special instruction should not be idiots, that is, children so entirely defective as to be suitable only for asylum care, for such children had no place in public schools, but children should be selected who are a "dead weight" in school, failing to be promoted because of their inability to keep pace with average pupils. Such children might be benefited by methods specially adapted to their weakness, and the course of study might be altered or curtailed to suit their capacity. He furthermore insisted that even," pupil assigned to these special schools, or separate classes, must be subjected to a careful physcial examination by a physican to determine whether their intellectual weakness be not the result of defectives senses, or other causes that might be removed. He closed his order by calling for a report from every school inspector in whose district such an establishment exists.

In 1894 was published the result of this inquiry, which showed that eighteen cities of the Kingdom maintained such special schools or classes; that while in previous years these classes had been partially filled with children morally unsafe, they had lately been withdrawn and now only children of dull intellect were thus treated separately. These were pupils who, during an attendance of two or three years in graded schools, had given evidence that they could be taught, but were unable to keep pace with normally endowed children.

The figures given for 1894 are as follows: Eighteen cites, twenty-six institutions, seven hundred pupils, forty-three male and twenty-one female teachers, and an average of about twenty four hours work work per school.

In August, 1896, a school report showed an increase to twenty-seven cities, and the number of pupils had increased to 2,017.

In 1896 Royal commission known as the "Committee on Defective and Epileptic Children," was appointed by his grace, the Duke of Devonshire, and directed to report as fully as possible upon the expediency of separating feeble-minded and epileptic children from otherwise normal children in the public schools of Great Britain, and the rereport of this commission published 1898 is an extremely thorough and