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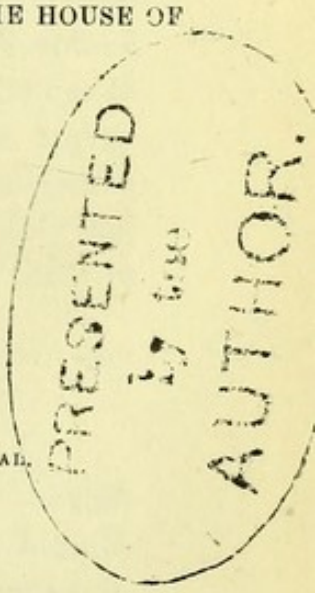
SCHOOL LIFE

IN ITS

INFLUENCE ON SIGHT.

A Lecture

DELIVERED BEFORE THE COLLEGE OF PRECEPTORS AT THE HOUSE OF THE SOCIETY OF ARTS, JULY 13, 1872.



BY

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SCHOOL-LIFE IN ITS INFLUENCE ON SIGHT.

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.

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 enquiries 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 shortsighted 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 weak-

ness 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 still more 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 diminution 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 rules 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 the 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 enquire 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, Dr. 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 analysed, 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—this is generally the right, while 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 bend 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 coinciding exactly with 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 impossible 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 footboard. 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 school-rooms, the seat of each child should be accurately regulated in proportion to its height.

To make this important arrangement practicable, I have invented a chair, the seat of which can be raised and lowered by means of a screw, while at the same time the back is brought forward in proportion. Such a chair will be a suitable seat for either a child or grown-up person at the same desk—will follow the growth of the child, and enable it to be, whether reading or writing, in a comfortable and healthy position, which facilitates instruction and discipline.

Should difficulties be met with in introducing this system into any particular school, it will give me pleasure to aid in overcoming them by my personal advice.

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