among girls the large majority of whom are at boarding school, and consequently affected by change of environment. It seems that there may be some advantage connected with an irregularity of the flow in young girls, since dysmenorrhoea is associated with regular menstruation in a greater proportion, 66 per cent., than it is with irregular menstruation, where the percentage is 34.

The Effect of Study on the Regularity of the Flow.—It is still a matter of common belief that education in girls has a harmful effect on the functions of the generative organs, and that the amenorrhoea which so often occurs as soon as a girl goes to school or college, after perhaps years of regular menstruation at home, is an indication that she is using her brain to the detriment of her health, the first organs to suffer being the generative organs. It certainly is a very common thing for amenorrhoea to set in for three months or more after a girl arrives at the school which supplies me with my data. But it is also a common occurrence among servant girls going from the country to situations in a town, and occurred frequently among hospital nurses who went abroad during the war; yet in both these cases there is no change in the character of the work, nor any greater mental strain. In connexion with this point it was of interest to compare the frequency of the occurrence of amenorrhoea among the boarders and the day girls. It was found that whereas it occurred during the first term in 24 per cent. of the boarders, it was only present in 5 per cent. of the day girls, although the mental strain is no greater for the boarders, but is, in fact, undoubtedly less on the whole, owing to the stricter régime allotting fixed hours for recreation and sleep. The only girls in whom there is a tendency to overwork are those studying for an examination, and from this point of view a record has been kept as to the nature of each girl's work. The total number of girls reading for public examinations was 297; of these the number who developed amenorrhoea during their period of study was eight—that is, 2.6 per cent.—and these, with one exception, were boarders, some of whom began examination work on entering the school, and were therefore liable to temporary amenorrhoea owing to change of environment. Hence we may conclude that whatever the cause of the amenorrhoea in the 29 per cent. of the cases examined may have been, it was not due to mental strain. In a few cases the amenorrhoea was associated with chlorosis or other signs of ill health, but this was very exceptional, only two cases being noted among the candidates for examination.

Dysmenorrhoea.

Whereas the boarders are more subject to amenorrhoea, dysmenorrhoea is relatively more frequent among the day girls. If under the term dysmenorrhoea are included all conditions of pain, discomfort, and malaise, the percentage of cases among those who have been a year or more in the school is 3.7 among the boarders and 11.3 among the day girls.

The Relation between Dysmenorrhoea and Study.—Of the 297 girls working for examinations there were seventeen—that is, 5.7 per cent.—in whom dysmenorrhoea began, or was accentuated, during the period of study. From this it cannot be concluded that study *per se* is the cause of the dysmenorrhoea, especially in view of the fact that the proportion of sufferers among the examination candidates is smaller than that among the total number of girls in the school who have reached the age of puberty, the relative figures being 13 per cent. and 15 per cent. It must be remembered, too, that if a girl is pressed for time, the first things she gives up are her games and walks. This is followed at once in some cases by constipation, pelvic congestion, and dysmenorrhoea. Among those who are my own patients the dysmenorrhoea has yielded at once to the taking of more exercise without any alteration in the course of the study. I would suggest, therefore, that pressure of brain work affects menstruation adversely only in so far as it encourages sedentary habits.

Relation of Dysmenorrhoea to Social Position.—That painful menstruation is more complained of among women of the leisured and educated classes than among those of the working classes is doubtless the experience of most general practitioners. The reason generally given is the increased susceptibility to pain brought about by careful nurture, and it is suggested that this increased sensitiveness is one of the prices paid for higher civilization. It is said

that dysmenorrhoea is unknown among savages. Statistics verifying this statement are not available, but since such a large proportion of carefully brought up girls menstruate without pain, dysmenorrhoea is clearly not a necessary accompaniment of civilization.

I would suggest that the greater frequency of dysmenorrhoea among the well-to-do is the result of the enforced inactivity to which so many of the children have to submit, owing to the anxiety of the mothers to "take every care" of their daughters during the period. In the poorer homes the natural activity of the girls is seldom interfered with, hence their relative freedom from dysmenorrhoea.

Date of Onset of Menstruation.

It is also stated that menstruation begins somewhat later among girls where the conditions of life are not good. The following table summarizes the data I obtained on this point, which, though having no direct bearing on the subject of this paper, may be of interest as it refers only to girls in whom health is a matter of primary consideration.

TABLE C.

Age of Onset of Menstruation.	Number of Girls.
9	1
10	12
11	69
12	224
13	357
14	309
15	125
16	40
17	7
18	4

CONCLUSIONS.

1. That the majority of schoolgirls are free from any menstrual disturbance.
2. That, if no unnatural restrictions are imposed, the proportion of girls free from any menstrual disturbance tends to increase.
3. That girls in normal health should be encouraged to take baths and exercise during the menstrual period.
4. That the amenorrhoea to which schoolgirls are subject is not caused by mental strain.
5. That study *per se* is not a cause of dysmenorrhoea, although if pursued to the exclusion of daily exercise it may be indirectly a contributory factor.

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THE PLACE OF MUSCLE RE-EDUCATION IN THE TREATMENT OF ANTERIOR POLIO-MYELITIS (INFANTILE PARALYSIS).

BY

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SINCE the necessity became apparent for a specialized form of muscle treatment in the after-treatment of the loss of muscle function caused by war injuries, the expression "re-education of muscle" has become very familiar. The modern conception of muscle re-education as a therapeutic measure is not, however, a war product; the principles on which it is based had been elaborated and applied to the treatment of infantile paralysis several years before the war. Muscle re-education is an entity quite distinct from the routine physical therapeutic procedures of massage, electricity, passive movements, and Swedish remedial exercises. In all cases of muscle weakness it is, in my opinion, the essential procedure, and any other methods used in conjunction with it are subsidiary. It is important, therefore, that a clear conception should be held of the meaning of the term "muscle re-education."

Muscle re-education as successfully applied to the early treatment of infantile paralysis is the gradual stimulation, and slow awakening to activity, of the voluntary motor impulse which has been lying dormant, temporarily put out of action by the interruption to its path caused by the oedema, toxicity, and vascular deprivation accompanying the acute inflammation in the neighbourhood of the anterior cornual cells of the spinal cord. With the gradual subsidence of the inflammatory process, recovery more or less rapid and complete occurs in the nervous structures, and muscle re-education then aims at restoration of the continuity of the motor impulse, and the re-establishment at the earliest possible moment of co-ordination with the almost intact muscle system. To do this calls in no small degree for patience, perseverance, and experience. After the first shock of the paralysis has passed off there is much mental inertia on the part of the patient as regards voluntary movement; recovery may be taking place in the spinal cord, and yet no call to action be made by the higher centres. The receptive and propagative powers of many of the anterior cornual cells having been lost or greatly diminished, voluntary movement over a particular area is found to be impossible; the attempt is therefore given up and a flaccid paralysis of variable extent results. To start the motor machine working again in its normal physiological manner, and not merely as a reflex imitation, a mental effort is required, and this can only be accomplished if the cerebrum is capable of interpreting correctly a spoken order for a particular limb movement, and then of activating the motor cells of the cerebral cortex for the performance of this movement; in a young child who is a recent victim of infantile paralysis, the amount of mental effort required is very appreciable. It is inconceivable, however, that any mental effort on the part of a child should succeed in producing movement in a limb if all the anterior horn cells subserving motor function for that limb had been destroyed, or, to quote an expression in common use, "irreparably damaged." Clinical study shows that the paralytic sequelae of poliomyelitis have undoubtedly a tendency to recover; this, to my mind, is explained most simply by the theory of gradual recovery of the nerve cells from the effects of the inflammatory process. Microscopic pathology shows that not all the anterior cornual cells in any one area suffer equally; the destruction rarely seems to be complete. Since return of motor function, either partial or complete, can be proved to take place after an attack of anterior poliomyelitis, it is necessary to postulate either, firstly, recovery of slightly damaged nerve cells, or secondly, nerve cells with intact connexions sufficient to ensure movement remaining active at other levels of the cord. It may only be the stimulus of great necessity which makes these long connexions respond, in order to ensure that function may gradually be restored to some degree of its former vigour. Muscle re-education, while recognizing the great importance of the morbid anterior cornual cells, at the same time desires and attempts to displace them from recognition as the sole factor of importance; it refuses to be prevented by the knowledge that the nerve cells may have been grossly injured from attempting to secure recovery of muscle function. If one assumes, as is supported by much clinical evidence, that some degree of recovery of muscle function is possible in every recent (two weeks to two years) case of infantile paralysis, no effort should be spared to regard and study muscle itself as the predominant factor in this disease, and in this way to endeavour to obtain the greatest amount of recovery possible.

The Importance of Muscle.

This conception is new. Hitherto, in these conditions, muscle has been largely ignored and attention has been concentrated on the pathological processes in the nervous system. Muscle must now be restored to its rightful and prominent place in the treatment of disorders of the neuromuscular system. To make careful, exceedingly painstaking, and accurate diagnoses of the site of the nervous lesion may be an intellectual pastime, but it alone is of no value from the point of view of the patient's regaining muscular function. Muscle cannot be left to fight for its existence unaided: in these neuro-muscular lesions we must concentrate our treatment on muscle itself, and must adopt every means in our power to coax tiny movements back and gradually to blow into a flame the spark which has so

nearly been extinguished. In poliomyelitis, after the acute stage of the illness, we are dealing with a nervous system portions of which have been more or less damaged; but with a muscular system, on the other hand, which should be nearly intact except in so far as it has been practically cut off for some weeks from its source of nervous energy. If no attempt at voluntary movement is made for some considerable time, a great and precious opportunity will have been lost. Without overlooking for a moment the importance of rest as a curative and helpful factor, I consider that rest alone will not restore muscle function, nor can it initiate it. If we rest the limbs in accurately fitting splints, and simply wait for recovery of movement to appear, both muscle and recovering nerve cell will, through their mutual absence of function, gradually react unfavourably on each other; the final result, in spite of massage and electricity, being the atrophy, fibrous degeneration, and wasted shortened limbs unfortunately so familiar in this disease. On the other hand, it would be wrong treatment, especially in the early stages of the disease, to attempt to obtain voluntary movement at the expense of grave muscle fatigue. This is a danger to be constantly watched for and guarded against; but I think it can occur very seldom, owing to the great difficulty experienced in getting a child to concentrate its efforts at muscular movement for a time sufficiently long to render fatigue possible. The ideal of treatment is a delicate co-ordination—recovery of muscle function going on hand-in-hand with nerve cell recovery. The neuro-muscular system is thus regarded from a clinical point of view as a physiological whole with interdependent parts exhibiting continual mutual action and reaction.

Rest must be combined with sane and skilled attempts at muscle re-education. At first rest for twenty-two or twenty-three hours out of the twenty-four on accurately fitting and properly devised splints is an essential part of our modern treatment of this disease; in my opinion, however, even more important is the temporary removal of the splints for a short period of time (twenty minutes to one hour one to three times daily, with adequate precautions against the positional stretching of weak muscles), for the purpose of attempting voluntary movement under the easiest possible obtainable conditions. In this connexion it is most important to remember that each weak muscle or muscle group must be very carefully studied, so that when the attempt to obtain movement is made advantage can be taken of every factor likely to be of help, such as, for example, leverage, direction of action of the muscle, effect of gravity, effect of working on a smooth flat surface (such as powdered cardboard); in view of the effect of fatigue, only a small amount of work should be done at any one time. There is a zero position for every muscle and muscle group—that position in which the paralysed muscle and its healthy opponent are in a state of equilibrium. This is the position in which muscle re-education should be begun each day and in which the limbs should be rested. Mackenzie, who originated the idea of this zero position, states also that a biological law underlies the recovery of a so-called paralysed muscle. Muscle or muscle group action is a complex function, one made up of several separate activities; the loss in the acute stage, and consequently the later recovery, follow in a definite ancestral or evolutionary sequence. According to this view one cannot regain all the functions of a muscle at once, even to a small extent, but by re-education one can gradually obtain them all, and finally then increase their strength of action. For example, the quadriceps femoris group, the extensor of the knee-joint, may, if affected by infantile paralysis, be able to straighten out the flexed knee when the patient is lying down, but be quite unable to keep the knee extended when an attempt is made to lift the heel off the bed. Similarly the flexors of the elbow may just manage to bend the elbow to a slight degree when the patient is lying down and movement is made along a smooth flat surface, but utterly fail to bend it when the arm is hanging by the side. The action of gravity associated with man's assumption of the upright position is chiefly responsible for these differences of functional activities.

The following case illustrates these considerations:

M. L., aged 6, was brought to me in January, 1920, for paralysis of her left leg and foot, left arm and right arm. The infection had occurred on October 5th, 1919, and thus I saw her

nearly three months later than I should have wished; especially in the case of the upper limb, early diagnosis and immediate treatment are of vital importance. I was informed that the paralysis had originally been more extensive, affecting the neck muscles also; there had been some slow improvement, most marked in the neck muscles, but also apparent in the left hand and left leg, but this appeared to have ceased. Massage was being given once daily, but no splints had been ordered, and no attempt had been made at re-education. On examination, both arms were found to be paralysed—the right completely, while on the left were present weak movements of the hand and wrist only, movements of fingers being good, but opposition of thumb to fingers weak. Walking was possible, but there was a definite limp with drop-foot on the left side, also hyperextension of the knee and some eversion of the foot. From clinical experience of this disease, I considered that I was quite justified in recommending treatment, but I was very guarded in my prognosis, especially as regards the right arm and hand. To my mind the essential movements to be recovered were abduction and elevation of the arms at the shoulder, flexion of the forearm, and supination of the hand, as well as dorsiflexion of the foot and extension of the knee. Before re-education could be attempted, however, some means of procuring anatomical rest had to be devised, especially for the arms. It was obvious that the dragging weight of the upper limbs was rapidly causing atrophy of the shoulder girdle muscles, and that unless this weight were removed the child would never again raise her arms (there is less justification for leaving a shoulder unsupported in a case of paralysis than there is for the non-setting of a fractured humerus). A double right-angled arm abduction splint of light iron was fitted to the patient's upper limbs. (So far as I am aware, this is the first reported case of a double-arm abduction splint having been used in the treatment of the paralyses caused by this disease.) By its means anatomical rest was given to the shoulder girdle muscles—to the deltoid muscle especially, but also to the flexors of the forearm and the supinators, as well as the hand muscles. The splint, so arranged that mid-supination was the resting position, was worn continuously, being put on after the morning re-educative exercises and taken off at night; it was not found possible to get it worn in bed. It is necessary to lay great stress on the importance of the right-angled abduction arm splint in the treatment of infantile paralysis affecting the upper limb—first, because adequate rest for arm muscles has not previously been sufficiently insisted on, or rather has been conspicuously neglected; and secondly, because of the necessity for overcoming the objections of the parents and the child to the wearing of a somewhat cumbersome apparatus. Rest for the left leg and foot was obtained by ordering, for twelve months from the onset, no walking and very little standing. To prevent deformity a special day and night shoe was provided, designed to keep the foot at a right angle and to prevent eversion or inversion; this was extended to above the knee, with a pad under the knee to allow of a few degrees of flexion. Active movements, after being originated by me, were helped and supervised by the mother twice daily for a variable time, depending mainly on the child's sense of fatigue; all movements were done lying down, and a constant endeavour was made to find easy limb positions. The exercises for the leg and foot were comparatively simple, being mainly concerned with developing the tibialis anticus and the quadriceps. Progress was uninterrupted; walking, when allowed, can now be performed in practically a normal manner. With regard to the arms the problem was much more difficult, but great perseverance by mother and child eventually produced the result that both arms could be abducted and raised above the head; flexion at the elbow could be obtained in both when the patient was lying down, but only to a comparatively small degree on the right side. Apart from a little flexion at the wrist, no further movements have occurred in the right arm, and the prognosis as regards the hand is still very uncertain. On the left side practically normal movements have been obtained, including pronation and supination of the hand, but the hand and arm cannot yet be raised above the shoulder when the child is more than half sitting up. The action of gravity then comes into play, and the muscles are not yet sufficiently strong to overcome it; the principle of gradual acquisition of function is being followed, however, and the child is being elevated stage by stage on pillows (this gradual elevation is the only method by which weak shoulder girdle muscles can be slowly re-educated to perform their normal natural functions). The improvement effected by rest and muscle re-education in the case under review has been continuous and considerable, and in my opinion no other combination of treatment could have produced results at all comparable.

The Immediate or Ideal Treatment.

For the treatment of infantile paralysis to be placed on a satisfactory footing there must be general recognition of the two guiding principles of immediate anatomical rest and of scientific muscle re-education, both to be applied at the earliest possible moment. Infantile paralysis being a notifiable disease, and the future of sufferers from it being of such grave importance to the community (a cripple is a constant charge on the State), it is advisable that parents of children affected should be given by the health authorities printed directions explaining how rest, especially for the arms, can best be obtained. The day is past when

we can stand calmly by and regard infantile paralysis somewhat in the light of a visitation or punishment; as a scientific profession we can no longer be content to give the hopeless and helpless prognosis "Nothing can be done." One requires to see very few of the complete arm or upper arm old cases of infantile paralysis to realize how miserable is the future of a young subject with both arms paralysed; wasting, shortening of the limbs, subluxation of the shoulder-joints owing to deltoid atrophy, and general disablement, possibly combined with a deformed leg or legs, make death almost preferable. If the lines of treatment above indicated are followed, much that is hopeful and cheerful can be safely promised.

Conclusions.

It is endeavoured in this paper to show that each and every child surviving the first onslaught of infantile paralysis can be assisted to regain muscle power; a few may remain permanent cripples, in spite of every care, but if treatment is begun at once and properly carried out the majority should recover more or less completely. The paralysis is not the disease; it is the obvious sequela. Our aim in treatment is, therefore, not the cure of the disease but the restoration of function; this must be begun at once, before postural defects have occurred, or fibrous changes in the essential structures have taken place. Rest must be given immediately; muscle re-education should be attempted as soon as we can reasonably be sure that the inflammatory process has ceased, which may be at the end of the first week. The clinical signs will be absence of pain, tenderness, or pyrexia. We must remember that unless guided volitional effort takes place, limbs may hang helpless which have, unknown to the individual, recovered a great deal of their power. Whatever may be the explanation of the changes in the spinal cord, it is most important for the physician to realize that the muscles, if only they are handled correctly, will show a large percentage of recovery. We can never tell in any individual case what the extent of that recovery may be, and it is the practitioner's business to exploit it in every case to its fullest capacity. It is essential that the attempt at muscle work be made under the easiest possible physical conditions; there must be no fatigue, and after attempting to work the muscles must be at once adequately rested in the correct anatomical position. Children and parents very soon take an intense interest in every detail of the treatment, especially if in the case of the former an element of play or game can be introduced in the exercises to vary the monotony. The three cardinal points of treatment are: (1) anatomical rest; (2) muscle re-education; (3) general care of the patient, particularly as regards warmth of the limbs, light massage for a short period preliminary to the exercises, careful superintendence of the whole life of the child, and the avoidance of fatigue and strain.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

ACUTE INTESINAL OBSTRUCTION CAUSED BY A HERNIATION OF SMALL INTESTINE INTO THE PARADUODENAL FOSSA.

The following case is of interest for several reasons: (1) the rare occurrence of the condition; (2) the insidious onset and gradual development of the symptoms of obstruction; (3) the ease with which the obstruction was relieved; (4) the rapid convalescence and the absence of shock, which shows the importance of using all anti-shock measures we have at our disposal in dealing with such cases.

I. H., aged 11 years, had complained of a feeling of discomfort almost amounting to pain after coming home from school. Her father, who had some knowledge of medicine, applied massage of a rather violent description to her abdominal wall, hoping by this means to procure an action of her bowels. As this failed, enemata were given, the result being a very slight action dark in colour. On the following day the discomfort and pain were exaggerated, she felt sick, could not eat, and the bowels had not moved, though she had passed some flatus. I saw her in the afternoon, with Dr. E. W. Sharp of Bradford, and found the following: The child was pinched about the face, her tongue was moist and slightly coated. She had not vomited, and she complained of an indefinite pain in her abdomen; the abdomen was not distended, there was a slight general rigidity, it moved with respiration, but there was indefinite