legs?" "Walk lame!" was the immediate reply.

One day after he had become interested in his number work we overheard him drilling himself in his room at the close of school. "Now count shoes," he said, "one shoe—two shoes—hm—m—good boy!" (the last in exact imitation of his teacher's tone and expression.) "Now count chairs—hm—m—one chair—two chairs—three chairs. (rood boy—very good boy!" This was kept up for a half hour when we thought it better to interrupt the drill and send him out of doors.

His second number report is as follows:

"NOVEMBER 29, 1899. *Arabics*—Has daily practice in writing and counting to eight, aiming to teach relative positions and values,

"Coins-Has practice in buying small articles, the cost of which does not exceed five cents.

"Addition—Some concrete work with coins has been given. Has made a beginning with written abstract addition.

"FEBRUARY 28, 1900. *Arabics*— Reads and writes to ten.

"Roman Notation—Reads and writes to IV.

"Coins—Buys small articles, paving for same, when value does not exceed ten cents.

"Addition—Has written work with aid of objects.

"MAY 15, 1900. *Arabics*— Reads and writes to sixteen. Has a fair idea of the relative positions of the digits and can illustrate their values with coins, balls, or other objects.

"Roman Notation—Writes to VI from memorv and reads to V'H from dial.

"Ordinals—Has had pratice to fifteenth on calendar.

"Coins—Counts and arranges in simplest combinations to fifteen cents inclusive.

"Addition—Has memorized six of the easier combinations and does written and oral work in all the combinations, the sums of which do not exceed six.

"The written work consists mainly in obtaining answers to written combinations by arranging objects to illustrate same, and in writing combinations from objects arranged by teacher.

"Has had much practice in buying small articles when cost does not exceed fifteen cents."

Now that a foundation has been laid, the work of further developingthe aroused faculties will not be difficult. John's life is far happier than it was nine months ago. His time is fully and pleasantly occupied and the hopeless, sullen expression which came from a dull sense of his utter uselessness to himself as well as to others has changed to one of happiness and animation. He has begun to realize that it is in his power to please those about him through doing to the best of his limited ability the work which is given him.

It seems almost criminal that a boy, who in nine months is capable of such improvement under proper conditions, should have been deprived of training for so long a time. For ten years his parents had known that there were schools for the training of children of arrested mental development, yet they were so selfishly fond of him that they were unwilling to bear the separation consequent upon sending him from home. They did him a wrong, the enormity of which they are just beginning to realize. Parents who are ignorant of the existence of such schools may be forgiven, but what shall be said of those who, through mere sentiment, fail to give their children the training which would make them less a burden upon the community?

MOTOR ABILITY AND CONTROL OF THE: FEEBLE-MINDED.

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THE remarks of observers on these subjects have been on their more complex manifestations, as walking, writing, working or employment in the trades. They have set forth their delay in walking, their awkward gait and their inefficiency in writing and work, producing poor and badly formed results, which normally would be ascribed to lack of attention and discrimination, and in all a general laziness.

Special talents for the production of a particular thing are frequently found but show results of no economic[1] value. Paralyses due to lesions of brain or cord are frequently found as insurmountable hinderauces to any further advance. Automatic instinctive movements will be considered under another head as we shall have occasion to remark again.

These are of value but they have to do with complex processes which call into play most of the powers of the mind. For purposes of study and investigation it is necessary to give the problems a simpler form. On this, so far as it has to do with the muscle sense, we have already had occasion to offer some remarks. Having now to do with voluntary motions, we will consider steadiness, the sense of locality as determined by active touch, motor ability as determined by taps with the consequent question of fatigue, and the grip of the hands.

STEADINESS.

The apparatus used to test the muscular control or steadiness was that devised by Scripture. "It consists of a flat block of hard rubber supported vertically by a rod. On the face of the block is a strip of brass in which there are live hard rubber circles 1, 2, 3, 4 and 5 mm. in diameter. Electrical connection is made by a binding-post at the back. The edges of the circles are flush with the brass." A long metallic needle set in a handle connected with a flexible conductor was used as a pointer. An electric bell introduced into the circuit indicated any

contact of the needle with the brass.

The arm of the child was supported on a Sanford arm-rest. He held the balanced needle like a lead pencil and touched the circles in order, beginning with the largest. Five trials, one for each circle, constituted a test. Two tests of each hand were made at a sitting" and there were four sittings at intervals of several days. If the child missed a circle at the first attempt, he repeated until the circle was touched. The circles were valued inversely as the squares of their diameters or 1,. 4, 9, 16 and 25.

There were thirty-five boys and thirtv-three girls tested. For the boys the average for the right hand was 11.8 + 5.3, for the left hand 10.1 ±3.8. For the girls the average for the right hand was 9.0 + 4.4. for the left hand 8.4 + 5.0. All of the children were right handed. Three of the girls tested were not able to perform the test.

Both boys and girls had better control of the right hand than of the left. The boys exceeded the girls, however, in the control of both hands. The mean variation was about the same for both boys and girls, but it was larger for the right hand of the boys and the left of the girls.

Grouping the children according to ages gave no indication of any dependence of muscular control upon age.

Dividing the children into three groups, A, B. C. according to their mental ability as estimated by one of their teachers we have the following averages:

	BOYS			GIRLS		
	No..	Right	**Left**	No.	Right	Left
A	11	13.8	13.0	8	15.0	15.9
B	15	12.4	8.9	12	7.8	6.6
C	20	7.8	6.8	16	4.9	*2.7*

This shows that there is a direct dependence of muscular control upon mental ability; the brightest children have the best control and also show less difference between their right and left hands.

Scripture, who made some similar experiments investigating the subject of education of muscular control, concludes that the "training seems to be of a psychical rather than of a physical order and to lie principally in the steadiness of attention. For any distraction of attention due to noise or other disturbances invariably lowered the per cent of steadiness. Concentration of attention upon the muscular movement to be performed was unfavorable, but fixation of attention upon the objective point to be reached by the needle was productive of the best results.'' In our experiments with those of lower grade, this seemed to be the most difficult thing, to fix the point to be reached. "Hither mental or bodily fatigue, particularly of the eve muscles, lowered the results.

Since the attempt has been made to classify the feeble-minded

according to the degree of attention manifested, these remarks have an important bearing in this direction. And perhaps this test might have some value as a means of diagnosis.

LOCALITY.

In order to test the direction of motion from touch stimuli the children were subjected to the following test. They were touched on the back of the left hand with the point of a common lead pencil. They were then required to immediately touch the same spot with a pencil held in the right hand, the eyes being closed during the whole proceeding. The distance and direction from the original spot were then noted. The results were:

	BOYS	GIRLS
Number	30	24
Average	11.2	10.5
Mean V;	5.0	4.3
Judgment:		
Good	16	*23*
Bad	4	1

The boys placed the pencil more frequently toward the fingers, the girls toward the forearm.

Two of the boys examined could not touch the same point with the eyes open by an average error of 2mm.; also thirteen girls with an average error of 3mm. (max. 5, min. 1).

Grouping the children according to mental ability, A being the brightest, we have;

	BOYS	GIRLS
A	9.5 + 4.3	11,1 '4.9
B	11.1-5.0	11.4+4.3
C	12.3+-6.7	8.4 + 3,4

With the boys we find that exactness of touch increases with mental ability, while with the girls there is no such indication. The results from a relatively large number of girls were thrown out because they could not properly fix the point with the eves open.

The smallest distance on the wrist in which two points can be felt as two has been found among Washington school children to be, for the boys 15.5 mm. and for the girls 14.9 mm.* The distance usually given in the books for the back of the hand is 31.6 mm., and for children twelve years old 22.6mm.

Our results from the steadiness reaction correspond to a circle of about 3mm. in diameter, showing greater error in direction of motion from touch stimuli.

The same difficulty and hence source of error was shown here much more plainly than in the steadiness reaction, that is, the difficulty of

***Report of** the Commissioner of Education. 1897-98

fixing the point to he touched. As we have shown, a number were unable to do this even with the eyes open although responding readily to the test. This error was practically definite for each child. Hence the lack of attention in this case is clearly a lack of adjustment of the organism to the point of stimulation.

MOTOR ABILITY AND FATIGUE.

These tests were made according to the method which Gilbert used on school children in Connecticut.* His results were used for comparison.

The children were required to tap as rapidly- as possible on a telegraph key for forty-five seconds. It was so arranged that these taps were recorded on a rotating smoked surface by means of a telegraph sounder. The taps during the first five and last five seconds only were recorded. The time was taken from the metronome, and by means of a switch the electric current was made and broken at the proper intervals.

Thirty-eight boys and fifty-seven girls among the school children were tested. Of these, fourteen girls (1 A, 4 B, 9 C) and five boys (C) showed no fatigue. This was due to a slow or irregular first reading. Fully half of those taking the test showed some sort of irregularity. This was looked upon as the normal condition with them so the results were not thrown out.

The readings for each child were compared with the normal for his age and the difference noted. For thirty-three boys the number of taps which they were able to make in five seconds was found to be 8.4 less than normal (31.5), with a mean variation of 3.5. For forty-three girls the average was 7.2 less than the normal (29.6) with a mean variation of 3.1.

The fatigue was measured by the per cent of loss in the number of taps made in the last five seconds. For thirty-three boys the average was 1.4 less than normal (18.0) with a mean variation of 7.6. For the girls the average did not differ from the normal (16.G) with a mean variation of 6.1.

Those children who tapped the fastest, coming nearest the normal, generally showed the greatest fatigue, although there were marked exceptions.

Grouping our results according to mental ability we have:

TAPS	FAT.	MAX.	MIX.
-3.0	—1.3	+14.3	—8.9
—7.1	—1.0	+ 13.3	-13.0
—11.9	—1.5	+ 17.0	— 10.0
-6.1	—2.5	+ 12.5	—8.2
—9.0	—0.2	+ 17.5	— 7.3
—6.4	—1.2	+ 12.5	-11.0

* Studies from Yale Pcysholog. Lab., Vol **II.** p. 64

The ability to tap decreases with the lack of mental ability.

This is particularly striking among the boys. Fatigue seems to depend upon the rate of tapping and not upon the speed of the individual, at least for the slower speeds. This is also shown by the fact mentioned above, that with some of the children there was no fatigue indicated, and in some cases the number of taps was increased at the end of the tapping time. Hence we can argue that the deficiency is nervous rather than muscular. Their will power was not sufficient to produce a rate of tapping which would show fatigue in the time indicated.

Hence we conclude that there is a slow and weakened motor ability with increased fatigue among the feeble-minded.

HAND GRASP.

In order to determine in a way the strength of feeble-minded children as compared with the normal, we made an investigation concerning their strength of hand grasp. For this purpose we made use of a Carroll Dynamometer, correcting the reading of the scale for each child.

For a standard of comparison we made use of the measurements of normal children made by Ada Carman in the schools of Saginaw, Mich.

Of the forty four boys and forty-two girls tested, only twenty-two of each were within the ages named of the normal school children. Comparing each age with that of the normal children and averaging the differences we have:

	RIGHT HAND	LEFT HAND
Boys.	-26.7 lbs.	-20.8 lbs.
Girls.	-17.0 "	—13.5 "

To such an extent do we find the grasp of our children subnormal.

Averaging the results of our children whose ages were above those given of the normal children (19 yrs.) we have:

	RIGHT HAND	LEFT HAND
Boys	56±3.2	56+3.3
Girls	31 + 1.7	29+1.4

These results are in pounds and correspond to the strength of grasp of a normal boy of fourteen years and of a girl of about twelve years,

The average mean variation for all of the children was:

	RIGHT	LEFT
Boys	2.2	2.7
Girls	2.1	2.0

This is lower than usual with measurements of the feeble-minded.

Grouping the children according to mental ability we have:

	BOYS			GIRLS		
	Right	Left	Age	Right	Left	Age
A	61.4	56.4	17	39.9	36.5	20
I!	60.7	53.5	22	36.7	34.4	*2°*
C	48.3	47.3	20	33.6	32.7	20

This shows that the strength of grasp depends upon mental ability. We have indicated the average age for each group, and so far as it enters in the result it would tend to favor the duller groups. Wishing to see how far this held good, we made comparison of the grasp, weight and height of feeble-minded children with normal children and we found them subnormal in the following amounts:

	GRIP.		WEIGHT.	HEIGHT.
	Right	Left		
Boys, subnormal	51.7%	52.4	13.7%.	5.5%
Girls, subnormal	46.2%.	44.2	12.3%.	7.5%

Thus taking the weight and height as an index of muscular development, we conclude that fully three-fourths of the deficiency in muscular power must be due to some central defect, as lack of nerve power or will power.

The chief difference between nervous impulses is in the amount of energy set free. And the strength of the nerve impulses, other things being equal, depends on the strength of the stimulus.* This is easily demonstrated in the nerve-muscle preparation, where the amount of contraction, within certain limits, is determined by the strength of the induction shock. So with our children the deficiency in the nerve impulses and the lack of nerve stimuli must be considered in the explanation of their deficiency of muscular power. In mental fatigue we find the same conditions, a lack of muscular power which is ultimately due to lack of nervous impulses.+ Hence can we conclude that the feeble-minded are in a state of permanent nerve fatigue due to early nutritional disorders?

Mentally the process of willing is accomplished when we hold in mind an idea to which we agree. Deliberation is the process of determining which idea shall be dominant, but this ended the resultant idea fills the mind and the action occurs. Oftentimes we will with effort; here in addition to the idea we have the mental picture of muscular strain which is thereby also willed.

The relation of the dominant idea to the nervous impulse is unknown. Normally the one follows the other, but in paralysis the nerve impulse does not result from the dominant idea. In fact, the strength of the nerve impulse varies in people from the superstrength of the energetic, strongly reacting people, through the medium reaction of the imbecile, down to the total lack of the same in idiocy and abulia.

While there is no doubt a variability within certain limits between the strength of the willed idea and the nervous impulse, yet from our studies along these lines we would expect a certain correlation between them. And from a weak nerve impulse we would expect a weakness or haziness of the willed idea. This can be deduced from the diminution of attention, the extreme of which is a state of distraction in which no

*Foster: Physiology, **Vol. I. p.139.**.

idea rules the content of consciousness but all seem to be of equal importance. This diminution of attention is in part at least due to lack of association which prevents the idea from developing (a very necessary thing for attention), which can be traced back to defective brain structure.

Consequently we conclude that among the feeble-minded we have a defective willed idea from lack of attention and association, also a defective idea of effort, as well as a weak nervous impulse. We have also found that the girls are weaker than the boys, that the left hand is weaker than the right, that all were right handed, that they were about one-half as strong as normal children of the same age, and that this difference is in great part central.

As the result of all these studies we have found deficient muscular control which varies according to the mental ability, a dull sense of locality, a deficient motor abilty with increased fatigue depending upon the rate of work, and a deficient strength of grasp which is chiefly due to central causes.

INSTITUTION CONSTRUCTION AND ORGANIZATION.

BY A. W. WILMARTH, M. D. CHIPIPEWA FALLS, WIS.

IT IS not my object in furnishing this paper to endeavor to teach the members of the Association. Many of them are older in experience than myself, and the most of them are as well, if not better able to form judgment on the points dealt with in this paper. This subject was taken up many years ago in the infancy of our Association. Many of the rules laid down at that time are equally in force at present. A riper experience, however, should have given us new ideas, audit is my wish to present the present views in regard to the construction and organization of the institution adapted to our work, so far as I am able to see them. If you find nothing of valuable information in this paper, it may at least furnish a subject for criticism, and possibly for profitable discussion.

The location is always the first subject for consideration. I think it will be universally conceded that a site not too far from some large commercial center is preferable. If too near, the institution is subject to so many visitations as to interfere seriously with the household work. If too far off from any large city, transportation becomes so costly as to increase very materially the running expenses of the institution. A distance of from twenty to fifty miles should be reasonably free from either of these objections, and at this distance land is cheaper than it is too near a large city. An abundant supply of good water is of course necessary, and it is a particularly difficult task to persuade a