**Our growing children : with special reference to the physical education of the weakly / by Gerard Smith.**

# *Our Growing Children.*

GERARD SMITH.

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## With Special Reference

TO THE

## PHYSICAL EDUCATION OF THE WEAKLY

BY

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# PREFACE.

AT a time when those who are responsible for the elementary education of the children of the people are waking up in England to the vast importance of a definite scheme of physical education (in this late realisation of their responsibilities being behind other nations), there is some danger that the special claims of the weakly children may be overlooked. I have attempted in these few pages to indicate the general principles which it is necessary to have in mind when arranging the physical education of children, but especially of the weakly.

I have ventured to deal with the serious matter of lateral curvature of the spine, and it is to be distinctly understood that in doing this I presume that every parent or guardian having charge of a child who is the subject of this deformity, will, when possible, place the child under the personal care of a surgeon practised in both orthopædic surgery and the special gymnastic exercises adapted for each patient ; but such surgeons are at present very few in number, and it will often

be necessary to rely upon unprofessional treatment. I trust that this little book may prove of use to those who have charge of such children, whether they be professed teachers of physical exercises, or parents.

No one "system" can be set up for the treatment of children with muscular faults and their resulting deformities; a "system" presupposes that all the children under care are alike, and there is only one condition in which this can be the case—I mean when the children are normal and perfectly healthy; under these conditions a defined system is a possibility, and that employed (though with less accuracy and care than could be wished) by our Board Schools is an excellent method. But the weak and faulty child, in a physical respect, needs to be studied apart.

During my experience in treating cases of spinal deviations and other faults in growing children, I have been so struck by the ignorance of parents and others in these matters, that I have undertaken the present work.

GERARD SMITH, M.R.C.S.

37, *Gloucester Place*,
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## CHAPTER I.

FORMATION OF HABITS—GENERAL EFFECTS OF MUSCULAR WORK — POSTURAL FAULTS — SCHOOL HYGIENE—SEATS AND DESKS—EYE-STRAIN IN SCHOOLS.

THE possession of a well-developed and symmetrical body may not be an absolute necessity for the due execution of intellectual work, and doubtless many men and women exist and have existed with undeniable intellectual powers, housed in weak and imperfect bodies; but it is also certain that a boy or girl with a healthy, strong, elastic and symmetrically developed muscular system, a body which is well under the control of its inhabitant, has a decided advantage over the weakly child, since brain work exhausts the strong less than the weak; and a good

physical groundwork keeps at a distance much of that terrible over-sensitiveness which parents and others so proudly boast of as "a highly strung nature"—the modern habit of purely intellectual people, which when fully fixed keeps them in a life-long state of suffering from exaggerated conceptions of both joys and troubles, favours and offences, realities and romances. Such persons live in alternations of impossible optimism and equally untenable pessimism, their want of physical groundwork preventing even their intellectual self-control.

The object, indeed, of all physical training is the attainment of symmetry of body conducing to health, and also the training of the muscles to obey accurately the will; not only for the sake of securing in after life the free and graceful (because unlaboured) combined movements, but also as part of the education of the brain cells in the habit of obedience to the will.

The formation of habits is a real structural work, the brain cells are actually modified by the repeated direction of the will, intercommunicating nerve paths are marked out in the brain which did not exist in the untaught infant; at every repetition of a movement or set of associated movements, the cells act more readily and with less effort of the will in directing them, for the nerve paths become more clearly marked out, and impressions tend to slide more readily along them, until in time the movements or combined actions become almost unconscious or

automatic. They have become habits, bad or good ; they possess the body, which loses control of them. Transfer the picture to the intellectual sphere, and we see the same formation of mental habits as is found in the less mysterious muscular training. The easily repeated muscular movement has its analogue in the ready recalling of memories and words, things stored up in the brain cells.

But this is entering upon too serious ground. What really concerns us in this connection is, that the muscles may be trained to obey the will, as may every other voluntary faculty ; and, moreover, that in muscular exercise we have a means of modifying the activity of the wear and repair of the body. The muscles are the responsible agents of all vital actions and reactions ; they are the seat of those changes upon which depend the due temperature of the body, as upon their activity depends the removal of waste and injurious matters from the blood, muscular contractions enforcing the circulation of the blood, and through it of all other circulations in the body. Digestion, absorption, secretion and elimination are dependent upon muscular work for their perfect performance.

The first effects of active movements are the obvious quickening of the respiration and pulse, on account of the more rapid using up of the tissues this more rapid combustion causing a demand for an increased supply of oxygen, just as with a furnace

more air is drawn in to complete combustion. This oxygen must be supplied by the lungs, hence the breathing becomes more rapid, and with this the circulation of blood through the lungs becomes more free (the blood being the carrier of oxygen to the tissues, taking up, as it does, the oxygen in the lungs) the heart meets the demand by increased action.

A man lying down, having a pulse of about 66, will, on sitting up, increase the pulse to about 70, and on standing up to about 75 or 80, simply because each position is one in which more muscular action takes place than in the former one. And this increase of respiration and circulation are reciprocal, or should be, in a state of health, neither being hurried beyond the demands of the other. In the well trained athlete this reciprocal action is properly educated, though even in him, the first rapid effort of running, for example, leads to some increase of the rate of breathing before the heart rises to meet the demand. As he goes on, however, sooner or later he gets what is called his "second wind," which means that he is no longer out of breath, as the heart and lungs have struck a just balance of action, and he can now go on until his strength is exhausted if need be—and increased supply of oxygen means more rapid waste of tissues, and therefore more rapid formation of waste products, chiefly of carbonic acid gas, which must be removed by the lungs, or it collects in the blood, blocking the free interchange of oxygen in the lungs.

This means carbonic acid poisoning, the chief symptoms of which are the retarding of the blood in the right or respiratory side of the heart, and the blockage of the breathing evidenced by laboured breathing and a blueish colour of the surface. The distressed state of a person undertaking violent exercise when not in fit condition, is not, therefore, one to be lightly regarded, and the occasional death of an elderly person during unusual exertion is proof of this danger. Elderly people may safely take even violent exercise, if from childhood upwards they have never given it up for any length of time, but it is seldom in this working age that such is the case. Few men or women are able to keep the due reciprocal action of heart and lungs equable for violent exercise after their young days.

It will be evident also that other organs besides the lungs will have a more free supply of blood during exercise, and thus many excretory organs, such as the kidneys and skin, perhaps loaded with waste products waiting for removal, will be enabled to throw off their burdens. We are always at work poisoning ourselves, unless by exercise we clear the excretory organs, and if we duly perform this duty our bodies are ready for taking in fresh supplies of fuel, appetite keeps up, and health results.

Sensations of weakness are not always the result of over-exertion ; many people feel continually out of tone, and come to the doctor for that refuge of the

drug worshipper, a "tonic"; they get the idea that more food is required, they take this at extra times, and perhaps add the most burdensome substance of all carbons—alcohol—to their food, in order to gain strength, thus piling on the blockage of the blood still more. It must be recognised that the feeling of languor and weakness is one of the results of the accumulation in the blood of our self-poisons, and that exercise removes these and gives refreshment and vigour.

Our brains, the organ of mind, partakes in these results. Blockage in the brain cell is not always only the result of absorbing cranky and exhausting ideas, but is often simply due to want of muscular exercise. The mind will not keep clear, and our life and expressions will not be the reflex of our true selves if we allow this blockage; regular, free and boylike exercise is the means of attaining to a real self-control, mental and physical.

The increased blood supply to a moving muscle is felt at the commencement of exercise as an aching or stiffness, the muscle swells up with blood. This is felt in healthy muscles, but passes off, as they get their "second wind" and the blockage passes away; the muscles then work on until fatigue from want of fresh food supply comes on. A weak muscle, however, will tire without this preliminary stage of swelling up with blood and consequent aching; the weaker muscles may be equal to a slight and short

effort with less aching than is felt by the strong ones, any slight aching in the muscles early in an exercise is, therefore, rather a sign of healthy circulation than the reverse, and those who feel no such swelling of the muscles are often persons who soon get exhausted.

The first steps in the education of the infant consist of learning to direct the movements of the limbs at the bidding of what can at first be scarcely termed its will, since the efforts are little more than mere reflex actions; when the eyes have learned to rest upon an object, or to follow a bright light the hands instinctively try to grasp what the eyes have recognised. At first the movements are not accurate, but are apparently aimless, and this wandering and jerky movement is only slowly replaced by direct and successfully aimed movement. The brain cells concerned in the various actions have to be educated and to be connected by nerve paths or threads which this education forms, from cell to cell. When this stage is attained the mere reflex movements, such as the closing of the hand when the palm is touched, or the movement of the eyes in following a light become will-directed and attain their aim. This process of path making among the brain cells is the habit forming before mentioned.

The infant is constantly on the move; it quivers with little muscular thrills and jerks, undirected or misdirected nerve discharges, and during the whole of child life this fidgetiness is the natural state. A

healthy child cannot keep still for more than a very few moments. Such an effort is a task for a child it is work, to be learned by degrees, and if too much stillness be demanded of a child, exhaustion and irritability is the result. Those who have to teach children should remember that movement is a child's rest, and enough of it should be scattered amongst the lessons.

The matter of what is called "over-pressure" in school work is not in my present scheme, but I may remark that I think the danger is not in the actual amount and number of the tasks set, as it is in the cast iron system of grading on the competitive lines which keeps anxious and conscientious children in a life-long state of worry, and fear of coming failure and catastrophe. Dull and stupid children, who have been told almost from their birth that they are the best and most faultless darlings the world has ever seen, and no children can ever equal them, will not suffer thus; but the clever, sharp, and therefore nervous child, who at the same time has not been praised too much, will not have a happy school life. There are also those most unhappy ones who have talents only in some special direction, and who are not capable of learning in other lines, who have to suffer very greatly because nobody ever discovers what their brains are fit for. The mental sufferings of such children are severe and pitiful.

Over pressure at school is inevitable in our day,

and will continue to be so for all classes of children who will have to work for their living ; the choice has to be made by the majority of parents between the mental health for the child and its progress amongst its fellows. One or the other is likely to suffer, except in the case of the children of the wealthy, whose education may take as much time as is convenient, and may proceed in the natural and gradual way, since there is no hurry for them to be thrown out on the world to get their living.

We have it in our power, however, to do much towards minimising this evil, by insisting upon a fair alternation of physical and mental occupation in school. After school hours, at all ages up to fully 10 years, lessons should cease, no home work being taken away to worry over up to bed time ; there should be plenty of time allowed before bed time for all trace of lesson worry to evaporate from the brain. Before, after, and during lesson hours, there should, at all ages before 15 years, be sprinkled shorter or longer intervals of physical exercise, which should be compulsory—especially with girls, who are more apt than boys to resent active exercise ; indeed, girls suffer more from over brain work than boys for many reasons ; a healthy boy, no matter what he may be doing, at the instant the bell rings to close school, will shut up his book and his brain at the same moment and rush off to his play, but the girl will soberly walk home, pondering upon her chances in

some coming examination, or of getting the better of another girl, or of other worries connected with her lessons; she is both more ambitious and more conscientious than the average boy, and has more of the competitive spirit in matters intellectual.

Below 7 years of age, all work should be play; from 7 till 12, brisk play should be put in short periods between the head work, and up to 15, there should always be at least half-an-hour given up to active exercise, in the course of the five hours which should constitute a day's brain work.

This is not a treatise upon school hygiene, so I will pass over the matters of diet and clothing, &c. I suppose that I ought to apologise for having so rashly entered upon the realm of intellectual work in children, but we do still worship those sad cases of pathological intellects; there is only one sight more sad than that of a precociously learned child, and that is the preternaturally religious infant—both are diseased products.

There are certain faults of school-life, on the physical side entirely, to which we must direct attention; the first in importance are those faults of posture seen so often in children. Every position taken in school should be part of muscular education, for every position of the human body is produced by muscular action, and this should be symmetrical and balanced by the due action of opposing muscles or sets of muscles.

The most fertile source of faulty postures in school are seats and desks constructed upon wrong principles; a child may be absolutely forced into bad positions by bad seats and desks, positions which lead to permanent deformity of the spine, if they are such as unequally exercise the muscles attached to that part.

We do not need luxurious seats for school children, which would encourage lazy habits of sitting; seats with backs fitting into every curve of the back up to the neck, take away the responsibility of the muscles to retain a healthy sitting position, but the angle of the seat with the back, and the shape and slope of the back of the seat must be such that the child has a constant hint of what is the correct position, the base of the spine, the pelvis, must be held upright upon the two natural points of bone on which we sit—the tuberosities of the ischium as they are called—and the angle which the back of the seat makes with the seat itself is responsible for this matter; the seat itself must so slope that the child naturally slides back against the back support. I am strongly in favour of a seat with a low back support which is inclined backwards only slightly, and is so shaped that the natural hollow of the last section of the spine is filled up when the child sits upright.

Fig. 2 gives an idea of the faulty position of the spine due to too low a seat.

Fig. 1 is Liebrich's seat and desk, with adjustable

foot-rest, the chair raised or lowered on movable boards. This seat and desk is the best which I know of.

The position of the feet is secured by a foot board at a natural slope, and children should be made to use this when at work; the desk must be at such a height that the arms rest upon it naturally when sitting upright, and the edge of the desk must come

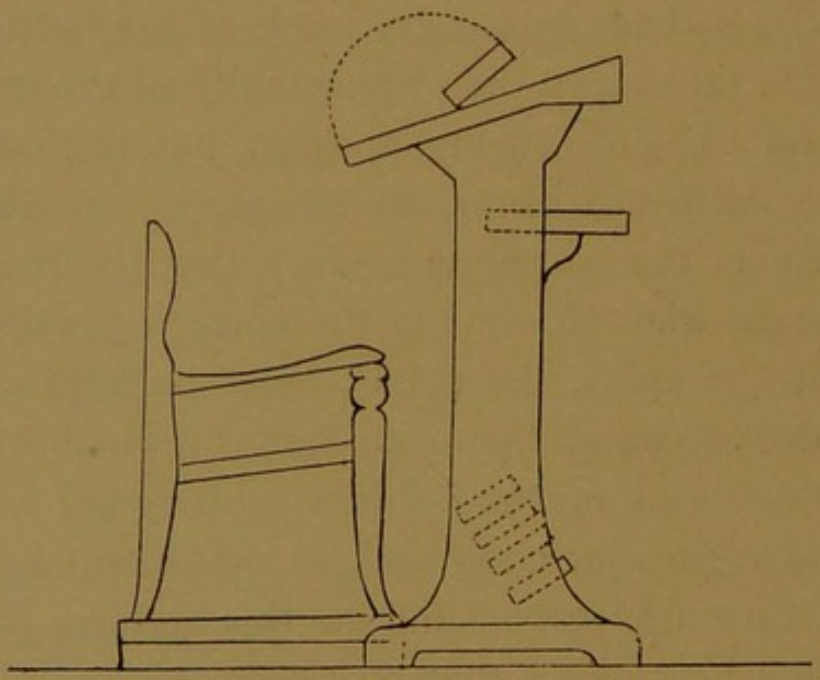


FIG. 1.

near enough to the child to enable him to read easily from the book when sitting upright; this necessitates a slope for the desk, which would be too sharp for writing purposes; some means of raising the lid, or a separate support on the lid, must therefore be made. It is obvious that as children vary in height and in proportions, these various parts must be adjustable,

as also must the distance between the desk and the seat; there are many good forms of such desks and seats on the market, amongst which the best as regards price, &c., can be chosen.

I am speaking of healthy children, and therefore hesitate less in advising the low back support; if a weakly child needs a high support, it should be such as may be used or not, at will; the seat may be as I have just described, with the addition of a slightly sloping continuation of the back.

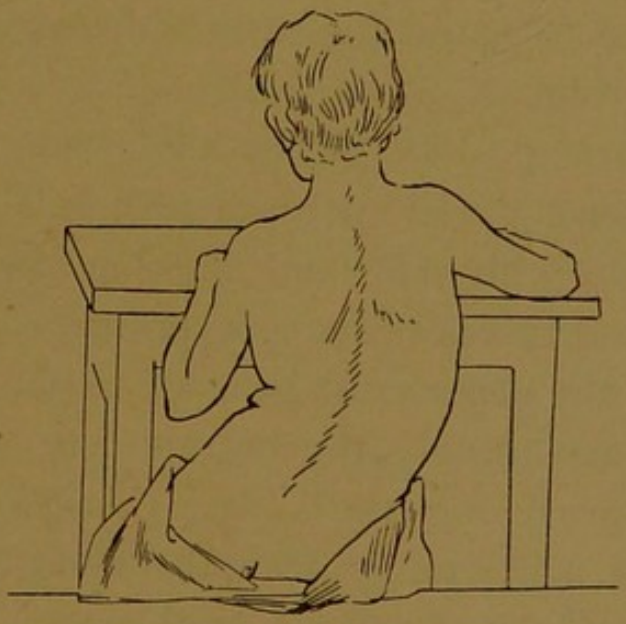


FIG. 2.

In writing, the child cannot see the work well it sitting upright, since the paper must rest on the desk; the child therefore leans straight forward, but only slightly and straight from the hips, not bending the spine much. I fear that I am on delicate ground

when I speak of the position which the paper should occupy, because the old-established conventional position is very dear to many teachers: the paper straight before the pupil in the middle line, its edge parallel with that of the desk, the elbow close to the side, the hand pointing straight forwards; but I believe that this position is an extremely constrained and faulty one, obliging the child to so twist the spine that it takes a serious faulty posture; or, if the child does not do this, he places the paper more to his right, thus securing a possible position for the writing hand, but being forced to crane the neck sideways, and overwork his eyesight.

The natural position of the arm, when the pen is held easily and placed upon the desk, is slightly away from the side, with the hand slanting slightly across the chest, and this is the proper position for the hand in writing; the paper must be made to follow this, and be sloped accordingly, the bottom left hand corner slightly approaching the body; this gives an easy position, the paper easily seen, the hand in a natural position, and the writing a legible and neat slope. Or the paper may be sloped the opposite way, the bottom right hand corner downwards, and the child and seat turned to the right, the paper being to the right hand of the writer.

As to this position in writing, I am rash in entering the arena; my own handwriting is the worst possible, due to the fact that much of my leisure school time

was occupied in writing reams of impositions, the value of which as correctives of my various evil tendencies was computed, not from what they taught me, but from the number of lines accomplished, a most absurd and inefficient method of punishment. Whilst testing for the best form of seat and desk, and position in sitting, for the school child, a very important matter will arise—it is the question of the eyesight in children at school; it is a fact, that all the influences which go to form the myopic or short-sighted eye, may exist in school; comparatively few persons become short-sighted in mature years (excepting, of course, in old age), many cases of the defect of short sight no doubt come on during school life, as the result simply of weak health. With perhaps, in the case of the poor, insufficient food, and other debilitating causes, there remain, however, a large proportion of cases which might have been prevented by attention to the position of the child, and the lighting of the schoolroom.

Too long hours at work, of course, can be passed over as too obvious causes; size and clearness of print is another matter to be attended to, especially in the case of the German language; the making of maps upon too small and detailed a scale is another fault too often found; the object of maps should only be to teach the broader characteristics of coast outline, &c.; small handwriting, with (in the case of girls) fine needlework, come also under consideration.

All these things lead to eyestrain, and before the sight gives in, there will very often be found headache; eye-strain being the most common cause of headache in school children, a child may be, quite unconsciously to itself, over working its eyes and the headache may be the only symptom of the fact; but the young eye has a great power of working at short range, and children will get a habit of holding the eyes too close to their work if not corrected by being kept in proper sitting position, for eyes can be trained in a very short time to work at *un*natural range. In lighting school rooms, the windows must be placed at both the back and sides of all rooms which are too deep for one set of windows to light the furthest end; the windows should reach to near the ceiling, and should be square at the top, not tapering off to a point, whilst outside there should be no ornamental overhanging eaves or other obstructions to the entrance of light from the sky. If it be necessary to modify the light (and the room should admit direct sunlight for at least some part of the day) the blinds should be of a semi-translucent material, and not of any of the primary colours, a neutral tint being the best—brilliant primary colours tire the eyes by the one set of vivid impressions.

It is an absolutely essential rule that no child should face the light when reading or writing, and black boards should be placed so that the light does not get reflected from them to the eye, or any shading of

the eyes from stray light be needed; the surface of such boards should be dead black, and not glossy. It should be distinctly understood that the eye is capable of being altered in shape by efforts to focus objects at short or long range, and that this effort, if long continued, brings about a permanent alteration in the form of the globe of the eye, and establishes the long or short sight.

Of course, many cases of long sight from short eyes, or short sight from long eyes, are the result of hereditary faults, but they may also be made out of naturally normal eyes by such errors as I have enumerated. Astigmatism, or inequality of curve of the front of the eye (the cornea), is an affair of heredity and will be identified by the oculist.

It is obvious that the occasional performance of systematic muscular exercises at intervals during school time, will be the best relief to the eyes possible. I cannot enter upon the large subject of the ventilation and warming of the room, my object being only to deal with matters affecting posture and muscular movements in children.

The faulty posture taken by the child who has acquired short sight by the habit of working the eyes at short range, or by any other cause, is one which will often produce squinting, the eyes converging towards the work; this is another reason why we must ensure a good relative position of the eyes and the work so that the eyes may be approximately parallel in working.

## CHAPTER II.

### General Arrangement of the Chief Muscles.

A TEACHER of remedial exercises must have at least an elementary knowledge of the points of attachment and action of the muscles which may be at fault and need educating, and in the slight outline which follows, it must be understood that I am writing only for the uninitiated, and that this has no pretence to be anything but a mere enumeration of the muscles, with their positions and actions.

The names of the muscles are fixed by very old anatomical customs, and we cannot well attempt to translate them into plain English, which is apt to be very much longer in expressing these things than is the Latin ; I shall keep mostly to the old names here, but the names of the muscles are of no importance, so long as the teacher carries in the mind a picture of their positions and uses.

The minute microscopical characteristics of muscular fibre, and the phenomena of contractility upon which depend the action of muscles, would be out

of place here, all those matters can be learned from books on physiology. I will content myself by saying that the action of a muscle consists in shortening, so that the two ends of the muscle move nearer to each other when a stimulus is sent down the motor nerve supplying the muscle, whether that stimulus be at the command of the will, or the reflex effect of any other external influence. If both ends of a muscle be movable, obviously both the parts to which it is attached will move when it contracts, but as a rule, one end is fixed by the action of other muscles, when the special action of any muscle is called out, so that only one end is free to move. The arm, for instance, may move when the shoulder is fixed. Again, many muscles are fixed to the body at one end, and to a limb at the other; or in other parts they may be fixed to a heavier part at one end than at the other, the lighter weight will then be moved. The fixed end of a muscle is called its origin, the movable one its insertion, and these two are interchangeable at will; for example, the muscles in front of the chest called the pectorals, when pulling the arms towards the chest, as in rowing, have the fixed point or origin at the chest, the arms being the moving end; but if the hands grasp a bar over-head, and these muscles pull, they raise the body from the ground, the movable point being then the body.

The state of rest in muscle is not one of absolute relaxation, that is, when we are in the waking condi-

tion ; during sleep it is probable that the voluntary muscles are absolutely at rest and quite relaxed, but when awake, even when a man is perfectly still, the muscles are in a state of slight and constant contraction, a condition of what is well called "tone," and a state from which as a starting point, the condition of shortening and actual work can be immediately called forth by the will ; it is evident that, unless this state of readiness existed, the first part of the contraction would be wasted in bringing the muscle to the necessary position of tone. It is probable that when a man is weak and wants "tone" his muscles really are in the condition of sleep, and his feeling of slackness depends upon a true state of this kind ; more effort is required in such a state in order to do muscular work. The absence, or exaggeration of this tone is indeed a very valuable index to the physician or surgeon, of certain states of the nervous system ; the position of the patient in this respect being tested by galvanism.

The muscles we have to deal with in remedial gymnastics are the voluntary ones, those which are under the direction of the will ; the involuntary muscles, namely, the heart and respiratory muscles, and those of the arterial and intestinal system, &c., are not, however, out of our power to improve, since the exercise of the voluntary muscles acts indirectly upon the involuntary. Respiration and circulation, absorption, digestion, secretion and excretion, are

all increased and stimulated by the exercise of the voluntary muscles, and the whole state of health thereby influenced for good, so long as the exercises cause not the slightest exhaustion.

Of the 480 muscles of the human body, mostly arranged in pairs on opposite sides of the body, we need only deal with those which produce the larger movements, those pairs in which a symmetry of action may lead to deformity; this equality of action must extend to the state of normal tone, for a relaxed and "atonic" state of one muscle or set of muscles on one side of the body, may lead to the opposite muscles gaining too great power and pulling the parts out of symmetry, a condition which in many instances, such as in the spine for example, would lead to serious deformity.

The three forms of lever, well known, no doubt, to all my readers, are exemplified in the arrangement of the muscular system, the first order of lever being that in which the fulcrum is between the weight to be moved and the working power; this is well shown in raising the body at the hips from the stooping position, the fulcrum being at the hips, the weight the body, and the power in the hamstring muscles.

In the second order of lever, the weight is between the power and the fulcrum, as in raising the body on the toes where the weight is that of the body on the ankle joint, the fulcrum at the toes, and the power in the calf muscles, and the third order is where the power

is between the fulcrum and the weight, as in bending the fore-arm at the elbow, where the weight is the hand and fore-arm, the fulcrum at the elbow joint, and the power in the biceps muscle.

The angles at which the muscles act is often such as to sacrifice power for the sake of rapid and free movement through a large space, and for compactness of form. As an example of this, take the biceps of the arm, its tendon is inserted close to the fulcrum; if it were fixed nearer to the hand greater power would be gained, but at serious sacrifice of space and freedom, and rapidity of movement and of beauty of form.

Most muscles act in the direction of the axis of their insertions, but there are examples where the direction of a muscle is changed by pulling over an angle, the tendons being between the two ends of the muscle, and running through special loops or pulleys of tough, inelastic membrane, holding the tendon down, and the further part of the muscle changing its direction.

The muscles which are on the surface are generally the longer ones, moving larger parts through free movements, and having their origin and insertion at some distance from each other; the deeper layers of muscles are as a rule shorter, and act through more confined movements, and parts nearer together.

In some instances, the contraction of a single muscle suffices for a single movement, but as a rule

several muscles or groups of muscles move in concert, as associated sets. Some muscles act at times as movers of a part, and at other times to fix a part in order that it may become the firm point from which other movements are made. Muscles assist, limit or restrain the actions of others, and all in the state of perfect health act smoothly in concert with each other in multiform combinations, constantly varying and rearranging themselves with almost unconscious ease.

Obviously, every movement has its muscles, and so we can name them according to the work they perform; some extend limbs, others bend them, these are "extensors" and "flexors," the former at the back of the limbs, spine, &c., the latter in front. For the sake of simplicity in naming, we call the pointing of the foot extending it, though it is an arrangement open to contradiction, in all other instances the rule holds good; there are also muscles which twist, "rotators"; others which pull the limbs towards the body, these are the "adductors"; others from the body, "abductors"; some which turn the hand on its back, so to speak, called "supinators," and others reversing the movement, the "pronators."

I have spoken of the reversal of the origin and insertion of muscles; there are many instances of this reversal coming about by ordinary necessities, but as a rule, the normal action of a muscle is from the body by its fixed point, or in the case of the limbs, from

the end nearest to the body or the origin or fixed point. The reverse action, which is less natural and seldom called for comparatively in ordinary life—as when muscles which normally move the arms, are made to pull the whole weight of the body by fixing the hands on a bar—is a strained and abnormal action, though any healthy man can constantly perform such movements, and should be able to move all his muscles in every possible way at any moment; yet in the case of the weakly children and young persons, with whom I am dealing in these remarks, such heavy and strained abnormal actions of the muscles do not come under consideration. There has been much harm done in the past by heavy gymnastics performed with wrenching swings and bars, heavy dumb-bells and clubs, &c. Even in the ordinary school gymnastics of our healthy boys, this system did not develop each muscle gradually and naturally; it produces trick gymnasts, but it is a system in no way suited to equally, and gradually, educate muscles which are at fault in their development, and cannot properly perform the normal duties demanded of them.

For the elementary sketch of the chief muscles which I shall now give, it will not be necessary to isolate every individual muscle, since in the exercises we apply we treat the muscles in groups having like functions; in many instances, therefore, I shall not separate out each member of the group.

The first group, that formed by the spinal muscles,

is one of considerable complexity, and to deal with it in anything like detail would greatly extend my sketch; I shall therefore simply class all the muscles behind the spine as erectors, and those in front as depressors of the spine. Figs. 3 and 4 show the chief muscles, the deeper groups being seen on the left side of the figure.

A large series of small muscles arising (having their origins) from the side processes of the vertebræ and passing to the backward processes of each vertebra above are not here seen, they are deep down, and are muscles which we cannot consciously direct by exercises; in this deep layer are also a series of little slips of muscle between the vertebræ and the ribs close to the spine, which act either as aids in erecting the spine, or as raising the ribs in breathing, according as the movable end is at the ribs or the spine; these also we cannot consciously direct, though they are no doubt exercised when any spine movements are performed.

Nearer the surface we come to the bulk of the erector muscles of the spine, some members of the group are seen between one vertebra and the next, and some attached to the vertebræ and the ribs, called the posterior serratus muscles, upper and lower "serratus," because "saw-like" where they are fixed to the ribs.

The great mass of this group is made up by the muscles which we feel when we have lumbago; it has

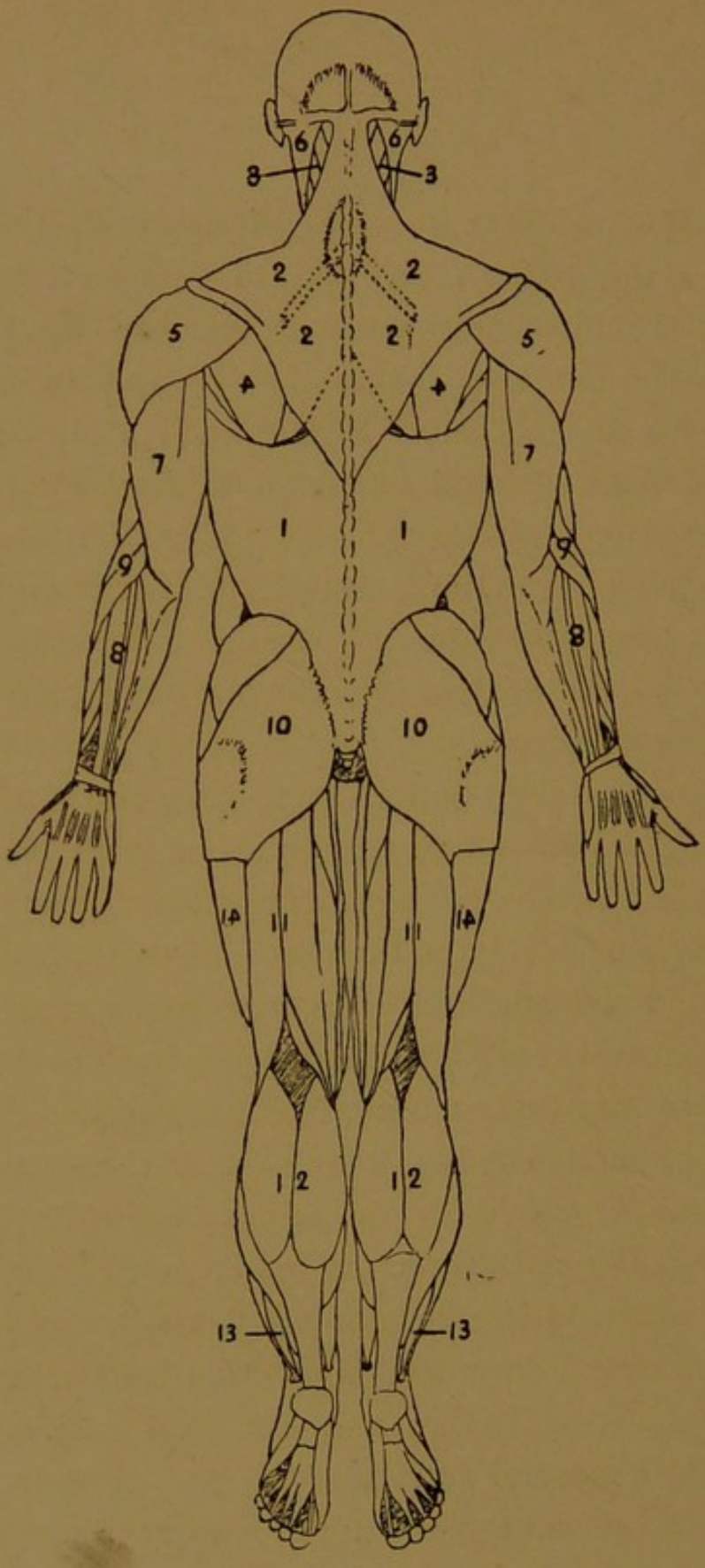



FIG. 3.

1. Latissimus dorsi (covering lower erectors). 2. Trapezius, (covering upper erectors and the rhomboids). 3. Erectors of head and lifters of angle of shoulder blade. 4. Scapular muscles. 5. Deltoids. 6. Sterno-mastoids. 7. Triceps. 8. Extensors of the hand and fingers. 9. Supinators. 10. Gluteal muscles. 11. Hamstrings. 12. Calf muscles (flexing leg; pointing foot). 13. Peroneals (abductors of feet). 14. Abductors of thighs.

origin from the last bones of the spine (the sacrum) and from the back of the pelvis, and runs up in sets of various length to be inserted into the ribs, the last portion passing quite up to, and to the side of, the neck vertebræ ; the total office of the group being to hold the back upright, or to raise it after stooping, and this action includes the neck and with it, therefore, the head. These spinal groups are placed on either, side of the spine and covered by the superficial muscles to be next described, they are not seen in the figure, being deeper down.

But this erecting of the spine refers only to when both the sides are acting equally, if one side only acts or one side more than the opposite, then the spine and body are bent to the acting side, or the ribs on that side are pulled back with the twisting round of the upper part of the spine, the chest being thus turned round one way or the other ; immediately under the skin, and overlaying the lower bulk of the erectors, is seen a muscle called the broad back muscle (latissimus dorsi), it passes from the lower part of the spine upwards and outwards, wrapping round the side of the chest, and is inserted into the upper arm bone (humerus); it pulls the arm downwards and backwards in the normal action, but if the arms be fixed by grasping a bar, these muscles will pull the body to the bar or break the bar.

Partly overlapping this last, and arising from the upper two-thirds of the spine, is the trapezius muscle,

a broad triangular muscle, inserted into the ridge on the blade bone (scapula), the ridge being called the spine of the scapula. If the whole of the muscle on both sides act together the shoulders are braced back, if the upper parts only act the shoulders are raised up towards the head, whilst if the shoulders are fixed by the lower part of this muscle, the upper part may pull the head and neck backwards, helping other muscles. Very little consideration will show how important it is that children should not fall into bad habits in the use of these muscles, since the straightness of the spine depends upon their equal action.

Other muscles attached to the shoulder blade are seen in the figure, one arising from the neck vertebræ by four tendons, is inserted into the top and back point of the blade bone, it helps to raise the shoulders, and is called the lifter of the angle of the scapula (levator anguli scapulæ) ; below this there are two muscles arising from the spines of the dorsal vertebræ, and inserted into the back edge of the scapula—they are called, from their shape, the rhomboid muscles, they pull the shoulders back.

Underneath the scapula, arising from its underneath edge and passing forwards round the chest, to be inserted into the ribs in many pointed masses or tongues, is the very important muscle called the great saw muscle (serratus magnus), the scapula rests upon it. When the shoulders are properly held in place this muscle pulls up the ribs in breathing, it does so at all

times, but acts more efficiently if the shoulders are held well back; this muscle also strongly forces the shoulders forwards, as in pushing an object in front (seen in fig. 4 where its "teeth" are inserted into the ribs at the sides.) This is the muscle well seen in a muscular and well-conditioned horse, which ignorant people mistake for its ribs; it is one of the extra breathing muscles. A person in any great difficulty of breath, as in asthma, will often grasp something with the hands, so as to fix the shoulders and permit this muscle, with others, to raise the ribs at each breath. Underneath the scapula, also, is a mass of muscle filling its hollow; from its position under the scapula it is called the subscapularis, it is inserted into the top and front part of the humerus, it acts to rotate the arm outward and to fix the shoulder, as well as being an adductor of the arm.

At the back of the scapula there are four muscles acting as a group to adduct the arm and rotate it outwards (*i.e.* to turn the thumb edge of the hand away from the body); these four are the supra-spinatus, arising from the hollow above (supra), the spine of the scapula, the infra-spinatus from below that ridge of bone, and the two teres muscles, major and minor, below the infra-spinatus, all four are inserted into the upper part of the arm's bone.

The great deltoid muscle now claims our attention, it forms the full roundness of the shoulder, protecting the joint, its action being the constantly demanded

one of raising the arms at the shoulder. Arising from the greater part of the spine of the scapula, and part of the collar bone (clavicle), the outer fibres pass under the inner ones, and thus are enabled all to pull with equal effect; being inserted into the upper and outer part of the shaft of the arm bone (humerus), the deltoid raises the arm to the right angle, the further raising of the arm being performed by the upper part of the trapezius.

Opposed to the muscles I have described as drawing the arms backwards and upwards there are, in front of the chest (fig. 4), the great breast, or pectoral muscles; the lesser pectoral arises from the third, fourth and fifth rib, and passes upwards and outwards to be inserted into a little process from the scapula, which points forwards under the collar bone and forms part of the shoulder, this is the coracoid process; the larger pectoral muscle arises from the greater part of the front of the chest and from the collar bone, and is inserted into the upper arm bone or humerus. The tendon is twisted on itself at the insertion, this arrangement securing the equal pull of the whole muscle; the great pectoral pulls the arm toward and across the body, and also rotates the arm inwards.

The neck and head muscles amenable to exercises may be divided for our purpose by a rough and not anatomically correct classification; those which extend the head, pulling it backwards, those which bend it forwards—and certain groups of these also rotate

and bend the head sideways; the muscles which pull the head back and keep it upright, are practically the upper portions of the erector spinæ group, passing from the upper vertebræ to the back of the head; the occipital bone which forms that part of the head is really another vertebra especially modified for its purpose. The complexus and splenius muscles form this group. When both sides act the head is drawn back, when one side only, the head is pulled to that side; these muscles are covered by the trapezius, which muscle, as also the levator anguli scapulæ, act as pulling the head back if the scapulæ are fixed by other muscles.

Further to the front, at the sides of the neck, there is a group between the vertebræ and ribs and the head, attached also as to part of the group, to the scapula; we need not examine them in detail, they are the scalene muscles, bending the head sideways, if the scapula are held firm, and shrugging the shoulders (with other muscles) if the scapulæ are free to move. More important from the exercise point of view are the sterno-mastoid muscles, they run from the centre of the neck in front; arising from the collar bone and top of the breast bone, or sternum, and passing up the side of the neck, are inserted into the great bosses of bone behind the ears, the mastoid processes of the temporal bones; when both act the head is bent forwards, when one only acts, it pulls the head round to the opposite side.

I shall not attempt an enumeration of the muscles

of the tongue and throat, as I shall not enter into the great question of voice production, which can never be taught by a book.

The arm muscles next claim attention. In the upper arm at the front is the well-known biceps arising, as its name implies, from two heads, the inner from the coracoid process before mentioned, the outer from the top edge of the shallow socket in the scapula, against which the head of the upper arm bone works. The long round tendon of this outer head of the biceps passes in a deep groove on the outer side of the head of the arm bone and is held in the groove by ligament, this arrangement helps to keep the arm bone in place, the two tendons join into the mass of muscle which is inserted into the outer of the two forearm bones (the radius), and being so placed as to bend the arms and rotate it inwards. I have already mentioned the reasons for this muscle being attached to the short end of the moving lever. Behind, and partially hidden by the biceps, is the great anterior, or front muscle of the arm (brachialis anticus), it passes from the humerus to the inner bone of the forearm, the ulna, and helps the biceps in action; from the coracoid process to the arm also passes a little muscle, the coraco brachialis, being a miniature pectoral muscle, and acting both to fix the shoulder, and as an adductor. The great extensor of the arms is, of course, at the back, it is called the triceps, having three heads of origin, the middle or long head, arising

from the scapula just below the joint cavity ; the outer head from the humerus, parallel with the joint, and the inner head from the same bone a little lower down and internally ; the three heads join at the back of the arm, and are inserted by a strong broad tendon into the elbow, the ulna here forming the point of the elbow. The action is, of course, to extend the arm, as in striking, or to push, or lift the body if the arms are fixed.

The forearm muscles are too complex to allow of a detailed enumeration here, it will be sufficient to observe that the group of flexors of the hand and fingers are in front of the arm (the palm aspect), the extensors behind, that the chief bulk of the outer, or thumb edge of the forearm is formed by the supinator muscles, which turn the hand palm upwards, and that the muscles having the opposite action, the pronators, turning the hand palm downwards, are deeper in the forearm. The exquisite arrangement of the palm muscles we must pass over, it will be obvious that the adductors of the thumb and little finger are in the palm, the abductors on the edges of the hand.

I now come to the group which act as opponents or balancers of the erectors of the spine; those muscles which raise the body to the sitting from the recumbent position, and bend the body forward in stooping. If all the muscles behind the spine be cleared away, there will come into view in front of the spine, or partly in front, and partly at the sides, a

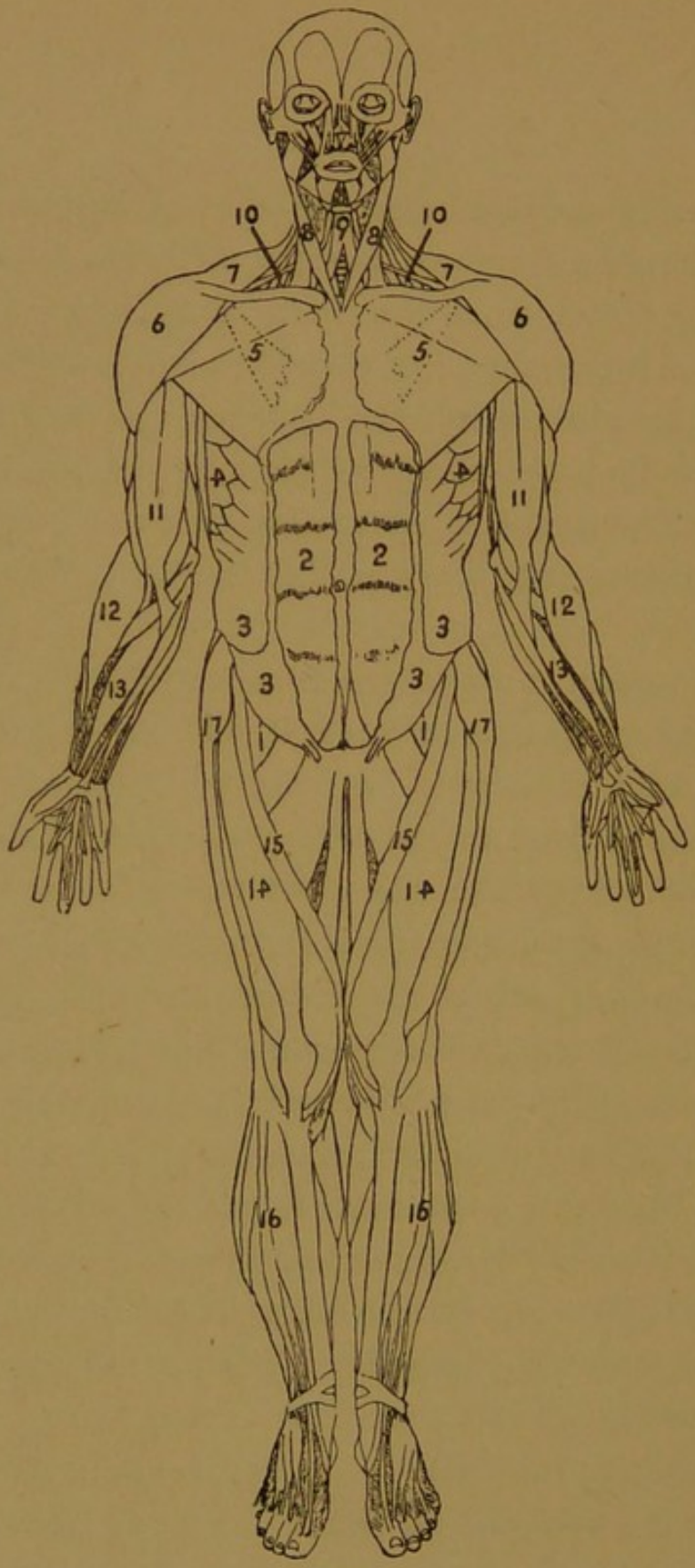



FIG. 4.

1. Insertion of psoas and iliacus. 2. Rectus muscles. 3. External abdominal muscles. 4. Insertions of serratus magnus. 5. Pectorals. 6. Deltoids. 7. Trapezius. 8. Sterno mastoids. 9. Muscles of larynx. 10. Benders of neck and raisers of first rib. 11. Biceps. 12. Supinators. 13. Flexors of hand and fingers. 14. Extensors of thighs. 15. Tailor's muscle (sartorius). 16. Raisers of feet and toes, and abductors of feet (peroneals). 17. Abductors of thighs.

pair of muscles passing from the crest or upper edge of the wing-like pelvic bones, a strong, square-shaped pair of muscles, called the quadratus lumborum; they are chiefly side benders of the body, but also forward helpers, and from the side processes of the great lumbar vertebræ, passing downwards inside and at the back of the abdomen, to be inserted into the thigh bones at their upper and inner aspect, are the great psoas and iliacus muscles, the chief benders of the body forwards, or, when the body is still, they raise and rotate outwards the legs. The iliacus muscle does not arise from the vertebræ, but from a great part of the pelvis, in acting it pulls on the pelvis not directly upon the spine.

The front of the abdomen is a sheet of muscles and tendinous expansion, at the centre there are two parallel muscles running from the bottom of the breast bone to the pelvis, these are the rectus muscles of the abdomen; being very long and thin they are strengthened by having bands of tendon across them at intervals, they are really a series of little square muscles held together by tendons, thus gaining more rapidity and power of action than if they were all one length of muscle, and other sheet-like muscles at the sides of the abdomen—their fibres passing in different directions—act partly as side benders of the body, and as breathing muscles, and also as compressors of the abdomen. The tendinous sheet at the centre of the abdomen forms the common insertion

of these muscles, except that of the recti, which are outside the tendon.

The diaphragm is a sheet of muscle closing the lower aspect of the thorax, its insertion being a central flat tendon; in descending it fills the lungs, the ribs rising at the same time, and the cavity of the chest being thus enlarged, as the diaphragm rises, it helps to expel the air from the lungs.

At the back of the pelvis we see the muscles between the pelvis and thighs, the gluteal muscles, forming the bulk of this part; there are three gluteals, one beneath the other, the largest being uppermost, and hiding the others from the position of their insertion into the thigh bone. This group pull the thighs back, and so push the body along in walking or running, they are used in jumping, and they rotate the thighs outwards and abduct it by pulling on the pelvis, they are erectors of the whole body. The adductors of the thighs are deeper placed, they pass from the pelvis to the head of the thigh bone, other adductors pass from the pelvis to the inner aspect of the shaft of the thigh bones.

The extensors of the thigh are in front, arising from the front of the bone and the pelvis, and attached to the knee-cap, which is attached to the front of the head of the larger leg bone, the tibia; with this mass of muscles we oppose those behind and extend the leg, as in kicking, walking, &c., or raise the thigh in front of the body. The "tailor's muscle," or sartorius,

is a thin strap-like muscle crossing from the outer point of the front of the pelvis to the inner side of the tibia at the knee—it acts in crossing the legs.

The flexors of the leg on the thigh, and those muscles which act with the gluteals in forcing the thigh and leg backwards are behind the thigh—the ham strings they are called—they pass from the pelvis to the leg below the knee. The flexors of the foot and toes are on the sole aspect of the leg, the abductors of the foot at the outer edge of the leg, and the muscles which bend the foot up on the leg are in front; when the foot and leg are turned outwards or inwards, you will find that the thigh moves also; the rotators of the thighs we have glanced at, and the ham strings help in these movements by one set acting alone, as they do also in the abducting and adducting of the thigh. The more minute muscles of the feet do not concern us in exercises, I will now therefore close this outline sketch of the position of some of the muscles.

## CHAPTER III.

### Suggestions for Arrangement of Exercises.

It is not possible to teach in writing the exact details of exercises, but I hope that the sketch of the muscles which I have given will enable the reader to obtain at least an idea of what constitutes a set of exercises. The following notes are not given with any pretence to supplying any system or fixed series of muscular exercises, but are merely hints upon which any intelligent person can found a convenient series of gradations in simple movements for weakly persons.

Bearing in mind that I have expressly stated how objectionable are the usual heavy gymnastics, which wrench and strain the muscles and joints, and are often founded upon the reversed or abnormal actions of the muscles; you will not expect to find here any description of swings and bars, or other machines for the teaching of the trick gymnast, our object being the gentle education of imperfect muscles.

Exercises may be passive or active, that is to say,

the pupil or patient may give himself passively to the hands of the teacher, who moves his limbs for him, and thus gradually educates the weak muscles to a correct sense of position and movement, or as in the usual methods, the pupil actively moves his body in imitation of the teacher ; it is only in extreme cases of weakness or deformity that passive movements are used, excepting, of course, those which come more or less under the head of massage, although in the education of weak breathers passive movements are of great value, and it may be sometimes useful in the case of a stupid child or other pupil to commence the required movements by a passive teaching.

Active movements, such as I have to deal with, may be performed without any weights or other appliances when they are called free movements, or they may be done with simple weights, such as dumb-bells, or with the ordinary wand or bar-bell, in order to more thoroughly enforce the correct positions, to interest the pupil, and to exercise the grasp and steadiness of the hand and arm. The useful apparatus, which is the invention of Professor Dowd, mentioned later on, gives us the power of very accurately educating almost any single muscle or group of muscles at will ; it may be added to all sets of movements, and the addition of the very moderate weights of which the apparatus makes use, will strengthen the deficient muscles effectually after the correct sense of posture and direction has been taught by free movements.

I think that for convenience in remembering the movements, it is useful to arrange some such series as follows, each set being perhaps a little more severe than the last, though all are so free from strain and difficulty that they are soon learned by even weakly pupils; there is, however, a great difference between simply remembering the mere movements and performing them absolutely correctly; even the simplest postures or movements should be done with perfect steadiness and smoothness, whilst the first position from which the exercise started must always be retained with rigid accuracy so far as those parts which are not moving are concerned.

In order that I may be able to refer to the movements which follow, when I come to treat of special movements for stated deformities, I have classified these few examples, not with the slightest intention of claiming for them the title of a "system" (we are all mad on "systems" now-a-days), but only for convenience of reference, it will be obvious that an intelligent person can invent hundreds more of such classified series of movements for themselves; I only give those which I have found in actual work to be acceptable to pupils and efficient in their action, each grade is to be regarded as an addition to the last, which is gone through first at each lesson. Since it is possible that some reader may do me the honour to accept my classification and gradation of exercises as they stand, for use as a system with normal

children, and may actually use them with pupils, I will not divide the movements into the headings of "free," "passive," &c., but will give examples of several kinds in each of five grades, so as to introduce a little variety and interest into the work.

*Grade A.*—(1) (Which commences every day's work, and from which, as a base position, every exercise starts. Correct, upright standing. Heels together, toes slightly apart, knees extended, hips extended, rotated slightly outwards and fixed, back muscles extended, scapulæ fixed backwards, fingers, forearms, and arms extended, hanging at sides, thumbs forward, neck upright, chin drawn in, eyes fixed upwards and forwards, but muscles not to be stiff and strained. An immense number of muscles are being used in this simple standing position, which can be estimated if a study is made of the dead skeleton, or if you try to make an unconscious person stand up on his feet. (2) Respiratory movement; simple deep breathing, not moving the shoulders up, and seeing that the top of the chest, the first few ribs, rise up at the end of each in-breath; the front of the abdomen comes well forward at the commencement of each in-breath, and sinks inward at each out-breath (not the reverse, as is common); four seconds in-breath through nose, mouth closed; out-breath quick through open mouth with a deep puff, varied by slow and silent out-breath occasionally. (3) Head movements; bend head forward, backward, and to each

side, a full second for each move. (4) Arms and shoulders; counting a full second for each move; one, bend elbows, place hands on hips, thumbs backwards, fingers firm on groins; two, hands on shoulders, elbows well back, backs of hands upwards, tips of fingers on points of shoulders; three, arms straight out sideways from shoulders; four, as at two; five, arms straight up at sides of head, palms inwards; six, as at two and four; seven, as at one; eight, to first standing position. (5) Body movements; No. 1, hand at hips, bend spine backwards, forwards and laterally, each way alternately, one second each move, repeat with hands clasped behind neck, elbows well back. (6) Leg movements; rise on tip-toes, hands behind neck or at hips, lower slowly. (7) Stride sideways with each leg alternately returning to upright position between each move. (8) Standing firmly; open and close feet from each other, pivoting on heels, two moves to each second of time.

*Grade B.*—Head movements of Grade A repeated, also breathing and add No. 1, breathing deeply in as arms rise up in front, arms extended, full in-breath attained when arms are overhead, arms fall slowly outwards and to the sides, as out-breath is given by mouth. (2) Arms; one, arms out sideways, at right angles with shoulders; two, arms overhead, palms inward; three, as one; four, arms crossed in front of chest as far as possible, elbows extended and stiff; five, as one and three; six, arms back behind as far

as possible, elbows extended and stiff; seven, as one, three and five; eight, to first position. (3) Elbows to sides, bent hands closed, carrying dumb-bells, twist wrists, repeat with wand; trunk movements. (4) Same as Grade 1, but with arms first overhead and then with arms out sideways at right angles with shoulders, repeat, holding wand. Legs; No. 5; one, raise right thigh in front, level with hip joint, knee bent; two, point leg and foot straight in front; three, as one; four, first position, repeat, with left hand on hips for this exercise.

*Grade C.*—Repeating all the former and adding. (1) Arms; one, arms extended diagonally, right up and out from shoulder, left down and out; two, left up and out, right, down and out; three, right arm up overhead, left down at side; four, reverse three; five, right arm forwards and upwards, left downwards and backwards; six, reverse five; seven, arms at right angles sideways at shoulders; eight, return to first position, repeat with wand, which touches shoulder of lowered arm at movements three and four, and touches the side at movements five and six. Body movements; (2) Arms overhead, bend slowly forwards, keeping head straight as possible, feet slightly apart, bend down and touch floor with finger tips, if possible; rise slowly repeat holding wand, arms apart. (3) Legs; leg extended on thigh, raise forward high as possible, leg stiff, foot pointed forward; two, carry leg outwards, stopping at sideway posi-

tion; three, backwards to central line; four, to first position, hands on hips (counting may be as thought best for this and other movements, some prefer to keep to numbers up to eight, and giving sometimes two numbers for each move, &c).

*Grade D.*—Repeat all former and add. Arms and legs; (1) Stride front, each leg alternately, advanced foot carrying all the weight, back foot, toes only on the ground, press forward on to advanced foot, throw arms out sideways at right angles with shoulders; as forward stride is made, lower arms as first position is recovered, repeat with other side. (2) Stride sideways, alternate sides, turning body at hips at each side stride, and throwing arms overhead; repeat with wand. (3) Lying on face on a low couch, with body from the hips over the edge, arms out overhead with palms resting on the floor, feet held down on couch by teacher; bend spine back as far as possible, raising the hands (arms stiff) from the floor, lower slowly. (4) Lying on back on floor, feet held down, hands on hips, rise slowly to sitting position, without using hands. (5) Lying on back on low couch, legs over the edge from hips, body held down by teacher, with sand bags (weight according to pupil's strength) hung on ankles, raise thigh up, leg extended, carry thigh out across body and back, repeat opposite leg and reverse direction with each leg, also raise both legs together, and then completely circle them slowly opposite ways.

*Grade E.*—Add arms, &c.; (1) Crouch down as if about to sit on the floor, but arrest the movement by placing hand on the floor, let weight rest on hands, raise feet from floor, shoot out legs behind till quite straight, tips of toes only resting on floor; teacher then hold feet clear of the floor, first by only a few inches, pupil straightens arms (the "wheelbarrow" position), slowly lowers by bending arms out sideways, till chest rests on floor, raises body again by straightening arms, teacher then raises feet further from floor, to increase the difficulty. (2) Same as No. 1 up to point where toes are on floor with legs straight out behind, turn slowly over "edgeways," so that only one hand rests on floor, and outer edge of one foot (which teacher places his foot against, to prevent slipping), then raise and lower as far as possible the free arm and leg slowly, return to position face to floor, and roll on to other hand, repeating same movements with arms and leg, return to upright standing by drawing feet up to and between hands, and rise. (3) Rise on toes, feet turned slightly out, bend knees, raise arms outwards at shoulders, sink slowly with spine upright and head back, until sitting upon heels, remain for a few seconds and rise slowly lowering arms after rising. (4) Arms out at shoulders, right leg advanced and raised, knee extended and stiff, then slope body back at hips until in straight line with advanced leg, still keeping leg and body in one line and arms out, lean forward, leg extended

behind, rise to upright position, arms still out, and on attaining upright position turn foot on which you are standing outwards, and slowly slope body sideways, leg in same line, repeat on opposite foot. (5) Kneeling on floor, teacher holding feet down behind, hands overhead, keeping the head up and spine stiff, slope forwards as far as possible and remain in that position. (6) Two chairs side by side, separated far enough for the pupil's chest to pass between the seats, pupil supports weight upon palms of hands, one on each chair seat, legs extended behind, toes only on ground, bend elbows outwards, and lower body until chest falls between chair seats, and rise again slowly; if this be too severe, a third chair may be placed in the centre to receive the chest at first, but in any case the whole body must be rigid and straight. (7) Arms out at shoulders, turn body and shoulders leftwards, so that right arm points forwards and left arm backwards, stride forwards with right foot far as possible, keeping arms straight out, bend and touch right foot with right hand, rise and carry right hand overhead, left arm behind with a complete circular sweep and touch left foot with right hand, rise, swing body to front, recover advanced foot, repeat opposite side.

Certain movements are called "resisted movements," when the movements of the pupil are resisted by pressure from the teacher's hands, the resistance being graduated according to the pupil's strength. These exercises are rather matters for the surgeon's

use, since by them he estimates the progress which the patient is making in muscular energy, and since also these resisted movements need application in each case where they are used, upon lines special to the case in hand. Under the head of "spinal curvature," I shall make further mention of these exercises. The method of adding slight weight to the movements (and at the same time steadying them) which best meets the general run of cases, is that of pulley and weight movements, which may be performed by means of one or other of the forms of apparatus now in the market, such as "Dowd's Health Exerciser," an excellent form for home use; another excellent apparatus is "Foot's Home Exerciser;" any provider of gymnastic appliances will give full information concerning these and other similar forms of apparatus. Some of the movements performed with either of these appliances I have illustrated (from Dowd's Chart), and shall refer to them when mentioning them as "pulley exercises." I must insist strongly that one great rule shall be observed in *all* muscular exercises, this is that the respiration shall be absolutely free, and the heart therefore able to pass onward the blood coming to it. If muscular exercises are performed with the bad habit of "holding the breath," the heart becomes greatly embarrassed, the right side, which has to perform the lung circulation, gets overloaded and frequent repetition of such a strain may result in serious

weakening of the heart ; therefore it should be a rule that the utmost freedom from constriction of the chest by the clothing should be secured, and that the lips be held slightly apart if the child from any cause is unable to inhale freely by the nose, though this latter failing is itself one which may be overcome by practice, providing all mechanical obstructions to respiration (such as enlarged tonsils, or post-nasal adenoids) are removed.

## PULLEY EXERCISES.

FIG. 5.

FIG. 6.

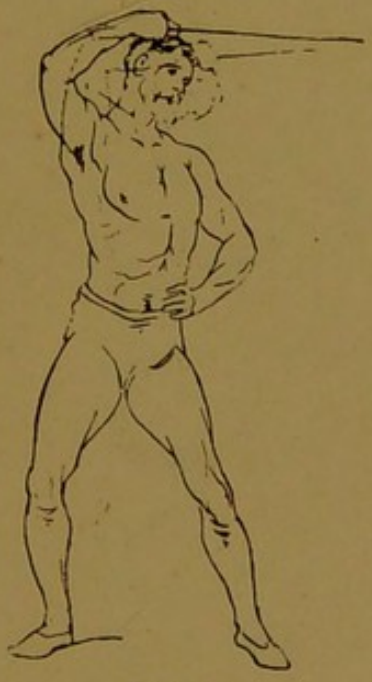


FIG. 7.

FIG. 8.

Fig. 5.—Trapezius Muscles, upper portion on back of neck. Handles back of head, move head backward.

Fig. 6.—Sterno-Mastoids, their forward action. Hands on head, bend head forward.

Fig. 7.—Sterno-Mastoid Muscles on side of neck. Both handles, hand on head.

Fig. 8.—Biceps Muscles on front part of upper arm. Crook elbows.

## PULLEY EXERCISES.

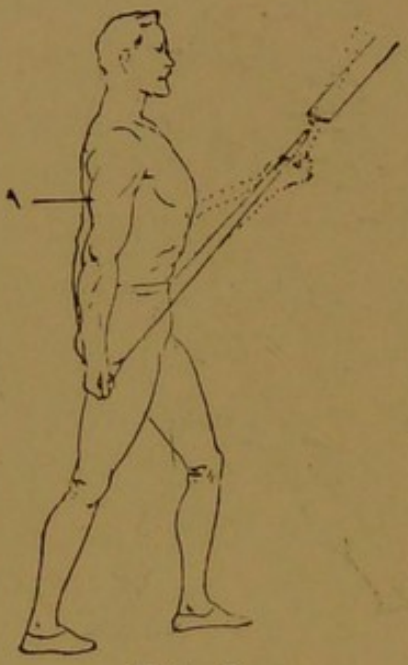



FIG. 9.

FIG. 10.


FIG. 11.

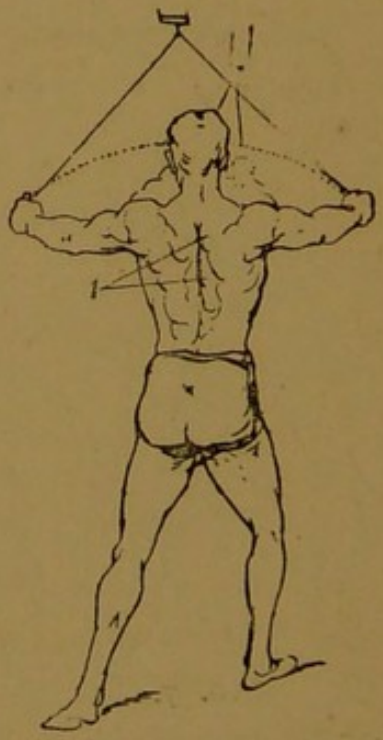



FIG. 12.

Fig. 9.—Lateral and Posterior Triceps, back part of the upper arm. Straighten elbows.

Fig. 10.—The Striking Muscles. Project arms straight forward.

Fig. 11.—Muscles of the Forearm. Crook wrists.

Fig. 12.—Rhomboideus, Trapezius and Deltoid, back Muscles, hands level with shoulders, move them backward.

## PULLEY EXERCISES.

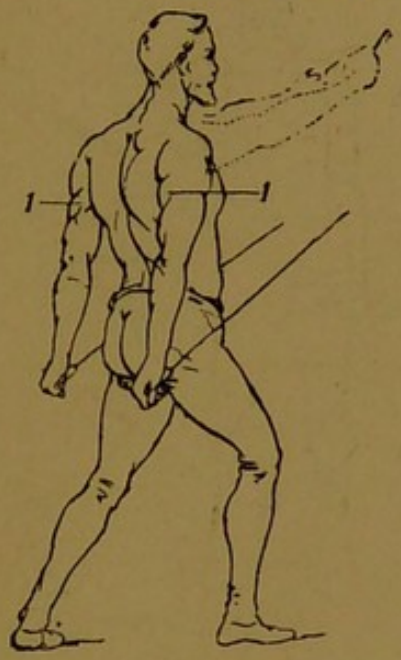


FIG. 13.

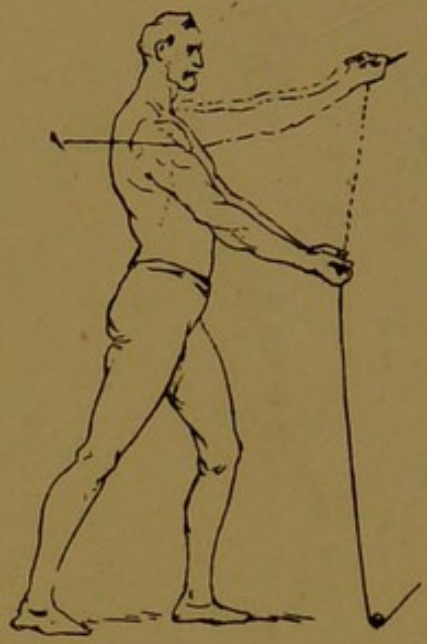


FIG. 14.

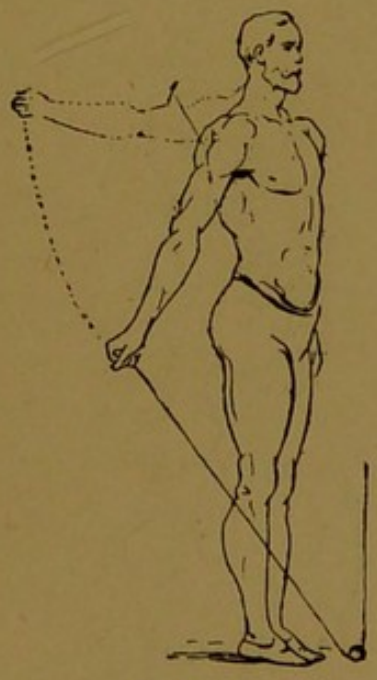


FIG. 15.

FIG. 16.

Fig. 13.—Posterior Triceps. Arms down and backward, and Latissimus Dorsi.

Fig. 14.—Anterior Deltoid Muscles on front of shoulders. Arms up straight and high.

Fig. 15.—Lateral Deltoid Muscles on side of the shoulders. Arm out and up.

Fig. 16.—Deepening the chest from the back. Arms straight back and up.

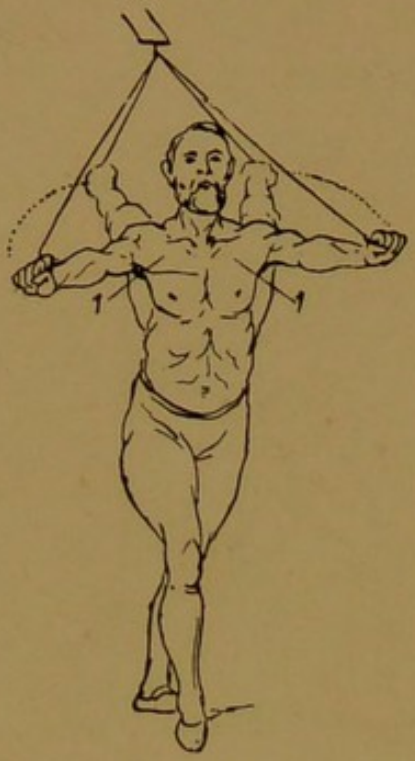


FIG. 17.

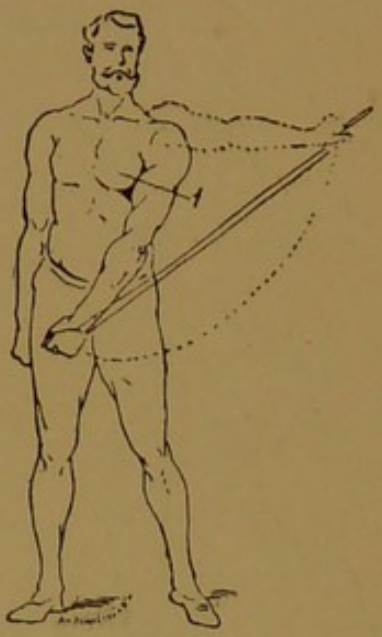


FIG. 18.

FIG. 19.

FIG. 20.

Fig. 17.—Upper portion of the Pectoral Muscles of the chest. Arms level with shoulders, straight backward.

Fig. 18.—Lower portion of the Pectoralis Major Muscles. One hand, both handles, arms front of body.

Fig. 19.—Serratus Magnus Muscles on the sides of the body under the arm. Move shoulder blades forward.

Fig. 20.—Rectus Abdominis Muscles on front of the abdomen. Hands on head, bend forward.

FIG. 21.

FIG. 22.

FIG. 23.

FIG. 24.

Fig. 21.—Erector Spinæ Muscles of the loins. Handles back of head, move body backward.

Fig. 22.—Obliquis Abdominis Muscles on the sides of the abdomen. Both handles, forearm on head, move body sideways.

Fig. 23.—Erectus Spinalus and the Ham String Muscles on back of thigh. Bend forward then well backward.

Fig. 24.—Gastrocnemius and Soleus Muscles of the calf. Raise on toes.

## PULLEY EXERCISES.

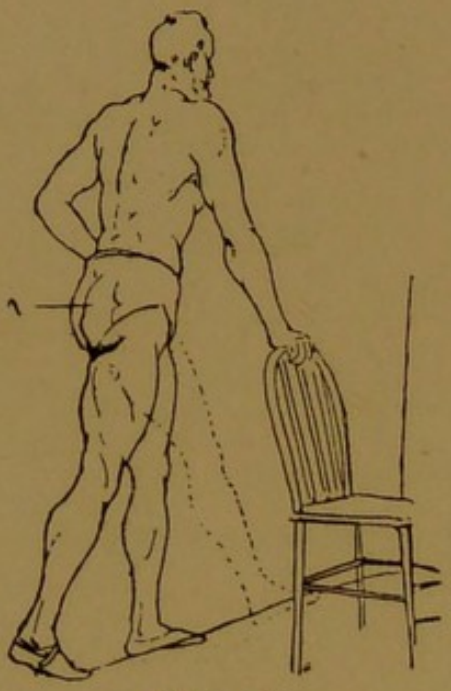


FIG. 25.

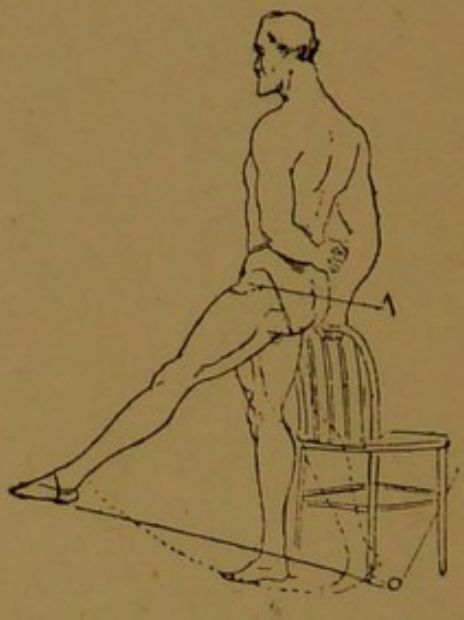


FIG. 26.

FIG. 27.

Fig. 25.—Gluteus Maximus, large muscles of the hips. Move leg straight backward.

Fig. 26.—Psoas Magnus and Iliacus, upper part of front thigh. Move leg straight forward.

Fig. 27.—Biceps of Leg, Muscles on back of thigh. Crook knee.

## PULLEY EXERCISES.

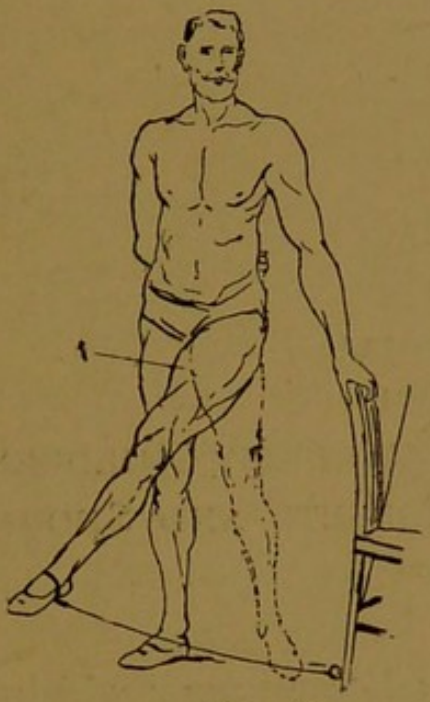


FIG. 28

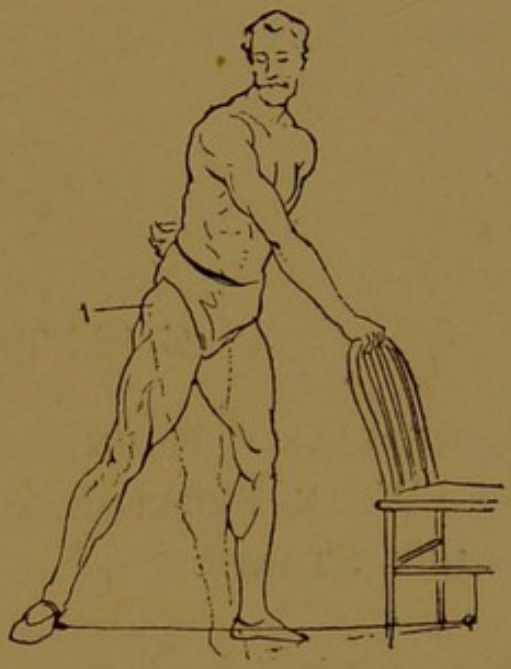


FIG. 29.

FIG. 30.

Fig. 28.—Adductor Brevis Longus and Magnus Muscles on inside of thigh. Move leg towards exerciser and back.

Fig. 29.—Abductor Muscles on outside of thigh, Gluteus Medius and Minimus. Move leg away from the other.

Fig. 30.—Peroneus Tertius, Peroneus Brevis and Longus, on outside of lower leg. Rotate the foot and leg outward.

## CHAPTER IV.

### Stoopers and Round Shouldered Children.—Weak Breathers.—Corsets and Shoulder Straps.

Having indicated the general lines upon which a merely weak and undeveloped child may be treated by muscular exercises, I will proceed to discuss a few more special cases, in which, at all events, at the commencement of treatment, it will be well that a selection of movements be made out of those previously described.

The principal effect of muscular indolence and careless habits of holding the body, is that of allowing the slack joints to assume such a position as the weight of the body and limbs naturally bring about; and one of the most common instances of this is stooping, resulting in round shoulders, a habit which gives a very good example for the study of the problem of how to correct such habits.

I have before mentioned the fact that the muscles in health, except during sleep or unconsciousness, are

not actually relaxed, even when the body is still; there is a slight but constant condition of contraction, which keeps the muscle in the ready position—a position which is called "tone," and from which efficient working contraction can immediately start; in many instances, the effect of muscular indolence is to destroy this position of tone by permitting the joints to fall slack, and allow the approach of the origin and insertion of muscles towards each other, so that there is not even the natural stretch on the muscle which is essential for tone. In the round shouldered person, for example, the arms fall forwards towards the front of the chest, and the pectoral muscles are let to go slack; they then rapidly waste for want of the tone position; the serratus magnus is another muscle which is slack in round shoulders; indeed in the general stooper all muscles on the hollow or concave side of any curve of the body lose their due tone.

We commence the treatment of the round shouldered patient, therefore, by trying to restore the natural stretch of the wasted muscles on the concavities. Take, for instance, the pectorals; we do not at first directly exercise these, but we exercise their opponents—the muscles at the back of the shoulders and those which pull the shoulders up and back, thus putting the most wasted muscles *on the stretch*, though not yet calling them strongly *into action*. To do this we commence with grade A, and educate the

standing position muscles; then grade B, No. 2 (except the word FOUR); this moves the deltoid, trapezius, rhomboids, and scapular muscles, and we then give a good drilling at pulley exercises, Nos. 12 to 15. Turning all our attention to the muscles behind and above the shoulders for the first two or three weeks of treatment, or at least exercising these far more than other muscles, we then go on to the spinal erectors, taking grade A, No. 3, avoiding the forward bends at first; then No. 5, with the same omission. You will understand that the side bendings of the body use the erectors, one at a time. Do such movements as grade B, No. 4, also; then grade D, Nos. 1, 2, and 3. The easy back twists of the light Indian clubs may be added here, and the upward and backward movements of dumbbells and wand.

After these are all done with freedom and without fatigue for an hour daily, it will be well to add the more special exercises for the pectoral muscles, such as grade B, No. 2 (complete); C, No. 1; E, No. 1 (for serratus magnus); pulley, Nos. 16, 17 and 18. The front spinal muscles can also now be attended to (psoas, iliacus, quadratus lumborum), this being effected by grade B, No. 5; C, Nos. 2 and 3; D, Nos. 4 and 5; and pulley, Nos. 20, 22, and 26. As each addition is made to the week's work, all the previous movements should be first repeated thoroughly, and subsequently the pupil will

go regularly through the whole of the different grades and all pulley exercises. The principle throughout is to note which muscles are chiefly wasted, bring them back to their natural relations with their attachments by exercising their opponents, and subsequently to exercise themselves.

If a general stoop is added to the round shoulders (as it usually is), we should incorporate with the above teaching all the erector spinæ exercises, giving them special attention, before enforcing the forward movements. I need scarcely re-enumerate them, as by this time you can pick them out very easily. But the question of stooping demands further attention, on account of the many bad results it has upon other parts of the body, chiefly upon the chest and therefore the lungs. A stoop is a general forward fall or bowing of the whole spine from relaxation of the erector spinæ muscles. It must be remembered that the expression "curvature of the spine" does not imply that the natural spine is a straight line, but that natural curves have been supplanted by unnatural ones. A stoop is not called a curvature, but, nevertheless, if extreme and long neglected, it may become permanent, and is then the same thing as a curvature. The normal spine has an outline of many curves, in and out, but all in the "fore and aft" direction. The sacrum, the position of which bone, as the base on which the spine rests, determines the direction of the lowest part of the spine, is sloped

slightly forwards in the natural state, so that the lowest or lumbar part of the spine takes a forward direction. If this forward direction were continued throughout the whole spine, you will see at once that the head and neck would be carried so far forward that the owner could by no means stand upright, but must fall forwards on rising to the feet; therefore the spine takes a "restituent" backward curve, to correct the lumbar forward tilt, thus the lowest curve of the spine has its concavity backwards, just above the loins. But this second backward tilt can no more be continued upwards than could the first forward tilt, or the head would fall back behind the centre of gravity, we therefore see another restituent curve in the back, or dorsal spine; this time it is forwards again. Thus the spine in the dorsal region has its curve with the concavity in front. This second natural curve is, of course, smaller in extent than the first, and it is in its turn corrected by a still less backward tilt in the neck part of the spine, the concavity being in the neck backwards again. I have not space to go into the grand results and arrangement of these various and beautiful curves, but, in view of our stooper, it is worth while to note how these normal curves provide due space and support for the internal organs, keeping the ribs in front at the proper distance from the pelvis, to place the front abdominal muscles in the state of slight stretch which is necessary to tone, and so carrying the shoulders and ribs,

that every freedom is ensured for the breathing muscles to act.

Now study a stooper; in him or in her (the latter most often) all the normal curves are merged into one long curve with the concavity forwards, the top of the spine is dropped towards the bottom, by the whole bending forwards, so that the front of the chest is nearer to the pelvis than is natural. This, of course, crowds the contents of the abdomen, and, as the muscular walls of that cavity are also relaxed, the abdomen protrudes in front in a very ugly way; there is added to this ugly feature the disappearance of the waist, for the natural loin curve being abolished, that part of the back looks broadened and flat. You will also see that this forward leaning of the spine in a stooper would result in carrying the head and shoulders far in front of the centre of gravity, if not in some way corrected, and this correction is done by the patient instinctively tilting up the pelvis in front, so as to get the pelvis under the upper part of the spine again; this effects a still greater approach of the thorax to the pelvis, and emphasises the ugly protruberance of the abdomen. You can understand now how a stooper is likely to suffer from all those troubles which are the result of bad and crowded circulation in the abdominal organs, derangements of digestion, constipation and its results, and, in girls, other obvious and serious health-breaking disorders. And you can also realise the imperfect respiration

which the dropped and relaxed chest brings about; hence it is important that we should add to our teaching of correct upright standing and carrying of the spine and shoulders, a thorough education in correct breathing.

It is a notable fact, that the deposits which usher in consumption, make their appearance very frequently first of all at the tops of the lungs, and that these portions of the lungs are those least fully expanded in the breathing of a weak person, and especially of a stooper; the connection of these facts seems serious, and it is also encouraging, because if we can teach our patients to use these apices of their lungs correctly, we may hope to prevent consumption in some cases; personally, I believe in very many cases.

There is a great deal of evidence collecting in favour of this view; that given by teachers of singing being perhaps the most striking. It is well-known, of course, that the first sign of lung deposits in early consumption, is a dull note given to the physician's percussion, at the top of the lungs. I venture to state that a slight dulness here sometimes only means that the apices of the lungs are not being used by the patient. I have tested this, and have found that some of the dulness may be made to disappear, and give place to the normal resonance; after a course of respiratory exercises, passive to commence with, followed by active movements, the dishonest, or the self-deceived enthusiast, might claim such cases as cures of incipient

consumption; but I think that they only mean that the patient has been taught to fill the tops of the lungs properly. Yet, it may be that deposits, when already existing, may be thus stirred up and got rid of by movements and education, before the dreaded bacillus has taken up his abode in them, time will teach us if we are too hopeful (it is a way time has).

Commence, then, the education of the weak breathing of the stooper by passive movements, by which I mean, placing the patient on his back on a couch, stand at his head, and go through the action of what is called "artificial respiration," telling the patient to keep time in breathing with your movements; the patient's arms being at his sides, bend them up at the elbows, grasp the forearm just above the elbows, steadily draw the arms up above the head, carrying them slightly outwards as they rise; draw the arms up forcibly, till the pectoral muscles are stretched—the patient breathing in during this movement, which occupies about three seconds; then carry the bent arms out sideways, down to the patient's sides, lean your weight on the ribs and arms, and press the air out of the lungs the patient meanwhile breathing out; this also occupying three seconds. You will then continue with the respiratory movements of Grade A, No. 2, and B, No. 1, insisting that there be no shrugging of the shoulders when breathing in, and that *the front of the abdomen shall move slightly forwards on taking an in-breath, and inwards on breathing out*; the diaphragm falling during the in-breath, and

rising at the out-breath, produces this abdominal movement, the lungs fill *from below.* If you are dealing with young ladies, whose parents have not confidence in the natural muscles to support their bodies, and have, therefore, encased them in splints (called corsets), you will convey a striking lesson by unlacing those splints whilst full in-breath, by combined passive and active movement is taken, and attempting, whilst the lungs are full, to lace the corsets as before; you will often find several inches more chest movement can be demonstrated as obtainable without the corset.

In stooping girls, the corsets used are often very wicked; the mother, seeing her daughter's waist going and her abdomen getting large, tries to repress those faults by corsets carried down low in front, and with a waist to them, with a view to support her and correct the "figure"; the result being that the crowding of the internal organs is increased, whilst the poor girl takes to leaning on her stay-bones for support, weakening her muscles by still further disuse, the responsibility of supporting her weight being taken by the splints; fortunately, the thing generally gives way, and the muscles have to exert themselves a little.

Corsets may do little harm beyond keeping the body too hot, if *they be fitted to the body and waist*, but the attempt so generally made of *fitting the girl to the corset*, can only end in disaster. A corset with a natural and pretty waist to it is of no harm *if there be such a waist inside it.*

Another artificial appliance often used in these cases is a pair of elastic "shoulder straps." Such things may be of use as reminders of the natural position; and I can sometimes recommend them; if they do not draw the shoulders back more than the slightest hint further than the stooper already holds them, place shoulder straps, passing from the waist up to two loops round the shoulders, and held together by a cross strap in the middle of the back, so that whenever the stooper increases the stoop, he or she will get a sharp pull-up as a reminder of faults already acquired, and no harm may be done; or arrange straps of an easily torn material, the tearing of which shall be payed for by forfeit of some pocket-money, &c., and again, you will do good; but if elastic straps are used to pull the scapulæ back completely, you will find that the rhomboid and other scapular muscles will be kept relaxed and soon lose their tone, whilst the pectorals may be, perhaps, developed by always pulling against the straps; so that when the straps are taken off, you will have simply transferred the loss of tone and wasting from the front to the back of the chest.

There is one set of permanent "shoulder straps," which it is our object to perfect, I mean the muscles at the back of the shoulders, and the erectors of the spine. Into the general question of artificial supports for weak backs I cannot enter here, but I think that there is too much tendency on the part of orthopædic

surgeons to take too exclusively one method or the other; every patient goes away from some consulting-rooms with an artificial supporting apparatus of some kind; whilst in other cases, every patient is forbidden to use them; and persons who have learnt to lean on them for years, are suddenly deprived of them, and go away feeling very "broke-in-halfed."

Some cases must have, at least, temporary artificial aid; most cases of simple muscular weakness do best without them; but an impartial judgment must be allowed to every surgeon, and patients should not try to tie him down to one "system" or another; (that word "system" is one of the greatest obstructions to scientific progress).

# CHAPTER V.

## Curvature of the Spine.

I UNDERTAKE this portion of my task with some misgivings, familiarity with the subject has taught me how specially dangerous in some hands is that "little knowledge" of the proverb, and the subject is one of such intricacy, needing so much of the special "surgical instinct," that I must premise that I can only deal here with the outside fringe of the matter. I feel strongly that the treatment by muscular education of cases of lateral curvatures of the spine is a matter for the orthopædic surgeon, and for the surgeon who has studied orthopædic gymnastics specially. Still, those early stages of the deformity which are seldom seen by the surgeon, and too often overlooked by the parents and teachers of sickly children, are often amenable to home treatment, and for this reason it is well that the reader should understand a few of the broad principles involved in the production, prevention, and cure of lateral curvatures of the spine in children. I say lateral curvature, because although a

very serious stoop is often called a curvature of the spine, in most cases it scarcely amounts to that deformity, and I use the term lateral curvature to include only such cases as are certainly free from all suspicion of disease of the bones (caries of the vertebræ). It must be remembered that in this serious disease there may be a lateral deviation of the spine though as a rule, the deformity is angular and forward. I need scarcely warn any intelligent reader that no child should be submitted to exercises whose symptoms give the slightest reason for doubt in this matter; surgeons of great experience often hesitate to pronounce an opinion as to the existence or non-existence of caries in some cases, and a disease which is so insidious and often difficult to clearly demostrate under the skilled eye and hand of an orthopædic surgeon, may well be overlooked by the non-surgical parent or teacher. No case of spinal deviation, however slight, should be submitted to treatment by exercises before being examined by a competent orthopædic surgeon, and all cases which have already formed any deformity which is not corrected temporarily by the voluntary efforts of the patient, are, in my opinion, not fit subjects for exercises except under the eye and hand, or at least the constant direction of a surgeon skilled in orthopædic gymnastics. Moreover, if during the progress of treatment any fresh symptom, either as regards the posture of the patient or the production of pain and weariness

should occur, the child should again be taken to a surgeon.

The extreme complexity of the structure of the spinal column is such that it would be impossible to in any way adequately describe it here; it must be remembered, however, that the natural spine is not straight by any means. When a man stands upright it will be seen that a hollow exists behind the region of the loins—a forward curve of the spine; this hollow does not exist in the region of the back and behind the shoulders, there being here a slight backward curve of the spine, whilst the neck again shows a still less forward tendency; in stooping forward or in people who stand in a slovenly and weak manner, such as the stoopers I have already mentioned, these curves are obliterated, the whole spine taking one general backward curve. But all these curves, either in the upright position or in stooping are strictly "fore and aft," the vertebræ occupy the central line, and although we can tilt and bend the spine freely in a lateral direction voluntarily, yet whenever the ordinary standing position of a person exhibits any lateral slope or curve of the spine that person has a "lateral curvature of the spine," a condition which is of a far more complex nature than its title would indicate; there is usually combined with the lateral deviation some twisting on each other of the vertebræ, producing "rotation," and gymnastic treatment (when applicable) must be addressed to both the lateral and rotary deformities.

During the growing period of life there are several faults of posture which are liable to be fallen into and which, if persistent, may cause a lateral deviation of the spine; a single general slope of the spine in a straight line, either laterally or forwards, is scarcely a possibility, because in standing up and walking such a condition would destroy balance; the head must be kept within the centre of gravity, and any slope of the spine as a whole in any direction would carry the weight over one way or another quite outside the central line, hence it comes that there are always various lesser curves produced as corrective of the main faulty deviation. In the healthy and normal spine this correction of one slope or curve by another is well seen; the position of the pelvis gives the key note to the normal spine, or at least the position of the lowest bone of the spine, the wedge-shaped sacrum, which is so placed between the pelvic bones as to slope forwards; the lower or lumbar part of the spine hence has a forward direction, which, if it were continued upwards, would carry the head and shoulders far in front of the feet in standing; therefore we find a backward slope developed a little higher up, completing the forward curve in this lumbar region; the same reasons demand another (but much shorter) forward slope between the shoulders, forming the backward curve, to be followed by the still slighter correction in the neck; and precisely the same tendency to correction is seen in the deformity of lateral curva-

ture; if from any faulty habit of standing, the spine has a tilt given to it laterally, this primary slope must be corrected by one above in the opposite direc-

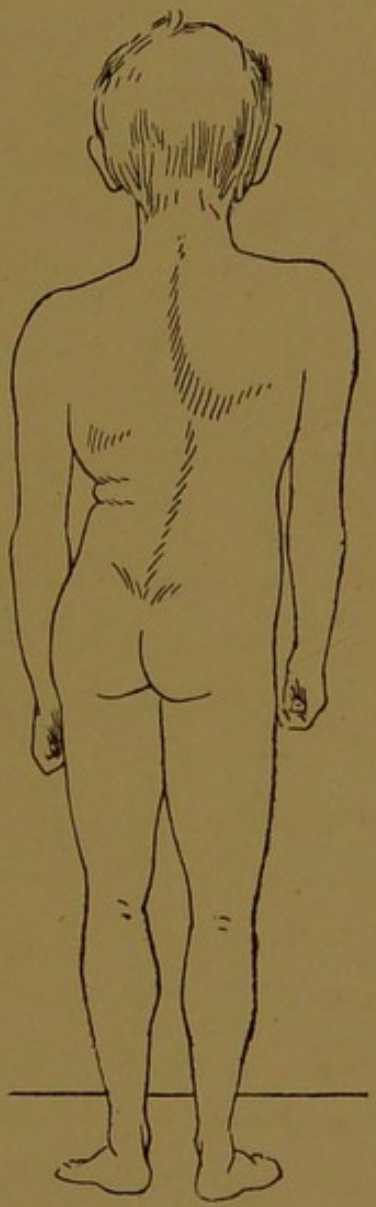


FIG. 31.

tion and so on through the chain of bones, the curves being more or less marked according to the severity of the slope which gives the key note. Take as an

example, the boy sketched in fig. 32, whose left leg is longer than the right, causing the pelvis to be higher on the left side ; the dotted line shows the corrective

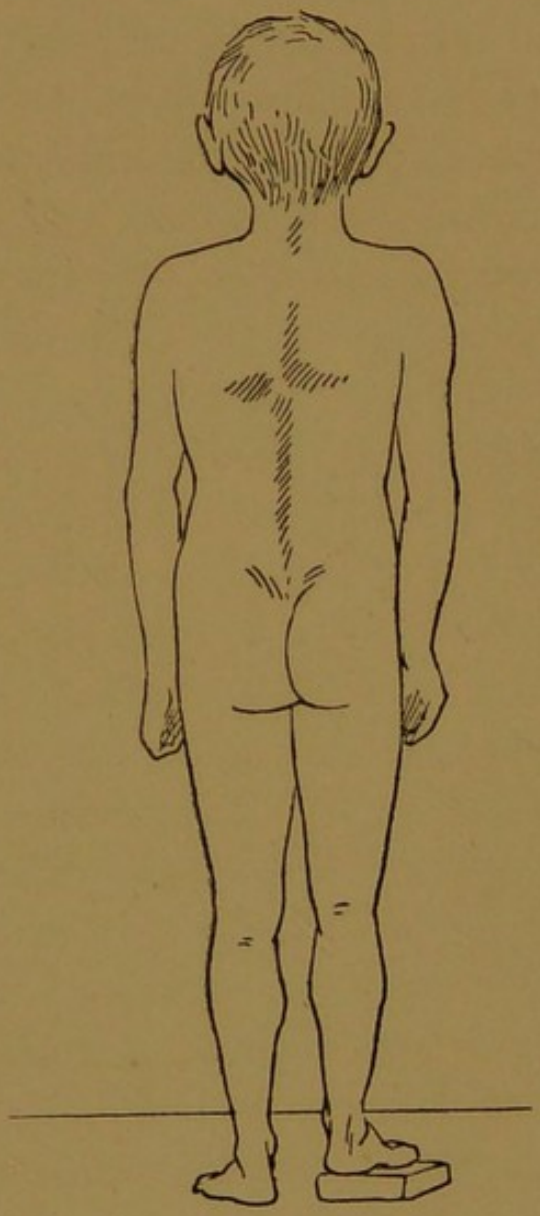


FIG 32.

curves resulting from the primary lower slope, whilst if the legs be equalised, as in fig. 31, these deviations are abolished ; in such a case if no permanent change

in the bones had taken place, a thicker sole to the right boot would cure the deformity, and nothing else could do so. The primary fault may be in the upper part of the spine, and if this become marked, corrective slopes will be developed below—such a deviation might be caused in many ways; one is muscular weakness and unequal development, aided by some bad habit of posture, such as that depicted in fig. 33, where the patient sleeps always on one side with the

FIG. 33.

lower shoulder propped up on too high a pillow; another fault which may cause lateral curvature was shown in fig. 2, when speaking of faulty seats and desks: the very common habit of "standing at ease" on one leg is also a fertile cause of lateral curvature in weak children. Other common postural faults are that crumpled up position taken by many children when reading in an easy chair, one leg curled up

under the body, the other swinging in front, the book to one side on the arm of the chair and the spine curled over towards the book ; the head dropped, and every possible incentive given to produce the common deformity. Again, the fact that girls have to carry the weight of much of their clothing dependent from the hips, and that the dragging of the weight on the hips and thighs is often felt more on one side than the other, owing to one leg being less strong than the other, will cause a very serious habit of lifting one hip above the other, to take the weight off one side ; the girl finding that to do this destroys her balance in walking, will instinctively lower the shoulder opposite to the raised side of the pelvis and thus produce all the data for a lateral curvature. The carrying of too heavy weights on one arm by the children of the poor, who often carry heavy babies, the almost exclusive exercise of one side of the body in certain games and occupations, are other causes ; riding, in the case of girls, always seated upon one side, is a fertile source of trouble ; every girl who is fortunate enough to get horse exercise during her growing time, should have a reversible skirt and ride on the off side often.

It will then be understood that the various deviations of the spine are governed by the fact that the weight of the head, chest, and viscera has to be carried by the pelvis, and for this reason part of the treatment may be the taking of a certain period of rest

daily; the common method of lying down flat on the back on a board is a very useless one, the proper position is the prone one, the child lying on its stomach naturally assumes a position in this way which throws the head and shoulders back, especially if supporting the chin on the hands when reading a book, a position which may be encouraged, this position really gives a little gentle exercise to the spine and straightens it, whilst the weight of the body is entirely removed from the spine for the time being.

Children who are the subjects of spinal curvature should never take long walks, the full weight of the body comes on the spine, and walking is a very severe exercise for a weak spine, the well-known back-ache from long walks would indicate this to be the fact.

The altered level of the shoulders is obviously a part of the deformity, the shoulder being higher upon the convex aspect of the curve in the region of the back and hollow of the flank, which is seen opposite the concavity of the lumbar curve, causes the prominent appearance of the hip on that side; in fact the surgeon is often told that the hip or the shoulder is "growing out," the fact of spinal deviation being overlooked by the parents. But this altered position of the shoulders, and the prominence of the shoulder blade are nearly always secondary to the main cause, which is the faulty level of the pelvis. If this be corrected, the secondary deviations in the upper part of the spine, which are attempts at maintaining the

centre of gravity, will gradually come right, since there will be no inducement for them to persist. The feeling of crookedness which the patient experiences at first, when the pelvis is levelled, is the result of the fact that these secondary dorsal curves are still uncorrected: as they gradually become educated towards the normal, the sense of want of balance is got rid of.

Before considering the exercises for this deformity I must again warn all non-surgical teachers of the grave responsibility they take if they continue to submit any child to exercises who experiences pain or weariness as the result, especially if that pain or difficulty be marked during the act of stooping or bending the spine in any direction. It is quite within possibility that such a case may be in the early stage of caries of the spine. You must not look to find pain in all cases of caries, for some cases go through the whole disease, and, unless properly supported, acquire the most extreme deformity without any special pain; but any approach to unnatural stiffness or difficulty in bending the spine is often a warning not to be neglected. In the first stages of the disease the child holds the spine very upright and stiff and straight, the natural gentle curves being rather abolished than intensified; there is often a worried, anxious, apprehensive expression on the face, due to the fact that any sudden movement or jar produces a sharp pain in the spine; the child becomes

perhaps rather morose and withdraws from the active play which was previously an attraction to him ; there is also some general paleness and illness ; now and then in young children there will be a fit of crying for little apparent reason—some slight jar or movement has hurt the spine. All teachers should be alert in watching for any such symptoms, and it will be safer to shift all responsibility on to a surgeon, at the earliest suspicion.

Supposing, then, that you have a case of lateral and rotary spinal curvature to deal with, and have obtained the opinion of a competent surgeon on the case to ascertain if exercises are advisable, you will commence the treatment by an education of the patient's lost sense of what is the correct and natural position. First ascertain if the patient can by voluntary effort hold the spine straight in the natural curves for even one second of time ; if so you may almost promise a complete cure by patience and care in exercises for three months or so. Next, by strongly holding the patient in the corrected position and gradually releasing your pressure, encourage the patient to hold the position as you take away your support ; if the natural curves can be seen to persist for a second or less as you cease your pressure, again there will be great hope, but a longer time will be needed. The pressure you put on should be on the most prominent part of the ribs, on the side of and slightly behind the greatest convexity of the dorsal curve, and you will

bring also counter pressure to bear on the opposite hip; force these two points towards the central line, the patient meanwhile holding the arm of the bulging side out from the shoulder at right angles and in front of the body, and the opposite arm up overhead; if by these means you can straighten the spine all may in time come permanently right.

You will find that the patient in most cases will feel that the natural position is terribly crooked, and the deformed one comparatively straight, because what is called the "muscular sense" has been lost by long bad habit of posture. After the tests above mentioned, place the patient opposite a mirror, and make him press himself into shape by forcing the bulging ribs and opposite hip towards each other, he will then gradually release the pressure, attempting to keep himself in shape, and the same movement should be repeated for twenty times or so, holding the corrected position, observing it in the glass for about ten seconds each time before the hands are removed.

You will, of course, understand that in the cases of the deformity which is the reverse of that seen in the figure of the boy with short leg, that is, in the cases where the dorsal curve is convex to the left, the points for pressure will be on the left ribs and right hip. The rib pressure must be as far back as the patient can get his hands. The patient should next repeatedly move the arms into the position I mentioned

as part of the correcting position when you were pressing the deformity into shape. He should raise the arm of the side opposite to the prominent ribs and shoulder well up above his head, whilst he carries the other arm at a right angle with the shoulder, with a strong swinging movement to the front of the chest, letting that arm swing well across the chest with the arms stiff, both arms being moved at the same moment. This movement is to be done quickly and smartly, starting from the position in which the arm which swings across the chest is already held out at a right angle from the shoulder sideways, the arm which is to rise overhead being by the side: repeat this movement about twenty times.

This exercise is only a continuation of the education of the sense of correct position; if you watch the patient from behind whilst the exercise is performed you will see how it draws the prominent ribs forward, and tends to twist the body in the correcting direction.

The next position I will refer to is that of having the arm of the concave side of the dorsal curve stretched up, and that of the convex side out, from the shoulder sideways; in some incipient cases, this position completely removes the deformity so long as the arms are kept well stretched up and out respectively. The position itself is worthy of study, for the same plan may be pursued in other varieties of deformity due to unsymmetrical muscular action, and

in considering any assumed position in which a muscular deformity is temporarily corrected, it is very important to observe that the muscles put in action in the correcting position are sometimes not those the development of which would permanently retain the corrected state, but are their opponents ; these opponents pull upon those muscles whose development is desirable for curative purposes, and so indicate them ; as an example, take the above position in a case of spinal curvature with the lumbar slope to the right, and consequent dorsal leftward curve, with the ribs on the right side prominent, on account of rotation of the vertebræ that way. By raising the left arm strongly overhead, the deltoid and trapezius (upper portion) act, and put the left latissimus dorsi not into action, but in a passively stretched condition, pulling on the latissimus dorsi as on a strap, the result being to pull the spine leftwards, so far as regards its lower two-thirds, and this is helped by a similar pulling upon the lower portion of the right trapezius by the partial elevation of the right arm, an elevation which is attained by the action of the deltoid and is not sufficient in extent to put the right latissimus dorsi on the stretch.

I have ventured on this observation because I think it is important for the teacher to distinguish between a muscle being put into action, and put passively on the stretch, and also because such experiments can sometimes indicate to us which muscle may be with

advantage exercised ; a permanently strong latissimus dorsi in a condition of natural tone on the left side, in the case we have supposed, would be the first step towards the cure.

You will then proceed to exercise the muscles which would pull the spine towards the central line, and in a case where the spine errs by sloping to the left, the left latissimus dorsi is one of these muscles, and a little further consideration will show that the left erector spinæ is another ; at the same time, it would be of advantage to make the whole thorax tend in a contrary direction to the deformed twist. For the latissimus dorsi, a good drilling at pulley exercise No. 13, with one arm only, according to which side the spine leans, the arm on that side away from which the lower half of the spine leans being moved ; then pulley No. 22, moving the whole body and not only the neck ; this is for the left erector, the movement being, of course, to the left, unless the deformity be the opposite to the example I am using throughout.

Following this exercise, will come with great value Grade E, No. 7 ; but always remembering that the patient whose spine is curved with its convexity rightwards, and the ribs on the right side prominent, should perform only that part of this exercise which turns the right arm and leg forwards, and in which the twist of the spine is from right to left ; that is, the first part mentioned in my description of the move-

ment. A patient with the opposite deformity will precisely reverse this movement, taking the left leg forwards and all movements in accord with this movement. It will scarcely be possible for me to enter into full details concerning lateral spinal curvature in such a work as this, since I am writing for non-medical readers, but the teacher of remedial gymnastics must at least be awake to the main points concerned in this common deformity, the treatment of which is, in my opinion, a matter best left to those surgeons who make a special study of the matter, but a deformity which will come frequently under the notice of non-medical teachers.

The reader probably knows that the vertebræ are formed of solid *bodies*, from which there project backwards the *arches* forming the passage for the spinal cord, and that from these arches stand out the *lateral processes*, and the *backward spinous processes*. In the healthy spinal column, the spinous processes, though capable of lateral twist, are during rest or the erect position, perfectly central, forming the median line of the body; but when a lateral curvature exists, the spine nearly always twists upon itself; when the fall of the column is to the right, curving back to the left in the upper, or "restituent" curve, the bodies of the vertebræ turn towards the right, and the spinous processes towards the left; hence the lateral process on the right side of a curvature whose convexity is rightwards, turn backwards, carrying the ribs with

them on that side, thus forming the protrusion of the ribs on the convex aspect of the curvature. Besides this, a most important point must be noticed, that the spinous processes turn towards the left in such a case, towards, that is to say, the concavity of the curvature, and thus tend to hide the extent to which the lateral curvature has developed; the bodies, which are the bulk of the column, usually deviate far more from the central line than would appear to an untrained eye to be the case.

But the importance of these main facts with regard to the application of gymnastic exercises consists in the fact that our traction by means of the patient's muscles must be so applied that in a case where the curvature is convex on the right side, and the chest twisted backwards on the right, the spinous processes shall be pulled to the right, whilst the bodies must be carried towards the left. The means at our disposal for bringing about this correction consist of the muscles attached between the shoulder blades and arms and the spinous processes, on the *right side*, and the muscles between the arms and the front of the chest on the *left side;* the first group of muscles are the rhomboids and trapezius on the right side, the second group are the pectorals of the left. In view of these facts, the teacher will see that to educate and strengthen these two groups is most important; backward movements of the right arm (in the case supposed) and forward movements of the left arm, will

be the movements required, the arms, in both movements, being held out at right angles with the shoulders; both arms may be moved together with slight resistance by the teacher, or what is better, each arm may be separately exercised by means of the pulley and weight apparatus, strictly moderate weights being used, so that the movements may be continued for a considerable time without fatigue: pulley exercises, Nos. 17 and 12, the latter with right arm only, and the former with the arms at right angles with the shoulder, and the left arm moving, will be the required movements.

With the reverse deformity, all this must also be reversed as regards right and left. The gluteal muscles, and the psoas and iliacus on the side from which the lumbar part of the spine slopes will next want attention; and exercises of grade C, No. 3, grade D, No. 5, will come into use, and pulleys 25 and 26. A most important movement, to be constantly practised, is a resisting movement, the pressure being applied from behind by the teacher, on the prominent side of the ribs only, the patient bending forwards and rising.

Grade D, No. 3, may be used afterwards, and at first it is a good plan to slightly tilt the low couch up on the side away from which the spine leans from the pelvis, so that the erector on that side is chiefly exercised for a time; the patient must also be well drilled in all other leftward bendings and strides, or right-

ward, as the case may be. Your right-leaning spine must thus be taught to go leftwards, the patient must think always of that direction, until not only is the correcting habit acquired, but the deficient muscles on that side are strong.

I have taken the most common variety as my example; two-thirds of spinal curvatures are of this direction, but you will meet with others in which the leaning of the spine from the central line begins only in the dorsal region, the lumbar spine being central. I think that the principles to be drawn from the above remarks will have given you the means of meeting other cases appropriately.

After the special movements, with which at first the whole lesson will be occupied, you will, of course, put your patient through the whole series, avoiding, however, all movements which evidently increase the faulty direction of the spine.

It will be discovered very soon by anyone who has to deal with these patients, that the most constant watching is needed to prevent their relapsing into faulty ways of carrying themselves; without the help, and perhaps, the manual direction of a teacher, their attempts to correct themselves will often lead to worse deformity. The friends of the patient must be instructed to keep him (more often it is "her") up to the mark during the times between the daily exercises, reminding the patient of sitting, standing, and walk-

ing as uprightly as possible. A moderate amount of daily outdoor walking should be enforced, and those who are strong enough for it should take part in the usual play and games of other children (or adults).

You cannot strengthen a spine by using a couch or back-board for many hours daily, yet it may be well to allow an hour's rest on the back after exercising; and there are cases of lateral curvature due to paralysis or weakness of muscles, where more rest on the back than this may be advisable.

I need scarcely dwell upon the necessity of care in the matter of dress. We dress our boy children now in a fairly sensible way, but the little girls have still too many articles of attire put on like the skins of an onion, one over the other, and too much tackle to support these articles; the simple rule, "absolute freedom of movement in every possible direction," is easily obeyed in the matter of clothing. As to corsets, I think that the first move to get rid of these is to carry the weight of all those lower garments which are now hitched on the hips, by the male plan of some form of suspenders over the shoulders (girls, having such suspenders so arranged as to avoid pressure on the breasts); or by attachment to the body for obvious reasons, or by attachment to the body clothing by buttons, as in a little child's dress. If corsets are to be worn, they must never be for the purpose of in any way modifying the natural figure, and must, therefore, never bring any pressure

to bear upon the body; in other words, the corset may be fitted to the body, but not the body to the corset. The question of artificial supports of other kinds comes under surgical attention.

## CHAPTER VI.

### Weak Feet and Legs—Peculiarities of the Infant Feet and Legs—Handling Babies—Boys and Girls—Conclusion.

Many patients with lateral curvature also have what is called "flat feet," indeed, this weakness is sometimes the first cause of spinal deviation; and a patient whose feet have given way in the soles will get little benefit from exercises for the spine unless the feet be also improved.

Fig. 34 gives the impression of a flat and a healthy foot.

The mark made by a healthy foot on the ground shows that the weight rests on the outer border of the sole, the heel, and the ball of the foot, the toes all being well pressed down; the inner edge of the waist of the foot should not make any mark, since here is the elastic arch of the instep. The arch is formed by the bones of the foot, forming the tarsus, and answering to the palm, or carpus, of the hand, by the row of long bones next to the tarsus called the metatarsal bones,

and by the heel. The joints between the metatarsal bones and the last row of the toe bones (or the first, according to which end you count from) form the ball of the foot, and the various bones are, of course, held together by ligaments; and the instep arch, which, on the inner side of the foot is raised from the ground, is maintained partly by ligamentous bands. But the ligaments alone are not able to keep the arch intact; much of the strength of the instep comes from mus-

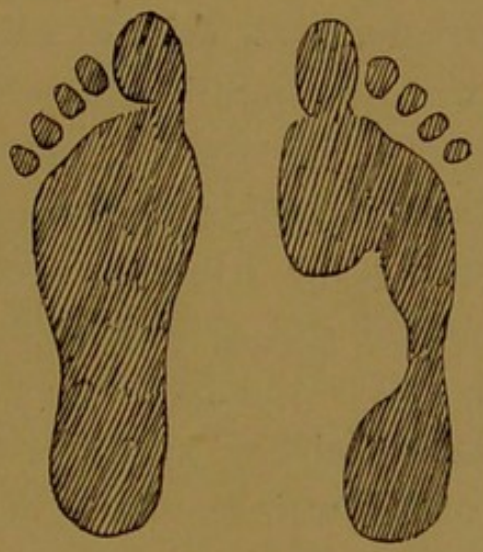


FIG. 34.

cular action, aiding the ligaments, the most important of the non-muscular supports being the "plantar fascia;" this and other ligaments give way when the muscles are weak, or unable to act freely upon their tendons in the sole of the foot. The muscles chiefly involved in this duty are those behind and to the outer side of the leg, the flexors and peroneals, whose tendons run along the sole, to be

inserted into the base of some of the toes, and into further bones of the toes. For health of action and continued elasticity and strength of this arch, it is necessary that it should be freely exercised, all the natural play of tendons, and joints and ligaments being fully and constantly used; this means that the foot must be used over varying surfaces of ground, that the central part of the arch shall be constantly springing, and the muscles all fully playing during this time; the foot, as we rise on the toe in walking, should bend freely, and this is exactly what our modern boots will not permit, since the waist of the sole of most boots is inflexible, and the foot only moves as a whole, often being turned on its inner edge when leaving the ground in walking, simply because the boot will not allow of a straight rising on the toes; and unless the foot rise on the toes and bend, the toes themselves do not get the free spreading-out action as the weight comes on them that they naturally need for exercise; add to this the flatness of our town pavements, and their rigid hardness, and you will find plenty of reasons for the arch of the feet giving way in weakly town-bred persons, especially if they crowd their toes into pointed boots, so as to still further diminish the normal play outwards of the toes.

The weight of the body is carried on the leg bones, the tibia being the one which is supported at the ankle, and this bone transmits the weight rather on

the inner side of the foot, or at least, over the arch of the foot, and not directly over that edge of the sole which rests on the ground. As the tendons and ligaments in these long, narrow, weak feet give way, the foot tends to turn up sideways and outwards, the inner part of the sole coming on the ground, whilst the tibia and weight of the body with it tend to slide inwards, the inner ankle projecting in consequence. In children, and not seldom in adults, there is also a tendency to take the weight off the aching and feeble feet by leaning the knees together, and, as the outer edges of the feet turn more and more upwards, there may be also developed knock knees; if the ligaments of the knees are weak and give way, as in such patients they do, the feet straddle apart, and the knees fall together, the muscles on the inner aspect of the legs also yield, as the foot drags outwards.

If a surgeon has found that flat foot exists in a patient, he will probably have ordered some temporary artificial support to the arch, but it is your duty to make this support ultimately needless. First of course will come the boots. In a bad case this will be settled by the surgeon, but in a slight or hardly-commenced case, the boots should obviously have perfectly flexible waists to the soles, so that the boot when off the foot can be doubled up backwards easily, and without breaking the waist. Room for the toes to spread is the next point, and freedom for ankle work the next; so that shoes are better

than boots, for the reason that, if the waist be stiff, there is a certain amount of rising of the heel out of the shoe which gives natural play to the foot; the thickness of the sole and heel of the boots should slope from out to inside, the outside edge being thinner. Exercises should be done with shoes off, in stockings or socks. Grade A, Nos. 6 and 8; Grade D, No. 1; Grade E, No. 3; pulleys Nos. 24 and 30 will be needed; followed by sitting on a chair with the foot resting on a support just above the heel, and turning the foot upwards, downwards, and inwards successively for many repetitions. Walking on tip-toes, with straps passed under the soles of the feet, and held by the hands, is a good exercise. For knock-knees, besides any mechanical support ordered, the exercises, Grade B, No. 5, and pulleys Nos. 25 to 30 may be added, as well as walking cross-legged, sitting on the floor cross-legged like a tailor or a Turk, and rising without aid from the hands; but all bad walkers, if they are so merely from weakness or carelessness, should become members of regular drilling and movement classes; only the extreme cases come under medical gymnastics.

Bow-legs, the opposite to knock knees, is usually accompanied by more or less bending of the bones; this you cannot alter by exercises, but much may be done where weak ligaments are at fault, by exercises throwing the legs apart and feet out and on to their inner edges, as pulleys 29 and 30.

It is well to note that the new-born child carries the legs in the position of bow legs for some time after its birth—the feet, indeed, are strongly turned inward, so that their soles can easily be placed flat against each other; the arch is not formed until after the child begins to walk. At first all the foot comes flat down, and if a child be very heavy, the weight may be too much for the feet, and no arch may rise, but this should be prevented by taking the child off its feet for part of the day, rubbing the feet with salt water, &c.; and if the new position of the feet and legs seem long in coming—if, in fact, the baby be keeping its bow legs and flat feet, or be walking on the outer edge of the feet—constant gentle pressing with the hands in the right direction will be useful. I have seen threatened club feet quite averted by the mother's careful acting upon surgical advice in this respect.

Babies encouraged to walk too soon will, of course, be likely to suffer in these ways. It is interesting to study the process of the infant's learning to stand upright; the backward state of the development of the erector spinæ muscles permits of that very free and easy shutting up at the hips, like the lid of a box or covers of a book, which is such a merciful provision for babies; the sudden kink, and the soft character of the part on which the infant plumps down being very commendable. The whole process is a lesson to adults in falling. The baby makes no stiff guarding contraction of its muscles to prevent a fall, and so

does not ensure for itself a painful fall on the back of its head, or some other bad place; the self confidence of the "grown up" which leads us to try and save our dignity in falling is bad; let us all imitate the simple faith of the bumping baby—let everything go slack and sit down when our fall comes.

The yielding nature of the infant's tissues, and the separate condition of the ends of the bones from the shafts, as well as the very soft state of their ligaments, is to be remembered when we handle them. The spine should not be allowed to support itself until the baby makes decided efforts in that direction; let it, however, often go through a modification of exercise, grade D, No. 3, which it is very fond of, but the head and shoulders are to rest on the mother's or nurse's knee, letting the baby raise the head.

All that horrible "joggling" of babies to keep them quiet is wicked; dancing a new-born infant up and down, thumping its back, and shaking it about to quiet it, are all in the same line; true, such a process sometimes does quiet it, the poor thing is so aghast and confused by it — we should probably get temporarily quiet if we were suddenly caught by a lively earthquake.

Dragging children about by one arm, or lifting them up on the kerbstone by one arm, and swinging them by arms or head, are all indefensible depravities; few seem to know what risks the child runs under such conditions; especially the head lifting, under

which cruelty, fatalities have occurred, unfortunately to the child, and not to the stupid creature who committed the offence. In handling babies, it is not the "gingerly" tip-fingered grasp, as with a claw, that baby likes; it may seem gentle to touch babies only with the tips of the fingers, and raise them with bunches of claws, or by levering them up by their arms, but it is not what the baby would choose. A baby feels safest in the broad, firm, all-enfolding palm and broad fingered grasp of a strong hand; the sense of security and comfort is evident under such conditions. Some of the worst handlers of babies I have seen have been the weak and gingerly fingered people—often nurses, sometimes mothers—and some of the best, medical men with large, broad, and strong hands, who are accustomed to pass many infants through those hands daily, as at a children's hospital: one of the tenderest handlers of babies I ever saw was a man with the hand of a giant.

I will conclude these humble pages with the remark that I have all through made no difference between the treatment of girls and boys, nor do I advise such distinctions being made. I find the mutual relations between children who are growing up far more natural and simple when both sexes have been educated together in physical exercises. Both are improved by the companionship; if this were not so it would make us think that the two

sexes were not intended as companions to each other. I would lash with all the fury of which I am capable the sickly prudery which dictates reasons for separating boys and girls at play, and I detest the idea that the end of childhood in a girl is to condemn her nevermore to be "vigorous" and free in all her movements. "Young ladyism" need never extinguish all participation in active games. Mercifully our girls have now conquered these notions in their elders, and we have golf, tennis, cycling, and other sports open to them. Nothing, of course, can excel horse riding, but few are so fortunate as to be able to enjoy that pastime. Rowing, again, is excellent, and now permitted to the emancipated girl, but few can be within reach of it.

As to the different treatment of girls in exercises, every case is to be a study in itself, but I would plead for the most tender consideration for young girls during periods of indisposition. The merest hint to any teacher, either of physical or mental education, should be sufficient to secure for a girl rest of body and mind if necessary under such conditions.

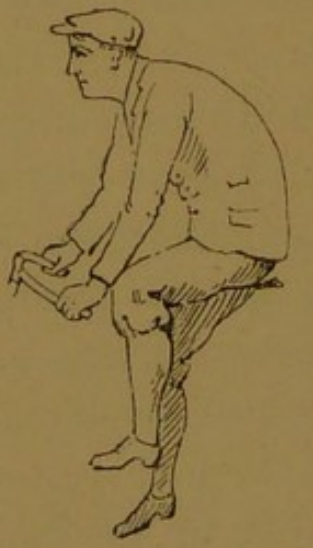
## APPENDIX ON POSTURE IN CYCLING.

As I have been a cyclist for more than twenty years (with some success on the racing path in days too long gone by), I wish to make some remarks upon the modern style of cycling. The question is often asked me by parents of growing boys and girls, Do you recommend cycling? I reply that cycling is one of the finest of exercises, and of physical educators, *providing the rider uses the machine properly*, but that it is about as injurious a pastime as can be devised (so far as postural faults are concerned) for boys and girls, if pursued as it is most generally, and with the usual posture. Fortunately the faults are perfectly easy to correct; the modern safety cycle is the best yet invented, and I have nothing but praise to give it with two excepted points; those points are—the saddle itself, and its position with regard to the handles. The relative position of the saddle and pedals is usually well arranged, but that between the saddle and handles is utterly wrong.

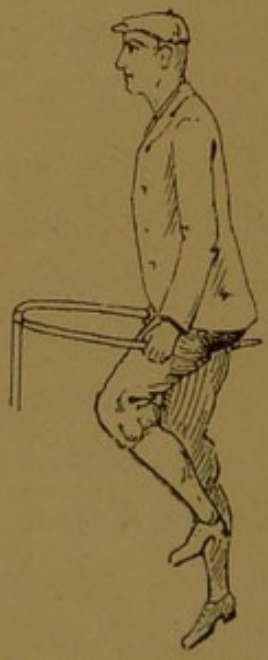
Speaking as I do as a veteran cyclist, I feel sure that all practical riders will at least agree with me

when I claim one fundamental point as the result of experience. I mean that the first and absolute

Choice of natural positions available with low backward handles.



Only available position with the usual low forward handles.



Useless exaggeration of the upright position.

necessity for efficient cycling is that *the arms must be straight;* full power of pulling and of fixing the body

centrally is secured by the straight arm. Next, it is necessary that when riding fast against the wind or uphill, the rider should lean forwards. These two points even the modern "scorcher" will probably grant me.

To these I add two more points which are certainly not noticed by modern cyclists. One, that the forward position should be a leaning from the hips, with the spine not curved forwards, and the shoulders braced back, not cramped forwards; and next, that both an absolutely upright posture, and one leaning forwards from the hips must be obtainable at will by the cyclist at his choice, the upright position being the rule, and to be gained without sacrificing the straight arms.

The modern cycle gives the rider the straight arm and the forward posture, but allows no choice of posture, and secures the forward position and straight arm by placing the handles low and forwards. This means that the posture is necessarily a *stoop*, with rounded spine and shoulders pulled forwards, and this is the fixed and only posture possible as the machine is commonly arranged.

It is of no use to merely raise the handles on the modern machine, for to do so is merely to throw away the straight arms and lose half the driving power, whilst the forward position becomes impossible, owing to the handles getting in the way, and rendering the arms helpless.

I propose to secure all the needed points by the simple means of discarding the low forward handles and the high forward handles, and using the low backward handles. This is the plan I always adopt on my own cycle, and with complete satisfaction. I have here illustrated my contentions by sketches which explain themselves.

The other matter is that of the saddle. I claim that this should be a *seat* and not a saddle in the strict sense of the term. There should be no part of the weight of the body carried on the perineum or "crutch," but all the weight, except what is borne by the pedals and hands, should be carried on the points naturally formed for that purpose—the two tuberosities of the ischia of the pelvic bones. This point is of more importance with boys than with girls, though with the latter there are serious anatomical considerations involved. I need not go into details—any sensible man or woman knows the main points I allude to. I would here call attention to a seat which I constantly use myself (and weighing 14 stone I am a good judge of the comfort of a seat). It is a seat I recommend to all cyclists, and especially to boys and girls; the pads should not be tightly distended. It is invented and made by Mr. Burgess, of 19, Preston Road, Brighton.

I suggest that the following rules will be found to apply to all normally formed individuals of either

sex, and if attended to, will secure a healthy and efficient posture.

The seat should be placed over a point about half-way between the centre and front rim of the hind wheel (speaking of the modern chain rear-driven safety cycle); a firm grip on the road is thus gained, with little weight on the front wheel. The height of the seat should be that which permits the foot to easily press the pedal at its lowest point without pointing the foot, whilst the handles should be carried back so that they are about half-way down the thighs at the highest point of the pedals, and the handles should be level with the seat, and in a line over the main axle (bottom bracket) of the machine; the handles should be wide enough laterally to well clear the thighs in steering. These rules I have formulated as the result of many years' experience.

# INDEX.