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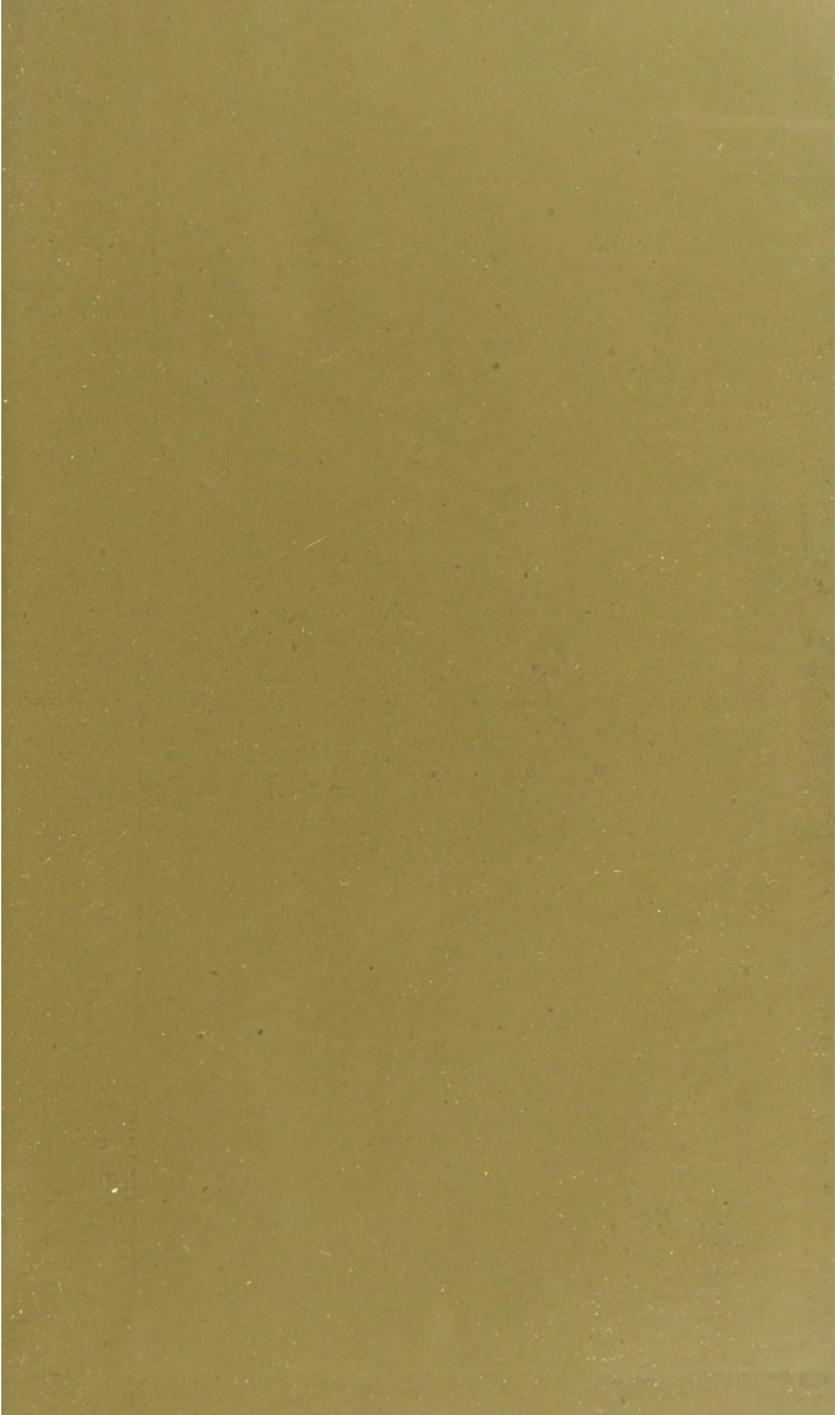
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CURVATURES AND DISEASE
OF THE SPINE
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ON
CURVATURES AND DISEASE
OF
THE SPINE



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ON



CURVATURES AND DISEASE

OF

THE SPINE



BY

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LATE SURGEON IN CHARGE OF THE ORTHOPEDIC DEPARTMENT, AND LECTURER ON
ORTHOPEDIC SURGERY AT ST GEORGE'S HOSPITAL

FOURTH EDITION



LONDON

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PREFACE

TO THE

FOURTH EDITION

THE following Chapters were written as Lectures, which were delivered in the School at St. George's Hospital. In preparing this Edition some additions have been made which I believe will increase any value which may attach to the volume. I have endeavoured not to enlarge the volume; and to place the subject matter plainly and concisely before the reader. I consider it both undesirable and useless to introduce exploded theories, which have nothing to recommend them but their antiquity; simply for the sake of disproving them. And thus I have contented myself with presenting my subject in as few words as I could employ to render it intelligible.

B. E. B.

April, 1888.



PREFACE

TO THE

SECOND EDITION

THE subject of Spinal Curvatures has not perhaps received all that attention which it deserves. Sir Benjamin Brodie, in a lecture which he delivered at St George's Hospital, in 1846, for instance, says, "When I first became engaged in a considerable private practice, and cases of Curvature of the Spine were presented to my observation, I was in doubt as to their nature and treatment. I knew nothing of them from my own experience, and I had learned nothing of them from my teachers. I felt that in this respect my education had been imperfect, and it took me no small trouble to supply the deficiency. Your situation," continued Sir Benjamin, "in this respect is probably not very different from what mine was formerly." This is a sad reproach, and yet I would ask, has anything been done to remove it. Has the student of 1864 opportunities of studying these affections which were not enjoyed at the time Sir Benjamin Brodie was speaking? I fear it must be said at the present day, as it was said twenty years ago, "that the hospital (and hospitals in general) will not afford the information which we stand in need of." Should this work be useful in teaching

something of the nature and treatment of spinal curvatures, I shall be well pleased to have spent time in writing it.

This Second Edition has been entirely re-written ; it has been much enlarged, and all the woodcuts are new. I am indebted to Mr Bagg for the great care and accuracy with which he has made the drawings. They were made with the *camera lucida*, and show very truly and exactly what they are intended to illustrate. I am also indebted to my friend Mr Wheeler, of Bexley, for permission to use several very important pathological specimens in illustration of the subject.

Throughout it has been my endeavour to adhere as strictly to truth as possible. I have desired not to exaggerate the importance of my subject, and yet to state it so fully as to call attention to a class of diseases which is at present neglected. No one can be better aware than I am of the imperfections of this volume ; but if my professional brethren will give me credit for a sense of duty in its preparation, and will accord to this Edition not less favour than to the first, I shall be well rewarded.

20, GROSVENOR STREET ;

October, 1864.

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PART I

CURVATURES OF THE SPINE

INTRODUCTORY

CURVATURES of the spine are known as anterior curvature (*lordosis*), posterior curvature (*kyphosis*), and lateral curvature (*scoliosis*). These terms—lordosis, kyphosis, and scoliosis—have been applied to curvatures of the spine ever since the time of Hippocrates. They were not used then, however, exactly in the same sense as they are now understood; for the term scoliosis, which now signifies lateral curvature of the spine, was then frequently applied indiscriminately to every form of spinal distortion.

Antero-posterior pathological curves are, for the most part, merely exaggerated conditions of the physiological curves. Thus we find anterior curvature existing especially in the lumbar region, and posterior curvature in the dorsal region. It will be shown farther on, however, that these conditions are not absolutely limited to a given region; but that the vertebræ above and below may be involved in the curve, even so as to reverse the normal curve of any region. These curves are rarely congenital; but they are for the most part induced through ignorance or neglect on the part of the nurse or through deficient nutrition.

Before proceeding to consider these pathological conditions, however, it may be desirable to examine the normal—physiological—curves of the spinal column,

and to consider very briefly their formation and their purposes.

The spine in the foetus is bent forward; its curve being moulded by the walls of the uterus: the head is bent upon the breast, and the thighs are folded upon the abdomen.

In the infant, the spine remains almost straight while in the horizontal position; the sacrum is only slightly curved, and the pelvis is more oblique than in the adult.

The normal—antero-posterior—curves are developed slowly, and depend in great measure on muscular action and on the erect position which man is destined to assume. At birth these curves do not exist; and even in the young child they are not constant, for they disappear in the horizontal position. Gradually, however, the antero-posterior curves become more permanent; and, long before growth is complete, the spine is found to have assumed, as a constant condition, lumbar, dorsal, and cervical curves; while, on the other hand, it has lost much of its flexibility.

On examining the spinal column of the adult in the erect posture, it will be seen that the base of the sacrum is so placed that it is to be found immediately above a straight line which may be supposed to pass through the heads of the thigh-bones. This is known as the inter-femoral line. It is shown in Fig. 1.

Naegele first demonstrated exactly the position of the pelvis in the upright posture. Prior to his demonstration, it was believed that the pelvis was more horizontal than is absolutely the case. The pelvis is so oblique that the anterior wall (pubes) presents upwards and backwards, and the posterior wall (sacrum and coccyx) presents downwards and forwards, as is shown in Fig. 2. Such, then, being the positions of the pelvis and of the sacro-lumbar articulation, the question arises, how is equilibrium maintained?

Equilibrium is the result of certain forces acting in front of and behind the spinal column; namely, the action

FIG. 1.

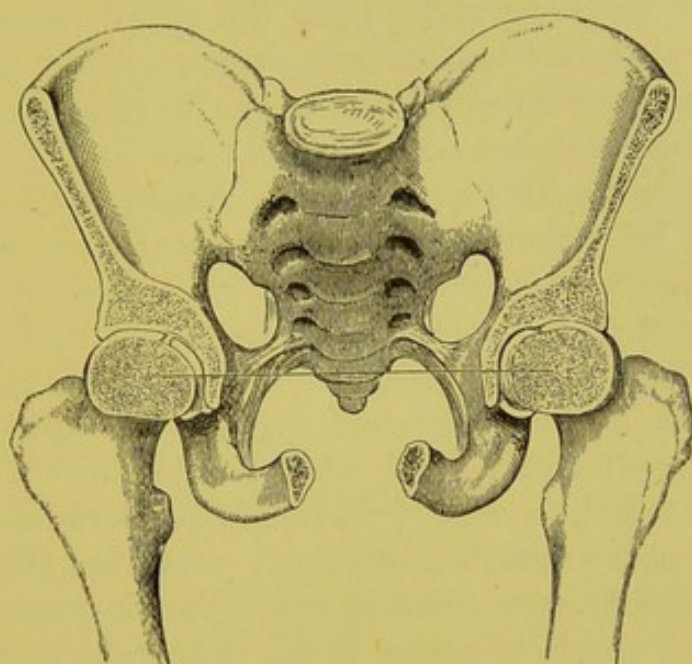
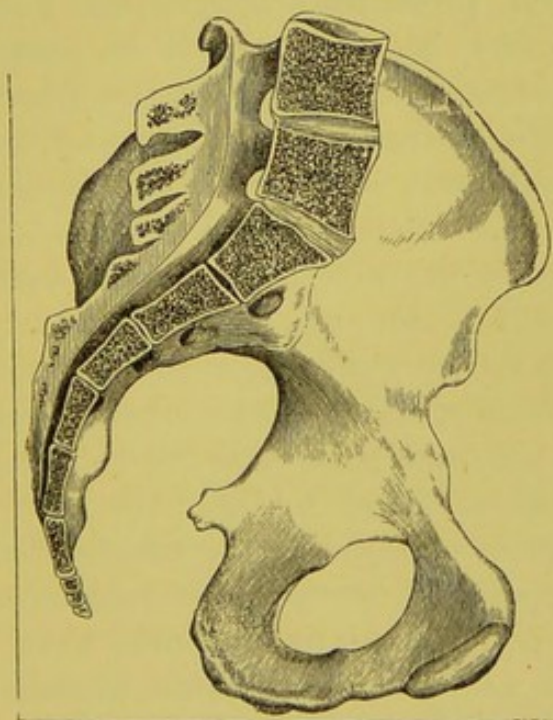


FIG. 2.



of the flexors and the extensors of the trunk, neck and head, and the resistance of the ligaments that hold together the several vertebræ which form the spinal column. In the erect posture these structures combine to poise the head and the vertebral column in the vertical line on the heads of the thigh-bones. (See Fig. 3.)

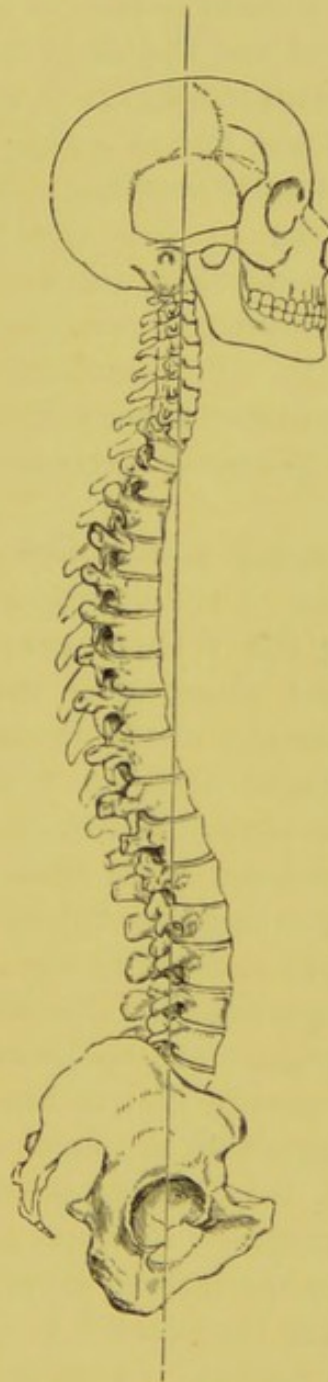
In considering this question, the weight of the viscera should not be forgotten. At the present time, however, the chief points alone will be taken into consideration.

The position of the sacro-vertebral articulation being, then, such as has been described, it becomes necessary for the maintenance of equilibrium, and that the head may be poised (its centre of gravity corresponding with a vertical line which coincides with the axis of the trunk, and which shall fall on the interfemoral line), *first, that the lumbar vertebræ shall be curved backwards.* This lumbar curve is the result of muscular action in the endeavour to maintain the spine erect. It is the reverse of the sacral curve; and it springs from the sacro-lumbar articulation upwards and backwards, the sacral curve commencing at the same articulation, and presenting downwards and forwards. When a curve has been formed, it is essential that a second curve—dorsal—shall restore the direction of the spine towards the perpendicular line; and, for a similar reason, a cervical curve is formed in the same direction as the lumbar curve. These several portions of the spine differ somewhat in flexibility, the lumbar and the dorsal portions possessing this quality very nearly in equal degrees; but in the cervical region the flexibility is three times greater than in either of the other regions. Thus, a structure is composed of segments of various circles, strong, yet elastic, fitted to bear the superincumbent weight, and capable of resisting the effects of shock.

It would, perhaps, be impossible to imagine a structure more perfectly adapted to its purposes than the spinal column, formed as it is of separate pieces, which are severally united by discs of fibro-cartilage, bound together by numerous and strong ligaments, and surrounded and

acted on by powerful muscles. Its flexibility and its curved form are, perhaps, of more importance even than

FIG. 3.



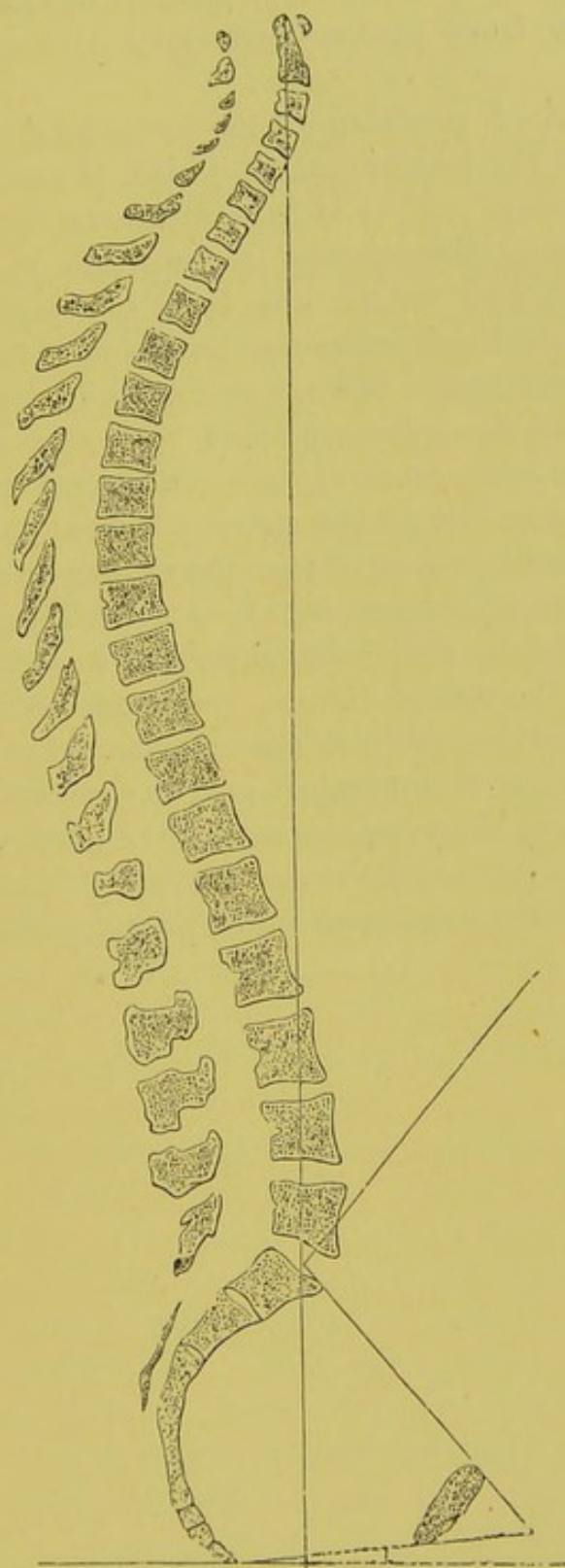
its great strength : these adapt the spine specially to its purposes.

I do not desire in this place to enter minutely into questions of physiology, and will therefore only allude to the opinions of some eminent physiologists, such as the Webers, Cruveilhier, Bishop, and others, who have stated their belief that the normal curves of the spine depend on varying thicknesses of the bodies of the vertebræ and of the intervertebral substances. It is true, as the Webers have shown, that, in the dorsal region of the spine especially, differences in thickness exist on the anterior and the posterior surfaces of the vertebræ; namely, that the vertebræ are somewhat thinner on their anterior surfaces, in the concavity of the curve, than they are posteriorly, while in the lumbar and the cervical regions the fibro-cartilages especially show differences on their anterior and posterior aspects, being compressed posteriorly.

To show the varying thicknesses of the anterior and the posterior surfaces of the vertebræ and of the intervertebral cartilages, the Webers caused the spine to be bisected in the mesial plane, after the viscera had been removed from the cavities of the thorax and the abdomen, the space having been filled up with liquid plaster of Paris. The relative normal positions of the various portions of the spinal column were thus obtained, and from that section the accompanying figure (Fig. 4) was taken, which represents very accurately the forms of the several curves and the proportions of the bones and cartilages which together constitute the spinal column.

But it has been already shown that the physiological—antero-posterior—curves do not exist at birth; and that, when first observed, they are not permanent, but are lost in the horizontal posture. Further, these inequalities in the vertebræ and in the intervertebral substances do not exist at birth, nor are they found until the spinal curves commence to be permanent. Also, they increase with age. Such being the case, it follows as a necessary consequence that these differences in the anterior and the posterior surfaces of the bodies of the vertebræ, and especially in

FIG. 4.



the fibro-cartilages, are due to the antero-posterior curves—are due, in fact, to the erect position of the trunk and to the pressure from above downwards consequent on that position.

The effect of pressure on the intervertebral cartilages is shown by the loss of height which is sustained at the end of the day. Thus it is well known that a man of middle stature, who remains in the erect posture during the day, will lose nearly one inch in height, and that this is regained only after he has been recumbent from six to eight hours. We must conclude, therefore, that these varying thicknesses of the bodies of the vertebræ and of the intervertebral substances are produced by pressure as a result of the erect position, and that they would not occur, any more than the antero-posterior curves themselves would be developed, in the horizontal position.

Thus, it may be stated that the normal—antero-posterior—curves of the spinal column result as a consequence of the erect position and from muscular action in maintaining equilibrium, and that unequal pressure occasions thinning of the bodies of the vertebræ and of the intervertebral substances in the concavities of the curves. This view will be confirmed by the consideration of pathological curves.

CHAPTER I

LATERAL CURVATURE OF THE SPINE

IN lateral curvature of the spine the vertebræ deviate from the mesial line of the trunk. This form of curvature may be divided into two stages, or periods; namely, *incipient* and *confirmed*.

By incipient curvature is understood such a condition of lateral deviation of the spine as is removable in the recumbent position, with the help perhaps of some slight pressure; while a confirmed curve is curvature with rotation of the vertebræ.

Lateral curvature is the most common form of spinal curvature. It occurs more frequently in the female than in the male; it seldom commences after the age of puberty, and it does not commonly occur as a primary affection.

Causes.—The principal predisposing causes are debility—muscular or constitutional, acquired or inherited—and rickets; and the exciting or proximate causes are bad habits of sitting and of standing, and through fatigue, induced perhaps by overwalking.

The effect of climate is often seen in the debility which precedes curvature of the spine. English children, especially girls, who are born in India, Australia (especially Melbourne), and the West Indies, if they are not sent home early, are extraordinarily liable to flat-foot, knock-knee, and spinal curvature. They are much more liable to these affections than those who are born in northern climates. And it may be stated generally that it is rare for any English girl who is sent home later than eight years of age not to have flat-foot and spinal curvature. Children become pale and weedy; and even more so

in Melbourne than in India. Some at ten years of age are brought over with spinal curvature already developed, and many are brought over from Australia even younger, in whom spinal curvature is advanced. It is probable that many of these suffer after they arrive in this country through the amount of exercise which they undergo whilst associating with children who are born here. The looser fibre of the southern children will not bear the exercise which is imposed on our more hardy northern children; and it is soon discovered after they arrive that there is something essentially wrong in their manner of standing, and especially in walking.

Over-exercise tells immediately on the southern child; and it tells prejudicially also on those of this country. There is no country in the world where constitutional walks are imposed on children of tender years as with us. It is mainly on this account that lateral curvature is seen more commonly in England than in any other country: it is seen especially in the boarding-school classes, and in those families where constitutional walks are imposed on the children. At school, those of eighteen and those of ten years of age walk for one hour or for two hours daily as is the rule of the school, quite irrespective of strength. In many of these schools there is not a girl who is not flat-footed. These daily walks are exceedingly injurious to all who are not in robust health. And, indeed, when it becomes a daily parade along the same bit of hard road, without any object to engage the attention or to inspire the desire to cover a certain distance, the result can only be weariness and lassitude. This may be largely noticed at Brighton, for instance, where the melancholy spectacle is to be observed twice daily of girls of all ages made to parade backwards and forwards, two and two, on a concrete walk, without any object but to show themselves, for the benefit of their house. The result of these walks is disastrous.

Sitting for prolonged periods in a constrained position, cross-legged or otherwise, or in such attitudes as are

often assumed in drawing or in writing ; or sitting for a long period on a narrow seat without support for the back, will cause the trunk to be inclined to one side or the other. In the first case position favours this inclination of the trunk, and in the second the trunk is allowed to incline to one side or the other, to obtain relief and in some measure to rest the back.

Again, the habit of standing, more or less on one leg, induces curvature. This habit is indulged in to a great extent, either through some local weakness or from fatigue ; for weariness is readily induced during the period of growth, and especially when growth is rapid. This attitude causes the hip to become prominent, and the pelvis to be inclined towards the opposite side. Together with this obliquity of the pelvis, the spine becomes curved. At first, the curve is temporary ; but at length, as the obliquity of the pelvis becomes permanent, the curve also becomes confirmed. Equilibrium is restored by means of secondary, or compensating curves ; and these are formed in regular sequence, and are determined by the position of the primary curve.

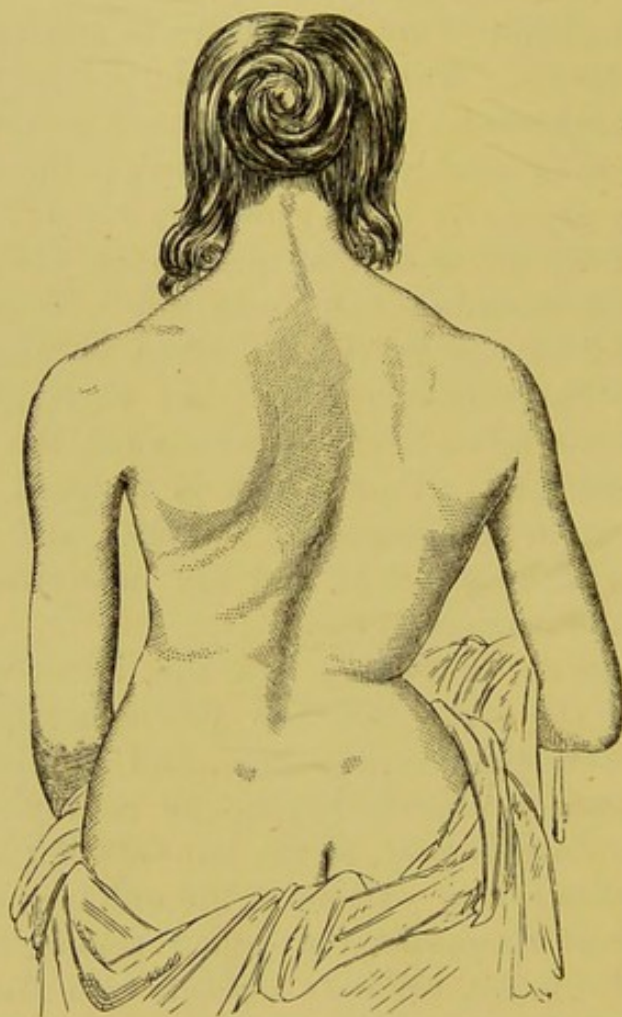
This is shown in Fig. 5. In this instance, through standing on the right foot the pelvis became oblique, falling towards the opposite side, and a lumbar curve was necessarily produced, having its convexity towards the lowest ilium ; namely, to the left side of the body.

The following is an outline of the ordinary commencement of lateral curvature. A young person, of from 12 to 15 years of age, presents herself with flat-foot, the left foot probably being flatter than the right, and the left knee perhaps somewhat inverted. The pelvis is inclined towards the left side, so that the left side of the pelvis is sensibly lower than the right. There is a lumbar curve, with its convexity to the left side, and a compensating dorsal curve with its convexity to the opposite side. The right scapula is raised and prominent, and the left shoulder drops.

Fig. 6 shows this case reversed. In this instance there

was flat-foot and knock-knee more marked on the right than on the left side, so that the right side of the pelvis was lower than the left side. This gave rise to a right lumbar curve, and to a compensating left dorsal curve. The right shoulder was three fourths of an inch lower than

FIG. 5.



the left, and the right side of the pelvis was half an inch lower than the left side.

It is because the left lower extremity is more frequently and more markedly affected than that of the right side, that there is found for the most part a left lumbar curve and a right dorsal curve. A right dorsal curve occurs about nine times more frequently than a left dorsal. And in ninety-five cases in every hundred the lumbar curve is the primary

and the dorsal is the secondary curve; that is to say, in these ninety-five cases the cause is from below (flat-foot or knock-knee or both or muscular weakness), occasioning an oblique pelvis and a lumbar curve, with a consecutive dorsal curve.

FIG. 6.



I find that of 1000 cases of primary lumbar curvature 893 have been formed to the left, and 107 to the right side.

A delicate child, if treated in the same manner as a stronger companion, will probably develop some irregularity of growth. The particular form of distortion will, however, depend mainly on the habits of the child. Thus, if the child stand or walk much, the ligaments of the ankle-joint

and those in the sole of the foot will yield and occasion flat-foot; and the internal lateral ligament of the knee-joint may yield and cause genu valgum. And if the foot or the knee of one side becomes either flatter or more inverted than on the other side, so as to produce flat-foot or knock-knee, then, by so much as the knee is more inverted and the foot is flatter, the pelvis becomes oblique. But an oblique pelvis must give rise to spinal curvature.

Inequality in length of the lower limbs, whether produced by a bent tibia or femur, by flat-foot or knock-knee, by muscular contraction, articular disease, partial loss of muscular power or congenital shortening, will induce obliquity of the pelvis and a primary lumbar curve.

It has been stated that the lower limbs are frequently not symmetrical, and that on measuring the two limbs one will be found longer than the other, the difference varying from one eighth of an inch to one inch and a half. Dr. Morton, of Philadelphia, measured the limbs of 512 boys, and found that in 271 there was inequality of length, and of these the right limb was the longest in 198.

I have failed to verify this statement, and I believe it will be found that in our population this difference does not exist; or that it exists to a small extent only.

If the limbs of a healthy boy be measured—one who is well grown, and who has never had any bone or joint affection—from the great trochanter to the inner malleolus it is rare to find the least difference in length. It occurs occasionally, but it is generally found that the shorter limb has been badly bruised, or that there has been at least some synovitis, or that the boy has been engaged in exercises beyond his strength.

Even when one of the lower limbs has suffered from infantile paralysis there is frequently no inequality in length. Of course there is great inequality in girth, but frequently not in length. In a paralysed limb there may be shortening to the extent of two inches or more; but this is rare. It is frequently said that there is a short limb when there is only a flat foot; the leg

bones and the thigh bones being equal in length on both sides. Selecting healthy boys who have neither been bruised nor had inflamed joints, probably not one in 500 would show asymmetry.

My attention was called to this subject very specially some years since by one who thought that he was able to account for obliquity of the pelvis through inequality in length of the lower limbs. On examining his cases it was found that in every one of them either one foot was flatter than the other, or that there had been some bone or joint affection. It was thought sufficient by my friend to raise the sole of the boot in such cases, so as to overcome the obliquity of the pelvis. But it need perhaps scarcely be said that in the majority of cases, such treatment is injurious.

Every curvature is produced by a special cause ; and while the cause remains, the curve itself cannot be removed, or if removed it will certainly recur so long as the cause exists. It is of vital importance, therefore, in the treatment of spinal curvature, to ascertain precisely what is the exciting cause in each case of curvature. Until this is done, and the cause is removed, it is useless to attempt to treat a spinal curve, except in the recumbent position.

Again, other causes of spinal curvature exist, namely, such as increase or diminish the power of a single limb. Thus the power may be increased by extraordinary use, as through carrying a burden on one arm, or as occurs in certain trades, where one arm is much more employed than the other. Fig. 7 was taken from a young person who habitually carried a heavy child on the left arm. And it is found that nurses, needlewomen, tailors, compositors, and some others are unusually liable to spinal curvature through the inordinate use of one arm. Also, when muscular power is diminished as through paralysis, partial or complete, of an upper extremity, or after amputation at the shoulder-joint or immediately below the joint, lateral curvature of the spine will occur

in the dorsal region, the convexity of the curve forming towards the opposite side. This is shown in Fig. 8, where amputation of the left arm caused the spinal column to be drawn away from the median line and to be curved towards the right side. This drawing was taken from a powerful man, who after the loss of the

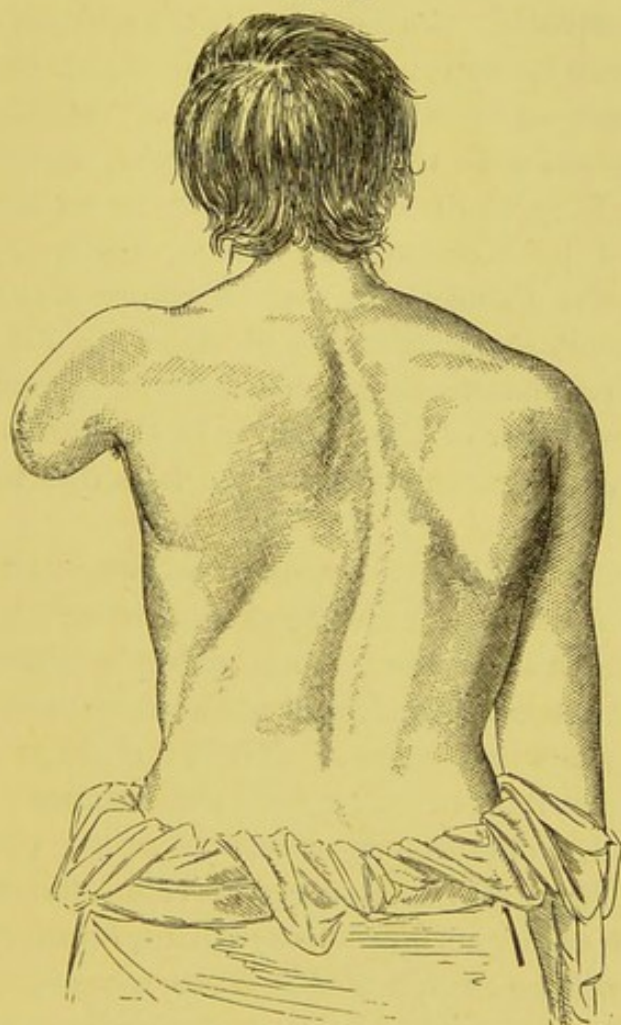
FIG. 7.



left arm continued to use a heavy hammer in the right hand. Also, it may be that there is little or no increase of muscular power on the side of the convexity, but the effect of constantly carrying a heavy weight on one arm may be to produce deviation of the spine, and a well-marked dorsal curve.

Also, lateral curvature occurs in rickets. Rickets, however, is a general disease which involves not the bones only, but every tissue of the body. It is sometimes hereditary ; but much more frequently it is developed after birth, through exposure to cold, and through insufficient or improper food. The whole skeleton may become

FIG. 8.



more or less softened, and the bones are curved through mechanical causes. Especially the lower limbs become curved, whereby the pelvis is rendered oblique, and spinal curvature follows. In this form of disease, not only is spinal curvature induced at an earlier age than when it arises from debility, but it is of an infinitely more severe

form. In the case from which Fig. 9 was taken, rickets was first developed at eight years of age, and the child was thirteen years old when the drawing was made. Here will be observed flat-foot, knock-knee, and obliquity of the pelvis, as well as spinal curvature. The lower limbs were first bent; then the pelvis was tilted to one side and became flattened, and subsequently the spine became curved.

This girl as well as her sister were patients at St. George's Hospital. Both of them were stunted in growth, and of unhealthy appearance. Until eight years of age they had been as healthy as the rest of the family, when they were seized with this form of disease, which gradually crept on. They were well cared for in every way, and were lodged in Kensington Palace, the parents being servants at the Palace. It was therefore somewhat difficult to account for this access of disease; for every surrounding circumstance appeared to be in favour of health. Distortion, whether of the spine or of the limbs, is greater when induced by rickets than when it is due to any other cause.

In a large number of cases it is found that where a child has not been brought up at its mother's breast, there is a tendency to rickets. And where a child has been fed with farinaceous food, and at the same time nursed at the breast, the same occurs. But if a child is brought up on farinaceous food or on any of the mixtures known as infant's food, rickets more or less is pretty certain to be induced. These children early develop flat-foot. It is certain that enlarged epiphyses will be found; and probably there will be evidence that disease has extended much farther. Such a child has a soft yielding fibre, and it becomes flat-footed as soon as it reaches the ground and begins to walk.

This rickety condition of the spine is sometimes, though rarely, developed without the long bones becoming affected. There will then probably be seen also rickety deformity of the ribs and of the sternum. Rickety limbs are found without the spine being rickety, and the trunk may

be rickety whilst the limbs remain sound, or, on the other hand, the entire skeleton may be affected with rickets. Rickety flat-foot or a curved tibia or femur will cause the pelvis to become oblique, and the spine to become

FIG. 9.



curved. But a rickety spine alone, and without other portions of the frame being affected, is very rare. Sir Benjamin Brodie stated that "it was the prevailing opinion formerly, and some hold the opinion still, that the common

cause of a lateral curvature of the spine is a rickety condition of the bones. This view of the pathology of the disease is not confirmed by the specimens preserved in museums of morbid anatomy, and no one who has seen much of these cases in the living person can doubt that the fact is otherwise. We are not, therefore, justified in regarding rickets as the common, or even as a frequent cause of spinal curvature : nevertheless it is the cause of it in a few instances.”*

Also, there is a form of curvature which is transmitted with a strumous diathesis, and which pervades certain families. There are families of which every member is thus afflicted—some severely, and others slightly ; but all, or nearly all, are affected with spinal curvature.

Again, spasmodic action of the muscles of the back, neck, and shoulder, will draw the spinal column away from the mesial line : it may exist at birth ; and occasionally it is met with together with other manifestations of morbid action.

Congenital curvatures are sometimes excessive in degree ; so that the trunk may be reduced to two thirds of its normal height. When the muscles of one side of the back are alone affected scoliosis results ; but when both sides are affected lordosis is produced.

A child four months old was lately brought to me with strongly marked lateral curvature, the convexity being towards the left side. It was affirmed that this state was observed immediately after birth. When the child cried the hands were clenched, the legs were flexed upon the thighs, and the thighs upon the abdomen, and the feet were extended, while the shoulder and the ilium of the right side were violently approximated.

Fig. 10 was taken from one of the most remarkable cases of spasm that I remember to have witnessed. In this instance torticollis and scoliosis were induced to so great an extent, that it was difficult for the patient to

* Lectures on “Distortion of the Spine not connected with Caries,” London Medical Gazette, vol. xxxviii.

remain standing ; and, indeed, this position could only be maintained for a very short period. The sketch gives unfortunately a very inadequate idea of this case.

After some duration of spasmodic action, loss of power, partial or complete, may ensue.

In the anencephalous and the hemicephalous infant

FIG. 10.



every variety of distortion of trunk and limb is to be found. And also somewhat similar distortions are seen with hydrocephalus and hydrorachis. Sets of muscles only may be retracted so as to produce torticollis, talipes or strabismus ; or, on the other hand, every limb as well as the trunk may be contorted. These and other forms of muscular retraction exist, both as congenital and as non-congenital distur-

tions: they are each induced by a like cause, and they differ only in degree and in form.

There are yet two other very rare varieties of lateral curvature to which it is only necessary to allude—viz. curvatures arising from malformations of the vertebræ, and those consequent on disease within the thorax. In the former there is occasionally seen, either deficient development of, or excess of development in, the lateral halves of some of the bodies, and indeed of other portions of the vertebræ. Sometimes curvature results from deficiency of the lateral half of a vertebra or from unequal development of the two halves of the column or from the presence of one or more half vertebræ too many. There is a remarkable example of this malformation in the museum at Vienna, which I examined with Prof. Rokitsky. It consists of four half-vertebræ, with their half-arches and processes in excess; from which the following curvatures of the whole column have resulted, namely:

a. "Curvature of the sacrum with the convexity towards the left, in consequence of duplication of the left half of the first sacral vertebra:" "*this curve is compensated by the addition of the fifth lumbar vertebra to a half right sacral.*"*

β. "Slight curvature in the lumbar and lower dorsal regions, in consequence of duplication of the right half of the first lumbar vertebra: the convexity at this part is directed towards the right.

γ. "Considerable curvature in the middle dorsal region produced by the left half of the seventh dorsal vertebra being double: here the convexity is towards the left.

δ. "Considerable curvature in the upper dorsal region, which is caused by the half vertebra interposed between the fifth and sixth dorsal vertebræ: the convexity here faces the right. The last two form a very compressed S curvature, and the vertebræ are twisted upon their axes and project backwards."†

* 'Handbuch der Pathologischen Anatomie,' Band i, p. 265, 1844.

† 'Pathological Anatomy,' Sydenham Society's edition, vol. iii, p. 230.

Rokitansky also gives an account of a still more singular specimen in the Vienna Museum, thus: "*Scoliosis produced by deficiency of one half of a vertebra.*—The spine of a tailor, 70 years of age. It consists of the cervical skeleton (excepting the atlas), of twelve half dorsal vertebræ on the left side and eleven on the right, of four abdominal and four sacral vertebræ.

"The six inferior cervical vertebræ form one curved hump; their bodies and articular processes are united each to each, into one piece of coarse cellular structure, the anterior surface of which looks as if the bony material had been poured over it in a fluid state and had then coagulated; while a tense, and partly ossified, ligamentous tissue stretches down over the arches.

"The sixth and twelfth dorsal vertebræ form the extremities of a slight curvature to the left, in the concavity of which (on the right side) there is half a vertebra wanting; for only the left half of the ninth dorsal vertebra exists, which is united to the eighth dorsal, and with it composes one very high body and a similar half arch on the convex side of the curve. There are two transverse processes of nearly equal size upon the half arch, and two spinous processes, which lie one above the other but are fused together."*

I have seen a somewhat similar instance of deformity in a child three months old; and also other cases at more advanced ages.

Effusion into the cavity of the thorax, which is followed by collapse of one side, is subsequently compensated by enlargement of the opposite side. After the effused fluid has been removed from the pleural cavity, the ribs sink to the compressed lung, the lung itself being bound down by adventitious membrane, so that it cannot expand. Thus the side becomes flattened and the lung remains contracted. Compensation afterwards follows, through amplification of the sound lung and enlargement of its containing cavity. When curvature arises from this cause the curve occupies

* Ibid., p. 232.

the entire dorsal region. Its appearance is shown in Fig. 11.

FIG. 11.



This curve is formed in the recumbent position ; and it forms as a single curve, and without a compensating curve, until the patient rises from his bed. Then compensating curves are formed, pretty much as in other cases ; and then also rotation of the vertebræ commences. Thus, a lateral curve is first formed, and it is followed by rotation.

CHAPTER II

FORMATION OF SPINAL CURVES

LATERAL curvature may commence either in the lumbar, the dorsal or the cervical region. No curve, however, can remain single, but secondary curves must form, to restore equilibrium. Thus a lumbar curve will run into a dorsal, a lower dorsal into an upper dorsal, and an upper dorsal into a cervical curve. By observation it may with precision be stated which is the primary curve, and for purposes of treatment this knowledge is of the greatest importance.

When a curve is formed from below upwards, there will be found an oblique pelvis. This will have been caused by some difference in the lower limbs—one being perhaps shorter or weaker than the other, and in consequence the spine becomes inclined towards the lower side of the pelvis.

This lumbar curve is ordinarily the primary curve. A primary cervical curve is caused by torticollis, and a primary dorsal curve may be caused by any considerable increase of or difference in the muscular power of an upper extremity, such as takes place with ankylosis at the shoulder or after amputation of the arm or with paralysis of an upper extremity or by carrying a heavy weight, such as a child, always on one arm. This dorsal curve terminates above in a cervical curve and below it blends with a lumbar curve. And a cervical curve induces an upper dorsal curve. Thus a spinal curve cannot remain single, except in the horizontal posture; for equilibrium must be restored by compensating curves being formed. A primary curve is never sufficiently com-

pensated by a secondary curve ; and therefore other curves form above and below it. Thus, a dorsal curve is always followed by one above and another below it, and a lumbar curve not only occasions a dorsal but also a sacral curve ; while a cervical curve is compensated by the weight of the head, which is inclined towards the opposite side, and by an upper dorsal curve. One curve runs into another, so that as one forms another is forming.

Thus, a primary curve may be lumbar, dorsal or cervical, and the position of the primary curve is determined by the exciting cause of distortion ; while compensation takes place through the formation of secondary curves, which are produced by the muscular effort to maintain the erect position. These curves are always undergoing change and becoming more rigid and compressed, until at length the height of the trunk is much diminished.

In the commencement of spinal curvature, the length of the lumbar curve depends in great measure on the degree of tilting of the pelvis. When this is much the curve is short, and when it is slight the curve is longer ; so that as obliquity of the pelvis increases the lumbar convexity becomes more prominent, and the curve itself represents the segment of a smaller circle. As rotation increases the curves become compressed, and the whole spine may lose several inches in height.

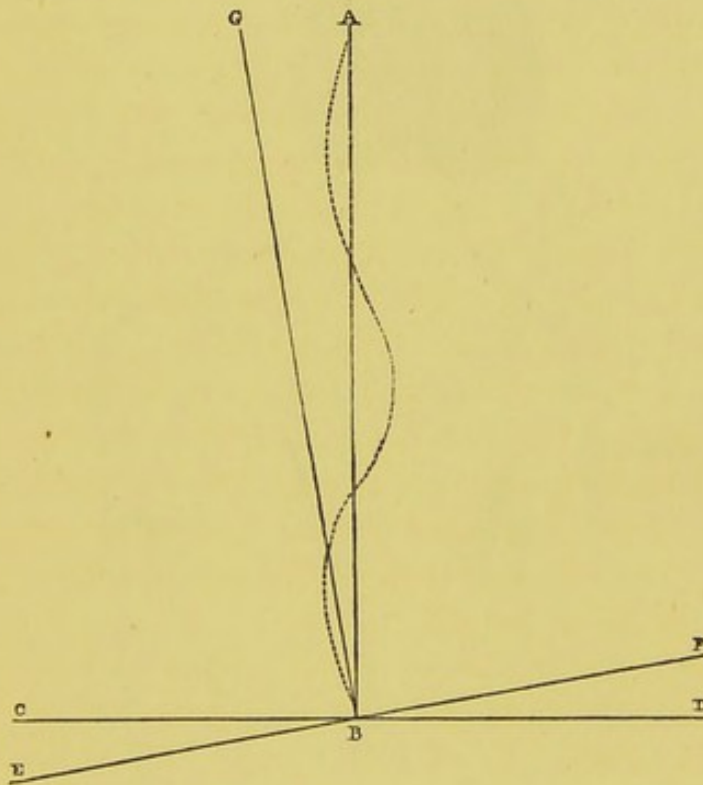
Perhaps the modes in which spinal curves are formed will be more readily understood by means of the following diagrams (Figs. 12 and 13).

Suppose the lines A, B, C, D to represent the pelvis and the spinal column in their normal relations ; namely, the spinal column forming a right angle together with the pelvis ; and let E F represent the oblique pelvis, and G B the inclined column still forming a right angle with its base. How is equilibrium to be maintained ? It is obvious that the line G B, if continued, would render equilibrium impossible ; and therefore, a series of curves about the perpendicular line A B are formed to maintain equilibrium.

It will be seen, however, in Fig. 13, that the cervical curve corresponds to the line G B. And such, indeed, must be more or less the case until equilibrium is restored through increase of the spinal curves. When such increase has taken place, as is shown in Fig. 14,—*scoliosis kyphotica*, the head is again restored to the perpendicular.

The symptoms and the external characters of spinal curvature vary according to the region in which the primary curve is formed.

FIG. 12.

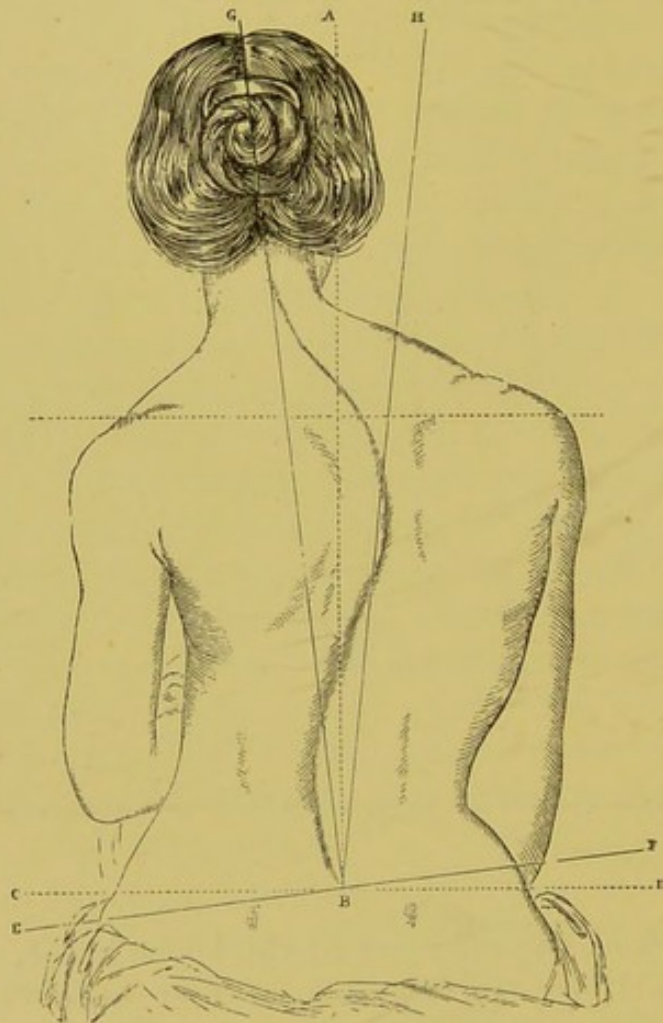


When, from any affection of the lower limbs, the pelvis becomes oblique, the spine must first be curved in the lumbar region. The ilium is depressed on the side of the lumbar convexity, and the loin falls in on the opposite side, through the recession of the lumbar vertebræ in the formation of the lumbar curve. From the concurrence of these two conditions the hip on the side of the lumbar concavity becomes prominent. This appearance is constant, and it is one of the most striking symptoms which may

be observed : it may always be seen even before a secondary dorsal curve is fully formed. This is shown in Fig. 15.

Again, when curvature commences in the dorsal region or when a compensatory curve has been formed in this region, the shoulders are no longer placed on the same level : one is raised while the other is depressed. The scapula becomes unduly prominent on the convexity of the

FIG. 13.



dorsal curve, and the shoulder is then popularly said to be "growing out." This increased prominence of the shoulder is due, in part, to the increased angularity of the ribs, and partly also to muscular action.

In the formation of a lateral curve the vertebræ become twisted, or rotated ; and consequently the angles of

the ribs on the convexity of the curve project abnormally, while the ribs themselves are rendered more horizontal in their direction and are more widely separated from each other than in their normal condition ; but on the side of the concavity the ribs become oblique and are depressed, so as to lie one upon another, or even to overlap one another.

FIG. 14.



There is considerable change also on the anterior surface of the thorax. On the side corresponding to the concavity of the spinal curve the ribs become unduly prominent at the lower part of the thorax, while they are still more prominent on the dorsal aspect on the side of the convexity. Hence the greatest diameter of the chest, in an advanced state of dorsal curvature, is in an oblique direction from behind forwards.

The muscles on both sides of the spine are somewhat pallid, and wasted. In the commencement of curvature they are tense on the side of the convexity, and later, as rotation increases, they become prominent through the projection of the transverse processes; and at length they become atrophic through disuse. In the concavity of the curve they are, for the most part, weak, relaxed, and inactive.

FIG. 15.



It has been shown that, at birth, the physiological spinal curves do not exist, but that they are due to the erect position; and that thinning of the intervertebral cartilages is due to unequal pressure. This compression is such that a man of middle stature, who has maintained the upright position during the day, is found to have lost nearly one

inch in height. Such is the case with the normal—antero-posterior—curves. And, when lateral curvature takes place, a somewhat similar course is observed. A slight lateral curve is first formed : it is not yet persistent, however, for curvature is effaced after the horizontal position has been maintained for some hours ; just as in the antero-posterior curves the height is restored after the recumbent position has been observed during the night. At length, however, the intervertebral fibro-cartilages which enter into the curve remain more or less compressed, and the curve continues to be formed even in the horizontal position.

During the incipient stage of curvature, then, the intervertebral cartilages become compressed laterally, and they recover their form when the superincumbent pressure is removed. When, however, this compression is continued from day to day, the intervertebral substances lose in a measure their elasticity, and they do not recover their full form during the period of repose, but remain somewhat compressed and wedge-shaped.

Confirmed lateral curvature is not purely a lateral deviation of the spine, except when it takes place after pleurisy with exudation, or after abscess within the thorax during recumbency. Under all other circumstances the vertebræ, which are involved in the curve, become rotated upon their axes and they are displaced laterally as the curve increases. After pleurisy or abscess, and during the formation of the thoracic curve, the patient will have been entirely recumbent. It is only when he rises from his bed that compensating curves are formed, and that rotation of the vertebræ takes place : motion is essential to rotation.

In the act of walking there is a lateral undulatory movement of the spine from the pelvis upwards, which corresponds to the alternate acts of raising the feet from the ground. As the weight of the body rests on the right foot, for instance, the pelvis is raised on the same side, and the undulation commences in the spine with the convexity towards the left side, and there is a compensating undulation in the dorsal region towards the right side. Again,

as the left leg is brought forward, the pelvis becomes horizontal, and as the weight is transferred to the foot so the pelvis is raised on the same side and rendered oblique, and the lumbar curve forms to the opposite side, as has been already explained.

Together with this undulatory motion of the entire column there is also a certain slight lateral movement of the vertebræ upon the intervertebral substances, especially in the lumbar region of the spine. This is a movement of rotation in the vertical axis of the column, and it varies from right to left and from left to right with alternate steps.* When, however, the column is no longer erect, but inclines laterally, this normal movement of the vertebræ is checked. Then, compression on the side of the concavity commences to be permanent. The immediate effect of this compression is seen in a certain amount of stiffness, or rigidity of the spine, which shows inability to rotate towards the concavity; and consequently the bodies of the vertebræ do not replace themselves exactly in the central position of the column.

But the bodies of the vertebræ are not all in the same measure rotated: those are most rotated which are nearest to the centre of the curve, and that vertebra which is central is the most rotated and the most wedge-shaped. This is shown in Fig. 19, where the vertebra in the centre of the lumbar curve is represented as wedge-shaped and rotated to the extent of one fourth of a circle, while those above and below are both less rotated and less wedge-shaped.

* These movements may be studied with advantage in young acrobats, in whom exaggerated positions of the trunk and limbs will display these movements of the vertebræ. They are also exaggerated through the use of the bicycle, and especially of the tricycle. Lumbar curvature may follow the inordinate use of these machines; and this is accompanied with pain in the course of the great sciatic nerve, and also of the small sciatic nerve. I have known this pain to be very severe on the posterior aspect of the thigh, and along the outer side of the thigh, and to reach to the calf of the leg, the heel, and the sole of the foot. When there is any difference in the power of the lower limbs, as frequently happens, a lumbar curve, under these circumstances, will be formed.

And in the same manner the intervertebral substances which enter into the curve are reduced in thickness.

In rotation the bodies of the vertebræ are turned towards the convexity of the curve, and the spinous processes towards the concavity.

In a severe form of curvature the bodies of the vertebræ undergo such rotation as to acquire a lateral instead of their normal direction. But, although the bodies of the vertebræ are rotated, the spinous processes undergo comparatively slight change in direction, and even it may be so slight as scarcely to indicate a lateral curve. This is shown in Figs. 16 and 17, especially in the dorsal region. Here the spinous processes scarcely indicate a lateral curve, although the bodies of the vertebræ are much rotated.

Perhaps the course of the spinous processes in the lumbar portion of the spine, as represented in Figs. 18 and 19, is even more remarkable than in the dorsal region, considering the greater rotation which has taken place.

Thus, it is shown that a spiral twist of the spinal column may exist to a very great extent, through rotation of the bodies of the vertebræ, without the apices of the spinous processes describing a corresponding curve.

This question of rotation has attracted much attention; and every one who has touched on the subject has propounded his own solution of it, with more or less confidence. Many have theorised on the subject, and opinions differ as to the cause of rotation and the time of its commencement. Rotation occurs both in primary and in secondary curves, but it is always considerably more advanced in the primary than in a secondary curve.

It has been stated by Dr Dods,* who was one of the first to draw attention to the subject, that lateral curvature always commences with rotation of the bodies of the vertebræ, and that it is produced by muscular action. Mr Barwell seems to have accepted this view.† Others have thought that a difference in the density of the anterior and

* 'Pathological Observations on the Rotated or Contorted Spine,' p. 30.

† 'On Curvatures of the Spine,' 3rd ed., p. 27.

FIG. 16.



FIG. 17.

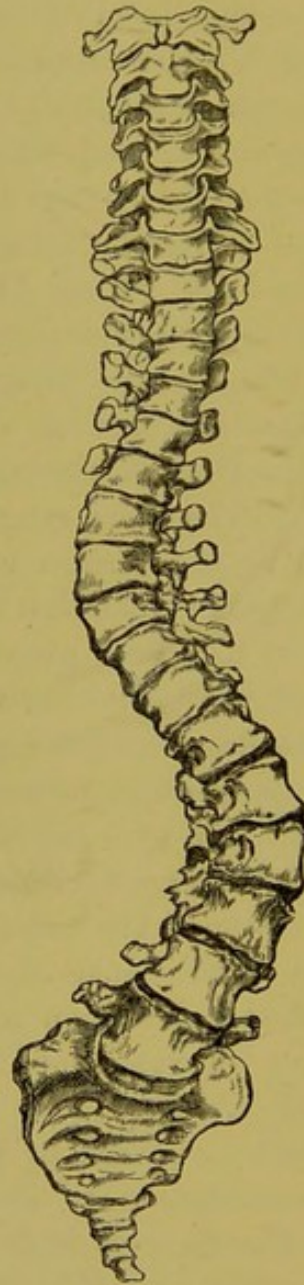


FIG. 18.

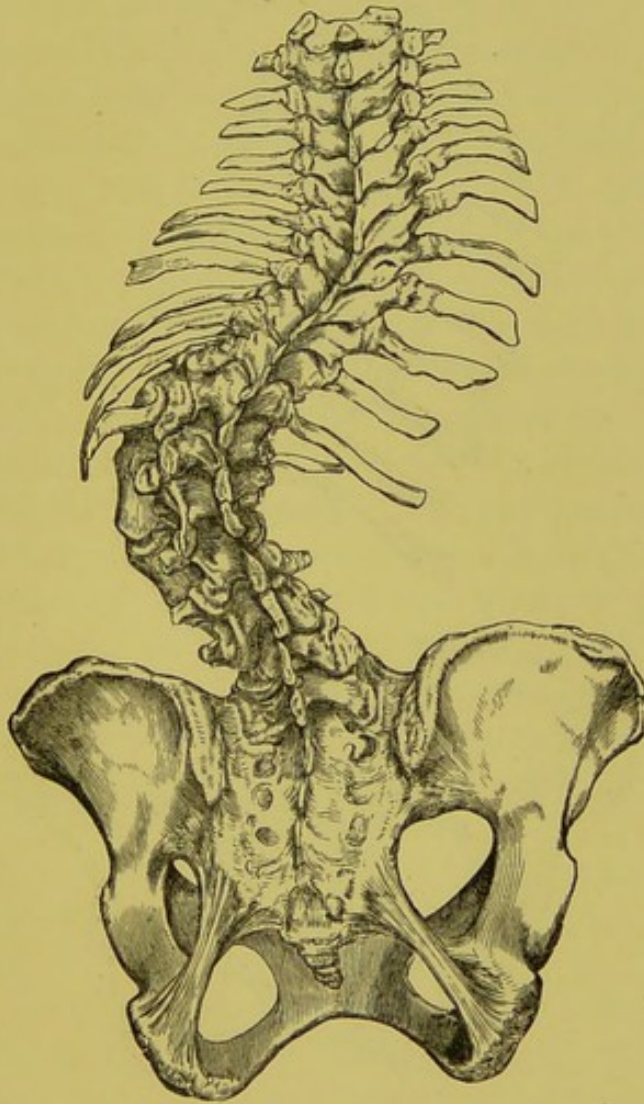
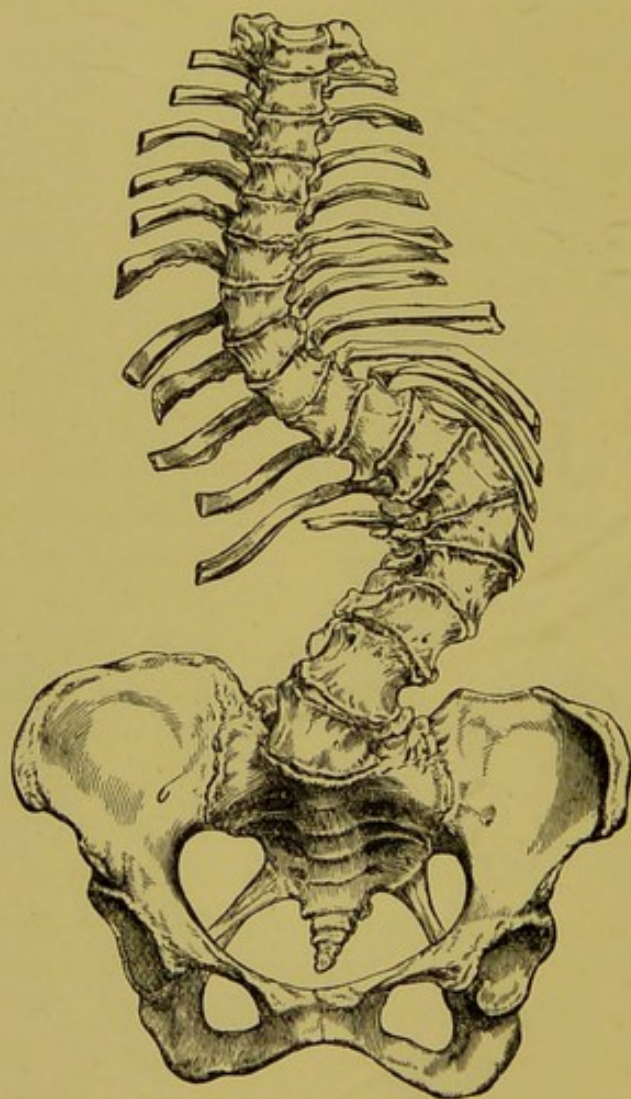


FIG. 19.



the posterior portions of the vertebræ would account for rotation. Mr Alexander Shaw believes that certain changes in the articulating processes are due to unequal pressure occasioned by rotation. He says: "In lateral curvature of the spine we have a distinct demonstration that the articulating processes give way more extensively than any of the other parts of the column. This is evinced by the rotation which the spine makes in its perpendicular axis, at the same time that it inclines laterally."*

Mr William Adams adopts Mr Shaw's views. He says, "I believe rotation to precede any lateral deviation of the spinal column, and its cause and mode of production to have been accurately explained by Mr Alexander Shaw."†

Dr Judson has lately expressed his views on rotation; and his explanation is so ingenious that I shall refer to it at some length. Also, he illustrates his theory by an instrument, which will probably be familiar to many in this metropolis, as it was lately extensively exhibited by Dr Sayre. Dr Judson writes thus: "In the present unsettled state of the question I propose an explanation as follows:

"The rotation of the vertebra in lateral curvature of the spine consists in an unequal lateral displacement of the body and the spinous process, the former being free from lateral attachment and therefore departing from the median plane, while the latter is held in the median plane by its muscular and fibrous attachments.

"While the spinous processes of the vertebral column are held in the median plane of the trunk by the strong and active fibrous and muscular structures which are attached, on one hand to the posterior portion of the spinal column, and on the other hand to the shoulders, the thoracic and abdominal parietes, and the hips, the anterior portion of the vertebral column is comparatively free from fibrous and muscular attachments.

"The bodies of the vertebræ have motion upon each other by the intervention of the intervertebral substance.

* 'Medico-Chirurgical Transactions,' vol. xvii.

† 'On Curvature of the Spine,' 2nd ed., p. 150.

They are unlimited in lateral motion, except by the intervertebral substance, the anterior and posterior common ligaments, their slight visceral and costal connections, and from being connected by their pedicles with the posterior portion of the vertebral column, the component parts of which are bound together by ligamentous and muscular structures.

“When the median plane of the trunk curves to the right or the left under the vertical pressure which is the direct cause of lateral curvature, their freedom from control allows the bodies of the vertebræ to fall away from the median plane, to the right or the left, while the posterior portions of the column are held in the median plane by their muscular and fibrous attachments. This deportment of the two components of a vertebra, its anterior and posterior portions, is rotation in the vertebra as a whole.

“The distinguishing feature of the explanation of rotation here proposed is the recognition of the fact, heretofore overlooked, so far as I am aware, that the posterior portion of the vertebral column, being a part of the dorsal parietes of the chest and abdomen, is confined in the median plane of the trunk, while the anterior portion of the column, projecting into the thoracic and abdominal cavities, and devoid of lateral attachments, is at liberty to, and physiologically does, move to the right and left of the median plane.”

Dr Judson concludes his paper thus :

“The immediate cause of the curvature is an inability to support the superincumbent weight. What tissues are at fault, and why they fail at a certain point of development, and in females more than in males, are questions which are not included in the subject of this paper.”*

From this paper we are to understand that the spine yields from above downwards, in the same manner as the curves are produced in the instrument which is figured by Dr Judson on the first page of his pamphlet, and that it yields from “inability to support the superincumbent weight,” and “curves to the right or the left under the

* ‘The Cause of Rotation in Lateral Curvature of the Spine.’

vertical pressure which is the direct cause of lateral curvature."

This instrument is doubtless based on experiments made by Professor Hermann Meyer, in which he showed that by vertical pressure on the spine of a seven months' foetus, he could produce lateral curvature with rotation. At fourteen years of age the same condition was produced by similar means, but not to the same extent; until the anterior longitudinal ligament had been removed: after its removal complete rotation was readily induced. But at twenty years of age rotation could not be produced even after removing the anterior common ligament.*

Dr Judson was familiar with this paper of Prof. Meyer's. It will not be difficult to show that an error underlies Meyer's theory; and that when reduced to practice it does not work.

As a rule, the lumbar curve is first formed through obliquity of the pelvis, and the pelvis is rendered oblique through some inequality of the lower limbs, either in length or in strength. In the early days of a flat-foot or a knock-knee, there will be observed a tendency for the pelvis to fall to the same side, and also a deflection of the lower portion of the spine with its convexity to the same side. When, however, the patient is placed in a recumbent position, so that the superincumbent weight is removed, the flat-foot and the knock-knee and the oblique pelvis and the deflected spine disappear: the arch of the foot is restored, the knee no longer deviates from the normal line, the pelvis becomes horizontal, and the spine occupies the median line. It need scarcely be said that at this period rotation has not taken place: when rotation commences the spine does not resume immediately its normal position.

A left lumbar curve, then, depends on a faulty condition of the left lower extremity, while a faulty right extremity gives rise to a right lumbar curve. And of the upper curves each one follows a regular course, in the same manner as the lumbar curve. Thus spinal curves are formed with

* "Die Mechanik der Skoliose," Virchow's 'Archiv,' vol. xxxv, p. 225.

precision ; so that the original defect being given it is easy to describe the curves which must follow : curves do not form to the right side or to the left as though by accident, but almost with mathematical precision.

So soon as spinal curvature commences the normal axis of the trunk is changed, and the column is no longer poised in the vertical line on the heads of the thigh bones. The superincumbent weight being no longer transmitted in the normal axis of the trunk, but falling on the side of the concavity of the primary curve, unequal pressure causes in the first place compression of the intervertebral substances which enter into the curve. After a variable time this compressed condition of the intervertebral substance is more or less permanent and it is not removed by ordinary recumbency. The body of the vertebra then begins to move laterally, through vertical pressure on the inner, or concave side of the curve, and in consequence of the absence of pressure and support on the convexity. And through this compression on the side of the concavity, a gliding, or semi-rotatory movement of the bodies with the intervertebral substances is established. This compression acts first on the intervertebral substance, and secondly on the body of the vertebra ; and causes thinning and lateral displacement, or rotation.

Rotation then, is immediately due to abnormal pressure on the concave side of the spinal curve, and to absence of pressure and support on the side of the convexity.

Rotation can never be a primary movement, but must always be a sequence of lateral deviation. Thus it is essential to rotation that the spinal column shall be bent.

The position which is assumed in commencing curvature is that of stooping forward with the head inclined towards the side of the lumbar concavity, and subsequently, as equilibrium is restored, to the side of the primary convexity.

Rotation interferes with direct flexion of the trunk ; so that it becomes necessary in stooping to bend towards the side of the concavity.

In health, the column is in itself perfect and able to sustain the weight which is superimposed in ordinary conditions; but when its base is rendered oblique, the column yields laterally; and being no longer perpendicular, it cannot support the superincumbent weight. Thus a lumbar curve is formed, the centre of gravity is shifted, and the superincumbent weight is transmitted to one side of the median line, rather than through the normal axis of the body.

Thus, being curved, the spine is unable to bear the superincumbent weight. It curves through obliquity of the pelvis, and not through vertical pressure, and it is unable to support the superincumbent weight because it is curved.

Curvature and rotation commence from below upwards in 95 per cent. of cases of lateral curvature, and not from above downwards, as is represented by Meyer.

The experiments to which I have alluded show the immense importance of the anterior common ligament. They also demonstrate that curvature precedes rotation, and that rotation can only arise out of curvature.

When curvature commences from above its progress is slower than when it commences from below. Yet the curves form in regular sequence, and the stability of the column is impaired; but it is never so much weakened as when its base has lost its horizontal direction and has become oblique.

In Figs. 18 and 19 it will be seen how the bodies of the vertebræ are rotated towards the convexity of the curve, and that they have become wedge-shaped. That vertebra which is the most central is also the most compressed: it may lose more than half of its thickness. It will further be seen that the spinous processes are somewhat curved towards the concavities of the curves, but not in the same degree as the bodies are rotated into the convexities. They may even scarcely be removed from the middle line of the trunk, notwithstanding that the bodies themselves are much rotated; because, as Rogers-Harrison has well said, "Behind the central part of the dorsal

column, there is efficacious resistance to its lateral displacement ; that before this central part there is no resistance to that displacement ; and consequently the vertebra must necessarily turn on its axis to arrive at the position which observation so frequently presents.”*

Therefore, in defining a spinal curve, we must not be guided alone by the line of the spinous processes ; but the condition of the entire trunk must be considered. To consider the spinous processes alone would mislead.

Figs. 20 and 21 represent an articulated spine, where the anterior and the posterior surfaces agree perfectly, and where the vertebræ are piled one above another with great care after the fancy of the constructor, but unfortunately without the slightest regard for truth. Such is the manner in which articulated spines are frequently put together ; and it tends to perpetuate an error. It is only fair to say, however, that the vertebræ having been taken asunder and the intervertebral cartilages removed, it is no ordinary puzzle to put the several parts together again as they had grown.

The transverse processes on the convexity of the curve, by rotation of the vertebræ, become prominent and cause the erector spinæ to project ; while, on the opposite side, they can be only imperfectly felt. Also, through the pressure caused by rotation the articulating processes become at length partially absorbed.

I am greatly indebted to Dr Judson for a pamphlet, entitled ‘ Mr Brodhurst’s View of the Causes of Rotation in Lateral Curvature of the Spine,’ in which he directs attention to the work of Mr Charles H. Rogers-Harrison, ‘ On Deformities of the Spine and Chest,’ a work of which I had never heard previously, and which was neither to be found in the library of the Royal College of Surgeons nor in that of the Royal Medical and Chirurgical Society ; nor could I find it at any of the medical booksellers. At last I found a copy of this work, and in it the following most important information, which has not only been neglected,

* ‘ Deformities of the Spine and Chest,’ p. 94, 1842.

but which seems to have been absolutely forgotten: no reference is made to Rogers-Harrison and his opinions by any author.

Mr Harrison wrote thus:—"As the articulating surfaces do not permit the spinal column to bend in a direction completely lateral, the vertebræ perform a rotatory movement from right to left, or from left to right, gliding on one another, which produces the twisting that always accompanies lateral deviations in a way more or less marked; so that its anterior part is, in its two halves, in an opposite direction.

"In this case, the transverse process on the side of the convexity is carried back, while that of the concave side thus becomes more anterior; the anterior surface of the body of the vertebra has no longer an opposite correspondence with the median or anterior line of the thorax: the lateral surface of that body, on the side of the convexity, has approached the concavity of the ribs of that side; and finally, the whole body of the vertebra appears situated more in the great cavity within one side of the breast than between the cavities of both sides.

"To conceive the cause of this extraordinary mode of arrangement, it is necessary to imagine that, in a well-marked curvature of the vertebral column continuing to sustain the weight of the body, the vertebræ of the middle of that curvature are, in fact, in the same situation as if they were urged by a direct and horizontal force on the side of the concavity, towards that of the convexity. In this impulsion, the body of the vertebra, isolated in its anterior and lateral parts, experiences no resistance; but the articular processes are powerfully restrained by their reciprocal connection. The transverse processes find, in their articulation with the tuberosity of the ribs, a resistance to their deviation, which would be very weak on the part of an isolated rib, but which becomes considerable by its union with the adjoining ribs.

"It results from this exposition, that behind the central part of the dorsal column, there is efficacious resistance to

its lateral displacement; that before this central part there is no resistance to that displacement; and consequently the vertebra must necessarily turn on its axis to arrive at the position which observation so frequently presents.”*

Dr Judson then proceeds to remark that Mr Harrison was opposed to the treatment of lateral curvature by mechanical support applied to the ribs. This observation

FIG. 20.

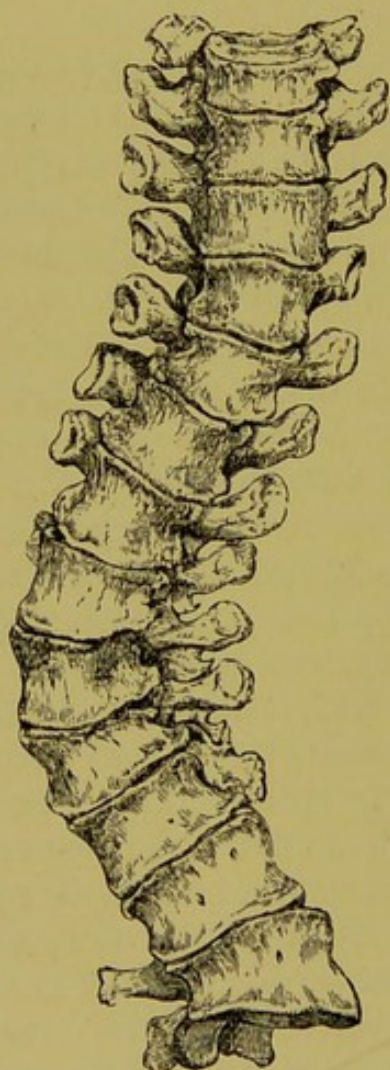


FIG. 21.



refers to the time when he wrote his book. At that time the spinal supports which were in use were of the most objectionable form. But subsequently I read a paper before

* Ibid., p. 94.

the Medical Society, on "Lateral Curvature of the Spine," and argued my views on rotation of the vertebræ. Mr Harrison was present, and when I exhibited the spinal supports which are still in use, and explained their employment, he withdrew his opposition, and stated on what his opposition had been based. It is difficult to understand how anyone with any knowledge of rotation of the vertebræ could use such instruments as were then in vogue: they could only increase rotation and flatten the ribs. I am informed that somewhat later his book was withdrawn from circulation, and this will probably in some measure account for its rarity. Rogers-Harrison explains rotation, but he does not explain spinal curvature. I must refer to these pages of mine for the explanation of spinal curvature with rotation, in health and in disease.

The ribs necessarily follow the altered positions of the vertebræ to which they are attached, and undergo a movement of rotation backwards on the convex side of the curve, so that their angles are rendered more prominent, and they become more horizontal in their direction, while the intercostal spaces become wider than in their normal state; but on the concave side the ribs sink and become flattened, the intercostal spaces also become more or less effaced through overlapping of the ribs, and the ribs themselves are carried forward and become prominent on the anterior and lower part of the chest. On both sides of the chest the ribs are flattened. Also, on the convex side of the curve, in consequence of the rotation of the bodies of the vertebræ into the convexity and the flattening of the ribs, the lung is compressed. Through these changes in the form of the thorax and others which are coincident with them, the capacity of the chest is diminished. Further, the appearance of distortion is much increased by the prominence of the scapula. On the convex side of the curve, this bone is thrust up and is placed obliquely, through the increased angularity of the ribs; and it is still further raised by muscular action. It is also occasionally observed that the edge of the latissimus dorsi does

not pass over the lower angle of the scapula, but that it lies beneath it, the scapula being raised.

Prof. Hueter* gives a representation of what he conceives to be the changes in the positions of the ribs and the vertebræ in scoliosis. Even if it were correct, which it is not, it would not be of much value, unless, also, he gave a representation of the entire spine. Dr George Johnson† has followed Hueter and with a similar result. If Figs. 28, 30, and 31 in Hueter's work are compared with Fig. 29 it will be seen how misleading they are. The former are intended to represent sections of the thorax in an ordinary case of scoliosis; but Fig. 29 represents a form of scoliosis which has passed far beyond any kind of effective treatment—a very rare and extreme deformity of the spine, and yet the ribs show less distortion than in the sections. And the position of the vertebra, which it is intended to show, is not less erroneous. Unless the sections are made as those by M. M. Weber, see p. 6, such an error is likely to arise.

In an ordinary case of lateral curvature the pelvis is oblique. The ilium on the side of the lumbar concavity is raised and carried backwards, and on the opposite side it is depressed and carried forwards. And when the superincumbent weight is unequally transmitted to the ground, the pelvis may become slightly flattened. When the pelvis is rickety it becomes flattened from above downwards, both through the superincumbent weight and by the resistance of the lower limbs; so that the space between the promontory of the sacrum and the symphysis pubis may be much diminished (Fig. 23).

When distortion of the spine is considerable and of long duration, slight flattening of the pelvis ensues through unequal transmission of the superincumbent weight. Thus, the ischium and the os pubis become somewhat flattened on that side on which the weight of the body is most thrown; namely, on the side of the convexity of the lumbar curve (Fig. 22).

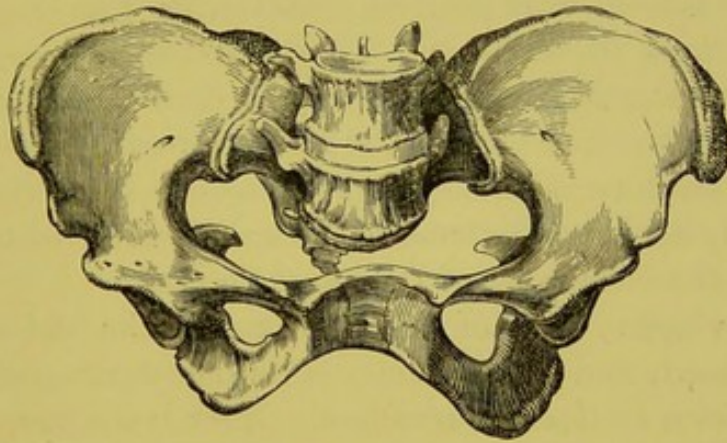
* 'Klinik der Gelenkkrankheiten,' Theil 3, p. 127, fig. 28, 1878.

† The 'British Medical Journal,' 1878.

And when any difference in length of the extremities has given rise to curvature, such difference as is occasioned, for instance, by a rickety femur or tibia, by genu valgum or other such cause, flattening may take place on the side of the shorter limb, that is to say, on the side of the convexity of the lumbar curve; but the flattening which occurs, except in a rickety pelvis, is slight.

In addition to cervical, dorsal, and lumbar curves the sacrum may be curved in a sense the reverse of the lumbar

FIG. 22.



curve; and the ilium on the side of the sacral concavity is then carried forward. Also, through these changes, together with the torsion of the spine which has occurred, the promontory of the sacrum encroaches somewhat on the pelvic cavity.

Distortion of the spine is never stationary; but it advances slowly, until, at length, ankylosis takes place between the bodies of the vertebræ, and also between the articulating processes. Ankylosis may ensue after absorption of the fibro-cartilages, or it may occur through deposition of bone along the bodies of the vertebræ, in riband-like masses or in the form of nodosities—stud-like masses, connecting two or more vertebræ, without the previous removal of the intervertebral cartilages.

The anterior surface of the thorax presents changes which are scarcely less striking than those which have

already been mentioned. Thus, on the side of the convexity, the ribs are flattened and depressed ; and, together with them, the position of the mammary gland is changed : its position varies, being depressed from a quarter of an inch to an inch or more. This necessarily depends both on the situation of the curve and on its extent. The gland retains, if not entirely, almost its normal relation to the ribs, and is depressed together with them.

On the side of the concavity of the thoracic curve, the ribs and cartilages become prominent ; so that the projection is frequently spoken of as a tumour. Sometimes pain is felt in this position ; and often this is the only seat of pain in scoliosis. This prominence is occasioned through rotation of the vertebræ and the consequent thrusting forward of the ribs and their cartilages.

The sternum also deviates somewhat from its normal position, its lower extremity being directed towards the side of the convexity of the thoracic curve.

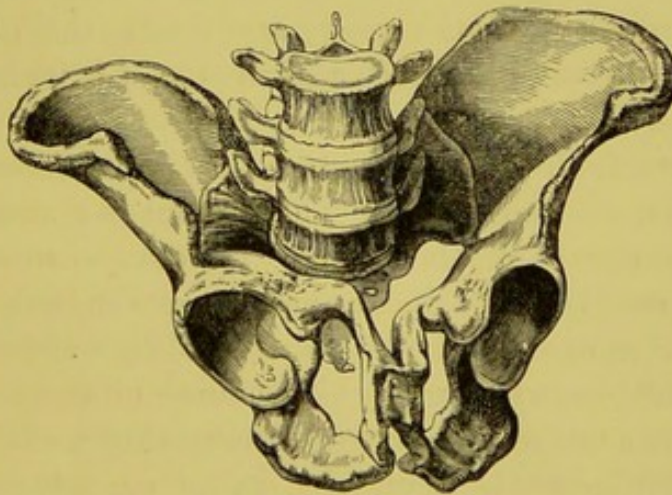
The viscera, both of the thorax and the abdomen, are compressed, and their functions become deranged in every severe form of lateral curvature. Such is the case, indeed, before distortion reaches its most severe stage. But especially the thoracic viscera suffer, being surrounded by bony walls. On examining the skeleton, one is apt to wonder how the functions of respiration and circulation can be carried on, so great is the change from the normal condition.

Rachitic scoliosis seldom appears until disease is fully established in the long bones and in the pelvis. The nature of the affection can, therefore, rarely be doubtful. A rachitic tibia or femur, by inducing obliquity of the pelvis, may cause spinal curvature. This is an every-day occurrence. The curve is not, however, therefore rachitic. On the other hand, the pelvis, the spine, and the ribs may be rickety and much deformed while the long bones remain unaffected. Rachitic scoliosis and ordinary scoliosis have little in common but the existence of a curve and the compression of viscera consequent upon distortion.

Rachitic scoliosis commences in the bony structures.

First, the periosteum becomes unusually vascular, tumid, and adherent to the bone. The structure of the bone itself is then somewhat swollen, and its vessels are filled with blood. The cells, too, of the spongy parts of the bones, and of the epiphyses of the long bones, become dilated and filled with sanguinolent fluid. Eventually the cell-walls are broken down, and the medullary cavities become chambers filled with this fatty, sanguinolent, dark-coloured matter. This fluid is found both in the cavities of the bones and between the periosteum and the bone; and at length the bones become soft and cartilaginous, being, in part, deprived of their earthy constituents, so that they are easily cut with a knife or as readily yield to pressure or to muscular force, and become misshapen. Wherever pressure is greatest, there is the most distortion. So in the spine it is found that the vertebræ which are most implicated in the curve are not only much compressed, but that they are twisted on their axes, and through pressure become misshapen.

FIG. 23.



Through the weight of the trunk also the pelvis is flattened and narrowed in its conjugate diameter; and this tendency to flattening is increased by the existence of lordosis, which, as a rule, is found together with scoliosis in rickets (Fig. 23).

In no other form of spinal curvature does the pelvis become so distorted as in that which results from rickets. Cases of this description are on record where a ball, one inch in diameter, could not pass the brim of the pelvis ; and in which the Cæsarean section was performed.

The ribs on both sides of the thorax are flattened, and they are distorted into every conceivable shape.

To this softened and tumefied condition another even more important yet succeeds. The bony substance becomes more and more firm, the outer surface being hypertrophied and of ivory hardness ; so that the distorted limb or spine, however misshapen, must so remain : change is impossible.

Briefly I will allude to the results of these changes on the thoracic viscera, as well as to those which take place in the structures which are attached to the trunk itself.

The thoracic space, on the convexity of the curve, is diminished by the flattening of the ribs, and by the rotation of the bodies of the vertebræ ; and the heart is consequently somewhat displaced towards the concave side. Respiration may be considerably affected ; and through imperfect expansion of the chest and lungs, the right side of the heart becomes dilated, and the blood is insufficiently aerated.

The aorta follows the inflections of the vertebræ, being bound down to the spine by its branches ; and thus it follows the curves of the spine. Its course under these circumstances is well shown in a preparation numbered 3416 in the museum of the Royal College of Surgeons. In a practical point of view, this course of the aorta may appear to be a matter of only small importance. It deserves to be remembered, however, for in an emaciated person, with the convexity of the lumbar curve towards the right side, the aorta may be felt immediately beneath the finger, lying out of its normal course, and on the right side of the umbilicus. I have known ideas of aneurysm of the aorta to arise in such a case. Some short time since I was much interested in a case of this description, where it was sup-

posed that a very severe lower dorsal curvature to the right was complicated with aneurysm of the aorta. It occurred in a gentleman aged sixty-five, and I had the advantage of the co-operation of Sir George Burrows and of Dr. Bloxam in the case.

Together with severe lumbar curvature there is always found obliquity of the pelvis. This is not a simple tilting to one side, but there is at the same time a slight movement of rotation of the pelvis itself, which, indeed, is necessitated by the circumstance of the lumbar curve and the rotation of the lumbar vertebræ; so that the anterior superior spinous process of the ilium is not only raised above that of the opposite side, but it is also thrown back; while on the opposite side it is depressed and carried forward. In the female this obliquity is of less importance than in the male. In the male, however, the triangular ligament of the urethra, together with the rest of the pelvis, is twisted, and consequently the direct course of the urethra behind the ligament no longer corresponds with that in front of it. This twisted condition of the urethra may cause a serious impediment to the introduction of a catheter into the bladder, even where stricture does not exist. Should stricture of the urethra be superadded it would be exceedingly important to remember the oblique position of the pelvis. I have known more than one instance where, without the knowledge of this fact, it would have been very difficult to introduce a catheter into the bladder. Whenever in cases of severe lumbar curvature it is necessary to use an elastic catheter, this is always withdrawn moulded into a sigmoid curve, corresponding to the lower spinal curves.

In the case to which allusion is made above (where it was supposed there existed aneurysm of the aorta), this difficulty occurred, and it was found impossible to introduce a catheter until this twisted condition of the urethra was explained.

CHAPTER III

TREATMENT

BESIDES all those measures which are usually taken to improve or restore health, it has to be considered what special means are adapted to the removal of lateral curvature.

The chief causes of lateral curvature of the spine are, as I have endeavoured to show, those which act on the pelvis through the lower limbs, and in all such cases the lumbar is the primary curve. The first object then should be to restore the horizontal position of the pelvis. This may be done in the recumbent position; when flat-foot or knock-knee, or any other deformity which may have occasioned obliquity of the pelvis, can be treated. But the recumbent position is not absolutely necessary for treatment; inasmuch as these various defects may be removed without recumbency, though the time occupied will be longer. Until, however, the trochanters are brought on to the same level, it is of little use to attempt to act on the lumbar curve. It is therefore imperatively necessary that any affection of the lower limbs—flat-foot, knock-knee, or other cause of obliquity of the pelvis—should first be removed: little progress can be made in redressing a lumbar curve so long as the pelvis remains oblique. It is for want of attention to this circumstance that some have failed to remove lumbar curvature.

I do not propose here to enter upon the question of constitutional treatment for debility, nor for rickets; neither will I touch further upon the treatment of such conditions of health as are induced by lengthened residence in climates unsuitable to the race; which by forcing growth, and

advancing the period of puberty, diminish strength and unfit such young people to associate on equal terms with those who have never been subjected to such influences. But I may call attention to the necessity of guarding against inordinate exercise, long walks, and much standing. Such girls need reclining chairs and suitable sofas.

In examining for spinal curvature, the shoulders and the hips must be uncovered, and the whole length of the spine should be traced with the eye, as well in the stooping as in the erect posture. Stooping may bring into view a rotated spine, which a practised eye even shall not discover in the erect position ; and, also, the loin may then be seen to have fallen in, while in the erect posture there shall be no apparent defect.

It would seem incredible that nowadays an error of diagnosis should occur with regard to angular and lateral curvature—a question in itself very simple ; and yet disease of the spine and scoliosis are frequently confounded, and the mistake is perhaps not discovered until irreparable injury has been inflicted.

I was lately called into Kent to see a young lady, aged twenty, who was supposed to have angular curvature in the upper dorsal region. She had been treated somewhat actively for this form of disease for two years by two well-known hospital surgeons, and I found her recumbent and with her head carefully supported. But there was no disease of the spine whatever, nor had disease ever been present. The spine in its entirety had never been examined, otherwise there would have been discovered a considerable lumbar and lower dorsal curve, and it would have been seen that the upper dorsal curve, which was unusually sharp and prominent, was compensatory and not angular. Thus, it is important in examining for spinal curvature and spinal disease to uncover the spine in its entire course.

If the lumbar curve is so slight that it can be removed during recumbency, spinal supports are not absolutely necessary ; but gymnastic exercises to bring the muscles

of the trunk and extremities into action may be employed, after the cause of obliquity of the pelvis, whatever it may be, has been removed. These exercises alternating with rest, together with such constitutional treatment as is generally understood to be suitable for invigorating the general health, will suffice to remove incipient curvature. But, although this statement is made in the fullest confidence of the efficiency of such treatment, it should at the same time be said that such cases need the most watchful care, lest they should pass on, as they easily may, to the next stage, namely, that of rotation. Gymnastic exercises, however, should be used with great moderation. Such patients are young and delicate, and cannot bear the usual practice of a gymnasium. A trapeze, such as can be fixed up in any room, is sufficient to bring into action well and quite enough the muscles of the trunk and limbs. Nutritious food, and plenty of it, with recumbency and abstention from walking exercise, are even more important than swinging. Yet it is useful to use the trapeze daily. When rotation has taken place, recumbency and gymnastic exercises will no longer avail, unaided, to restore the spine to the median line of the trunk; but mechanical support is then needed, together with such other measures as will now be considered.

The treatment of spinal curvature should commence as soon as the curve begins to be formed; or, as Sir Benjamin Brodie said, "The treatment of the disease cannot be begun too soon after the first signs of spinal curvature are perceptible."* For, if curvature be allowed to progress, deformity must go on increasing until equilibrium is restored by the formation of compensating curves. And after rotation has commenced, distortion becomes rapidly worse if neglected; and, indeed, it very soon becomes incurable. However slight, then, the curve may be, it demands immediate attention. It is supposed by some that a child may, unaided, grow out of lateral curvature.

* Lectures on "Distortion of the Spine not connected with Caries," 'London Med. Gazette,' 1846.

No hope can be more delusive: it needs all the care that can be bestowed on it to remove even incipient curvature.

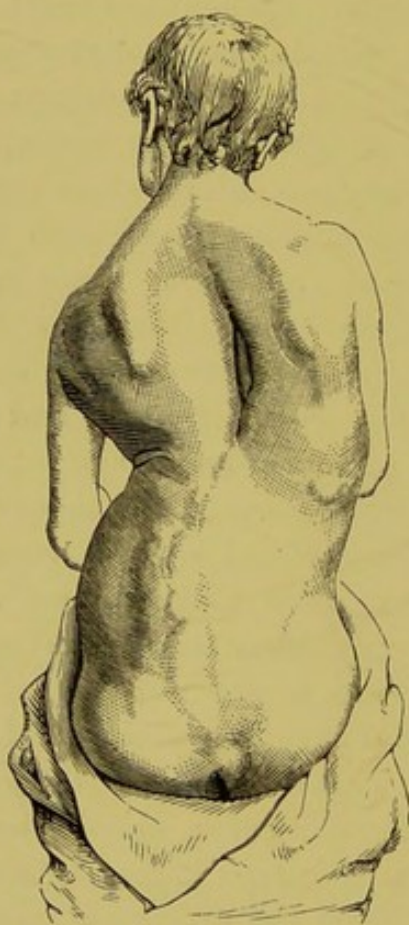
If it be a fact that one curve is first formed, and that others are subsequently formed as compensatory of this primary curve—and no one can doubt it who has watched such cases—then it should follow that treatment must in the first instance be directed especially to the removal of the primary curve. To endeavour to remove a secondary curve without giving efficient support to the primary curve is the most certain mode that could be devised of increasing the original curve and rotation. Having determined then which is the primary curve, pressure should be made in that direction which shall tend to restore the ribs to their normal positions, and also to replace those vertebræ which have undergone some rotation. This is most effectively done by applying the force to be employed below the greatest convexity of each curve.

When the lumbar curve follows and is caused by a dorsal curve, it is of much less importance than when it is formed as a primary curve. As secondary curves both the lumbar and the cervical require comparatively small attention. There is then little or no obliquity of the pelvis, and it is only after considerable deformity has taken place that there is any rotation of the pelvis. In treating the dorsal curve the plate of the spinal support should be applied below the greatest convexity of the curve. And the lumbar curve should be supported in a similar manner; and perhaps it may be necessary to apply a third plate to support the upper extremity of the dorsal arc.

As examples, Figs. 24 and 25 were taken from casts: the first in September, and the second in the following January. The first cast was taken before treatment commenced, and the second when it was nearly complete. It will be observed how great is the rotation both in the lumbar and in the dorsal region in Fig. 24, and how great is the deformity. Before this patient came under my care she was placed in a Sayre's jacket. This she wore for five

months, during which time it was only once re-applied. When it was applied the curvature was very slight, but on removing it at the end of five months the deformity was such as is represented. When the second cast was taken, namely, in January, the spine was not only nearly straight, as is shown in Fig. 25, but it was supple ; so that

FIG. 24.



the patient could bend in every direction. I adduce this as a very severe example of deformity. It was considered very doubtful if treatment would avail anything to remedy the serious injury that had been done ; and I draw attention to Fig. 25 with infinite pleasure, representing, as it does, a result which no one dared to expect. It may, I consider, be looked upon as a triumph of patient endurance and science. But I may observe that, during the whole

time this patient was under treatment, she always expressed that she was entirely free from pain, and that she was quite comfortable in the supporting instrument. She grew considerably in height and became much stouter ; and her general appearance was so much improved that her

Fig. 25.



mother, on first seeing her, exclaimed that she did not know her.

The manufacture of a spinal support and its application, are matters of considerable importance in relation to curative measures. A spinal support must be perfectly fitting in all its parts ; it must be light, and so tempered that it shall not bend with the weight of the body, and yet that it may be bent when mechanical force is applied, without

breaking. The band about the pelvis should fit exactly, and therefore it must be fashioned to the pelvis itself; and the lateral plates which are carried on levers and moved by compound movements (lateral and antero-posterior) should correspond exactly to the surfaces to be acted on. Therefore it is necessary that a cast of the back be taken, so that the spinal support may be accurately fitted. The lateral plates should be so placed that they may apply if possible to the lower portion of each curve, and they will be broad in proportion to the curves to be acted on.

The dorsal curves will be acted on through the ribs. The plates therefore should be moulded to the shapes which these have assumed, and they will from time to time need to be re-modelled. The force will be applied in the reverse direction to that in which deviation has occurred, and the pressure should, as much as possible, be made to follow the course of deviation of the parts themselves; and consequently, it should never be directly lateral.

It is necessary that the plates of the support shall be accurately in contact with the curves at all times when the patient is not recumbent, and that as the curves alter the plates shall be changed, both in shape and in position. When the combined forces of a well-adapted instrument are made to act in the directions now indicated—namely, obliquely towards the centre, they tend to unbend the curves. The movement which is thus commenced in the primary curve is often greatly assisted by muscular action; and in this manner the several curves are at the same time or in succession acted on and unfolded.

The action of the spinal support should be that of uplifting, and therefore pressure will not be made on the greatest convexity of the curve, but on the lowest arm of the curve, and on the extremities of the arc. By making pressure upwards and forwards, rotation may be overcome and the curves themselves opened. This action induces extension of the spine; and there will be found an immediate increase in height to the extent of three fourths of

an inch to one inch, and even more. Pressure should commence at the seat of the primary curve; and there it should always be greatest.

Rotation of vertebræ may be overcome with the hand alone, if it has existed only for a short time; and thus lateral curvature may be removed, even when the patient is erect. Much more so may this be done when she is recumbent. The action of the spinal support is intended to continue this pressure upon the vertebræ, that their replacement may be effected, and that they may be maintained in their normal positions; and, if the support is perfectly made and properly applied and adjusted, this object must be attained. I am aware that many anatomists and pathologists, who have had but little opportunity of seeing what may be done in those who are young and healthy, will think that I am speaking metaphorically. I should be ashamed here to write in the language of hyperbole, or to be misunderstood in one iota. I have neither exceeded nor lessened the exact truth. That which I now describe I have demonstrated in numberless instances to those who, by their special knowledge, are best able to judge.

It is rare that a cervical curve requires special treatment unless there be contraction of the sterno-mastoid. It is then a primary curve, and requires for its removal the section of both the sternal and the clavicular portions of the muscle. Then the head should be supported as well as the dorsal compensating curve. When the cervical curve has to be acted on directly, whether as a primary or as a secondary curve, pressure will be applied to that side of the head which corresponds to the concavity of the spinal curve. The twisting or rotation which the head undergoes in such cases corresponds to that of the pelvis. When the anterior superior spinous process of the ilium is carried forward, and there exists also a cervical curve, the ear of the same side is raised and carried forward, while the other is lower and carried backward. Thus, with a cervical curve, even without retraction of the sterno-

mastoid muscle, the head is twisted and the face is placed obliquely.

When the principles of construction are understood, the only remaining difficulty is to carry them out. An instrument may be so constructed as to be useless. But, that it may be useful, it must be so fitted that it cannot tilt. It consists of a pelvic band, which is accurately fitted to the pelvis. And upon this are fixed uprights which carry plates, and others which support the shoulders. The plates are accurately fitted to the lower arms of the curves, and with these such pressure may be made as is necessary to unfold the curves. The plates are to be raised as the curves are opened. Each case demands an instrument exactly suitable to its peculiarities: each one differs, and scarcely two are alike.

Friction may be employed with great advantage, the patient lying on the face, and on a flat, resilient surface. It should be made with the open palms along both sides of the spine; thus acting on the entire lumbar and dorsal regions. This friction should be made by strong arms, with all the force that can be borne, especially on the side of the convexity; and some lubricating substance may be employed to save the integument from injury.

Whilst curvature is being removed, attention should be directed to the development of muscular power by means of exercises; such as swinging, riding, swimming, and the like. These alternating with rest, will, if judiciously employed, rapidly produce a marked increase of muscular power, as well as improvement in the general condition of the patient. But, as is well said by Shaw, "when the spine has become in the slightest degree distorted, it is necessary to pay strict attention to the effects produced by each kind of exercise."* And I entirely agree with Dr Henry Dick, who wrote "gymnastic education is not the great panacea against spinal curvature. Lest I should be misunderstood, however," he continues, "I consider gymnastics and bodily training good adjuvants in the treat-

* 'On the Nature and Treatment of Distortions of the Spine,' p. 187.

ment of spinal curvature, when indicated."* By swinging is meant suspension by the hands. It should be continued only so long as neither to induce fatigue nor pain. Deep lateral movements, on the side of the lumbar convexity, as well as antero-posterior movements, may be practised before lying down at night and after the spinal apparatus is removed.

A spinal chair should be used during the day ; and the spinal support will then be worn both with comfort and advantage during the whole day. The inclination of the chair should be such as can be borne for a considerable period with ease ; and it should never be such as to cause inconvenience, otherwise a lateral inclination of the trunk will be speedily assumed to overcome this inconvenience. Thus, the chair may be raised or lowered as circumstances require ; and in it all studies may be pursued.

A sloping seat is recommended by Mr Barwell for lifting that side of the pelvis which is abnormally depressed. I believe that an ordinary spinal chair is of more use however, inasmuch as it is more conducive to complete rest. As a rule, in sitting, the pelvis is not oblique ; but in standing only. But, if the pelvis were from any cause oblique, a cushion, such as is recommended by Dr Little, may be employed. The cause of obliquity in spinal curvature is not to be found in the pelvis, but below the pelvis, and therefore in sitting the pelvis for the most part becomes horizontal. A sloping seat does not tend to diminish a spinal curve ; but the pelvis being raised beyond the horizontal line on the side of the convexity, not only is the lumbar, but also the compensating curves are increased.

For these reasons the spinal chair in ordinary use, the back of which can be raised or lowered at pleasure, is not only pleasanter to use, but it is more effective as a means of treatment.

With regard to the employment of bandages in the treat-

* 'British Medical Journal.'

ment of spinal curvature, I would express the opinion that they are useless for cure; and unfortunately they are not harmless. They cannot be kept applied; and they are ever to be found where they are not intended to be. But, even if they could be fixed they would be useless after rotation has taken place. And with regard to the plaster-of-Paris jacket recommended by Dr Sayre, I have had opportunities of seeing it applied by himself, and of watching the effects; and I observed that in every instance where the jacket was used, the curve was increased and the height of the trunk was diminished. Also, in some instances, after its application, there is complete loss of power in the trunk and the lower extremities, so that the patients can neither stand nor sit as a result of the treatment. But also a patient may become so powerless after the application of the plaster-jacket, that she may not be able to move in bed. Some fatal cases also have been recorded. Besides, the jacket is a very dirty appliance, and not only is it unsuitable and injurious, but it is an abuse of a patient's ignorance, under the plea of treatment.

Mr Reeves says, "The plaster-of-Paris bandage is worse than useless in any form of lateral curvature."* When the bandage is worn for a fortnight there is found to be an increase in the lateral curvature; and the curve increases somewhat in proportion to the time that the bandage is worn. The deformity which is depicted in Fig. 24 was very slight when the bandage was applied. It was worn for five months, and at the end of this time it had increased so much that it is very rare to see so severe a form of curvature.

Every back splint, under whatever name, is simply useless in lateral curvature; and not only is it useless, but it is absolutely injurious: it invariably increases the curve. It is impossible to suppose that a Sayre's jacket, or a poro-plastic splint, or a splint constructed of any other material, can prevent rotation of the vertebræ and the increase of lateral curvature. The most ignorant

* The 'Lancet,' 1879.

person would know better. Instead of being cured those who submit to such treatment soon discover that they become every day more and more crooked. The worst cases of lateral curvature that have come under my notice during the last few years, have been treated with some sort of splint before I have seen the patient. Splints give no lateral support; and therefore they are useless to prevent rotation: they increase curvature and thus diminish the height of the trunk. I possess full notes of forty cases where Sayre's plaster-jacket was applied. In all of them accurate measurements were taken, both before and after the application of the plaster, and in every one increase of deformity was proved. And it is not alone that increase of deformity takes place, but it is such rapid increase as could take place only when a splint or a bandage is worn. All back splints cause wasting of the muscles of the back; and they increase the undulations of the body, especially in the lumbar region, in walking; and, therefore, they give rise to increased rotation of the vertebræ. But Sayre's jacket, pressing as it does on both sides of the curve (the convexity and the concavity alike), necessarily rapidly increases rotation and lateral curvature. Besides, the weight of it is a great objection to its use: it is at least double that of a spinal support. I lately removed one from a child who came from the neighbourhood of Liverpool, which was more than double the weight of a spinal support large enough for an adult.

Many of these splints are applied in sheer ignorance, and because there is perhaps some pain in the back. They frequently are applied even when there is no curvature of the spine; and I can have no hesitation in saying that their unnecessary use has tended greatly to increase spinal curvature. It is equally unjustifiable not to treat a spinal curve when it is forming, and to encase a back in a splint where a curve does not exist,—thus to increase or even to create a spinal curve. I may say with Dr Bauer, "I cannot conceive how the gutta-percha splint of Schild-

bach, or the 'elastic muscles' of Davies could make any difference in the results."*

Shaw writes: "The following anecdote, for which I am indebted to a very eminent surgeon, will set the question of the propriety of wearing the back collar in a correct point of view. He was consulted by a gentleman, who is now one of our first tragedians, as to the best mode of correcting a stoop which he had acquired. My friend told him that neither stays nor straps would do him any essential good, and that the only method of succeeding was to recollect to keep his shoulders braced back by a voluntary effort. But the tragedian replied that he could not do this as his mind was otherwise occupied. The surgeon then told him that he could give him no further assistance. Shortly after this conversation, the actor ordered his tailor to make a coat of the finest Kersey-mere, so as to fit him very tightly when his shoulders were thrown back. Whenever his shoulders fell forward he was reminded by a pinch under the arms that his coat cost him six guineas, and that it was made of very fragile materials. Being thus forced, for the sake of his fine coat, to keep his shoulders back, he soon cured himself of the stoop. My friend was much obliged to him for the hint, and afterwards when consulted whether young ladies should wear shoulder-straps, permitted them, provided that they were made of the finest muslin or of valuable silk, for tearing of which there should be a forfeit."† This anecdote illustrates perfectly the injurious effect of wearing the shoulder-brace—"back collar"—and the advantage to be gained by muscular exercise. The brace will cause atrophy and loss of power of the rhomboid muscles, so that when it is removed the shoulders fall forward and cannot be replaced voluntarily; whereas, by bringing these and those other muscles, such as sacrolumbalis and longissimus dorsi, which are intended to

* 'Lectures on Orthopædic Surgery,' p. 178.

† 'Further Observations on the Lateral or Serpentine Curvature of the Spine,' p. 111, 1825.

maintain the spine erect, into action and causing them to become developed, a stoop—kyphosis—may be overcome.

Again, numberless cases are not treated because the parents are advised that a child will “grow out” of a spinal curvature. It is not difficult to understand that with a slight curve some doubt might arise as to the absolute necessity for interference, but when curvature has already become severe, hope is still expressed that gymnastics and time will together perform a cure. Curvature increases greatly through neglect, especially the upper dorsal curve becomes prominent and angular, the scapula being raised on the projecting ribs; while on the side of the concavity the ribs fall away, being flattened. Thus, one shoulder is much raised above the other, giving the appearance as of a hump on the shoulder.

There is nothing new in the mode of extension as applied by Sayre. The same apparatus is figured and highly recommended by Stafford.* He called it the “spine elongator.” Also, one somewhat similar was employed by John Shaw. It is figured in his work on ‘Lateral Curvature,’ p. 245. But it dates much farther back than Stafford. Glisson introduced this practice in the seventeenth century. He writes thus: “*Artificialis corporis suspensio perficitur ope instrumenti cujusdam pensilis ex fasciis ea arte formati, ut pectus sub axillis complectatur, caputque sub mento alia fascia circumdet manusque binis ansis excipiat, unde corporis onus partim à pueri manibus, partim à capite, partim ab axillis in aëre pendulum sustineatur ita, ut ab adstantibus non sine voluptate huc illuc impellatur. Etenim ad ossa curva restituenda, ad articulos deflexos erigendos ad curtam corporis staturam elongandam, conducit. . . . Aliqui, ut magis distendantur partes, calceos plumbeos pedibus adaptant, et contractiori corporis lateri pondus adjiciunt, quo facilius partes ad æqualem longitudinem extendantur. Hoc autem exercitium solis robustioribus competit.*”† And the practice

* ‘On the Diseases of the Spine,’ p. 80.

† ‘De Rachitide,’ p. 415, 1671.

of swinging in spinal curvature is yet much appreciated. In Germany "Glisson's swing" is known and used, and it has been in use ever since Glisson's time. The exercise of the muscles is praiseworthy, and has been practised certainly for two centuries in this country and elsewhere. But extension alone, and without other means, must be held to be useless in the treatment of lateral curvature of the spine.

My colleague, Mr Baker, has put the case of suspension and the employment of the jacket well. He says, "In the consideration of this subject in relation to lateral curvature of the spine it appears strange that the same form of treatment that is applied for the cure of caries of the vertebræ should have been so confidently recommended for the treatment of lateral curvature, as the two affections are so entirely different in their pathology and progress. Angular curvature is always the result of one cause, viz. caries of the vertebræ, so that it is rational to treat all cases in a similar manner; on the other hand, lateral curvature is due to a variety of causes, and it appears somewhat irrational to suggest one form of treatment for all cases, and for all the different stages through which the deformity passes."*

I have not seen any treatment that will compare favorably, even remotely, with the mechanical treatment which I have advocated. This can never occasion such results as those above alluded to; but the beneficial results may be seen every day.

Thus, whether treatment be pursued in the upright or in the recumbent position, or in both, the aim should be to unbend the curve. This point has been illustrated by Jules Guérin,† and by my late colleague, Mr Lonsdale.‡

* "On the Treatment of Spinal Curvature, with special reference to Sayre's Method," 'Transactions of the International Medical Congress,' 1881, vol. iv. p. 165.

† 'Mémoire sur l'Extension sigmoïde et la Flexion dans le Traitement des Déviations latérales de l'Épine.'

‡ 'Observations on the Treatment of Lateral Curvature of the Spine.'

The question is how best to carry it out? Longitudinal extension is quite useless. This was long since proved by that most able teacher, Guérin; who, by his report to the French Government in 1848, to the effect that "longitudinal extension alone must be inoperative," stopped a mode of treatment which if not quackery was nothing.

Pressure must be so applied as to act on the rotated bodies of the vertebræ and on the extremities of the arcs, to unbend the curves and to remove pressure from the side of the concavity. Lonsdale carried this out in the recumbent posture; but he subsequently lost what he had gained, for when the patient resumed the spinal support (which was a modification of Tavernier's), it was unequal to continue the action, and the patient simply subsided again into the former contracted position.

By placing the plates of the spinal instrument as I have indicated, the same action is continued in the upright and in the recumbent position, and treatment may be continued almost as well in the upright position as when the patient is recumbent. Thus the extremes of the arc will be acted on, whether the curve be formed in the cervical, the dorsal, or the lumbar region, by acting on the head, the shoulder, the lower part of the thorax, or the lumbar spine, as is rendered necessary by the nature of the curves and the cause of deformity. When structural change has taken place in the bodies of the vertebræ, it is impossible to restore the spine to the median line; but when rotation is slight and it has been of short duration only, and the spine is not rickety, an absolute cure may in every case of spinal curvature be effected.

CHAPTER IV

ANTERIOR CURVATURE OF THE SPINE

ANTERIOR curvature affects, for the most part, the lumbar region of the spine, and is an abnormal increase of the physiological curve of that region. It occurs, also, in the cervical region in infants. It is then due to rickets and to deficient muscular power; and it is sometimes due to caries. When anterior curvature takes place in the lumbar region it is, for the most part, of rachitic origin.

As a congenital affection it is also combined with monstrosity, spina bifida, and dislocations of the femur.

An hereditary disposition to lordosis is sometimes observed; one or more members of a family being affected: it may be the only sign of a rachitic tendency. Usually, however, the epiphyses and the shafts of the long bones are affected, and the pelvis is contracted.

Anterior curvature is for the most part limited to the lumbar region of the spine, the dorsal and the sacral portions being implicated only inasmuch that their normal curves become exaggerated. Occasionally, however, a part or even the whole, of the dorsal curve may be reversed; and then the anterior curve will consist of the lumbar vertebræ together with the dorsal.

In lordosis, the obliquity of the pelvis is augmented, the anterior wall being carried backwards and the sacrum and coccyx being raised, so that their concavities present more directly downwards, and the superior portion of the pelvis inclines forwards. The sacro-lumbar articulation, in consequence, is no longer found immediately above the interfemoral line, but in advance of that line. Thus

equilibrium is disturbed, and that it may be restored, the weight of the upper part of the trunk must be thrown behind the vertical line of the body. In this manner a compensatory antero-posterior dorsal curve is produced.

The external appearances presented by anterior curvature, then, are such as are indicated by the changes in

FIG. 26.



the skeleton above mentioned : the lumbar region is rendered remarkably hollow, while the dorsal is rounded ; the nates are raised, and the head is thrown back ; the abdomen is unusually prominent, and the stature is necessarily stunted. They are represented in Fig. 26.

Whatever tends to increase the obliquity of the pelvis will give rise to this form of curvature. Thus, it is a

necessary consequence of congenital dislocation of the heads of the thigh-bones (upwards and outwards), Fig. 27. It is always a very marked feature of the case, so that it is sometimes held to be the chief, rather than a secondary feature only. A child was lately under my care for congenital dislocation of the thigh-bones, in whom lordosis was, as it always is, very marked; so that the dislocation had been overlooked, and attention had been directed to the spinal curvature alone—a result only of the dislocation. The drawing for Fig. 27 was taken from this child. I saw the child with Sir William Fergusson, and I may mention a fact which surprised me much at the time, viz. that this was the first case of congenital dislocation of the femurs that had ever been seen by Sir William Fergusson.

Lordosis may be induced equally by unreduced non-congenital dislocation of the thigh-bones. Thus it may follow rheumatic inflammation and subsequent dislocation of the head of the thigh-bone on to the dorsum ilii. In these cases, as in those last mentioned, great efforts are made to sustain equilibrium; the extensor muscles of the trunk are rendered tense and prominent, and, standing out firmly, they leave, especially towards the lower part of the spine, a deep sulcus in the median line. And in a similar manner ankylosis of the hip induces lordosis.

Some years ago I saw, together with Mr. Brookes at Shaldon, in Devonshire, a similar deformity, but arising from a totally different cause, and I allude to the case because it is rare. Fatty degeneration of the muscles of the abdomen had taken place, and the abdominal viscera hung suspended consequently in a huge, tumid paunch; the weight of which had, in part, occasioned the distortion in question. This was one of the most remarkable cases that I ever saw. The effect was increased, also, by fatty degeneration of many other muscles, such as the trapezii, rhomboidei, serrati, latissimus dorsi, the pectoral muscles, and those of the lower extremities. Many of these muscles were so far destroyed that they could not even be traced. In this instance the unsupported pendu-

FIG. 27.



lous belly, together with the loss of muscular power, seemed to give rise to lordosis, in a somewhat similar manner to that in which the gravid uterus is sometimes known to act. There were nine members of this family, all of whom had suffered in the same manner, with the exception of one who, when nineteen years of age, went to Ceylon. They were all healthy up to nineteen or twenty, when they were, male and female alike, in turn attacked with fatty degeneration. One of the sons, aged thirty-eight, had entirely lost the use of his legs, and could with great difficulty drag himself upstairs. Twelve months previously with a great effort he could mount on horseback. The father was a singularly healthy-looking man, having no other ailment than a slight tendency to articular rheumatism.

Bearing heavy weights around the neck and shoulders will also induce this form of curve. That a considerable burden may thus be slung, borne upon the neck and shoulders and suspended in front, it is necessary that the shoulders shall be thrown back, and that, consequently, the loins shall be projected forward. If this practice is continued, the increased lumbar curve becomes more or less permanent. I have also known prolonged gymnastic exercises to produce a somewhat similar result.

The pathological changes which are induced are chiefly as follows. The lumbar spines are approximated; the articulating processes of the vertebræ are pressed forcibly into contact one with another, and the ligamenta subflava lose something of their elasticity; the bodies of the vertebræ undergo absorption, and the intervertebral substances are compressed, posteriorly. The extensor muscles of the trunk are strongly developed. Ankylosis of the articular processes of the vertebræ, with or without fusion of the bodies, may at length take place, through which the distortion is rendered permanent.

Although lordosis is, for the most part, limited to the lumbar region of the spine, the lower dorsal vertebræ may become involved in the curve; or, indeed, the entire dorsal curve may be reversed. This is, however, a very

rare form. I lately saw an instance in which the sacrum was almost horizontal, and the head was forcibly thrown back, while the anterior curve was formed by the whole of the vertebræ, lumbar, dorsal, and cervical.

Treatment.—It has already been said that lordosis is never a primary affection, but that it is the result of disease, or that it arises from the position of parts which are entirely independent of the lumbar region itself. This affection is for the most part developed in childhood. But in childhood the normal curves of the spine disappear in the horizontal position. Hence it is obvious that the recumbent posture must be in itself a powerful agent in the treatment of this form of curvature. Doubtless, whatever the cause of anterior curvature may be, the treatment should be followed whilst the child is recumbent. The child should be placed in the supine position, for the shoulders can then be raised, whilst, in addition, the thighs may be flexed upon the pelvis. In this manner an anterior spinal curve may at length be removed.

When anterior curvature has been induced by rickets, it is especially important to observe the recumbent posture ; for the upright position tends to increase deformity.

Cases, however, occur in which it is not practicable to observe constantly recumbency, and it then becomes necessary to substitute for it a portable instrument, which, receiving the weight of the head and shoulders, transmits it to the pelvis. The spinal column is thus relieved, and the extensor muscles are less violently thrown into action. It is a very imperfect substitute, however, for the recumbent position.

The influence of the muscles in distorting the arms and forearms is well known : exercises should on this account be forbidden in rickets. Passive movements of the limbs, however, when they are practised gently, are beneficial, both locally and generally ; the muscles then tend to increase in size, and the circulation is accelerated.

The treatment of lordosis which is induced by congenital dislocation of the femur is simply the treatment of

the dislocation itself. As dislocation is removed, so also is the curve which is produced by it. And, also, those consecutive curves (consequent on Pott's disease, and on ankylosis of the hip, for instance), which tend to restore and which help to maintain equilibrium, require little more care than is afforded by a well-adjusted support.

I am glad to refer to a case of double congenital dislocation of the femur which I saw with Dr. de la Cour, and on which we together operated; a case represented by Fig, 27 except that the lumbar curve was still more pronounced than in the figure on p. 71. This child has now every possible and normal leg movement, and the excessive lumbar curve is removed, so that the spinal curves are now normal.

CHAPTER V

POSTERIOR CURVATURE OF THE SPINE

POSTERIOR curvature is a much more common affection than that last mentioned. It occurs in childhood, in youth, and in old age; and is thus one of the most common forms of spinal curvature. In infancy, the cervical, the dorsal, and the lumbar vertebræ are engaged in this curve; while in youth the middle and the upper portions of the dorsal spine are especially implicated; but in old age the spine is most bowed in the upper dorsal region. In infancy, the muscular system is mainly affected; while in later life the skeleton itself undergoes change, and the intervertebral substances become compressed.

The causes of posterior curvature of the spine are debility—whether in infancy, in youth, or in old age—rickets, muscular rheumatism, and partial paralysis. Also, some occupations are apt to induce a stoop in those engaged in them. Thus it is, for instance, with watchmakers, engravers, embroiderers, writers, shoemakers, and others, whose occupations require a stooping position. This position, which is at first irksome, becomes easy, and at length more or less permanent. Those also who are subject to asthma acquire a stoop, which even becomes diagnostic of the disease. Also kyphosis may be congenital. The following instance is recorded by Rokitansky.

*“Kyphosis produced by the twelfth dorsal vertebra consisting of two divided lateral halves.—*The spine of a woman, æt. 55. The two portions form triangular rudiments inserted laterally between the eleventh dorsal and first lumbar vertebræ, with their points directed inwards; and they are united with the first lumbar in such a

manner that its body is very high at the sides, whilst in the middle it seems low, and is in contact with the eleventh dorsal. In consequence of this deficiency in the median line, the vertebral column is bent backwards at a very obtuse angle."*

Debility, especially in infancy, is the commonest cause of posterior curvature. The curve, for the most part, occupies the entire length of the spine, from the occiput to the sacrum, the spine projecting backwards. The normal curves of the spine have not as yet been formed, for the muscles of the back have not the power to support the trunk, and the head in consequence falls forward. This bowed condition of the spine increases, and the dorsal vertebræ become more prominent; for, notwithstanding its weakness, the child is seldom kept recumbent. Nutrition under these circumstances is imperfect, and symptoms of rickets perhaps begin to show themselves; such as frequent diarrhœa, perspiration about the head and neck, general wasting, and a blanched condition of the skin. The child is uneasy and fretful. Swelling of the ends of the long bones may now be observed; especially of the carpal extremity of the radius and of the tarsal end of the tibia; and the vertebræ will probably assume a somewhat more prominent appearance.

Some of the worst forms of this disease which I have seen have been produced in Russia. Bad ventilation and intense cold are among the causes of rickets, both in the palace and in the cottage in that country. In our own country, especially in the manufacturing districts, insufficient and ill-assorted food, together with want of sobriety, and damp and dark dwellings, often underground, make rickets a very common disease.

Fig. 28 was taken from a Russian boy, who had been born and bred in a palace in St. Petersburg, the son of a great nobleman. It is perhaps the worst form of posterior curvature that I have seen.

In youth, posterior curvature occurs not seldom during

* *Op. cit.*, p. 233.

rapid growth, as a consequence of debility. At this period the lower cervical and the upper dorsal vertebræ are especially affected. A stoop which is thus acquired, either during rapid growth or after illness, may continue permanently in manhood. Also, those who are near-

FIG. 28.

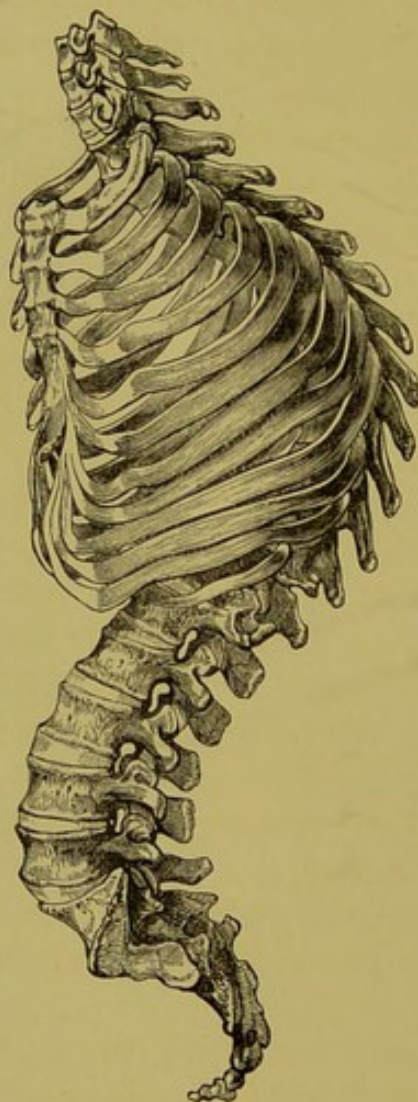


sighted, and who do not habitually wear glasses, are apt to accommodate their figures to their imperfect vision, and may thus acquire a stooping posture.

Posterior curvature is not attended with tenderness in the course of the spine, so that firm pressure may be made along the spine without causing pain. Should, however, tenderness be found on examining the spine, destructive

disease or caries must be suspected. And, indeed, caries is often so insidious in its advances, that irremediable mischief may already have taken place before disease is recognised.

FIG. 29.



In old age an abnormal increase of the dorsal curve occurs through debility. A similar condition is frequently observed, especially among the labouring rural population, consequent on chronic rheumatism.

The pathological appearances differ according to the age at which posterior curvature is observed. In infancy the muscular system is chiefly affected; while in the adult the

intervertebral substances become compressed anteriorly ; and in old age fusion of the bodies of the vertebræ, or more partial ossification, may be found. Together with these changes, the whole trunk is more or less affected ; the chin rests on the sternum, the ribs are approximated, and respiration is laboured in consequence of diminished mobility. Fig. 29 shows the condition of the thorax and spine in the adult.

The treatment of this affection in childhood is simply to maintain the horizontal position until debility is so far removed that the child has acquired the power to assume a sitting or a standing posture.

A slight form of support enables children to assume a sitting posture. When, however, the head droops, recumbency ought to be maintained ; otherwise an apparatus to support the head becomes necessary. Such children should be treated for debility in the horizontal position.

As strength is gained, means may be taken to increase muscular power by well-directed exercises. These may be used either in the horizontal or in the upright position. And as muscular power becomes developed, so the antero-posterior curves of the spine become formed, and the erect position becomes possible. In more advanced age mechanical support is necessary to redress or to support simply the bent spine.

Hereditary kyphosis will seldom be removed by any means : it is, for the most part, conjoined with thoracic disease.

Perhaps the best form of support is that which is made with a stiffened pad, which has been accurately moulded to the lower portion of the curve. This is carried on a framework which supports the shoulders. And by means of rack and pinion joints attached to a band around the pelvis, levers act so as to produce moderate pressure.

PART II

DISEASE OF THE SPINE

CHAPTER VI

DISEASE OF THE SPINE AND ANGULAR CURVATURE

DISEASE of the spine occurs very frequently among children, following, for the most part, upon an accident, and less frequently it is found affecting the adult. No period of life is exempt from this disease ; but it is essentially a disease of childhood. It is seen more frequently in the male than in the female. Thus of 500 cases which I have tabulated, 297 were of males. Disease may occur in every portion of the spinal column, from the head to the sacrum, but it is more frequently observed in the dorsal than in the cervical or in the lumbar region ; first, because the dorsal is most exposed to injury, and secondly, because it is the most extended portion of the spine. Yet it occurs very frequently in the cervical region. In the dorsal region it is attended with the greatest deformity, but in the cervical with more danger to life.

Although an accident usually precedes the development of spinal disease, it would appear occasionally to arise out of a deposit of tubercle in the cancellous structure of the bone, which softens and breaks down. It is probable, however, that in every case the deposition of tubercle in the cancellous structure is secondary to, and consequent upon, traumatic inflammation.

In its mode of progress this form of inflammation does not materially differ from that which is observed in other

articulations. It is first developed in the body of the vertebra. There are many examples, however, to show that the intervertebral substance may become diseased before the bone.

In the commencement, that is, immediately after an accident, the bruise at the seat of injury is painful, and it may be acutely painful. Pain is then due to the bruise. On the other hand, pain may be due to movement alone : it will then depend on laceration of ligamentous and other fibres. An accident with these consequences is usually attended with a certain amount of shock, and perhaps, also, with momentary unconsciousness. Having recovered from the immediate effect of the accident, the child may entirely forget the circumstance. Thus, in an early stage, disease of the spine is frequently overlooked. Later, the pain to which it gives rise is sometimes styled neuralgia, and, again, it is supposed to be connected with thoracic disease. Pain may continue to be felt by the child for months, and by the adult for years without the disease being recognised. It is experienced long before any irregularity of the spinous processes is observable, and it is attributed to anything but the right cause. Often this pain is spoken of as *rheumatic*, and, extending up to the occiput, it is described by the child himself as *headache*. It is not uncommon to see such cases where disease has advanced so far as to produce considerable deformity, where caries of the spine is not even suspected.

The following are cases in point :

CASE 1.—I saw with my colleague Mr Tatum, Mr H—, who at nineteen years of age was a crack billiard player, and, being unable to ride and to indulge in field sports, he devoted much time to billiards, and much to painting. At this age he could not rise to straighten himself from the table after delivering his stroke, and would remain bent and with his back almost at the same angle during the entire game ; and in this posture he would continue without change for several successive hours. His back became at length more rigid, and he lost flesh. He saw many physi-

cians and surgeons, and was always supposed to be suffering from rheumatism. He was heir to a large entailed estate, which he became possessed of at twenty-seven years of age; and he laid out all his available money in setting this place in order that he might enjoy it, and pass it on to his son. When he was thirty-two years of age, it was thought that he had thoracic disease, and he was sent by Sir George Burrows to Madeira for the winter. There he became worse, and suffered so much pain that he resolved to return home; and as he bore movement very badly, he was slung in a hammock, and in this manner was brought to his house in St Andrew's Place, Regent's Park. *Until this time, his spine had never been examined.* I saw him some few days after his arrival. He was sitting in bed with his shoulders and head slung forward and supported in an apparatus constructed by Mr Bigg, and I found the entire length of the dorsal spine carious and extremely painful to the touch, and the patient frightfully emaciated. In this position he remained day and night, for he could not bear to be moved. There was no sign of abscess. Some few days later I was hastily called to him at 5 a.m., and found him unconscious and moribund, one gallon and more of pus having escaped from the posterior mediastinum *per anum*. As he left no son his estate passed to his cousin, and he left his wife a pauper.

CASE 2.—I saw, with Dr Beale and with the patient's father, a medical practitioner at Liverpool, and subsequently with Dr Little, a gentleman twenty-six years of age, of a strumous diathesis, who two years previously had hurt his back while stooping. His back remained "stiff" and painful from that time. We found the four lower dorsal vertebræ carious, and there was an abscess in the lumbar region. He had just taken his passage to China, having no notion that he was suffering from disease, until the abscess was discovered by Dr Beale. He was placed on a couch, and remained on it for three years, until firm ankylosis had taken place. Pain subsided, and his general health improved in a short time after he

began to lie down. In the course of ten months the abscess was absorbed. At length he was upright and strong, and tolerably active, with scarcely any projection of the vertebræ. Three years later he married. Lithotomy was subsequently performed by Sir Henry Thompson, and a considerable calculus of phosphate of lime was removed. This formation of calculus in the bladder is not very rare in spinal disease.

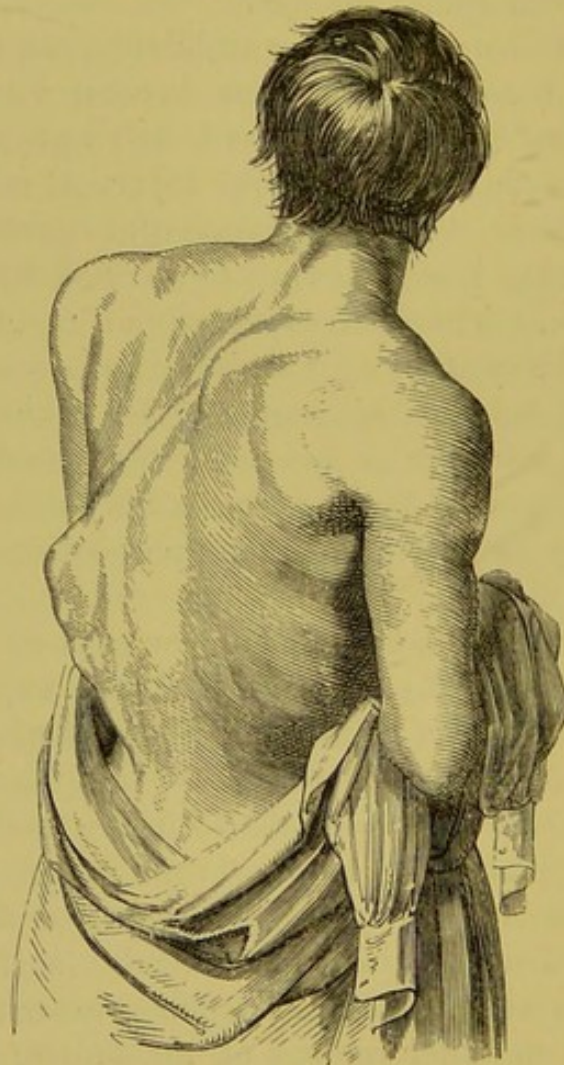
In some few days after an accident pain becomes less acute. The muscles of the back become rigid when the dorsal vertebræ have been injured, and especially those of the neck become rigid when the injury is in that region. Pain continues so long as inflammation exists, and when it is diminishing it may always be excited by pressure or by percussion. The child moves about carefully, placing his hands on any piece of furniture as he passes through a room; and he rests his hands or his elbows on a table to support the weight of his head and shoulders, and in walking rests one or both hands on his thighs, to prevent so far as may be friction of the opposed diseased surfaces, one upon another.

This position is adopted for the sake of the support which is afforded by it, and that the superincumbent weight may thus be in some measure removed from the diseased structures. At the same time the muscles of the back are thrown into action to fix as much as possible the affected parts; thus to prevent movement and the pain which is caused by movement, in the same manner as is observed in all disease of articular surfaces. Muscular rigidity takes place to a much greater extent in the cervical than in other regions of the spine; and for this reason that, in the normal condition, mobility is greater in the cervical portion than in any other portion of the spine.

At length, suppuration is established and the cancellous structure of the bone breaks down. Then, the upper portion of the column falls forward and a spinous process becomes prominent. As disorganisation proceeds, a gap of greater or less extent is formed, one or more bodies of

vertebræ being involved in the disease. That vertebra, the body of which has been most excavated, becomes the most prominent, and its spinous process forms the apex of the angular projection (Fig. 30). Thus caries is established and angular curvature is produced.

FIG. 30.



In this form of disease, the anterior portion of the spinal column, namely, the bodies with the intervertebral substances and the ligaments, is alone liable to become carious. The posterior segment, consisting of the spinous, transverse, and oblique processes, with the pedicles and arches, shows but little disposition to fall into a similar state of disease.

Cases, however, are recorded in which the posterior, as well as the anterior portion of the column, has been found to be carious.

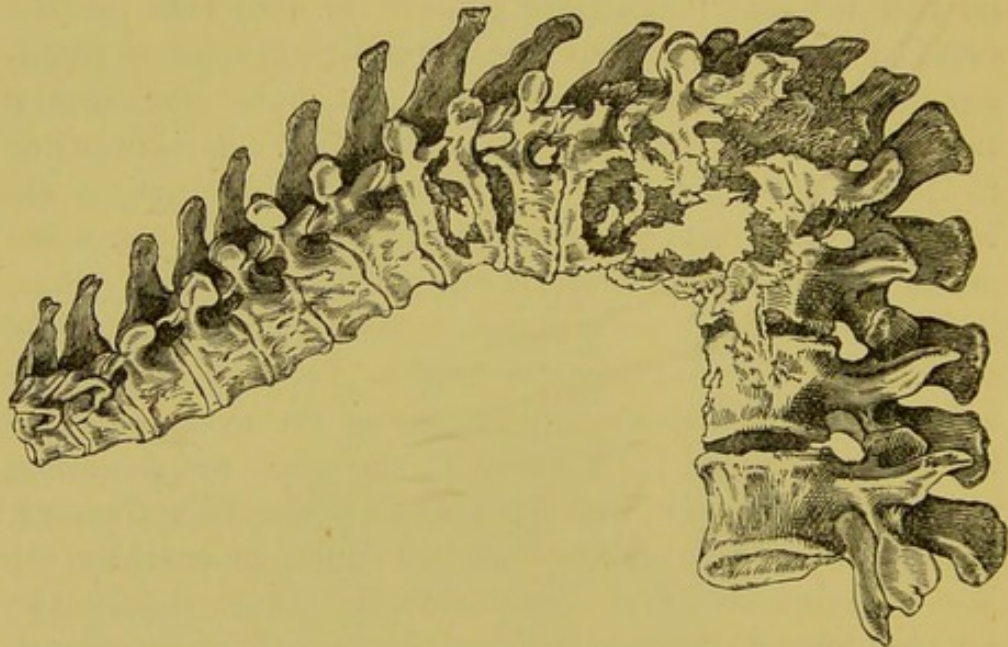
The deformity which ensues is greatest in the dorsal, and least in the lumbar region. But the greatest deformity from an equal amount of destruction occurs in the upper dorsal region. This is due to the shape of the vertebræ, as well as to the formation of the vertebral curves; for the bodies of the dorsal vertebræ and the intervertebral substances of this region are thicker behind than in front, or the reverse of that which obtains in the cervical and in the lumbar regions, and deformity is on this account necessarily greater in this than in the cervical or in the lumbar region, the dorsal spine presenting its convexity backwards; whereas in the cervical and in the lumbar regions it presents forwards. It is also due to the weight of the head. Further, the dorsal spines are long and superficial; and any increase of the curve increases the prominence of the spinous processes. Thus, loss of substance produces more deformity in the dorsal than in either of the other regions, and it is rapidly followed by an angular appearance of the spine. When the chasm is deep, the muscles of the back are powerless to support the trunk, and the upper portion falls forward. In the lumbar region, the vertebræ allow of considerable loss of substance with comparatively small deformity; for they present a concavity backwards with short spinous processes which are buried among powerful muscles, while the bodies are broad and deep.

Thus, the displacement of the column forward increases as the chasm increases, and the spine from the seat of disease may even become horizontal instead of being vertical. This is especially the case when disease occurs in the middle and lower dorsal vertebræ, where destruction is great, as is portrayed in Fig. 31.

The amount of deformity depends much on the rapid progress of disease as well as on the extent of destruction, and on the locality of the disease. In the first instance, the

muscles spring into action and become rigid, and so hold the diseased portions of bone immovable, that pain which would be caused by motion may be avoided. As destruction proceeds the trunk becomes more and more bent; but an effort is made to preserve equilibrium: the head is thrown back, and the spine below the seat of disease is curved forward, while at the seat of disease itself the back is rendered more prominent. This is the result of the upright position, and of neglect, or in other words, of leaving the spine without efficient support.

FIG. 31.



When ankylosis has taken place compensating curves form above and below the union, so that equilibrium is restored as the patient resumes the upright position. And whether the projection be much or little, the curves are formed in proportion, both in length and in depth, to the amount of angularity and displacement which may have been induced. In an advanced stage of disease and when displacement or ankylosis has taken place, the muscles undergo atrophy.

The extent of bone destruction depends in great measure

on the treatment to which the patient may have been subjected. Little or no deformity may remain, and kyphosis may disappear entirely or almost so in the prone position: bony union shall follow, and a strong and upright column will result.

The following is a case in point:

CASE 3.—J. N—, aged twenty-six, for many years had suffered from disease in the lower dorsal region. There was only slight pain on pressure, but deformity was considerable. Four vertebræ were implicated, and there was pus in the right iliac fossa. In the prone position, deformity was eventually entirely removed. Then, a retaining apparatus having been fitted, he turned about as he pleased, but he was always recumbent. The pus was absorbed soon after he began to lie down. The column became strong, and within three years of rising from his couch he took charge of a large parish in the south of England, which he has administered for several years, and where he is a most active incumbent. When I first saw him, he was walking without any retentive apparatus. He suffered much pain, and always leant on a stick or on the table when he had the opportunity. He had lost three inches in height.

When disease is established in the cervical region, the head is somewhat thrown back, and it is more or less fixed; and the muscles are thrown into action to prevent motion and to avoid pain, while the head seems to subside on to the shoulders. This is especially observable in children. It may also be noticed in adults. On the other hand, the head may be held forward. Also, the muscles of one side of the neck are sometimes more contracted than on the opposite side, and the head is in consequence inclined to one side or the other, as in wry-neck. And, indeed, disease in this region may so closely simulate ordinary wry-neck that an error of diagnosis may easily be committed. Generally, however, the head falls back, and the child is unable to raise it. In this region, any movement of the head, especially sudden or rotatory move-

ments, cause excruciating pain; and even sudden death has been occasioned by such movements—namely, in cases where the atlas and the axis were involved in the disease. Under such circumstances the spinal cord in its especially vital portion may be crushed between the atlas and the odontoid process.

The following is an instance in which cervical disease was mistaken for torticollis.

CASE 4.—Caroline S—, aged forty-three, was admitted into St. George's Hospital with caries of the fifth cervical vertebra. The head was firmly fixed and inclined to the right side, the ear was drawn towards the right shoulder, and the chin was projected in the opposite direction. The muscles on both sides of the neck were rigid, but they were much more contracted on the right than on the left side. Such, then, was the position of the head when the patient entered the hospital. After the head had been efficiently supported on pillows for some few days, the muscles became relaxed and the wry-neck disappeared; for irritation had ceased.

Occasionally, two portions of the spinal column are simultaneously attacked with caries. Such cases are rare, however, and their treatment differs in nothing from others which are more simple.

In the dorsal region, the great length of the spinous processes, and the forward curve which this portion of the column naturally assumes, tend to make any projection of the dorsal spine remarkable. The thorax, also, undergoes considerable change in its external form: the sternum is rendered prominent, while the ribs are compressed laterally, and they project backwards together with the vertebræ. All the viscera, both of the thorax and the abdomen, have to accommodate themselves to their altered parietes. The heart and lungs suffer especially: the heart's action becomes irregular, and respiration is hurried.

When disease occurs in the lumbar region, it is sometimes attended with considerable pain, but rarely with

much deformity. Fig. 32 represents disease and disorganisation of a lumbar vertebra, where the column has fallen forward and encroached on the medullary canal, without, however, producing deformity.

Abscess, when it occurs, is always a serious and often a fatal complication of spinal disease. Happily, under treatment, disease for the most part terminates in anky-

FIG. 32.



losis, and without the formation of abscess. Rather it should be said that pus is formed in small quantities only in connection with the diseased vertebræ, and that being absorbed as it is formed, it does not collect in sufficient quantity to burrow and form an abscess. The pus lies in contact with the carious bone and occupies the gap in the bodies of the vertebræ, as is shown in Fig. 33. Varying according to circumstances, the abscess either remains stationary, or the sac enlarges and the abscess passes upwards and downwards or downwards by the sides

of the bodies of the vertebræ, or it may pass down on either side of the bodies, the sac bifurcating. When the abscess is double the two parts seldom present at the same time; but one will probably only appear when the other is already tense. This is especially the case with psoas abscess.

In the neck, the pus passes between the muscles and comes to the surface, burrowing among the fasciæ; sometimes it shows below the mastoid process of the temporal bone, but more frequently it is found lower down and nearer to the spine: commonly it gravitates along the bodies of the vertebræ. In the thorax it lies behind the costal pleura, and perforates the diaphragm through absorption, having become adherent to it: thus it gains the psoas muscle. Here, lying behind the peritonæum, a sheath is formed for the abscess by the fascia iliaca. Thus it proceeds downwards to Poupart's ligament. A large accumulation of pus may form in the iliac fossa; or perforating the abdominal walls, the pus will pass with the conjoined tendons of the psoas and iliacus muscles and point at their insertion. When it arrives at this spot, at the top of the thigh, it is known as psoas abscess; and it still retains this name, whatever its downward direction may be. It may pass in the course of the Sartorius even to the knee; or having emerged with the psoas and iliacus tendons it may be diverted somewhat inwardly, and still more rarely somewhat outwardly.

Instead of passing in the course of the psoas muscle, however, the abscess on passing through the diaphragm may be deflected backwards, and perforating the abdominal parietes will show itself as a broad and low swelling in the loin, on one or on both sides of the vertebral column. It is now known as lumbar abscess. And when disease is located in the lumbar vertebræ the abscess will pass upwards and backwards, and perforating the quadratus lumborum will appear in the loin to the outer side of the erector spinæ. Abscess in the iliac fossa may be absorbed, but psoas abscess is rarely absorbed. I have

known the iliac fossa to be cleared in numerous instances by absorption.

It is occasionally seen that the contents of an abscess come to the surface along an intercostal space. And instances are known where adhesions having formed between the abscess and the lung, the contents of the abscess have been voided by coughing and expectoration. And also, in a similar manner, it may discharge itself through the œsophagus or the bowel or the bladder.

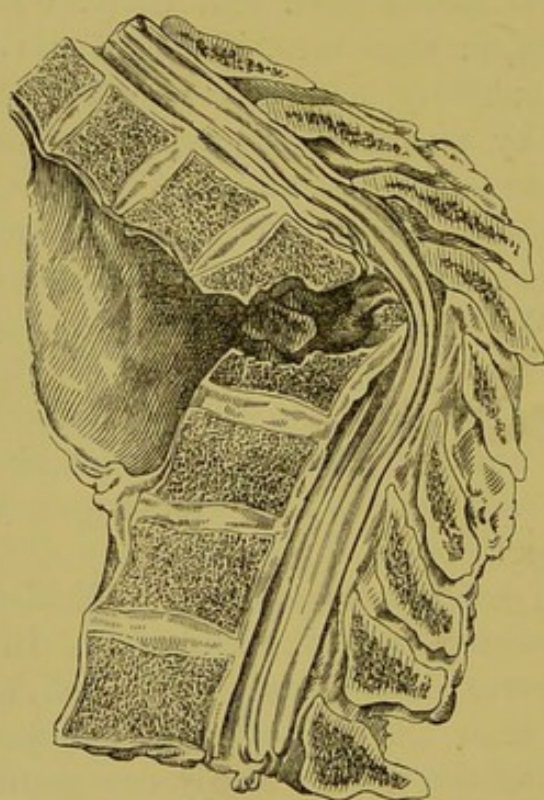
When, unfortunately, pus accumulates in such quantity that an abscess shows itself externally, whether in the groin, the loin, or elsewhere, it should never be allowed to open spontaneously, but the contents of the sac should be evacuated by means of the aspirator; or the opening may be made antiseptically. Tension having been relieved by the withdrawal of pus, the opening may be closed; and the operation may be repeated as it becomes necessary. Without motion, probably the abscess would not have formed. If motion be allowed after the abscess has been emptied it will again fill. It will probably re-fill after it has been emptied, even though perfect quiet be observed; so that the aspirator may have to be used more than once.

I have only once experienced any difficulty in emptying the sac of the abscess with the aspirator. In this instance the needle became choked, not with flocculi, but with semi-solid matter, after the fluid portion had been drawn off. On withdrawing the needle nearly one pound of matter, having the consistence and the colour of putty, was extruded from the wound. It was extruded continuously in coughing. The wound healed, as it usually does when the needle is withdrawn.

When several vertebræ become affected, so that the chasm in the column is considerable, an angle more or less acute is produced, and the canal itself may be encroached upon, as in Fig. 33. This encroachment may occasion pressure on the spinal cord. Should this take place suddenly or increase rapidly, it will be followed by

paralysis. When, however, deformity increases slowly through the resistance of the structures in the posterior segment of the column, the cord becomes so tolerant of pressure that probably loss of power will not ensue ; it is protected by the theca vertebralis, and it accommodates itself to the pressure to which it is subjected. Partial paralysis, however, is apt to occur when motion is permitted. And, again, muscular power will be restored by

FIG. 33.



continued rest of the body. There was lately under my care, in Drummond Ward, an instance in point. In this case disease was limited to the lower dorsal region, and there was very slight displacement ; so little, indeed, that when the patient was recumbent, it was scarcely possible to distinguish any abnormal projection of the spinous processes. The displacement was, however, conspicuous enough when the patient stood up. This patient could

not be persuaded to remain quiet in bed ; but she would now and again get up and move about in the ward. Violent twitchings of the lower limbs followed these efforts, and they lasted, perhaps with acute pain, for twenty-four or more hours, and then ceased : the limbs then became motionless and flexed upon the trunk. After another short period the muscles gradually relaxed

FIG. 34.



and the limbs resumed their normal condition, and motion and sensation were again perfectly restored.

In the case from which Fig. 34 was taken the bodies of at least five or six vertebræ were destroyed ; but, notwithstanding the great deformity which was produced, no symptoms of compression of the cord were ever experienced : this deformity was formed very slowly, and without abscess.

Thus, for the most part, when destruction of the bodies of the vertebræ takes place rapidly, paraplegia, more or less complete, will probably ensue ; and especially this is the case if movements of the body are permitted. But when caries has advanced slowly, paraplegia may not occur. When in disease of the spine motion is permitted, a sense of weakness or of pain is experienced at the seat of disease ; and this is always increased by percussion or by firm pressure. Somewhat later, painful twitchings are produced by movements of the trunk, and afterwards sensation becomes somewhat blunted. Tenderness begins to be felt in the course of the psoas muscle, or otherwise in the loin or in the neck, according to the seat of disease ; and presently a slight swelling, communicating a doughy sensation, may be perceived, which increases according to circumstances to larger dimensions.

When paralysis occurs, motion is first lost, and subsequently sensation ; and it occurs thus for the obvious reason that the anterior columns of the spinal cord, from which arise the nerves of motion, are more especially subjected to pressure and irritation, lying, as they do, immediately in contact with the carious bone, rather than the posterior columns, from which the nerves of sensation proceed. Paralysis is not, however, as I have already shown, in proportion to the amount of deformity, but rather to the rapidity of the change which is effected.

Through pressure at the seat of disease the cord becomes disorganised and motion is impaired or lost. Loss of motor power may be complete, and sensation may yet be retained, or, on the other hand, both motion and sensation may be lost. Also, power may or may not be retained over the bladder and the rectum. This depends on the amount of disorganisation of the spinal cord, and also on the position of the injury. Again, one extremity may be more completely paralysed than the other. Sensation may be lost as well as motor power ; but sensation is never lost whilst motor power is retained. When sensation and motion are lost bedsores frequently

form, and when the control of the bladder and the rectum is lost, it is difficult to prevent sores : they occur even with good nursing. The following are cases in point.

CASE 5.—A young lady of seventeen was suspended and a Sayre's jacket was applied at Bristol. She lost suddenly all power of motion in the lower limbs, and sensation as high up as the ribs, as well as control over the bladder and rectum, whilst she was being suspended, and before the jacket was fully applied. So great injury was inflicted by the suspension, that she soon afterwards died. Large sores formed over the sacrum and the sacro-iliac synchondroses. The disease was in the upper dorsal region.

CASE 6.—A lady, fifty years of age, was thrown out of a carriage at Alton, Hants. She was slightly bruised only, and presently ceased to think about the accident, but continued to lead her usual life until within two months of the time at which I saw her, experiencing pain in the back more or less for about two years, which she looked upon as rheumatism, and never spoke of even to her intimate friends. Two months before I saw her it was observed that she remained sitting in one position and without moving for a long time, when it was found that she was paralysed : she had lost sensation and power of motion as high as the waist. Full power of the bladder and rectum was retained. Large sores formed over the sacrum, and on either side, over the sacro-iliac synchondroses. There was no deformity of the spine ; but great tenderness existed in the lumbar region : so much so that she objected to the gentlest examination. I saw her with Mr Curtis. There was disease of the tenth dorsal vertebra.

CASE 7.—A single lady, aged forty-eight, developed carcinoma of the left breast. This was removed. Two years later there was found a tumour involving the uterus and its appendages. Presently after, there was entire loss of sensation and of motion, as well as of power over

the bladder and the rectum. Sores formed and healed with difficulty over the sacrum. The bodies of three lumbar vertebræ were destroyed, but without deformity.

CASE 8.—A lady, aged forty-six, fell and struck the sacrum. She lost all power of motion in the right lower extremity, but could stand firmly for a short time and with a little help on the left leg. Sensation was perfect. She had complete power over both the bladder and the rectum. There was no deformity of the spine, but there was acute pain on touching lightly the lower dorsal vertebræ. Loss of motor power commenced twenty months after the fall. This patient had increased in weight, until she attained to eighteen stones. The actual cautery was applied on several occasions with good effect, and ultimately paralysis was entirely removed. When disease has been allowed to proceed uncontrolled, and there is acute pain at the seat of disease, the actual cautery may be beneficially employed.

These sores occur especially when sensation is lost. Pressure does not excite pain, and therefore the patient is not reminded to move. Unless the position is repeatedly slightly changed, and the skin is kept dry, sores rapidly form. Indeed, it is difficult to keep the surface whole. The back of the heel is also liable to suffer from pressure, and it is therefore desirable to place the heels in hollow pads.

When sensation as well as voluntary motion is lost spasmodic movements of the limbs are apt to occur. The knees are jerked up, and again the muscles relax and the limbs are allowed to fall; or, again, the limbs are more violently flexed, and they remain more or less bent until they are replaced by an attendant. These reflex movements are excited by any irritation, such as touching the soles of the feet, any movement of the body, shaking the floor in approaching the bed, or, again, indigestible food, or defecation, or a breath of cold air, or anything or almost nothing will excite these spasmodic movements: they are extremely disturbing and wearying, and some-

times, though not usually, they excite pain. I may be allowed here to introduce an interesting case, which was read by Mr Lawrence Humphry, before the Cambridge Medical Society. It is entitled "*Slow Compression of the Spinal Cord*," and is as follows. It is given in much greater detail than I have employed in Case 7, but it is in essential particulars similar.

"A gentleman, seventy-two years old, active for his age, and engaged at his profession until his last illness. His family history showed a tendency to gout, and his sister died of cancer of the breast. In June he began to complain of pain in his back, and he stooped more than usual. The pain was not constant, and he was frequently troubled with gastric derangement and vomiting. In October he went to London and consulted a physician, and the opinion formed was that the liver was at fault. The pain became worse, and there was found to be an obtuse bend in the lower dorsal region of the spine, with projection of the spines of the five lower dorsal vertebræ; there was also some tenderness on pressure. The seat of the pain, which he constantly felt, was somewhat lower down in the lumbar region. In December, in addition to the constant aching he was seized, usually at night or in the early morning, with violent spasms, and pain in the stomach and loins. Up to this time there was no sign of paralysis, and sensation was normal, but the pain extended down the legs and across the abdomen, as if the nerve-trunks were in some way irritated. He was seen in consultation with Dr Paget from time to time, and in December Dr Bristowe was also called in, and the question was raised of a new growth involving the spine and nerves. At the end of December there was some improvement; he got up and walked about. In February, a moxa was made on each side of the spine, in the region of the obtuse bend, which was now very evident. There was some relief from the constant pain, but paralysis, which had begun to appear in the lower limbs at the end of December, became more complete, and the muscles were soft and flabby.

Sensation began now to be impaired, and reflex action was slightly exaggerated. There was also considerable retardation of sensation, so that as long as twenty-five to forty seconds elapsed before a stimulus applied to the leg was acknowledged as felt. In other parts of the body sensation was natural. He was unable now to retain his motions if relaxed, and passed them under him. In March he was unable to pass his urine, and had to be relieved by the catheter. He was provided with a soft india-rubber instrument, which he used three times a day for nearly four months. A fortnight before his death the sphincter became paralysed, and the urine dribbled constantly away. There was no great tendency to bed-sores. Emaciation was considerable, but cancerous cachexia was not a marked feature. His mind was perfectly clear to the last, and he was able to transact legal business not long before his death. He died on July 1st. The post-mortem examination revealed a sarcoma, occupying the middle and lower dorsal region of the spine, and extending in and amongst the muscles of the back. On section, the bodies and spines of the vertebræ were found softened and invaded by the new growth. The body of the tenth dorsal vertebra, being crushed in, had given way, so that the spinal canal at this part was much narrowed, and the cord tightly nipped just above the lumbar enlargement. The growth had not attacked the meninges or nervous structures. There was no evidence of malignant disease elsewhere."

At the same time that caries affects the bodies of the vertebræ, adhesive inflammation is set up in the posterior segment of the spine and in the surrounding structures. This tends to consolidate the disjointed vertebræ and to prevent friction. It is seen more extensively in the neck than elsewhere, because mobility is greater in this region than in any other part of the spine; and it is observed least in the lumbar region where mobility is least. In the neck it frequently assumes very considerable proportions: it may become as large as the fist. This formation, by

tending to prevent motion, leads to ankylosis ; and when consolidation has taken place the boss is absorbed.

CASE 9.—Some years ago I saw, with Sir William Fergusson, a young lady who at eighteen years of age had disease of the fourth, fifth, and sixth cervical vertebræ. When she was first seen there was very slight deformity, so that her friends believed her health would be improved and the spine not further injured by half an hour's walk daily in Hyde Park. She was wheeled into the park, and there took her exercise wearing a support to fix her head and spine. During the remainder of the day she was recumbent. In the course of one month there was developed a boss over these vertebræ as big as a man's fist. From this time onward and until ankylosis was complete, she remained recumbent and with the neck so fixed as to be motionless. When ankylosis had taken place the boss was absorbed gradually and very slowly, and in about three years from the period of resuming her active habits it had entirely disappeared. There remained very slight shortening and thickening of the neck, and no absolute appearance of remains of disease ; so that even critical observers have failed to detect any abnormal appearance whatever. She was married about five years after ankylosis was complete, and having been married for fifteen years, she died in February, 1888.

Spurious as well as true ankylosis occurs. It consists for the most part of a thin plate of bone or of bone and fibrous matter, which is formed in the course of the posterior surface of the spinal column. It does not fill up the space caused by the removal of the diseased bodies ; and being slender it is liable to be broken through, with only a slight movement of the body.

Spurious is more common than true ankylosis ; and, indeed, when disease is extensive, true ankylosis is rare. With spurious ankylosis a certain amount of health and activity may be enjoyed, so that even laborious exercises are undertaken ; but such robust health is never attained to as when true ankylosis has taken place. Any exercise

may suddenly rupture the uniting band if the spine is unprotected; when paralysis, local inflammation, and abscess rapidly follow, and probably death.

Spondylolisthesis.—Such was the term given by Prof. Kilian* to displacement, partial or complete, of the fifth lumbar vertebra from the sacrum. Sliding downwards and forwards into the true pelvis it carries with it those vertebræ immediately above it, and thus increases the lumbar curve, and diminishes the space at the brim of the pelvis.

I desire to allude to this form of disease, because a certain confusion occasionally occurs between lordosis which is produced by spondylolisthesis and by caries of the spine, by congenital dislocation of the heads of the thigh-bones, and by rickets.

This disease would seem to commence with inflammation of the intervertebral substance between the sacrum and the vertebra. The intervertebral substance becoming inflamed undergoes atrophy. It may even be entirely destroyed; and the ligaments, especially the anterior common ligament, are softened. The attachments of the vertebra are thus loosened, and the slightest accident, as slipping on the floor, may then cause the vertebra to project. It thus becomes displaced forwards into the pelvis, and through this movement the conjugate diameter of the pelvis is contracted: natural labour is thereby hindered, or even it is rendered impossible.

I have seen an example of this displacement in the Pathological Museum at Vienna with Rokitansky, where the intervertebral cartilage was atrophied, but *in situ*, and the fifth lumbar vertebra had fallen forwards into the pelvis. Half of the body of the vertebra was displaced.

Several examples are recorded by Kilian, and admirable drawings are given.† Among others mention is made of

* 'De Spondylolisthesi gravissimæ pelvangustię causa nuper detecta commentatio anatomico-obstetricia.' Bonnæ, 1853.

† 'Schilderungen Neuer Beckenformen,' 1854.

Christie Moore, described by John Shaw in the catalogue of the Windmill Street Museum. She is described by Shaw* as measuring "31½ inches from the top of the head to the heel, and from the angle of the jaw to the pelvis only 12 inches;" and, he continues, "in this instance the curvature of the spine was caused by rickets." She died in childbed, her first child having been born prematurely. Although this case is cited by Kilian as one of spondylolisthesis, it is clearly a very severely rickety spine, the lumbar curve encroaching on the pelvis, but without separation from the sacrum. Again, Robert, of Coblenz, gives an admirable drawing of congenital dislocation of the femur† in a child; and represents it as a case of spondylolisthesis such as is described by Kilian. Lambl‡ and others have copied these drawings. I will here relate a case of spondylolisthesis which had been treated as caries of the spine until she came under my care (Case 10). This lady was married at thirty-six years of age and had one child. She was married again at forty-two, and again had a child. When she married she had a graceful light figure of 5 ft. 5 inches in height. When her second child was born she suffered extremely, and it was eight months before she could walk downstairs. Until then she was carried down, and could only lie in her Bath-chair. I may mention that her first husband was seventy years old, and that his child died, phthisical, before her second marriage; and that her second husband was young, vigorous, and an old acquaintance.

Although my patient walked in a stiff and awkward manner, and always suffered from "*rheumatic*" pains in the loins, she could neither sit in any chair, nor lie on any bed without pain. At length entire recumbency became necessary, and a splint was worn for twenty months. Pain had long entirely subsided; and as she felt well, she

* 'On the Nature and Treatment of the Distortions to which the Spine and the Bones of the Chest are subject,' 1824.

† 'Beiträge zur Geburtskunde,' von Scanzoni. Band 3.

‡ 'Das Wesen und die Entstehung der Spondylolisthesis,' Ib.

rose from her couch. Some months later she was caught, whilst driving, in a snowstorm. In forty-eight hours severe pain returned in the loin, but she could only be persuaded to lie down so long as pain existed. As soon as it ceased she moved about, but very carefully, and was drawn about in a donkey carriage. Coming downstairs for a drive she slipped on a stair, and fell in a sitting posture. She could not rise, and was carried to bed. Opiates, to relieve pain, which was constant, were given for several days, more or less continuously. She continued to lie in a splint without movement for several months, and when at length she got up she could only stand leaning forward on a stick or on her nurse's arm. She had become a little, bent old woman, and her hair was as white as snow. At length, *post mortem*, it was seen that the intervertebral cartilage between the sacrum and the fifth lumbar vertebra was destroyed, and that the vertebra itself was protruded into the pelvis, half of the body of the vertebra being displaced forward. The body of the vertebra was infiltrated with tuberculous matter, and was commencing to break down: it still retained its shape however. There was pus in the iliac fossa, on both sides of the pelvis. This lady was a patient of Dr Mantell's.

Prof. Herrgott believes that the body of the vertebra is first affected—Potts' disease.* Neugebauer thinks that without previous inflammation the fifth vertebra is displaced suddenly, through the superincumbent weight, or, as he expresses himself, "C'est une action purement physique: la pesanteur."† But it is probable that this disease always commences with inflammation, and that the part first affected is the intervertebral cartilage, through which the vertebra is loosened; and that displacement is due to a slight accident, or even to assuming the erect posture.

* 'Spondylizème et Spondylolisthesis,' 1883.

† 'Du Bassin Vicié,' p. 11, 1884.

The following case shows the commencement of this form of disease.

CASE 11.—J.W—, æt. 4, in climbing up to a water-butt, fell on to his back. He was slightly stunned, but recovered immediately ; and it seemed as though he was not otherwise hurt. He ran about as usual the same day and on the following day, and on the next day he walked a distance of two miles. In the evening there was complete loss of power of the lower extremities and of the left arm. Also, he lost control over the bladder and the rectum. This continued for three months, when the power returned. He soon recovered the use of the arm, but he remained in the same condition with regard to the lower limbs for sixteen months, when I was asked to see him. Up to this time he had not been recumbent, but had sat up as though the spine were sound. Nothing had been done for him, except that he had been galvanised twice every week. I found the lower limbs entirely powerless, and sensation much impaired. There was acute pain on pressure between the sacrum and the fifth lumbar vertebra, and the vertebra was slightly displaced forwards. He was placed in a splint and kept recumbent. After some weeks of recumbency the actual cautery was applied. In the course of three weeks muscular power began to return, and in four months he could, whilst recumbent, move his legs freely, and sensation although somewhat retarded was immensely improved. He was kept recumbent until pain had entirely ceased, and sensation and motion were again normal. No appreciable change took place in the position of the vertebra, but it became fixed instead of being movable, as before. The position of the pelvis and of the vertebra indicated that in its loosened state it might easily have fallen still more forward. The pelvis remains oblique and the lumbar curve as considerable as is represented in Fig. 26, p. 69.

It is not uncommon that inflammation shall extend from the spine to the *sacro-iliac articulation*. It may arise from injury or from exposure to cold or it may

result from parturition. For the most part the bones of the pelvis or of the spine are diseased as well as the articulation. I lately saw in the neighbourhood of Chesterfield a case of sacro-iliac and lumbar disease where necrosis of the right ilium had been produced. When the disease is localised there is puffiness about the joint with great pain. If possible, pain is greater than that which accompanies spinal disease. Suppuration and necrosis may follow, or ankylosis may take place.

But perhaps the worst case of this form of disease that I have seen occurred after parturition in a strumous person. The disease after some years was much relieved, and even it was thought to be cured, when it was again excited by fatigue and exposure to cold. This lady died worn out with suffering. There was no abscess. I saw her with Dr Hutchinson and with Sir William Gull.

In no respect does the treatment of these cases differ from that of disease of the spine.

The symptoms are recognised with considerable difficulty, so that suspicion of hip disease may cross the mind. And, indeed, it is sometimes difficult to move the hip-joint without exciting pain. Under ordinary circumstances the recumbent position is to be maintained, but resting on the nates is sometimes too painful to be borne. A heavy person may then be slung, and the pressure can in this manner be modified to afford great relief; and still more relief may be given by the additional support afforded by two broad linen adhesive bandages or by belladonna plasters applied in broad strips. Suppuration will probably not occur when treatment is commenced early.

The *coccyx* is little liable to disease except through injury; but injuries to the sacro-coccygeal joint are not uncommon. A fall on the ice, or on to the edge of a stair or other angular projection, may cause displacement of the bone forwards; and it may be displaced at a considerable angle so as to press upon the rectum. Intense pain is occasioned by the accident, which is followed by swelling. Pressure over the articulation is painful; or

rather, acute pain is excited by the least touch. Defecation excites pain; and also walking upstairs or walking otherwise than slowly on a level surface. Running is impossible; and the act of sitting is acutely painful.

All local applications are useless. The only treatment of any avail is to replace the bone. This is effected instantaneously by the finger in the rectum. Usually the bone returns into position with a click. When it has once been replaced there does not appear to be any tendency for it to be again displaced.

These cases are not really uncommon; but the case that impressed me more than any other was the following:—

CASE 12.—A young lady, aged twenty-two, while skating at Christmas, fell in a sitting position on the ice. I saw her six months after the accident. She had become pale and thin, and had lost appetite. Lying on the back was painful, and sitting was very painful; so that it was necessary to use an air pillow. Defecation was impossible except with laxatives. She could walk slowly for about ten minutes. Pain extended from the sacro-coccygeal joint, which was highly sensitive, to the first lumbar vertebra. It is rare to see anyone so much distressed as this patient was. The coccyx was displaced forward, and pressed on the rectum. On touching the bone and pressing it slightly downwards and backwards it was instantly replaced. At the same instant all pain left her: the effect was magical. Immediately, the expression of her face changed, and she exclaimed, "I don't know what you have done, but all my pain has gone, and I feel quite right." From that moment pain ceased, and it did not recur.

The coccyx is said sometimes to be painful in hysterical persons. I have never known such a case however; but a painful condition of the bone, with thickening, follows inflammation. This inflammatory condition is usually of a rheumatic character. Pain is great, both in sitting and in lying on the back. Not only does the coccyx become thickened, but it may become ankylosed; and, losing its

normal forward curve, it becomes less curved. Excision under these circumstances may be necessary.

Atlo-axial disease.—Disease of the first and second cervical vertebræ deserves separate mention, inasmuch as they are shaped differently to other vertebræ, and they contain within their area a specially vital portion of the medulla spinalis. Fortunately they are less liable to disease than any of the bones of the spinal column. Being protected by the occiput, these vertebræ are seldom injured by force directly applied; but being the centre on which the head rotates, the axis, and especially the odontoid process, suffers from violence to the head.

When atlo-axial disease is set up it assumes a chronic form, and softening of the soft structures between the bones takes place, which is followed by ulceration of the cartilages and partial destruction of the vertebræ. Under these circumstances the movements of the head are attended with extreme danger. The weight of the head will cause the atlas to slide forward upon the axis, and the ligaments being ruptured the medulla will be crushed by the posterior arch of the atlas against the odontoid process. Mr Holmes refers to a case of this kind where death occurred instantaneously on the nurse lifting the patient from the bed. It was found *post mortem* that the transverse ligament was ruptured, and that the odontoid process pressed upon the spinal cord.* Here, also, as in other parts of the column, displacement of bone and consequent compression of the medulla may be so gradual that paraplegia may not supervene, and recovery may take place with some slight deformity only. On the other hand, the entire body, from head to foot, may be paralysed, and recovery may subsequently take place. Again, after fracture, with only slight displacement, paralysis may continue after ankylosis has taken place, with complete repair, as in Mr Whitmore's case of John Carter, related by Mr Hilton.* In this instance the patient fell

* 'The Surgical Treatment of the Diseases of Infancy and Childhood,' p. 542.

from a tree, forty feet, and injured the fifth, sixth, and seventh cervical vertebræ. He was paralysed below his neck, and remained paralysed, although ankylosis of the vertebræ took place with very little deformity and encroachment on the spinal canal. The bodies and arches of the fifth, sixth, and seventh cervical vertebræ became blended together by bone, and the body of the sixth vertebra was displaced. Mr Hilton remarks, "Everyone must admire the perfect and level union by new bone which has taken place at the fore part of the spine, and if nature could have been as effective with the spinal cord this patient might have perfectly recovered." It is exactly the circumstance of sudden violence rather than of gradual compression which constitutes the essential difference in the paralysis of these cases. In either case recovery may take place, but the prognosis is much more favorable when compression takes place gradually than where paralysis results through violence suddenly applied.

An interesting case of displacement in consequence of disease of the first and second cervical vertebræ is recorded by Sir James Paget ;† and although there is no history of the case, it is interesting as showing the two vertebræ "firmly united by bone in such a position that the uppermost part of the spinal cord, during and after the process of osseous union, must have been confined within an exceedingly narrow space." It is probable that in this case there was very extensive paralysis.

Also, Mr Alexander Shaw relates a case of displacement of the atlas upon the vertebra dentata. Unfortunately there was no life-history. The preparation showed "the two upper vertebræ and the occipital bone distorted by disease and united by ankylosis."‡ Mr. Shaw states "that all the bones exhibit that strong marking of the processes and eminences which give attachment to the muscles and ligaments, and that solidity of structure

* 'On Rest and Pain,' p. 102.

† 'Med.-Chir. Trans.,' vol. xxxi.

‡ Op. cit.

which denotes that the individual shortly before death possessed full muscular power."* And he infers that ankylosis must have been complete for a long period before death, because the ossific matter forming the union had become perfectly dense in texture and its surfaces were rounded and smooth.

CASE 13.—Several years ago a gentleman was thrown on to the crown of his head through his horse falling in the hunting-field. He was supposed to be dead; but consciousness being restored it was found that he was paralysed below the neck. He was brought up from the north of England in the course of a week to be under the care of Sir Benjamin Brodie, and, being my cousin, I saw him. There was fracture through the axis with slight displacement, and it was believed that some other of the cervical vertebræ were fractured. Ankylosis at length took place between the occipital bone, the atlas, and the axis, and the head became immovable, and the neck also remained perfectly stiff. He recovered muscular power perfectly, so that he became as strong a rider and walker as before his accident. He was a fearless hunter; and although he was never again in the first flight, as before, yet he was not far behind. These accidents are usually fatal.

Necrosis of portions of the cervical vertebræ occurs as a result of syphilis. I saw, with Dr William Ogle, a patient in St George's Hospital who had an ulcerated pharynx, through which passed three bodies of vertebræ. I saw the patient extract one of these: it was entire. The others were more or less disintegrated. On passing the finger through the aperture the vacant spaces of the third, fourth, and fifth vertebræ were easily recognisable. There was no deformity of the neck.

Portions, also, of the atlas and of the axis have been expelled in other cases in a similar manner. Such an instance is recorded by Mr Hilton of a patient of Mr

* Ibid., p. 290.

Babington's,* where the articular surface of the anterior part of the atlas, and also a portion of the odontoid process of the axis, were expelled in coughing. In such cases the head becomes fixed. There are many specimens in the London museums which show ankylosis between the occiput and the atlas and the axis.

* Op. cit., p. 99,

CHAPTER VII

DIAGNOSIS AND PROGNOSIS

DISEASE of the spine occurs most frequently in childhood : perhaps the largest number of cases may be seen in the first and second years. There will be observed in the first instance *pain*, secondly *rigidity*, and thirdly *deformity*.

The first period is short, and is soon followed by rigidity, and the acute pain is succeeded by duller, but yet persistent pain. Should the pain not be absolutely persistent, it is excited by gentle percussion or by light pressure. So long as inflammation exists there is pain. When pain endures and the temperature is high the first stage of disease should be suspected.

After the first few days the period of rigidity is established, and the spine loses its natural flexibility. Especially this is observable when the neck is the seat of disease. Then, also, there is increased heat and swelling. Sometimes this swelling takes place to a considerable extent. Coagulable lymph is poured out, especially in the posterior segment, and the column becomes fixed and motionless. Not only is there more swelling in the neck on account of the greater natural flexibility of the part, but this is more apparent than elsewhere ; it may extend to three or four inches in diameter and be proportionately raised. As ankylosis takes place this swelling subsides, and little or no deformity, but some thickening, may alone remain.

It is only necessary to touch lightly, or to make gentle pressure, to ascertain exactly the seat of disease. It is

quite inexcusable to rotate the head violently, to lean heavily on the head, to jump a child down from a chair, or to make it run up and downstairs. All these means are resorted to to form a diagnosis, but they are entirely unnecessary and barbarous. When pain has somewhat subsided such measures will excite a fresh access of inflammation. And occasionally hysteria and chorea may thus be excited. I lately saw a young lady, twenty years of age, who had been after this fashion, very considerably examined. Choreic movements were excited, and the case was treated as one of chorea. But there was also disease of the second and third lumbar vertebræ, which, unfortunately, had been overlooked.

Neuralgia of the spine should be recognised and distinguished from the first stage of disease—the only stage with which it can possibly be confounded. Unhappily it is not alone in the spine that neuralgia is mistaken for disease. I have known such an error occur more than once when excision of the knee-joint has been performed, and all the structures within and without the joint have been found to be perfectly healthy. And I suppose every one is familiar with cases where amputation has been performed for pain in a limb (especially a knee or an elbow), and where the pain, having re-appeared on the healing of the stump, it has been chased, morsel by morsel, until there was nothing left to amputate; but the pain still continued about the hip or the shoulder as before, only removed a little nearer to the trunk. Equally so in the spine, neuralgia may deceive. When the hand is brushed lightly over the back exquisite pain is experienced in the neuralgic condition, but the same action excites no pain in disease. More or less pressure is necessary to excite pain in the inflammatory stage of spinal disease, but in neuralgia of the spine pressure is borne more easily than a light touch.

Thus, in the inflammatory stage, and before deformity is apparent, light pressure of the finger along the spine will disclose the seat of disease.

There is a certain tenderness in the lower cervical region, common enough among young women and in those who suffer from exhausting discharges. Also, it is not absolutely confined to the sex. It may be accompanied with swelling. Pressure induces uneasiness rather than the pain which accompanies disease, and there is never rigidity of the spine as in cervical disease. It is occasionally mistaken for spinal disease. More than once or twice I have relieved such a patient of her head-rest.

When the stage of deformity arrives, a prominence of one or more spinous processes is formed. Disease is then far advanced, and partial destruction of one or more bodies has taken place.

All will admit that disease ought to be recognised in its first stage: it is then, however, often overlooked. A child may be watched assiduously, but disease is not recognised perhaps until a knuckle of bone is prominent. Then probably also abscess has formed; but nothing has been done to prevent deformity.

CASE 14.—A boy, aged four, at three years of age fell from his nurse's arms, but was caught before he reached the floor. There was considerable pain, for the child screamed and continued to scream, and during the next and the following days he complained of pain, but he never could specify which was the seat of pain. He was examined continually, but it always remained doubtful which was the seat of pain. At length pain subsided somewhat, but after that fall the movements were never as they had been previously; but they were made with care and deliberation—slowly and painfully. At length a dorsal vertebra became prominent, and then, and then only, spinal disease was recognised.

At this stage, namely, at nine months after the accident, I was asked to see the child, and found him moving about in a stooping position, often resting his hand on the thigh; with disease of three dorsal vertebrae, and an abscess in the iliac fossa. A felt splint was applied to the back, and the child was fixed on a

mattress and kept there. Presently, the abscess entirely disappeared; but another formed in the course of a rib, and, continuing to burrow, was aspirated. When the pus was removed, detached bone was felt beneath the erector spinæ. I cut down upon this and removed the body of a vertebra entire, together with necrosed portions of other two vertebræ. The incised wound healed immediately, and the abscess closed, and re-opened only after some months, whilst the child was at the seaside, for the expulsion of another small piece of carious bone. The wound closed immediately after, and has remained closed. The child was kept recumbent, and was tended by his mother with the utmost care; until it was obvious that ankylosis had taken place. He was then fitted with a portable support, and was allowed to move about. Recovery took place without angular deformity, and with thickening only at the seat of disease.

The boy is now twelve years of age and is perfectly upright; with his head well set up above his shoulders, and without inclination to stoop. He has joined, without leave, in rough games, and has had several tumbles, and has always come out scathless.

Pain is an invariable symptom in the commencement of spinal disease. A child fails to point out the seat of pain, but it is always acknowledged readily enough when the finger is placed upon it. After early childhood, however, there is never any doubt as to the seat of injury. A man is thrown from his horse, or his horse falls with him, or he remains in the saddle as his horse recovers himself, and the spine is in each case injured. In very few minutes he is perfectly aware that he is injured. But a child is always tumbling about, for the most part with impunity: now he strikes his back against a stone, and another bumps himself in falling against the edge of a stair. He is hurt at the time, but soon forgets it, and perhaps it is never known by those around him that he has done more than he does every day.

These nursery accidents are prolific causes of spinal

disease. When an accident occurs the nurse will probably deny all knowledge of it. She will allow a child to slip off her knee whilst she is dosing, and catch it by its clothes before it reaches the ground. And again, perhaps one somewhat older will fall from its chair, and after the first cry there will not be anything apparently wrong, until the child is observed coming downstairs very quietly, with the greatest care and the gentlest movements, and with rigid muscles.

CASE 15.—A child, aged two, fell downstairs and hurt her arm. After this fall she refused to walk, always saying that she was tired. In the course of twelve months it was observed that the shoulders were round, the head was thrown forward, and that the child could not stand erect. I saw her with Dr. Millar, and found the third, fourth, and fifth dorsal vertebræ prominent, and an abscess lying immediately beneath the skin alongside of the spinous processes. The child was placed in a splint and the head also was supported, and she was kept recumbent until synostosis had taken place. In the course of six months the abscess was entirely absorbed; and at length, when the child was allowed to walk, she was perfectly upright and without any abnormal irregularity of the dorsal spine. At ten years of age this child was well-grown, healthy, and strong, with the normal spinal curves exactly maintained and without irregularity.

Almost every case of spinal disease may probably be traced to some trivial or more serious accident.

CASE 16.—Major S—, aged forty-five, was riding a young unbroken horse over a rough piece of country in New Zealand when they both came to grief. He fell heavily and struck his back. After some little time he was able to drag himself home. In the course of some weeks he found that he was losing power, so he came back to this country.

The lumbar region was extremely tender, but there was no deformity. Loss of motion and sensation were complete in the lower extremities, and of the bladder and

the rectum. Three vertebræ were diseased. I saw him with Sir William Gull.

CASE 17.—Mr D—, aged twenty-eight, was thrown from his horse in Natal on to his back. After some few minutes he was able to remount, and to ride many miles to his home. His back was never free from pain, so he came over to this country. The fifth, sixth, and seventh dorsal vertebræ were diseased, but there was no deformity. Percussion induced great pain, but otherwise there was none. When sitting or standing there was no irregularity at the seat of disease, but increased convexity and extraordinary mobility. He was sent to me by Dr Hermann Weber.

CASE 18.—I saw with Sir George Burrows, Mr Else, and Mr Sargent, a gentleman twenty-six years of age, who, while riding in Ireland to Parsonstown, met with an injury to the spine through the stumbling of his horse. He was severely jerked, and immediately afterwards pain was felt at the junction of the cervical with the dorsal vertebræ. He continued his ride as far as Parsonstown notwithstanding, and subsequently walked through a part of Ireland, for he was unable to ride as much pain was caused by the motion of his horse. This took place in September, and I saw him in the following May. He returned home complaining of pain in the neck, but he continued to move about as formerly. Nine months after the accident, pain had increased considerably. Then he began to see the necessity of lying down; but even at this time he rose often from his couch to walk from room to room.

In May, I found the fourth dorsal vertebra prominent and carious, and the seventh cervical unusually movable. I insisted strongly, as had been done before, on complete recumbency; but in vain: he would invariably walk from room to room when he considered it necessary. In July, the power of the lower limbs was partially lost, and also the command of the sphincter ani. In August, the intercostal muscles became paralysed, and he died in September.

Sir William Gull, who had seen him previously, was present at the post-mortem examination and wrote to me thus: "The intervertebral cartilage, between the fourth and fifth dorsal vertebræ, was destroyed, and the adjacent bodies were extensively carious." And in addition, Mr Sargent remarked "that a portion of the body of the fourth dorsal vertebra came away as if it were completely detached, and the medulla spinalis was compressed and softened for the space of one inch."

This case shows the importance of rest when even so slight an accident as this appeared to be has occurred.

When spinal disease is recognised in an early stage, whether in the child or in the adult, and treated as any other joint disease is treated, promptly, and with absolute rest, there is no reason why it should not terminate favorably; and there is every reason why it should not be succeeded by deformity, abscess, and paralysis. Disease may be cut short while in the inflammatory stage, and it is little liable to become chronic. And even when a vertebra first becomes slightly prominent with swelling around and osteitis, and before caries is established, if absolute rest of the entire body is enforced, it is probable that disease may not extend farther. When caries is established, especially in the dorsal region, some prominence of the spinous processes will probably remain.

There is no more doubt as to the result of such a case, when disease is recognised in an early stage and carefully treated, than after a similar injury to any other articulation. And it is well known that the use of a joint may be entirely restored, even after serious injury, if complete immobility is for a time maintained, and the joint itself, as well as the limb, is adequately supported.

When the bodies of certain vertebræ have been destroyed, and a chasm has been produced, bony ankylosis may take place, even though three or four vertebræ are implicated in the disease; and our museums show that this may take place without deformity and without encroaching on the medullary canal. Specimens are not

wanting which show this result of bony union even in the neck. In the lumbar region it is quite common, and in the dorsal region complete bony union takes place, but rarely without some deformity.

Paraplegia with loss of motion is due to pressure somewhat suddenly applied to the anterior column of the cord. And when sensation is also lost deeper seated injury will have been incurred. This may be due to disorganisation or it may be due to pressure which can be relieved, as in the following case, which I lately saw at Woodford :

CASE 19.—A clergyman's daughter, aged fifteen, fell and struck her back. The accident was scarcely noticed, but some pain remained in the upper part of the back, and after seven months there was observed a prominence of some of the vertebræ. She was made to lie down, but was not otherwise treated. Suddenly, she resolved to sit up ; and forthwith, whilst she was exclaiming that she could sit up perfectly well, was paralysed. I saw her on the following day. There was disease of the last cervical and two upper dorsal vertebræ, with some slight tenderness on moderate pressure, and some little deformity ; and there was total loss of motion of the lower extremities, and of sensation as high up as the ribs, and paralysis of the sphincters. She was kept perfectly motionless and flat on her back, and in four months she had entirely recovered both sensation and motion, and the control of the bladder and the rectum. During the period of paralysis she was greatly troubled by jerking of the limbs during sleep, and as she was going to sleep. This was so great that the legs were sometimes jerked out of bed.

CHAPTER VIII

TREATMENT

FROM what has gone before it is obvious that spinal disease may be divided into three stages ; and for purposes of treatment it is convenient to consider :

1st. The stage of acute pain.

2ndly. Pain with rigidity.

3rdly. Deformity.

First. Immediately after the accident there is a period of acute pain, when it is well to apply an ice-bag to the injured part of the spine. And as the child throws himself about, being in acute pain, the ice should be pounded, otherwise it might injure him still further. At the same time a sufficient opiate may be given to induce sleep. As pain becomes less acute cold applications may be discontinued, and an accurately fitting splint may instead be applied. This splint should be worn in the recumbent position until pain and tenderness have entirely ceased.

When a child continues to complain of pain after an accident, but is unable to define the seat of pain ; when he no longer cares to play with other children as before, but lies down, and prefers to lie down, it should at once be suspected that he has met with an accident which needs attention. The injury may be so severe that it may lead to angular curvature of the spine ; or the dorsal pain which has been excited may be removed in some few weeks by recumbency and entire rest. Whether the accident is to terminate in angular curvature or the patient is to be restored to his former state of health and freedom from disease will depend entirely on the manner in which the accident is, in the first instance, treated.

The patient should be placed perfectly flat on a well-

made horse-hair mattress, and without a pillow for the head ; but the neck should be supported by a roll of linen immediately below the occiput, and a splint should be applied the whole length of the spine to give it adequate support. It is not important of what material the splint is constructed, so long as it fits accurately and the patient can lie in it comfortably. The chief points to be desired are that it shall be made rapidly and easily ; and, as regards the patient, that there shall be absence of pain, and a motionless condition.

When all pain has subsided, and the child can move freely on the bed, a starch bandage or a plaster-of-Paris bandage may be applied, and after some time he may be allowed to move about the room. The bandage should be applied in the recumbent position. Suspension should never be permitted.

If disease were recognised and treated at this stage, we should never see angular curvature of the spine.

Secondly. When disease has progressed beyond the acute stage, and the patient is again able to move about, he controls the pain by steadying the head and trunk ; either throwing the muscles of the back into action and thus making himself preternaturally erect, or by resting one or both hands on his thighs. Thus he moves about gently : no longer springing or jumping or stepping boldly, but he moves slowly along the floor or, in coming down stairs, he plants both feet on every stair, with evident anxiety not to jar or shake the body. On examining the back, the muscles are found to be rigid to keep the spine fixed and upright. And whatever he does, whether kneeling or sitting or standing, the muscles are thrown into action to prevent a sudden movement of the spine : he lowers himself on to his knee to pick up anything from the floor, and in lying down he is not less cautious. If the muscles are for a moment relaxed incautiously, the child screams with pain. At this period, the actual cautery relieves pain. A light touch with the cautery iron on either side of the spinous processes of the affected vertebræ, at white

heat, gives more immediate relief from pain than any other treatment whatever.

During all this time, the back should be supported by a splint accurately moulded to the surface, and the patient should be constantly recumbent. If the cervical vertebræ are injured the neck should be supported by the splint, and there should also be a prolongation from it to the occiput, to give support to the head and to prevent any movement upon the axis. Disease in this portion of the spine is much more serious than when it occurs lower down. Deformity is less than in the dorsal region, but softening is liable to take place in the upper part of the spinal cord, and to terminate fatally. Also, the odontoid process may become displaced through destruction of the ligamentous attachments, and being displaced backwards, through a sudden movement of the head, will crush the medulla. Death, under these circumstances, is instantaneous.

Before an abscess has formed in the neck attention will have been attracted to the part by the pain which is suffered. And in the dorsal region there will probably be an angular projection before any abscess is discoverable. But when the lumbar vertebræ are diseased deformity shows itself later, and an abscess may first form and appear outside the erector spinæ.

But, although abscess may have formed in connection with the upper dorsal vertebræ, showing itself perhaps in the back, piercing the muscles in close proximity to the spinous processes or along a rib; or though it be a lumbar abscess or a psoas or an iliac abscess, it may be absorbed, and recovery may take place with a firmly ankylosed spine, and with little or no deformity. When, however, an abscess has formed in connection with the cervical vertebræ there is always a certain amount of shortening of the neck, even though there may be no angular projection. After an abscess has formed, unless a motionless condition of the patient is observed with absolute recumbency, it will not be absorbed.

When the abscess has to be evacuated the patient's

life is in peril. It is therefore of prime importance to prevent the formation of abscess. The erect position excites movements of the carious bones one upon another, and thus causes an increased formation of pus, which, indeed, may probably become so plentiful that it cannot be absorbed. Besides, it favours the gravitation of pus towards the groin. For these reasons, also, the recumbent position should be maintained. Thus, until inflammation has ceased and repair is advanced, absolute rest in the recumbent position should be maintained.

Whilst a child is recumbent the general health improves ; he sleeps and eats well and is happy, all his functions are well performed, there is no fear of abscess, and repair is progressing. But, when he is allowed to get up he suffers with pain of various kinds, "*rheumatic*" and "*growing pains* ;" he becomes restless in sleep, loses appetite, colour, and weight, notwithstanding the bandage or support that is applied. Therefore, until ankylosis is advanced movement should not be permitted.

When a child has been uncared for, and has been allowed to move about, supporting himself by resting his hands on the thighs, any form of splint or bandage around the body affords immense relief ; and thus bound up of course he will walk upright and freely, and without supporting himself by placing his hands on his thighs. It has always been a difficulty in hospital practice after the support has been effectively applied, and the child is relieved from pain, to keep him recumbent. He has no difficulty in sitting or standing, and he does it when the nurse is absent. But the question which every surgeon has to put to himself is, Is it right to allow him to sit or stand ?

Prof. Pirrie answered this question thus :—" Rest of the diseased parts and the recumbent position, whether the body be prone or supine, are of the utmost importance from the very commencement of the disease, until a cure is effected by ankylosis."*

But it is not sufficient that the child shall be kept

* ' Principles of Surgery,' 2nd edition, p. 463.

recumbent. It is of the utmost importance that he should be kept recumbent until repair takes place, so that abscess and deformity may not occur ; but unless a retentive apparatus be added to the recumbent position, abscess and deformity will surely follow. It matters very little what the form of support is so long as it is comfortable and holds the spine perfectly in position. A support to the back is even more necessary in disease than a splint in fracture of a long bone. A perforated felt splint to support the entire length of the spine, and perhaps also the occiput, is light and cleanly, and answers its purpose well. There should always be two in use, so that when one is wet and being dried, the other may be applied.

Growth is sometimes rapid, after having been checked, when recumbency is first observed. It is not unusual to find that disease having gone on for one, two, or three years growth has stopped, almost, if not entirely, during this period ; but with recumbency it recommences, and the lost height may be regained in the course, perhaps, of two years. Thus, I have known three inches in height to be gained in six months in a case where during the previous three years there had been absolutely no growth whatever ; and this continued until the full height was made up. I refer to the case of a Russian Prince, Case 20, who for three years had been treated in Germany and in France. A record was kept of this case during this period ; and it was admitted by everyone who recorded that there had not been any growth for three years. I advised that he should be kept recumbent ; and in the first six months he grew three inches in height. After that time he grew three inches in the following nine months, and four inches in the following year. He grew also proportionately in breadth. He was recumbent for two years ; and when he left his couch, being then seventeen, he was broad, stout and strong, and of a fair height. I saw him with Sir Benjamin Brodie and with Sir William Fergusson.

When the recumbent position is maintained there is small difficulty with appetite, and the patient is ready to

receive whatever is given. The diet should consist mainly of animal substances, and there is no necessity to feed inordinately. The tendency is under these circumstances to increase in weight, and sometimes this takes place to a very inconvenient extent, so that it becomes necessary to observe a strict regimen. This is especially necessary with adults.

Thirdly. When deformity arises is it to be removed? Is it justifiable to remove the angular deformity, and straighten the spine?

It has been so long taught that the correct treatment of spinal disease is to allow the disjointed vertebræ to fall one upon another, and thus to become in some sort united, that many hold the opinion still that angular curvature cannot be removed. Mr Solly even wrote that only an ignorant man or a knave would pretend to correct the deformity of angular curvature, and he contended "that the maintenance of its curve, and not its obliteration, is the thing to be sought for."* But Mr Solly's views of treatment are also peculiar. He says, "In all cases of angular curvature entire rest is absolutely necessary, and this must be continued for some time, seldom less than four or five months, and often for a year or a year and a half. The exact position in bed must vary with circumstances: as a general rule that which is easiest to the patient is best, and the lateral position will frequently be found so, taking care to support the back with pillows that are fixed so that they cannot be pushed away." And Prof. Bauer says "we are able to arrest the progress of the disease, and we can avert, but cannot remove its ulterior consequences."†

The removal of angular deformity depends on the stage at which disease has arrived. Until repair has commenced, and ankylosis, true or spurious, has formed, angular deformity is removable at least in part; but when repair has commenced, it is not justifiable to interfere with it.

* 'Surgical Experiences,' pp. 27 and 77.

† Op. cit., p. 134.

For the purposes of treatment the prone position is perhaps the best ; but it is advisable that the patient shall be placed supine for several hours in the twenty-four. Any change that is effected in the spine can only be done very gradually, and it is made simply by observing the horizontal position and by the use of splints.

In the first instance a cast of the back should be taken, and upon this a splint may be blocked to fit accurately to the back, and to support efficiently the ribs. In this the patient will lie. It will be removed for purposes of cleanliness when needed. After a time it will be observed that the splint no longer fits well, and that it needs to be re-blocked ; and perhaps this may have to be done every two or three months or even more frequently, until there is little or no projection left. Abscess becomes absorbed during this period, and ankylosis eventually takes place. When bony union has formed, a spinal support to give additional security may be applied, and exercise may be permitted.

A good form of support is made with a horse-shoe shaped pad. This will support the ribs, without making pressure on the spinous processes. It should be so placed that if there be an angular projection remaining the pad shall be immediately below it, and it may rest on the angles of the ribs. When deformity is low down the pad may be borne on a single lever attached to a pelvic band ; but when it has to be applied to the upper dorsal region a double lever is necessary. And when the neck is the seat of disease, the support should extend to the occiput, so that no motion whatever of the head or of the cervical vertebræ may be allowed to take place.

Dr Taylor's antero-posterior support is useful when the figure is slight, and equally so is Mr Chance's modification of it. The first-named support is more solid, and better adapted for wear, and I therefore prefer it.

Exercise may be permitted when repair has commenced, if a well-fitting apparatus be worn ; but violent exercise should not be permitted until consolidation is complete.

It is difficult, however, to persuade patients and parents that care is needed for many months after repair is far advanced.

CASE 21.—A child was sent over from China with disease of the ninth dorsal vertebra. I saw him with Dr Barclay. He was a puny, delicate boy, and had been half starved on the voyage, and the chances were greatly against life. However, he was kept recumbent in a splint, and eventually grew into a fine, strong and tall lad, and at ten years of age he could bend about in every possible manner. He went to school at Harrow, and walked a mile to and fro daily. He was in wonderful health and spirits, and ready for any fun. He was cautioned that all his movements should be even and regular, and that no wrestling or tumbling or rough play of any kind could be allowed. For fully one year this kind of life had been led, when on an unlucky day he spied a wood-pigeon's nest in a high tree in his father's grounds. The next moment he was on his way up to it, but he did not arrive there; for just before reaching it he nearly fell. He broke through some bony union, and this was followed by inflammation and many abscesses, which at length terminated fatally.

Thus, it is important to support and protect the spine, and especially the seat of disease, long after a patient has come to enjoy freedom of movement.

Spinal abscess, in whatever position, should not be punctured, unless tension is great, and ulceration is imminent; for it is better that the pus shall be absorbed than that the abscess shall be opened. When the abscess has been opened and is discharging, the pus is apt to assume an unhealthy character, and even to become foetid. There is then danger of septicæmia, even though the opening may have been made antiseptically: hectic may then supervene.

Under these circumstances, the abscess should be freely laid open, and the cavity washed out with a weak carbolic acid lotion.

Although an abscess should never be opened unnecessarily, an opening should never be allowed to form, through ulceration. In the first place, the most convenient spot will be selected for the opening ; but this is frequently not selected by nature. Even it might be said that the most convenient situation is seldom selected by nature ; and a second and more dependent opening has to be made. A portion of the contents of the abscess can be drawn off with the aspirator, tension may be relieved, and the wound can be closed ; whereas, if ulceration takes place, the wound remains open. This withdrawal of pus may be repeated if necessary. But, if the discharge be thick and flaky and will not pass through the needle of the aspirator, the opening may be enlarged antiseptically and the contents of the abscess withdrawn. The aspirator needles should be made of fine steel and with finer points and larger eyes, and the needle itself should be of larger calibre, than is generally in use. This is a perfect mode of opening an abscess when the puncture can be made readily and the contents of the abscess drawn off in a stream. In two days the little wound has entirely closed ; and there is no fear, with this instrument, of incurring the danger of foetid pus.

In spinal abscess an open wound is to be avoided and drainage-tubes are to be shunned. Few things are more injurious and debilitating than a long-continued, exhausting discharge. If it were only for cleanliness the aspirator is to be recommended. But this is the least of its virtues.

When pus, having collected in considerable quantity, is found to be burrowing, it should be withdrawn without delay. And having withdrawn the pus search may be made for any detached bone ; and loose portions may be at the same time removed. But until there is evidence that the bone is loose and can be readily removed, an exploratory operation is to be deprecated. Force should never be employed to remove the bone. The surgeon's skill will prompt him when to interfere.

I lately saw a young Jew, who had caries of the fourth and fifth dorsal vertebræ, and an iliac abscess. He was moving about without support and resting his hand on the thigh. Pus having burrowed, had passed through the inguinal canal into the scrotum, and also the perinæum was infiltrated with pus; so that both the perinæum and the scrotum had to be opened.

Now that recumbency has been so much insisted on, it will perhaps be asked, when is suspension to be employed?

Suspension would scarcely be employed, unless there were deformity, for the object of suspension is to remove or diminish angular curvature. Sometimes Dr Sayre practises extension thus: a boy five years of age, with Pott's disease in the lumbar region "was held out as straight as possible by two assistants pulling, one from the shoulders, and the other from the ankles," and the straightening of the spine thus produced, is shown in his book, Fig. 5.* But Dr Sayre prefers suspension to stretching the spine, and he writes thus: "As it is difficult for an assistant to hold a patient suspended during the application of the dressing, I make use of a very convenient apparatus contrived by Mr Reynders, of New York, which consists of a curved iron cross-beam, to which is attached an adjustable head and chin collar with straps fitted to axillary bands. To a hook in the centre is fixed a compound pulley, the other end of which is secured either to a hook in the ceiling or to the top of an iron tripod about ten feet in height. The head and chin collar and the axillary supports having been carefully adjusted, the patient is gradually drawn up until the feet swing just clear of the floor."†

It would scarcely occur to any one familiar with such morbid appearances, as are figured on pp. 86 and 92, to use suspension. Notwithstanding it is done, and with serious results; paralysis occurring during suspension, soon

* 'Spinal Disease and Spinal Curvature,' p. 25.

† Ibid., p. 17.

to be followed perhaps by death. No one can be surprised that fatal cases have occurred, and paralysis of the limbs, during suspension, or as an immediate consequence of suspension. Among others, Mr. Willett has recorded such cases.*

Suspension was practised by Glisson in the seventeenth century. When, however, pathology came to be better taught, such treatment was held to be barbarous. No system of treatment can be more unjustifiable. In some parts of Germany they are not content to suspend their patients by the head and shoulders, but in this position chloroform is administered, so that, by removing muscular action, the spine may be more easily straightened. I have not yet heard of this practice being introduced into England.

For my own part, I should not, under any circumstances, suspend a patient with caries of the spine: first, because it is attended with great danger, and secondly, because it is entirely unnecessary. It is dangerous, inasmuch as it induces abscess and paralysis, and it breaks through repair; and it is unnecessary because the horizontal position effects everything that can be desired without danger. The horizontal position promotes union also, whereas suspension prevents it.

Suspension in caries of the spine, whether in the inflammatory stage or when repair is taking place, is opposed to pathological teaching and should be prohibited. And although the plaster jacket may give relief where no previous application has been employed, it prevents thoracic respiration, and it promotes collapse of the walls of the chest; so that its effect on the thorax is more injurious than the tightest stays.

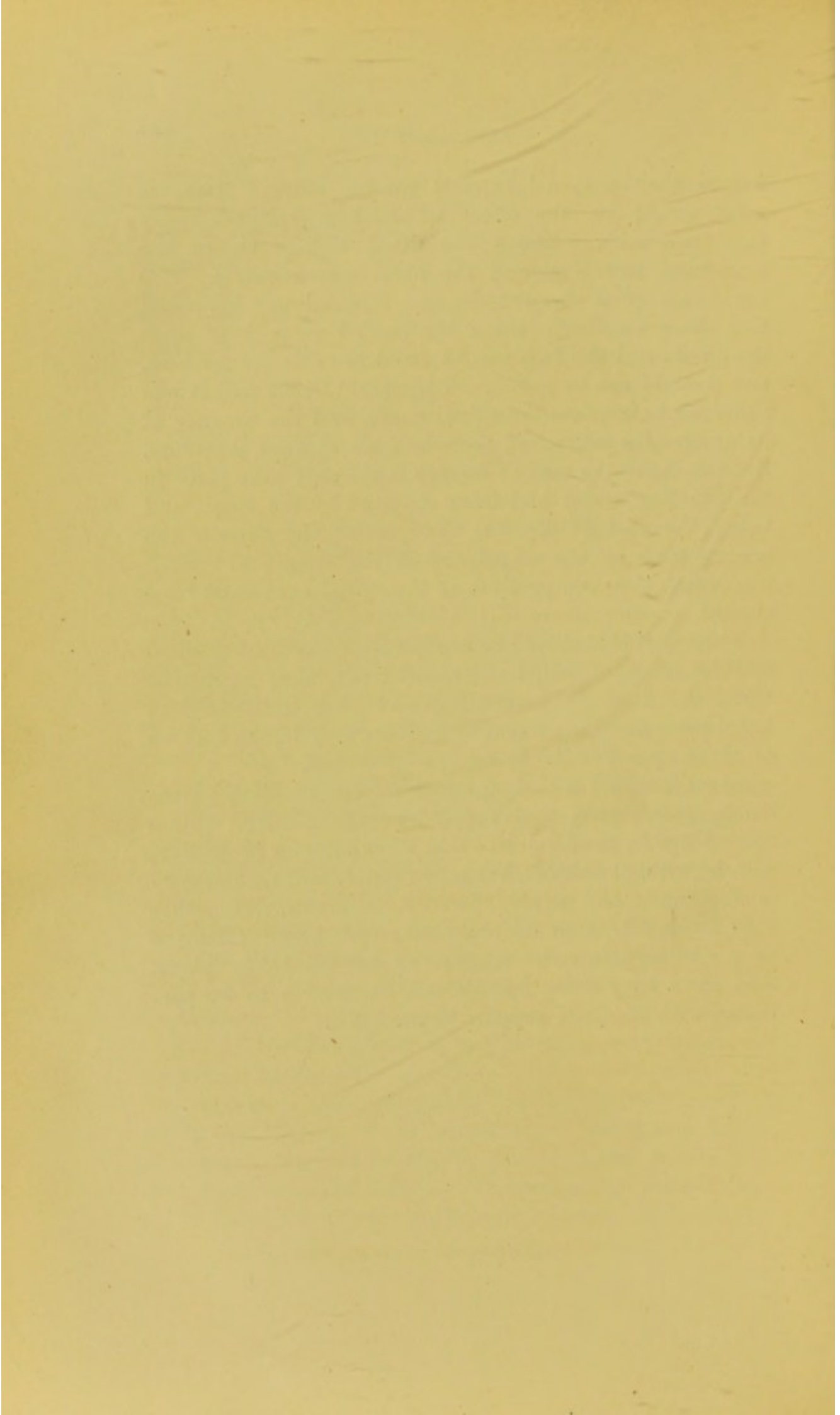
CASE 22.—I saw in January last a clergyman's child, æt. 6, with disease of the second, third, and fourth dorsal vertebræ. She was wearing a plaster jacket which had been worn for eight months. It covered and rested upon the diseased vertebræ. It was very heavy, much heavier

* 'St Bartholomew's Hospital Reports,' vol. xiv.

indeed than a spinal support for an adult. Imagine what would be the effect of such a splint—heavy and immovable. The splint fitted tightly on to the projecting vertebræ, and the child was growing. She could only grow downwards, and it absolutely happened that she grew downwards: the head became bent upon the chest, and the face was directed towards the ground, and it could not be raised. The weight of the jacket was sufficient to increase the spinal curve, and the manner of its application prevented growth in an upward direction. Growth above the seat of disease could only take place in the direction which had been assumed by the spine, and below the seat of disease, the greater the growth the greater must be the angularity of the spine; so that, if continued, slow compression of the spinal cord must have ensued.

The splint that should be used in the recumbent position may be made of felt, leather, gutta percha, or poroplastic material. It should be made to fit exactly to the back in every part, and thus fitting it matters very little of which of these materials the splint is constructed.

In conclusion I will repeat that so long as inflammation exists, recumbency and support to the diseased spinal column are to be observed; and when angular projection, with or without abscess, has taken place, still recumbency in the prone and supine positions alternately, together with a support, is to be observed; care being taken to alter and lengthen the support as growth takes place. And when bony union has formed, exercise is to be permitted with adequate support to the back.



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