THE EDUCATION OF A PARTIALLY PARALYZED MUSCLE*

By Earl Barnes

The conclusions of this paper are based mainly upon eight years' experience with a little girl who, when eighteen months old, was stricken with infantile paralysis. During these years I have seen the best specialists in America and England in general neurology, massage, electric treatment, mechanical appliances and corrective exercises. I have also seen many other cases of infantile paralysis and have watched the development of many of them under different forms of treatment or neglect.

The paralysis to be considered in this paper is due to the destruction or impairment of some of the nerve cells in the anterior horns of the spinal cord. These cells under normal conditions send out the motor impulses that cause the muscles in different parts of the body to contract, producing action. Infantile paralysis directly affects neither the muscles nor the nerves. It simply demoralizes or destroys the battery lying behind these. Unlike rheumatism, it leaves the motor apparatus unimpaired except in the nerve centers where the motor impulse originates. Since its victims are generally children whose growth is still to be accomplished, the treatment following the acute period of disease, which rarely continues more than a week or two, is mainly educational and belongs rather to educational experts than to physicians.

In the case in which I have been specially interested the child, a girl of eighteen months, strong and healthy and walking freely, was at first so badly paralyzed that she was entirely helpless. She had to learn slowly to creep again, and only after months was she able to stand supported by braces on both legs. From the first, however, there was a steady improvement and now, after eight years, she is taller and heavier than the average of ten-year-old girls; the trouble is confined almost entirely to the left leg below the knee; and she walks miles without any braces of any kind, swims and rides a bicycle or a horse. The muscles contracting the left foot and toes downward are active, but the muscles that lift the foot and toes have not recovered their action.

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In this recovery mechanical appliances, braces and supports have been freely used under the best orthopedic direction to be found in America or England. Such supports, whether of rubber, leather or metal, have two functions. By supporting the weaker muscles they enable the child to stand and move about, thus adding greatly to the health and happiness of the child. They also insure the weaker muscles and tendons from being overstrained and thus prevent deformities which it would be very difficult to correct where control and nutrition are already weakened.

On the other hand, mechanical appliances always interfere in some degree with circulation, which was already impaired and thus increase the probability of atrophy. They also make it possible through the new leverages they establish for the child to act without calling all the muscles into use. If a foot can be put where one wants it without using the muscles of the foot, even the partial work they might do is left undone and with disuse power is not recovered and even what exists may be lost. In the education of impaired muscular control mechanical appliances are often indispensable, but they are at best a necessary evil.

In the treatment of these cases frequent and sustained massage is always necessary. In the case under consideration impaired muscles were massaged every two hours of waking time during the first year and daily since with brief exceptions during holidays or travel. The massage, by exercising the tissues, increases the blood supply and works out broken down tissue. By strengthening the blood supply and aiding nutrition it prevents atrophy.

However, it must be remembered that the initial difficulty does not lie in the muscles but in the nerve cells in the anterior horns of the spinal cord. There is doubtless some reaction upon these nerve cells through massage, as will be explained later, but the principal values of massage are to keep up the general health and keep the bony levers and their muscular attachments in good order so that if function of the nerve cells is restored the machinery of action may be ready for use. Massage can also keep unused muscles stretched and thus prevent deformity.

The effect of electricity on muscular action is still too uncertain for a layman to pass any judgment upon it. I have tried both galvanic and ferradic currents but with uncertain results.

So far we have discussed the means for keeping the muscles in good condition, but how are we to reach the nerve cells in the anterior horns of the spinal cord. Some restoration of function will come steadily with renewed health and the natural
processes of growth, but specially devised exercises will certain­
ly accelerate and increase this restoration. This is the point where definite education comes in.

All of Dr. Edward Seguin’s work with the feeble-minded rested on the belief that even passive exercises tended to strengthen the nerve centers. Thus to make an imbecile think, he exercised his arms and legs and the other parts of the body along lines of coordinated action, established in the human system by many generations of ancestors for useful purposes. The teaching of Dr. Montessori implies the same belief in the value of organized activity in strengthening nerve centers, though she does not state it so clearly as does Dr. Seguin.

Our present knowledge of the nervous system enables us to understand how action may strengthen the nervous system. An efferent current is sent out from a motor center only when that center is aroused by an impulse coming from the sensory centers or from an ideational center in the cerebrum. Now opposite the anterior horns of the spinal cord are posterior horns of sensory nerves into which sensations are poured from all parts of the body. These sensory cells of the posterior horns have their connections. They are connected directly with the motor centers in the anterior horns of the cord, with the cerebellum, and with the cerebrum.

Let us imagine then what would happen if we tickle a child’s foot. The sensation will be carried in along an afferent nerve to the nerve cells in the posterior horns of the cord. This impulse will then undergo some change, not well understood, and will pass on as impulse to the impaired motor cells of the anterior horns, to the cerebellum and to the cerebrum. If the child be passive, or even asleep, the impulse will pass out of the anterior cells to the muscles of the foot and it will be withdrawn from the tickling finger. If the child is awake and attentive the outgoing impulse will be strengthened from the cerebrum center and the foot will be still more vigorously withdrawn. If stimulation and exercise mean growth and health, as we believe they do, then all these centers must be improved if they are normal or merely impaired. Thus, all massage, by exciting a multitude of sensations that flow into the posterior horns and pass on to the motor centers in the anterior horn, to the cerebellum and the cerebrum, must strengthen all these centers even if the massage is received in a purely passive state.

But in exercises the child’s attention and will can be brought into play and so the returning body of sensations excited by the action must be vastly more effective than when the child is passive. Further, if these exercises are so planned as to
correspond with the habits of the race, which by long repetition have become almost or quite instinctive, our training will be doubly effective because it will move along lines of least resistance. Walking, talking, handling, are types of such action.

Thus if the muscles of the legs are affected we can put the child on a tricycle and tie his feet to the pedals. If he is then pushed about the thousands of sensations excited in connection with a movement of the legs habitual to the race will pour back through the posterior horns of the spinal cord and pass on to the impaired motor cells of the anterior horns, tending to strengthen all of them; they will also pass on to the cerebellum and the cerebrum from which they may come back as voluntary effort still further strengthening the impaired cells. Walking, swimming, horseback riding will broaden and strengthen the general training of the impaired centers.

But the nerve cells of the motor centers, if not entirely destroyed, undergo different degrees of impairment. Some are capable of very slight response while others may remain very nearly normal. Here the specialist, intimately acquainted with anatomy, must come in to devise special exercises. If the right foot turns outward exercises must be devised that will make the foot turn in. Understanding the game, but not necessarily its purpose, the child will concentrate his attention and his will upon it. Such effort as he can make he will put forth and the sensations awakened by the effort and its movement will travel back and ultimately produce an effect upon the impaired centers which should control that action.

It is obvious here that the cooperation of the patient is of the greatest possible value. Hence the educator must call to his aid every possible device that will interest the child. Approval, praise, rewards, emulation, a sense of steady advance, will make the child his own best aid in working through the otherwise dreary repetitions that lie on the road to recovery.

Meantime, with skillful direction and unfailing courage, the restoration of function may go on for years. I have seen constant unremitting effort fail to produce any visible result for a year, and yet eventually lead to almost complete restoration.