School life in its influence on sight and figure : two lectures / by R. Liebreich.

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PREFACE.

It is now six years since I delivered the first of these two lectures. The interest which the London School Board took in the matter, and the large scale on which that body carried out in practice the principles which I had laid down, were an encouragement to me to give further attention to the subject, and also to devote such time as I could spare from my professional duties to the study of the influence which posture has on the figure, and particularly on the spine. In fact there is more connection than might at first sight be supposed between certain anomalies of the eye and those slight curvatures of the spine which are only too often artificially produced during schooltime; there is for instance action and reaction between weakness of the spine and certain defects in vision, it being a fact that short-sightedness increases curvature of the spine, and that this latter tends to produce or to increase short-sightedness; and, above all, bad posture is a cause common to these two very different diseases. I therefore had no hesitation, when a second edition of my lecture on 'School-life in its Influence on Sight' became necessary, to let it appear together with a lecture delivered only a short time ago, and to give them the common title, 'School-life in its Influence on Sight and Figure,' hoping thus to call the attention of parents, teachers, and medical men, to whose care children are entrusted, to both these subjects.

16, Albermarle Street, *July*, 1878.

I.

SCHOOL LIFE IN ITS INFLUENCE ON SIGHT.

A Lecture delivered before the College of Preceptors at the House of the Society of Arts, July 13, 1872.

Considering the great care which, in English schools, is bestowed upon the physical well-being and development of the children, I have been surprised to find almost everywhere arrangements more or less injurious to the Organ of Sight. I am inclined to believe that this arises from the masters, architects, and others concerned in school arrangements, not being sufficiently acquainted with the first principles laid down for the preservation of sight. It seems to me as if the question, what those principles are, had never yet been asked.

Therefore I think it is very opportune to lay a thorough consideration of this subject before the College of Preceptors. I shall not have to speak of the different diseases of the eye to which childhood is subject, and which therefore often appear during the school-life of a child; but only of those changes in the functions of the visual organ, which are immediately developed under the influence of school-life. These are three in number,—

1. Decrease of the range of vision.
2. Decrease of the acuteness of vision.
3. Decrease of the endurance of vision.

1. Decrease of the range—Short-sightedness (*Myopia*)—is that condition of the eye in which rays of light from an infinite distance, i. e. parallel rays, are united in front of the retina in consequence of an extension of the axis of the eye. The rays

must be made more divergent with the aid of a concave glass, in order to see distinctly.

Short-sightedness is developed almost exclusively during school-life; rarely afterwards, and very rarely before that time. Is this coincidence of time accidental?—i. e. does the short-sightedness arise at the period about which children go to school? or has school-life caused the short-sightedness? Statistical inquiries prove the latter to be the case, and have shown, at the same time, that the percentage of short-sighted children is greater in schools where unfavourable optical conditions prevail.

It is true that short-sightedness is often hereditary, but this must not be thought to mean that the children of short-sighted parents are born short-sighted. They have only the predisposition to become so, and this predisposition is developed during school-life, more or less, according to certain external conditions; and the more so, of course, under conditions which tend to produce short-sightedness even in children who have no hereditary predisposition.

If the predisposition is thus hereditary, and new cases are continually added, we can easily understand that short-sightedness in general must be continually on the increase. This, with regard to civilized countries, is an established fact; and if you flatter yourselves that there are fewer short-sighted people here than in any other country, you must not therefore think that England is an exception with regard to the relative increase of myopia.

But is myopia in itself actually a defective condition of the eye? The notion that short-sighted eyes are the most durable is one commonly received, but this unfortunately is no proof of its truth. It is merely founded upon the fact that short-sighted eyes can see near objects distinctly without the aid of glasses, at an age when normal eyes require the assistance of convex lenses.

This advantage, when the short-sightedness is very slight,

may be considered to counterbalance the inconvenience of concave glasses being always necessary in order to see distant objects clearly; but in a higher degree of myopia the advantage is entirely outweighed by more serious considerations. The far-sightedness that appears about the age of forty-five, and steadily increases with years, is a purely physiological condition of the healthy normal eye. It has no other disadvantage than that of rendering convex glasses necessary for reading. It is only in cases where a prejudice against spectacles, or a certain vanity and reluctance to appear old, deprive the eye of its natural assistance, that it is accompanied by fatigue and weakness of sight. A high degree of short-sightedness, on the contrary, is a pathological condition, caused by anatomical changes in the membranes of the eye, which involve a greater tendency to serious complication than the normal eye.

Short-sightedness has an injurious influence on the general health by inducing a habit of stooping. Its increase from a national point of view is to be considered a serious evil. In former times, when literary education was confined to a small number, this question was of little or no importance; but now, especially when England is about to extend the benefits of school education to a far greater number of her citizens, the question how to prevent short-sightedness deserves serious consideration.

2. The decrease of acuteness of vision—Amblyopia. In general, this serious condition is the result of positive diseases of the eye, which may exceptionally be induced at school, but which are of too individual a character to be considered here. Amblyopia of one eye only is, however, often produced by unsuitable arrangements for work, which disturb the common action of the two eyes, and weaken the eye which is excluded from use.

3. Decrease of endurance—Asthenopia. This very frequent affection, which has destroyed many a career, prevented the development of many a fine intellect, and deprived many of

the fruit of their laborious exertions and persevering industry, arises principally from two causes. The first is a congenital condition, called hyper-metropia, which can be corrected by convex glasses, and which cannot therefore be laid at the door of school-life. The second is a disturbance in the harmonious action of the muscles of the eye—a defect which is difficult to cure, and which is generally caused by unsuitable arrangements for work, in a manner which I shall presently explain.

Do not be afraid that I am about to enter on a scientific explanation of the various causes of these disturbances of the organ of sight. For the three anomalies I have mentioned all arise from the same circumstances—viz. insufficient or ill-arranged light, or from a wrong position during work.

Insufficient or ill-arranged light obliges us to lessen the distance between the eye and the book while reading or writing. We must do the same if the desks or seats are not in the right position, or of the right shape and size.

When the eye looks at a very near object, the accommodating apparatus and the muscles which turn the eye, so that the axes converge towards the same object, are brought into a condition of greater tension, and this is to be considered as the principal cause of short-sightedness and its increase.

If the muscles of the eye are not strong enough to resist such tension for any length of time, one of the eyes is left to itself; and whilst one eye is being directed on the object, the other deviates outwardly, receives false images, and its vision becomes indistinct—*amblyopic*. Or perhaps the muscles resist these difficulties for a time, become weary, and thus is produced the dimunition of endurance.

How can these evils be prevented?

The light must be sufficiently strong, and fall on the table from the left-hand side, and, as far as possible, from above. The children ought to sit straight, and not have the book nearer to the eye than ten inches at the least. Besides this the book ought to be raised 20° for writing, and about 40° for reading.

Are these rules attended to in English schools? I have, in order to find an answer to this question, visited a great many schools, and made inquiries about others. Having done so, I must state as my opinion—which, after having entered more into detail, I think will be yours also—that hardly in any school in England are these things attended to, at least not in anything approaching a perfect manner.

The proper light is most easily obtained if the class-room is of an oblong shape; the windows being in one of the long sides, and the tables arranged parallel to the short walls, so that the light falls from the left side. The desk of the master ought to be placed near the short wall towards which the scholars look.

This simple arrangement is at the same time the most practical, and has been received in every country as a matter of course. I was therefore much astonished to find this arrangement in England only exceptionally, sometimes in one class-room of a large school, and sometimes in the single class-room of a small school. On such occasions, the master generally excused himself by saying that I should find his arrangements rather old-fashioned, and expressed a wish to alter them. I had therefore to examine, 1st, if the English arrangements were better or worse than those adopted by the rest of the world; and, 2ndly, what might be the motives for this exception from the rule. I tried to find the principle or system which regulated the arrangements, but soon found that none existed, and that the lighting of the rooms depended entirely upon accidental circumstances. Sometimes the windows were in the short sides of the room, sometimes in the long; sometimes in one, sometimes in two or more sides, adjacent or opposite. Further, the arrangement of the desks was also accidental, and differed in every class-room in all possible ways.

From my conversations with the masters, I clearly perceived that in these arrangements, other considerations, to which I shall refer, had been attended to, while the matter of light

had been entirely overlooked. Those schools only which are under the superintendence of the Committee of Council on Education are exceptions to this rule. The Education Department, in its rules to be observed in planning and fitting-up schools, has made regulations for the lighting of class-rooms, and has chosen, of all the different kinds, the very worst. No. 15 of the rules is as follows:—"The windows should be so placed that a full light should fall upon the faces both of the teachers and of the children." Light coming from the right hand is not so good as that from the left, because the shadow of the hand falls upon that part of the paper at which we are looking. Light from behind is still worse, because the head and upper part of the body throw a shadow on the book; but the light that comes from the front and falls on the face, is by far the worst of all. In the first place, it does not attain the object desired; and next, it is most hurtful to the eye. The object is to make the fully illuminated faces more visible to the master; but the children, instinctively desirous of avoiding the unpleasantness of the full glare, assume all sorts of positions which turn their faces *from* the master. In reading, they turn the head round the vertical axis, generally towards the right, in order to let the light fall on the book, which, when held straight before them, is completely in shadow; while in writing, or in reading (the book being on the table), they bend their heads as low as possible, in order to shade their eyes by the projection of the forehead. In this way the faces are much less visible to the master than if they were held upright and illuminated from the left side; and if, according to the regulations of the Committee of Council, the light also falls full upon the face of the master, he will be entirely prevented from seeing them.

This method of lighting the room is very injurious to the eye, because, firstly, the retina becomes fatigued by the full glare upon it, and the diffused light renders the comparatively dark images of the printing and writing more difficult to be

perceived. Secondly, the position assumed by the children, in order to avoid the disturbing influence of the light, places the axis of the eye in a very unfavourable direction, which, as I have already mentioned, and shall explain more fully by-and-by, induces short-sightedness, differences in the sight of the two eyes, and certain weaknesses of the muscles of the eye.

The motives for this diversity in the lighting of rooms cannot easily be given, as they are different in almost every school. I will, however, mention a few of the more prevalent.

Some of the principal schools are in buildings, two, three, and even four hundred years old. Here the windows are not in the most desirable positions; comparatively speaking, however, the lighting in the large class-rooms is very good. They have high Gothic windows, and the light falls through them more directly from above. The more directly the light falls from above, the less is felt any fault with regard to the side from which it comes. In small old buildings, the lighting is frequently very bad. This would have been of little consequence where the old building serves merely as a nucleus for new ones, were it not that the unfortunate idea of building the new part in the old style has deprived the children of the favourable opportunity of obtaining several well-lighted rooms, in addition to a small number of badly-lighted ones.

If we have to condemn this sacrifice of a most important object to architectural taste, what shall we say when one of the first architects in England builds, at an enormous cost, a perfectly new, large, splendid school on an extensive piece of ground, open on all sides, and who lights every class-room from three sides at once, by low broad windows; thus rendering it impossible to place the desks in any suitable position? Are trustees and architects aware of their responsibility, when they build a school without consulting the masters, and only for outward show? Or have they no misgivings of the evil consequences resulting from such unpractical arrangements in a school?

In the schools of the middle classes I have generally found

better arrangements with regard to light, especially where limited means did not allow the architect to ornament the house in the Tudor style, in which the upper part of the window i. e. the most important, is useless, but obliged him to build in a simpler manner. Buildings with rectilineal and rectangular ground plan, with high, rectangular modern windows, do not produce such a pretty effect in the landscape, and do not proclaim the genius of the architect to the superficial beholder; but this seems to me of small consequence in the case of institutions of such practical importance as our schools.

In the schools for the poor, where the light depends essentially upon the situation and means of the school, and where the first is often unfavourable and the latter limited, no one can be blamed for the lighting, which is generally insufficient rather than ill-arranged.

With regard to the various positions of the desks and seats, it is difficult to give any account of the reasons for them, as in most cases they appear to be the result of mere accident. Sometimes unimportant circumstances, such as the position of the door or fireplace, or the best place for the black-board, &c., have decided the matter. More frequently it has depended on the desire to have the faces of the children in full light. Against this I have already declared myself, in speaking of the Government regulations. Most frequently, however, the wish to place the children as near as possible to the master, has regulated the arrangement, and has led to placing the seats in a horse-shoe form. This seems to be the favourite arrangement of all, and I am convinced that the large majority of my hearers are in its favour. I am therefore very sorry that, from my point of view, I must declare positively against it. In the first place, only one-third of the children can have a proper light; next, as is the case with the front light, it defeats its own object. The children in this position are *not*, as much as they might be, under the eye of the master. If he turns to the right end of the horse-shoe, his back is turned to

the left, and his eyes would require the mobility of the chameleon's to survey all the children at the same time. The arrangement of seats adopted in other countries, makes it easy to see the whole class at a glance, and without turning the head. The principal objection raised against this arrangement is that it is difficult to see several rows placed one behind the other; but this is easily overcome. The benches need only be raised one above the other; or, what is still simpler and more desirable, the master's place might be sufficiently raised. If you will only make a practical trial, and not form an *à priori* conclusion to the contrary, you will soon be convinced of the correctness of what I say. Other objections, as, for example, the difficulty of changing places, are also easily overcome. I believe that you would then all return to that simple arrangement which alone affords a suitable light. In most class-rooms it would be easy to make the necessary alterations, nor would this arrangement prevent the head-master from surveying the different classes (separated by curtains) if he is in the right position.

The lighting of the rooms in the evening ought to be as similar as possible to that by day. It is difficult to arrange gas-light well, but easy to arrange it better than has been done in most schools. Almost everywhere I have found naked gas-jets, which give an unsteady, bad light. Glass cylinders would make the flame whiter and steadier. Reflectors would improve it still more. They might in most cases be made to perform at the same time the office of ventilators, carry off the bad products of gas-burning, and improve the general ventilation of the room.

Ground-glass globes ought not to be used: they are useful for the ordinary lighting up of a room, as they diffuse the light more equally throughout all parts; but, for that very reason, they give an indistinct light for work, and, if they are opposite the eye, are dazzling and injurious. This property of diffusing light renders ground glass useful for lighting up the darker

parts of a room by daylight also, where there is no direct light from the window; but care must be taken that it be only used for skylights or the upper parts of windows. If lower, it is hurtful, and positively injurious if opposite to the eye. It ought therefore never to be used for the lower parts of windows to prevent looking out. In such cases it would be preferable to cover the lower part of the window altogether, as the light which comes through is of little importance. In some schools I have observed windows of ribbed glass, used on account of its strength, so that balls from the playground may not break them so easily. Instead of this, wire netting ought to be used, as the optical effect of this glass, in that position, is decidedly hurtful. In drawing classes, the employment of such glass is sometimes very useful, if the light comes, as it ought in such cases, from the higher part of the room. If the glass should reach lower, it would, by diffusing light, destroy the distinctness of shadow on the plaster casts. I may here observe that the arrangement of seats in these ought not to be the same as in ordinary class-rooms. Generally a diagonal arrangement is preferable; or, if the room is long and very narrow, and the pupils only draw from copies, and the light comes from the top, it will be best to turn the back to the light.

If you have thus placed the seats in the right position, and taken care to have a suitable light, there will be no optical reason for the children assuming an injurious posture, and we have then to inquire into the mechanical causes for such a posture, viz. the form of the desks and seats.

The injurious effects which the crooked and stooping position of children in schools has upon their health, in particular on the lungs, abdominal viscera, figure, and sight, have lately excited much attention among physicians, and produced the works of Barnard, Schreber, Gast, Passavant, Guillaume, Coindet, Fahrner, Cohn, Heinemann, and many others. I recommend to your perusal especially the excellent work of the Swiss physician, Fahrner, entitled 'The Child and the Desk.'

These various investigations have led to an almost unanimous opinion as to the causes of the unhealthy posture assumed by the children; while, as to the means to be adopted for obviating these evils, there is now also an equal consensus of opinion. Formerly it was supposed that a bad posture arose partly from the inattention of the master, partly from the negligence of the children; but now it has been clearly proved that, from anatomical and physiological reasons, it is impossible that children should preserve a good posture with unsuitable seats and desks. The faults of the furniture commonly used have been carefully analyzed, and the following have been found to be the most important:—

1. Want of, or unsuitable, backs.
2. Too great a distance between the seat and the desk.
3. Disproportion, generally too great a difference, between the height of the seat and that of the desk.
4. Wrong form and slope of the desk.

If the back is wanting or unsuitable, the strength of the muscles which keep the spine straight is not sufficient to maintain it long in an upright position; the body stoops, and the lower part of the spine becomes bent forward, presses on the viscera and lungs, and prevents the free action of these organs. If the child has to read a book placed on a table at too great a distance, it sits on the edge of the seat, a very unhealthy and fatiguing position. It rests the body on the two arms, and if the difference between the desk and seat is too great, the chest is supported by the projecting shoulders, instead of the shoulders resting on the thorax. Soon this position becomes too fatiguing; the head, bent forward, becomes too heavy, and must be supported by one or both hands at the temples, or by the chin resting on both arms. Thus every possible modification of the two positions immortalized by Raphael in the two angels at the feet of the Sixtine Madonna, is adopted by the children; but while the angels look into the far ether, our children stare into a book, which, in one of these positions, is only two or

three inches from the eye; and, in the other, sideways from the head, and therefore at an unequal distance from the two eyes.

It is still worse when writing; with desks and seats of the ordinary form, only one arm rests on the table, it is generally the right arm, the left hangs so that the elbow approaches the left knee, and only the tips of the fingers hold the book on the table. The edge of the book is no longer parallel with the rim of the table, but slanting, or even perpendicular to it. If one observes the position which the upper part of the body assumes, we find that the lumbar vertebræ are bent forward, those of the chest towards the left, and those of the neck forward with an inclination to the right; at the same time, the lower part of the shoulder-blade stands too far off from the ribs, and is elevated too much towards the right, and the shoulder-joint is raised and pushed forward. To be in such a position for several hours of the day, at a time when the youthful body is rapidly developing, must naturally produce permanently bad effects. Statistics prove this to be the case. In Switzerland, for instance, 20 per cent. of all school boys, and 40 per cent. of girls, have one shoulder higher than the other. The well-known orthopædic surgeon, Eulenburg, also states that 90 per cent. of curvatures of the spine, which do not arise from a special disease, are developed during school-life. These statements have particularly struck me, as coniciding exactlywith the period of the development of short-sightedness, and I have paid the more attention to this relation between spinal curvature and short-sightedness, as they seem to form a circulus vitiosus, in so far as short-sightedness produces curvature, and curvature favours short-sightedness; while evidently the same bad arrangements are at the foundation of both these anomalies.

How can these great evils be removed?—First of all, the benches must have backs, and these must not be high, and not slanting backwards, as I found them in some schools. These only favour a negligent reclining posture, the body slides forward, and the position becomes unsuitable for reading, and im-

possible for writing. The back ought to be straight, and consist of a piece of wood only 3 inches broad. If this is fixed at the proper height, viz. close above the hips, it supports the loins sufficiently to make it easy and comfortable for even the most delicate children to sit perfectly upright. The seat ought to be broad enough to support almost the whole length of the thigh, and the height of the seat such as to allow the sole of the foot in its natural position to rest on a foot-board. The edge of the desk must be perpendicularly above that of the seat, and just high enough to allow the elbow to rest on it, without displacing the shoulder. I think that all who have carefully considered this question will be, on the main points, of nearly the same opinion. I must add another condition, which is of special importance for the eye, viz. that the desks should have an inclination, for reading, of about 40°, for writing 20°. The need of this arises from a physiological law, which is not so generally known as most of the other laws relating to the eye. It has, therefore, not even been considered by physicians, who have made the improvement of school arrangements their special study. Mr. Heinemann, who has addressed you on the subject of school seats, has deduced the necessity of having table-tops with a slope of 1 : 3, from the foreshortening of letters lying on a flat table, which diminishes the image of the letters on the retina, and thus causes a greater exertion of the eye. This, however, is of small importance, and need hardly be considered; the true reason for the necessity of an inclined desk is as follows:—

The eyes are moved in different directions by six muscles. The muscles of both eyes can only be brought into contemporaneous action in a certain way. Thus we can only move both eyes at the same time up or down, or bring them together from parallelism to convergence, and *vice versâ*, not, however, from parallelism to divergence. Of the possible combinations of the muscles, some can be brought into action for a length of time, others only for a few seconds. Thus we can only with

an effort look at a near object, if it is higher than the eye. On the contrary, we can look with ease at an object equally distant if it is below the eye. If we want to see distinctly with both eyes, not a point, but a line or a plane, a particular turning of both retinæ is required for each position of the object. Only when this turning can be produced by a combination of muscles which can be effected with ease and for some length of time, can we look at the object long without fatigue. Therefore you must not think that the natural position of the book while reading depends upon chance. It is a physiological necessity; if we strive against it, the eye becomes fatigued, and if the effort is repeated regularly and for a long time, a derangement of the harmonious action of the muscles of the eye is the consequence.

This is the reason why it is so fatiguing to look at the pictures of a gallery, hung high on a vertical wall, while we could see without fatigue the same number of pictures placed before us one after the other upon easels. For the same reason it is so hurtful to read while lying down, and, as we have often occasion to observe, it produces great weakness of sight (asthenopia) in those who are forced to lie down much. Therefore it is necessary, if we want to look long at any plane surface, as for instance a book, to place it so that for the central position the axis of vision is set at an angle of about 45° downwards, and we ought therefore to give the book an inclination which will place it nearly perpendicular to our axis of vision, viz. at an angle of about 45° with the horizon. For writing, the same inclination of the book would be advantageous, but mechanical reasons prevent this, and we must be content with an angle of about 20°.

In order to answer both requirements, I have had a desk made, which, by a very simple contrivance, gives the desired position either for writing or reading. There is, as in Heinemann's model, a flap which moves up and down. By the shape which I have given to this flap, and some small details

in the construction, I have succeeded in giving, without mechanical inconvenience, the inclination of 20° for writing, and 40° for reading. For writing, the distance between desk and seat is zero, for reading it is 5 inches, which has no disadvantage, and enables the children to change their places more easily.

If I were to confine myself to the proposal of such a desk, I should be deceived in the hope of seeing it introduced into English schools. The great difficulty of giving children of different sizes suitable school furniture would in this way not be diminished. Shall I then recommend to you the American system, where every child has its own seat and desk measured? or the Swiss system, where seven or more different sizes of seats and desks are made, to suit the different classes? I would no more do so than prescribe to one of my patients a medicine I knew beforehand he would not take. I should prefer a less efficacious treatment if it were more likely to be followed. I have therefore endeavoured to find a method by which the English school furniture may be greatly improved, without coming too violently into collision with other arrangements and the method of teaching in use here, and which will yet satisfy the demands of hygiene as much as possible.

I shall consequently make the following propositions:—

1. One and the same size and model of desk should be used for children and grown-up persons of both sexes.

2. The adaptation to the height of each child should be effected by varying the height of the seat and the foot-board.

3. The edge of the table is always to be perpendicular to that of the seat.

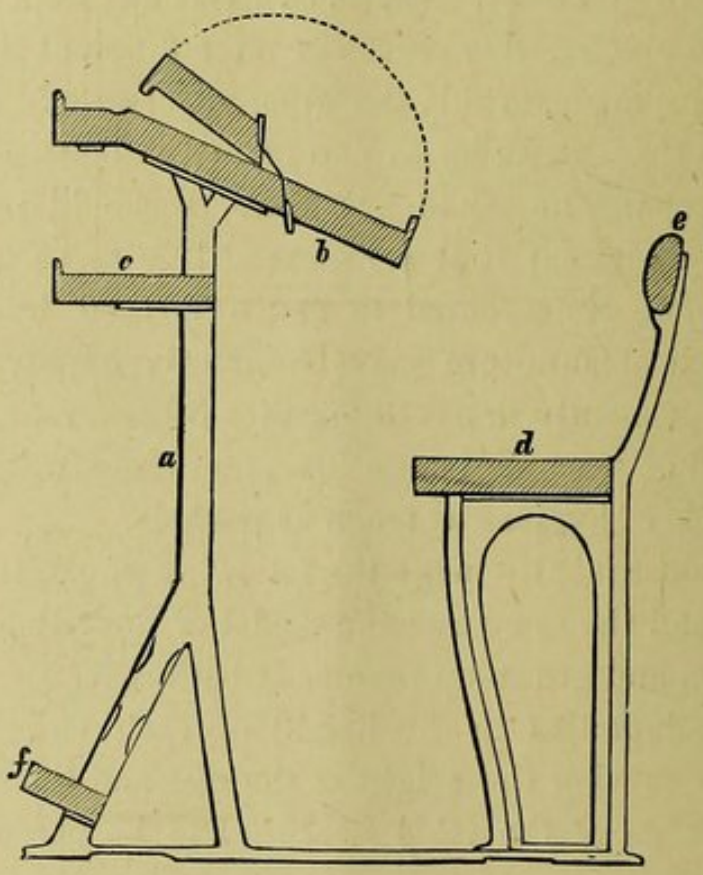
4. No seat is to be without a back, and the top of this is always to be one inch lower than the edge of the table for boys, and one inch higher than the edge of the table for girls.

5. In all classes where the boys change places, the height of the seat is to be regulated in proportion to the average height of the pupils.

6. In all girls' schools, in all those boys' schools where the children do not change places, in boarding schools, and in private schoolrooms, the seat of each child should be accurately regulated in proportion to its height.

Figs. 1, 2, and 3 show sections of school furniture made according to my calculations of the average sizes of children of three different classes. The relative height of the desk, the seat, and the foot-board are, in No. 3, adapted to the average

Fig. 1.



proportions of children of seven, eight, and nine years; in No. 2 to children of ten, eleven, and twelve years; in No. 1 to the average proportion of children of thirteen, fourteen, and fifteen years.

These are the proportions which the London School Board accepted in adopting the principles laid down in my lecture.

Fig. 2.

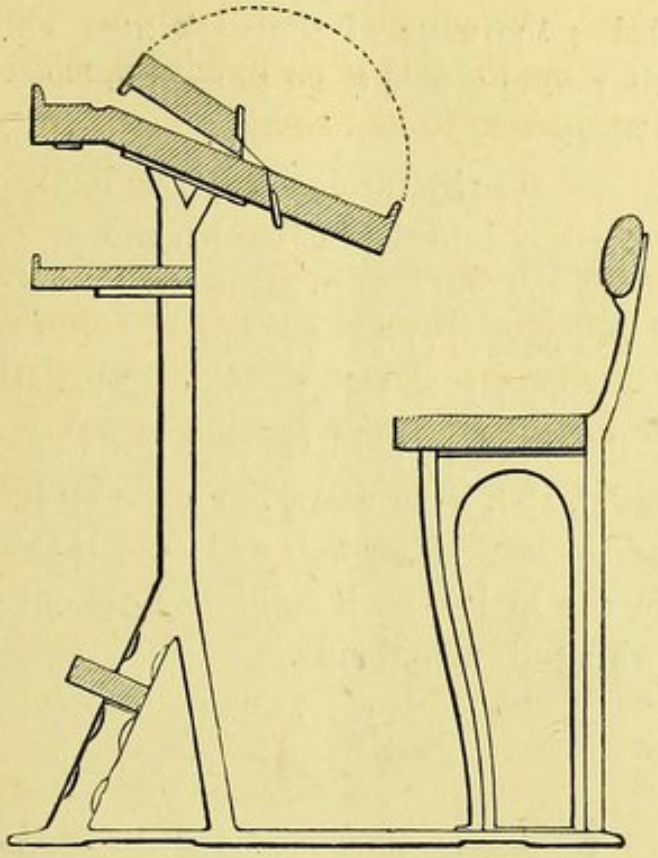
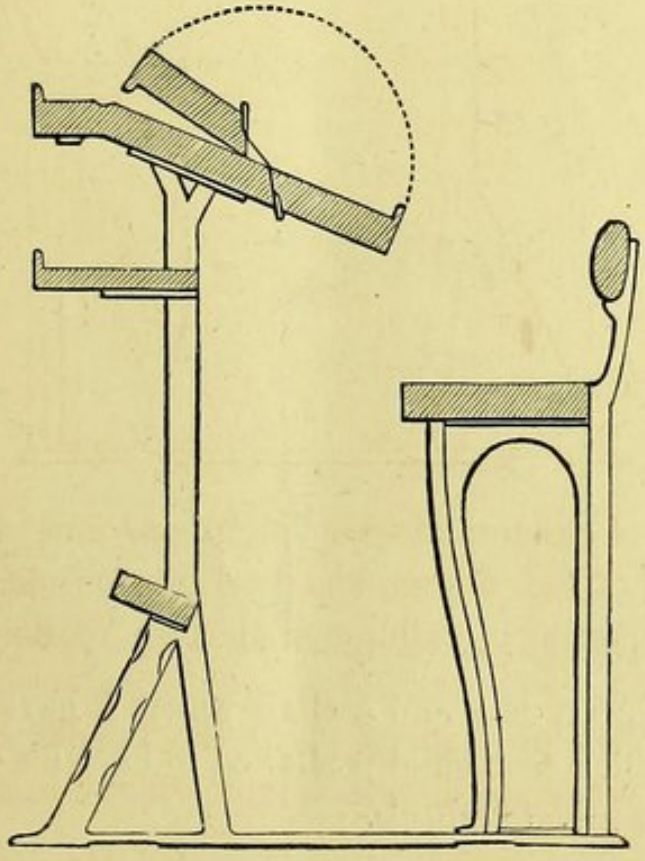


Fig. 3.



The flap *b* has three different purposes:—

1.—To bring the edge of the desk near enough to the children, to enable them to use the back-board when writing.

2.—To transform (by turning up) the inclination proper for writing into the inclination proper for reading.

3.—To allow the children to stand up in their places, and also to pass in and out easily.

The London School Board desks are double desks, with one flap for two children. I should have preferred to give a separate flap to each child, and, if necessary, to make up for the greater expense by using one desk for four children; if the back-rail is intercepted in the middle each child may get out of his place without disturbing his neighbours.

Fig. 4.

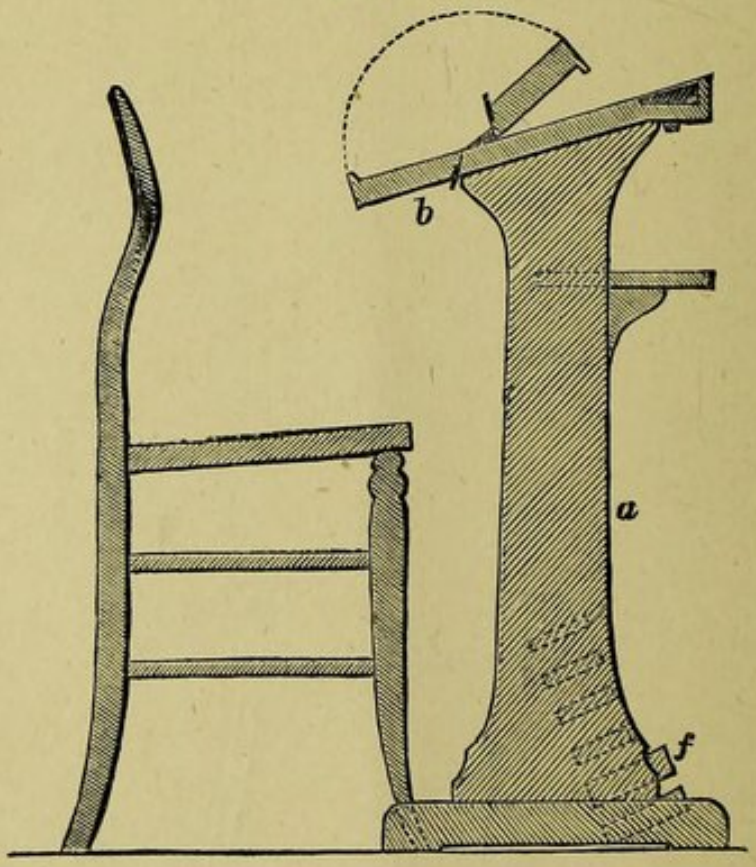


Fig. 4 shows a desk and a chair which I have designed for schools in which each child is allowed to have his own desk and seat, and for private schools.

The desk is the same for boys and girls of different sizes. The proportions of children, or grown-up persons, are adapted to the desk by the use of chairs of different heights and by the shifting of the foot-board *f*. The shape of the back of the chairs is different for the two sexes; the projecting part of it fits into the hollow of the lower part of the spine. The chair must be placed so near the desk that the flap, when turned down, touches the child while it is sitting upright. In order to regulate the height of the chair, it is sufficient to put a rule on the top of the desk, so as to continue its sloping outline towards the elbow of the child. The elbow of the arm which rests on the desk should fall just into the continuation of that sloping outline. If it is higher or lower, a lower or higher chair has to be chosen.

II.

SCHOOL LIFE IN ITS INFLUENCE ON FIGURE, AND ESPECIALLY ON THE SPINE.

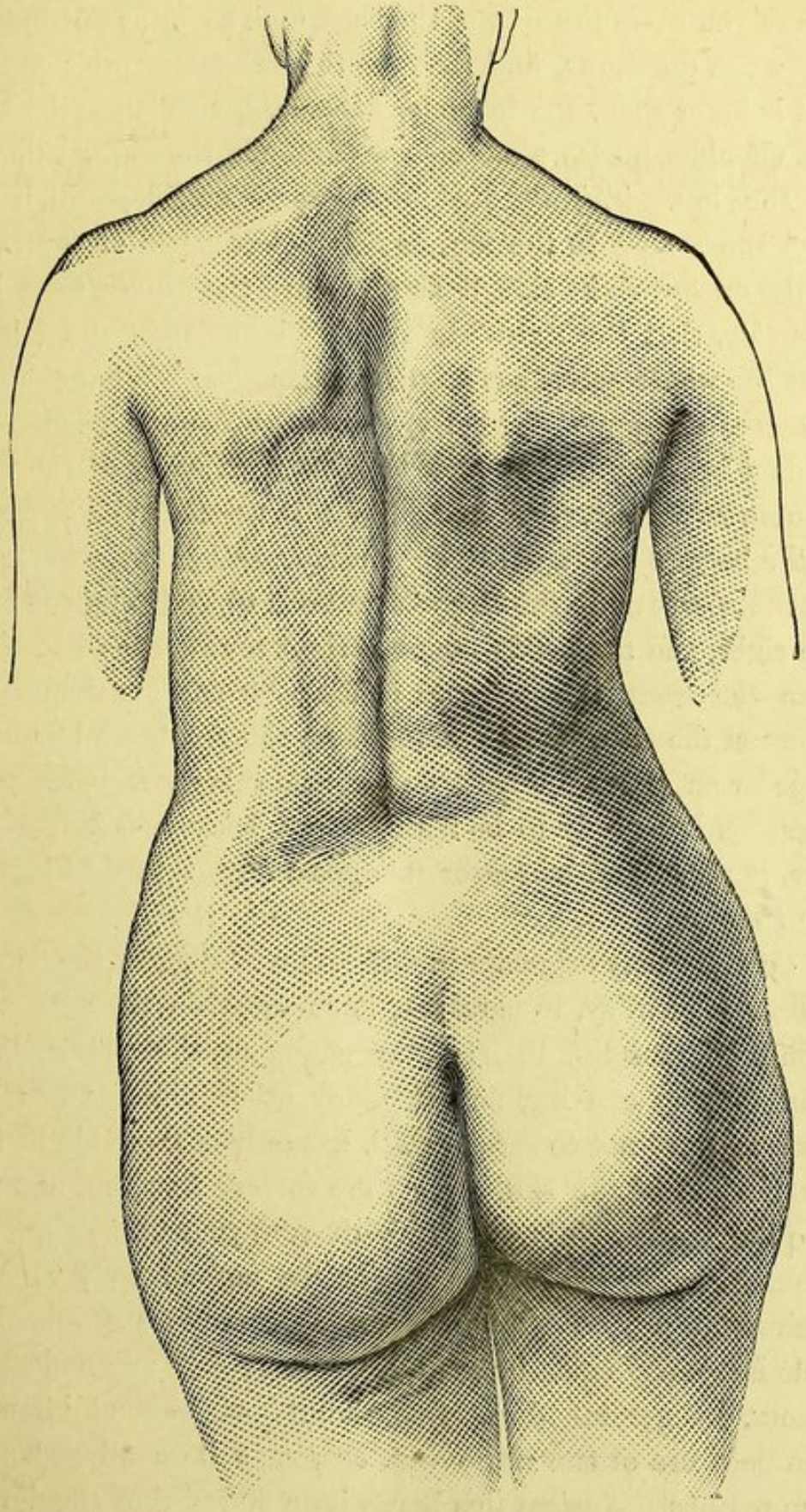
A Lecture delivered before the Society for the Development of the Science of Education, June 5, 1878.

Several Members of this Society were present at a Lecture which I delivered six years ago before the College of Preceptors, at the house of the Society of Arts.

The subject of that Lecture was: School Life in its influence on Sight. I laid down in it the rules for lighting school-rooms, and for the position and form of the benches and desks. The influence, which the following of these rules exercises on the sight, formed the principal subject of it; I only incidentally mentioned the influence of posture upon the spine. It is to this latter point, which I have been closely investigating during the last six years, that I should like to draw your attention this evening. I hope to make you share my conviction that the frequency of the so-called scoliosis, or lateral curvature of the spine, has its principal origin in the position in which the children sit during their school-time, especially while writing. Few of you may have realized the frequency of this curvature, and yet most of you have daily opportunity of observing it.

The number of boys with lateral curvature is very considerable, but far smaller than that of girls; for among those of the higher classes, more than half will be found to have at least a slight curvature. I shall afterwards enter more minutely into the reasons of this fact; but first allow me to draw your attention to the alterations which are visible in the figure of those children whose spine has undergone the before-mentioned

FIG. 5.



deviation from the normal state. The drawing which I place before you gives the view of the back, and, so far as outlines and shade can do, shows, *first*, that the right shoulder projects more, and is lower than, the left one. *Secondly*, that the ribs below the shoulder-blades also project more on the right side than on the left. *Thirdly*, that the lateral outline, which runs from the armpit to the legs, is on the left side almost straight, whilst on the right side it shows above the hip a strong bend. *Fourthly*, that the right hip stands higher than the left, and that the whole pelvis has an oblique position. What the drawing does not show distinctly, but what can be easily made evident in every case of this kind, is a twisting of the spinal column round a vertical axis. By this twisting, the upper half of the body is so altered in its relative position to the lower half, that it seems as if the thorax had been turned from the left to the right, and the pelvis from the right towards the left. Seen from the front, this is made evident by the chest appearing fuller on the left side and flattened on the right, whilst the hip projects on the right side, and appears higher. The lateral deviation is scarcely to be noticed, first, because it is really not so very great, and moreover its appearance is partly hidden by the twisting.

Scoliosis may originate in different affections of the bones, as well as in pleurisy, in paralysis, in rheumatism affecting single groups of muscles, in irregular shape of the pelvis, in the shortening of one leg, and in many other diseases. Of such cases we have not to speak at all, but only of those slight forms of deviation of the spine which are so very frequent, and occur in quite healthy children. They deserve your earnest attention the more as they are alterations of the normal body which are exclusively produced by unfavourable conditions of school life. This has been denied by several authors; and anatomical conditions, congenital disposition, habits of the children, the prevalent use of the right arm, &c., have been alleged as the true reasons. Against this it has been stated that the develop-

ment of scoliosis has been statistically proved to be simultaneous with the school-time of children; that this disease does not affect children who are not put to school; and that the similarity of the deformity and of the appearance which a normal body assumes during the usual writing position, is most striking.

To these arguments I have to add another one, which, as far as I am aware, has not been mentioned by any author; and this argument seems to me a very forcible one. I constantly observe that the different methods of writing, and different postures assumed for that purpose, produce anatomical modifications in the shape of the curvature, which are in every case characteristic of those postures. Let us consider three different postures.

First: the left elbow rests on the table; the weight of the head and upper part of the body is supported by the left shoulder-joint and by the ribs of the left side, which lean against the table; the right forearm rests only lightly on the table, and the right elbow is placed near the right ribs. This posture is almost exclusively adhered to in English girls' schools. The lateral curvature of the spine produced by it differs from the description given in German orthopædic handbooks, by the right shoulder, though more projecting, being lower, and not, as generally described, higher than the left; and, moreover, by the lumbar, that is the lower curve, being much greater than the upper, the dorsal curve; and by the twisting round the axis being the prevalent alteration.

Second posture.—The right elbow rests on the table. The left one hangs down, the left hand rests on the edge of the table, and on the copy-book. The weight of the head and upper part of the body is supported by the right shoulder-joint and the ribs of the right side, and slightly by the left hand. This posture we find in many German girls' schools, but very exceptionally in England. The curvature produced by it corresponds better to the description given in surgical papers. It shows the right shoulder higher and only slightly more projecting

than the left. The lumbar curve is not so strong, and the dorsal curve stronger than in the form of curvature produced by the first posture. The twisting also is not quite so strong.

Third posture.—Both elbows rest on the table. The weight of the head, which is strongly bent forward, is equally supported by both shoulder-joints, and the chest-bone leans against the edge of the table. This is the favourite posture in English boys' schools, chiefly in those of the higher classes. It seldom produces scoliosis, and if so, only the slighter forms; but it produces very frequently another slight deformity, which may be described as an augmentation of the natural bends of the spine. In these cases, both shoulder-bones stand higher, and their lower angles stand off from the ribs. The shoulder-joints are pushed forwards. This is the deformity most frequent in boys. By this I don't mean to say that the universally stated difference in the frequency of scoliosis for both sexes depends upon this difference in the posture. It is, on the contrary, perfectly clear that everywhere scoliosis is more frequent amongst girls than boys, even where the boys sit exactly in the same position as the girls. This depends upon the bones, ligaments, and muscles being stronger in boys; further, upon the fact that the growth of the boys is extended over a longer period, and that therefore mechanical influences do not produce so much effect upon them as upon girls, their growth being completed in so much shorter a period; and lastly, upon the antidote against the writing position which boys possess in their games and bodily exercise, and in their facility of indulging in all sorts of postures of which girls are naturally deprived.

What now, anatomically considered, is the process by which this affection is developed? Are the muscles first affected, or the ligaments, or the bones?

On this question there has been considerable discussion, chiefly between those who base their views on the purely physical ideas of gravitation, pressure, traction, and so forth;

and those, on the other hand, who lay great stress upon the physiological action of nerves and muscles. It would lead me too far to enter into this discussion, and I must therefore limit myself to the description of my own views in the matter.

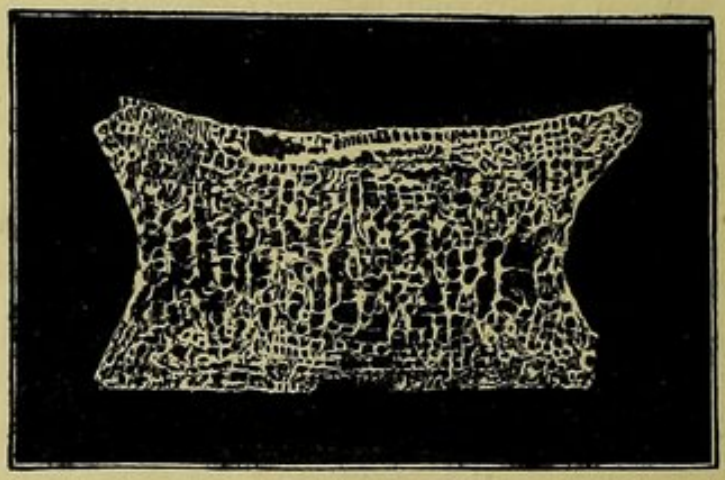
The ligaments, I believe, in the beginning undergo a stretching in a mere mechanical way. The ligaments which connect the processes of the vertebræ are elongated on the convex side of the curve. The very strong and elastic ligaments connecting the two large surfaces of every two vertebræ are at the same time drawn sideways by the twisting of the spine, and unequally pressed upon, in consequence of the weight coming in an oblique direction. They become, therefore, gradually thinner towards that edge to which the vertebræ incline during the writing posture.

Soon the bones, and especially the vertebræ of the lumbar region, begin to yield to the traction produced by the twisting of the spine, and the oblique pressure of the weight caused by the curve. It is a well-known fact that even the strongest bones of the human body are influenced in their shape by a continuous, though slight, traction or pressure. Nevertheless, it appeared strange that the vertebræ, which are fit to support the weight of the body for the greater part of the day when in the normal position, should be altered in shape by being several hours in a certain abnormal position. I have therefore made anatomical researches to explain this fact, and I shall show you preparations which demonstrate the results of my researches.

The vertebræ have to offer a large surface, they have to carry a great weight, and at the same time they must not be heavy. They are, therefore, essentially formed by a spongy substance of bone, the tissue of which appears by superficial examination to be quite irregular. I have, however, by means of fine cuts, made systematically in different directions, been able to prove that the elements of the bones are arranged in an absolutely regular, though very complicated, manner. So you will see, in the horizontal sections, which are made through the

vertebræ at the height of the insertion of the processes, bundles of lines forming regular curves, which cross the corresponding ones coming from the other side. In the horizontal sections, which are near to the upper or lower surface, the principal lines form regular concentric circles running parallel to the outline. More important for the subject of our lecture is what you see in the vertical section. Here you find, first of all, that the network formed by the elements of the bones is finer on the top and the bottom of the section, and much wider in the

Fig. 6.



middle part. A still more important difference between these parts of the vertical section is, that in the top and bottom part you recognize some strong horizontal lines, and that, on the contrary, in the middle part the elements form very strong vertical lines, connected with each other by very fine lateral branches. This middle part is the one in which the modifications in the form of the vertebræ originate.

The elements of this part are strong enough to carry a weight which falls upon them in a strictly perpendicular direction, and as long as they are in their normal position; but as soon as, by a shifting of the superior and inferior surface of the vertebræ, these elements are brought ever so little out of their vertical direction, even a vertical pressure, and still more so a lateral one, will make them break down. You will easily understand this, if you think of those iron beams by which, in

modern buildings, the square wooden beams are now frequently replaced. These beams answer the purpose only as long as their largest diameter is vertical, and as they are loaded from above. In any other position they would break down.

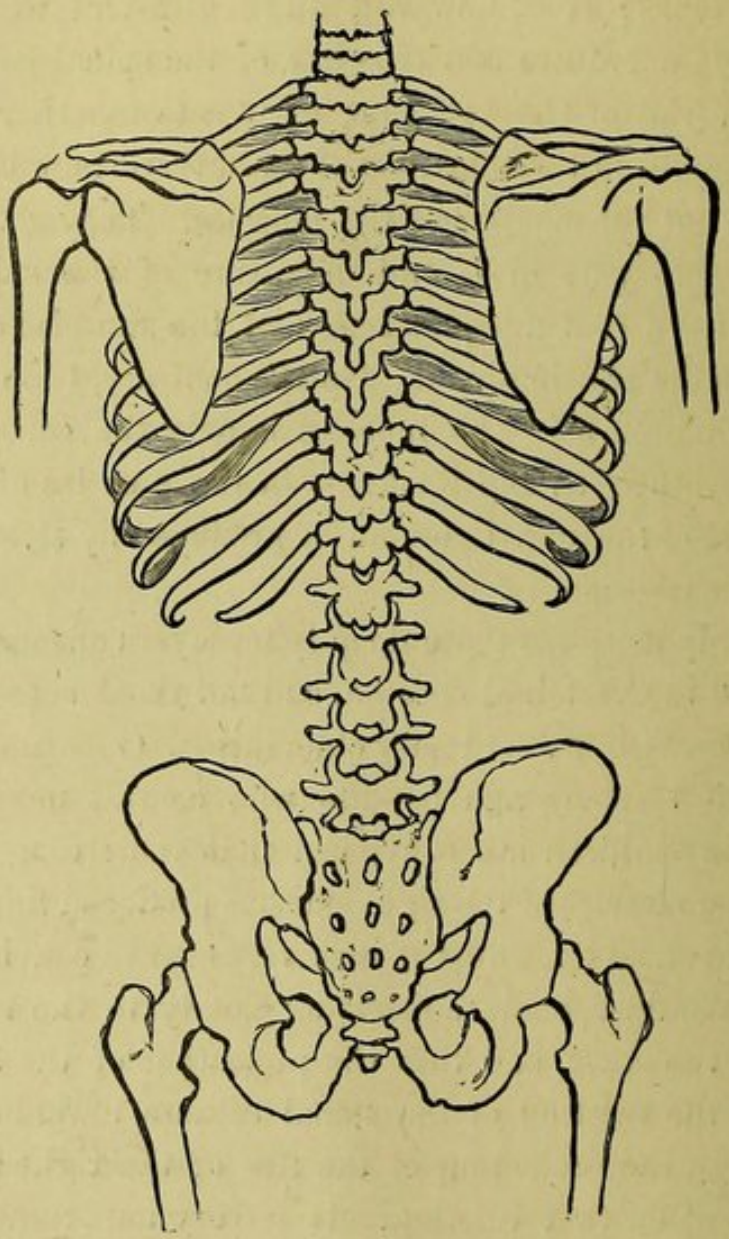
The diminution of height produced by the breaking of the elements of the middle region is, it is true, very small in a single vertebra; it is, however, quite sufficient to produce a considerable curvature and twisting of the spinal column, if it affects a series of the vertebræ, as it acts together with the similar changes in the thickness of the intervertebral ligaments.

I have not yet mentioned the muscles. They act, however, a considerable part in lateral curvature of the spine. Still, I don't believe that unequal action of the muscles of the two sides forms the starting-point. On the contrary, I am convinced that the difference in the muscles is only the consequence of lateral curvature, as the weakness in the muscles of the more convex side of the spinal column is produced by stretching and prolonged extension.

This only concerns those deep-lying layers of muscles which are next to the vertebral column, and not those superficial ones which are accessible to ordinary observation. Only too frequently I find that teachers and parents who consult me about this affection in children are convinced that the stronger development in the muscles of the right side has produced the projecting of the right shoulder, whilst it is so very easy to convince oneself that the shoulder blade adheres as closely to the ribs on one side as on the other, and that the projecting of the shoulder is caused by the twisting of the spinal column towards the right, and through the projecting of the ribs of the right side, which is dependent on that twisting. It is very important to get rid of such mistakes, because they lead to positively pernicious measures, which are carried out with the more energy the more parents are impressed by the external symptoms—namely, the projection of the shoulder and the hip; and the less they give attention to the real disease in their children, the curvature of

the spine. Such false views of the matter can alone explain the success of a very fashionable stay-maker, who, to the great satisfaction of the mothers, apparently diminishes the projection of the shoulder. She systematically produces in the course of a

Fig. 7.



few years a deformity of the whole thorax, which she, artificially, adds to the scoliosis while pretending to cure it. I have had the opportunity of minutely examining a large number of her victims, and I shall describe to you the process, partly in order

to caution you against it and partly to show you to what extent it is possible artificially to produce modifications in the bones of girls not yet fully grown.

Madam ——, by means of straps, draws the shoulders backwards, and so near together that they touch one another, and by that cover the part of the spine lying between them (Fig. 7). Then with gradually increasing force, and by means of stays which are exceedingly strong and stiff in front, she presses the ribs so tightly together that they are flattened at the side, whilst the hindermost ends of the ribs become more convex and are pressed so much backwards, that the spinal column sinks as it were into a recess, and thus advances towards the chest-bone. In the ordinary dress the waist appears very small and cylindrical, the lower ribs flattened, the higher ribs with the chest-bone more convex in front, while the whole back appears flat like a board, and the shoulders angular and high. The mother, who has not taste enough to see that this artificial doll's figure is by no means beautiful, and who does not know that the child had and still has a lateral curvature, and that this deformity is only partly hidden by the addition of another deformity, is quite satisfied. It is only in evening dress that she discovers the disfigurement of the shoulders, the deep fold formed by their displacement, and the very ugly modifications in the appearance of the neck.

School hygiene, however, has not to deal with any surgical treatment, whether right or wrong, but with the precautions to be taken to prevent school life from having an obnoxious influence upon the health of the children. The precautions necessary to prevent spinal affections I feel entitled to recommend to your careful consideration the more strongly, as they are identical with those I had to ask for in the interests of the preservation of the sight of the children. A back rest is necessary to avoid short-sightedness, and good light is necessary to avoid curvature of the spine. For preservation of sight, as well as of a normal figure, the possibility of remaining in a normal

posture during school-time, and especially when writing, is an absolute necessity. But what, now, is the normal posture?

The upper part of the body is to be kept straight, the vertebral column neither twisted to the right nor to the left; the shoulder-blades both of the same height, are, together with the upper arm, freely suspended on the ribs, and in no way supporting the body; both elbows on a level with each other, and almost perpendicular under the shoulder-joint, without any support; only the hands and part of the forearm resting on the table; the weight of the head freely balanced on the vertebral column, and not on any account bent forward, but only turned so much round its horizontal axis, that the face is inclined sufficiently to prevent the angle at which the eye is fixed on the book from being too pointed.

As to the form to be given to school furniture, in order to enable the children to assume the desirable posture, I must refer to my former lecture on "School Life, and its Influence on Sight." I shall, however, show you some models of benches, desks, and seats (Figs. 1, 2, 3, and 4), and at the same time draw your attention to the inclined chair I designed for replacing the so-called inclined board used chiefly in young ladies' schools, and this by a great mistake. The aim of the method of lying down on an inclined board or on the floor is to rest the back, when tired, in a position where the weight would be taken from the vertebræ, and where those parts of the body which had momentarily lost their symmetry, would be gradually forced back into a symmetrical position. That, instead of attaining this end, the method has rather a contrary result, and is, moreover, generally disliked by the children, is explained by the following reason:

The vertebral column, in its normal shape, has certain regular curvatures, both in the sitting and in the lying down posture. If we lie with our back on any flat surface, our body touches it with only a comparatively small portion of its outline.

This small portion, therefore, has to bear a disproportionately

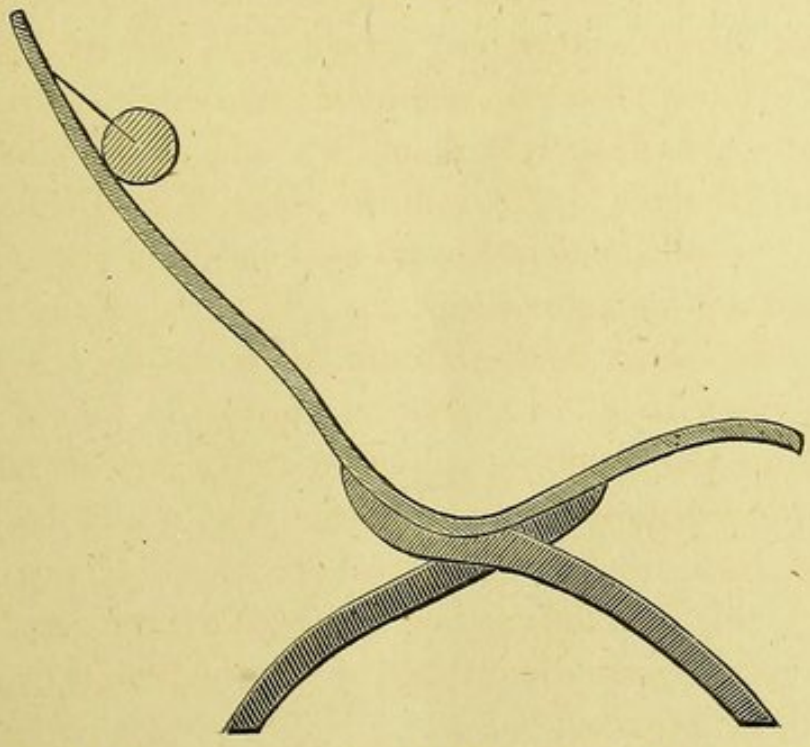
great weight, and suffers inconvenience accordingly, while the non-supported parts of the vertebral column are forced out of their normal curvature by the weight of the parts of the body resting on them.

This is at once fatiguing and hurtful. And yet even those who themselves have suffered from this procedure, are still found to cling to it.

In analyzing this question I have come to the following result: if a hard surface is to give the back rest, without making it suffer, it must have certain curvatures so adapted to the normal shape of the body, that this latter is supported everywhere, and its weight equally distributed.

These curvatures I have carefully studied, and following their outlines, I have designed a couch adapted to the inclina-

Fig. 8.

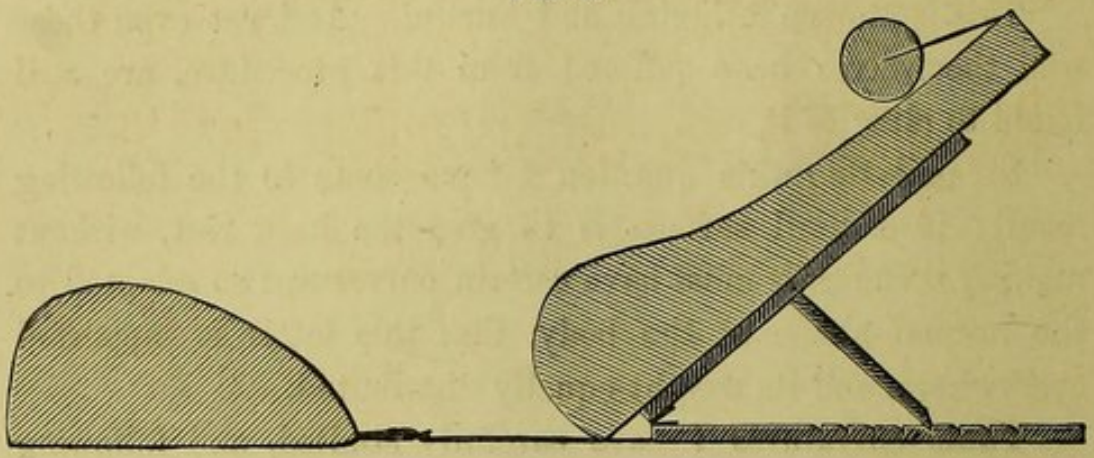


tion of the body at an angle of 45°. For girls who have any predisposition to lateral curvature of the spine, it will be found useful to let them do every work that will admit of it, while reclining on such a couch at an angle of 45°.

I should specially recommend to let them rest on it from

time to time during the day for ten minutes or more, in order to relieve the fatigue of the upright position. For very delicate children, and for grown-up persons with weak spine, I have

Fig. 9.



designed pillows which support the body in the same way as the inclined chair, but are softer, and admit of a change in the degree of inclination.

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