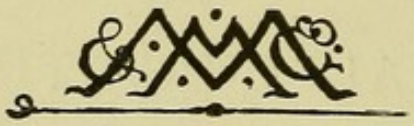
The causes and treatment of lateral curvature of the spine.

THE CAUSES AND TREATMENT OF LATERAL CURVATURE OF THE SPINE



THE CAUSES AND TREATMENT OF LATERAL CURVATURE OF THE SPINE

BY

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FIFTH EDITION

CAREFULLY REVISED

WITH NUMEROUS ILLUSTRATIONS

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PREFACE

THIS work, the first edition of which appeared in 1868, was almost entirely rewritten when a fourth edition was needed about six years ago. Concerning the motive which caused me to undertake such a task, I venture to quote a few passages from the preface affixed to that edition.

"Probably every one who has had much to do with the treatment of scoliosis, of necessity a gradual process, must have been troubled with the difficulty of ascertaining with accuracy improvement or the reverse, still more, of computing the amount of either. Yet a reliable means of doing so is essential—scientifically, because without it we cannot *know*—practically, because a surgeon in full work cannot possibly remember, after several days, the exact aspect of many backs. His views as to the progress of the case are therefore founded upon mere impression, and may be quite opposed to that of the patient herself or of her relatives. I determined

therefore, to devise an instrument giving easily interpreted indications in language so untechnical that any lady could understand it. The result of my endeavours is the 'scoliosis gauge,' described in Chapter VI., which gives rapid and concise measures of all deviations and malpostures. The use of this instrument pointed out to me at once a previously undetected abnormity, which I have described under the name of amesial pelvis.

"The next point is an important addition to treatment, the motive to which was this: very soon after the third edition was printed a fortuitous sequence of severe cases occurred, both in my public and private practice, many of which had been years under different sorts of treatment. For those who had, as also for those who had not been thus circumstanced, I was well aware that no benefit could be obtained by loading their backs and shoulders with from four to six pounds weight of metal; while fatiguing them with ineffectual gymnastics and suspensions would only add to the trouble, already sufficient, of their lives. My elastic bandages designed to produce changes in the posture of loins and chest, I find to be most valuable in all moderate degrees of deformity; yet, in the more severe, their action, though always beneficial, was somewhat slow; while in the most advanced forms I always had to tell my patients that I could only produce a relatively small amelioration

combined with considerable increase of comfort. With this I could not, however, rest content, and certain cases, very refractory to every method that had been employed, induced me to consider and then very cautiously to try some means of applying force to rectify the two chief aberrations, rotation and lateral deviation. My efforts culminated in that which is described in the text as 'rachilysis,' a name adopted, because both morbid anatomy and clinical experience teach me that, in all but the latter phases of the third stage, shortening of the ligaments, a condition we frequently treat in the limbs with success, is, in by far the larger number of cases, the fault most necessary to be overcome. Loosening of the spine—that is setting the vertebræ free to accept the influence of a slighter, but more persistent force, has been in my hands remarkably efficacious. Certain cases at the end of the volume attest this with such force that I might hesitate to publish them ; the records are, however, made not by me but by the scoliometer, I being only the amanuensis."

The book in due course went forth and was favourably received ; but one of my critics (I believe in the *Lancet*) observed that I had set my readers "a hard task." Although resenting at first this observation, a fresh revision of the book showed me that he was right. I had in fact made it hard reading by mixing with the narrative of how lateral

curvature is caused, increases, and may be cured, pathological and anatomical descriptions. The defect has in the present edition been remedied as far as possible by relegating those perhaps rather dry but very important details to an appendix. Thus, endeavour has been made to relate the origin, detection and cure of lateral curvature as an evenly flowing and let me hope as an interesting history, scarcely interrupted by references to this or the other part of the appendix. My task in preparing this edition has therefore been rather re-arrangement than re-writing.

The number of illustrations has been much increased and it is hoped improved. For this purpose photography has been largely employed, for the woodcuts of the fourth edition were to me most unsatisfactory. Attempts made last summer to procure better ones resulted in disappointment, and the conclusion was forced upon me, that the very subtle lighting and shading, which indicate the asymmetry of a deviated figure could hardly be portrayed by any artist, unless my patients could be kept standing for hours before him. By making certain arrangements in my well-lit consulting room, by procuring a very rapid lens and using the quickest of plates, I can get an excellent negative in from five to ten seconds, according to the brightness or dulness of the day. These without being touched or otherwise tampered with (save oblitera-

tion of pinholes) were handed over to the engraver,[1] and have been used in this work to elucidate my descriptions and to illustrate certain of my cases.

It may also be said that the aid afforded by these records has been very valuable, enabling me to demonstrate the result of treatment to patients or to parents sometimes at a distance, to whom a bare record of angles and of measurements by the scoliometer mean but little. Yet for my own use photography does not supersede that more accurate instrument.

In conclusion, let me say that the action and the result of rachilysis (my new treatment) has in no way disappointed me. Indeed, more experience as to variations in its mode of use, and as to the frequently considerable force, that may be painlessly applied, has enabled me obtain from it better and more rapid results than, when I published the fourth edition, I could have anticipated.

RICHARD BARWELL.

55 WIMPOLE STREET,
May, 1895.

[1] It may be permitted me to record my thanks to Messrs. Walker and Boutall, of Clifford's Inn for their care in securing such accurate reproductions.

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CHAPTER I

THE NORMAL SPINE

THE spine consists, from the lowest loin to the head, of twenty-four bones, an equal number of intervertebral cartilages being placed between the bodies—that is to say the weight-bearing parts of any two contiguous vertebræ. These substances impart elasticity and springiness to the column as a whole, and act as a medium of separation and as a bond of union between the separate bones,[1] certain backward projections from these "bodies" serving to restrain mobility within safe limits, to protect the spinal cord during the various movements and shocks to which the creature is necessarily exposed, as also to furnish surfaces, excrescences, or depressions for the attachment of muscles that move the

[1] For further anatomical and physiological details, see Appendices I. and II.

spine, whether altogether in unity or each segment or congeries of segments separately. For it is to be noticed that the column in its separate parts and in its entirety is completely under the control of muscles. Like every other bone, or combination of bones, it possesses no inherent power of movement, and although it may at first sight seem well to say that this or the other posture is due to the necessity of balance, such phrase only masks the real problem ; for the particular position which equilibrium demands can only be compressed upon the bones—whether of the limbs, of the head, or of the back—by muscular exertion. The human perpendicular position is essentially one of effort, as therefore, of course, the various inflexions of the back demanded by that posture. For the spine of an infant is straight, or rather it is from the head downward bowed slightly forward—*i.e.*, it tends to be convex backward. While so young as to be constantly recumbent, the baby's spine simply takes the curve of the surface on which it lies. The thighs are kept flexed on the abdomen ; except during the occasional moment when the infant "stretches," the lower limbs are never held straight, and save at those moments there is no sign of any forward bend of the loins. When the baby sits up on the nurse's arm, the back bends in one simple antero-posterior curve (convexity backward). In all these positions the pelvis is nearly horizontal—that is to say, the brim of the true pelvis projects at little more than a right angle from the line representing the axis of the lumbar spine.

If the baby be observed during that occasional act of stretching, it will be noticed that he (I neglect the movement of the arms) forces the thighs downwards into lines parallel with a continuation of the body's axis; in consequence, the front of the pelvis and the lumbar region of the spine bend forward—it arches over that space of the couch on which it was previously lying flat. The same straightening downwards of the thighs is necessitated by the new posture the child must assume when, a month or two later, he begins to "feel his feet," and soon afterwards to stand. This new perpendicular posture of the thighs demands the same depression of the front of the pelvis, and the same arching or anterior bending of the loins. In this standing or erect posture the necessity of balance comes strongly into play, for the descent of the front of the pelvis means, of course, an oblique position of the sacrum, whose upper surface—that basis on which the column rests—no longer looks directly upwards, but also very much forward. The last lumbar vertebra follows this direction; but it is evident that the rest of the spine cannot do so, for if it did the whole trunk would be bowed forward, and the child would fall on its face.[1] To obviate such loss of balance, the column above the last lumbar vertebra is bent pretty sharply backwards by means of those strong muscles placed behind the loins, which for that reason are called the "erectors of the spine." That this position is essentially one of effort, *i.e.* is the effect of muscular exertion, is further shown by the

[1] See Appendix III.

fact that when the person, now no longer an infant, reposes, the forward bend of the loins is abrogated. In sitting it is only occasionally, and when not quite at ease—when the person is "behaving himself"—that the loins take that position; they as a rule simply bend with backward convexity. Also in lying down on his side to sleep the individual bends his whole back in one gentle curve in the same direction from top to bottom. In all exercises and active games the normal curves—*i.e.* this position of erect posture—continually vary: any one not yet old can bend the whole spine backward into a curve of considerable sharpness, and can also bow forwards so as to arch the spine strongly in the contrary direction.

These antero-posterior movements are, however, not by any means the only ones of which the spine is capable; it can at will be bent to either side or can be twisted on its long axis—that is, with regard to the former, each vertebra can be inclined upon the one below it at a slight angle; each one next above then adds its increment of lateral inclination so that, though each bone may slope but little, the sum of all these angles throughout the column is considerable. In the same way, in twisting the spine, the degree of turning which each bone can execute is but small: the sum of the rotation, however, amounts to a considerable part of the circle. While the first edition of this book was in preparation a work appeared which seemed to me singularly mistaken in that it ascribed to the spine but a very slight and subordinate degree of mobility;

I only refer to it now as having supplied to me the motive for a very careful and extended series of experiments designed to estimate the degree of lateral and rotatory mobility of the spine. First, as to lateral flexibility, I produce here the photograph of a young man's back ; he is moderately active, but

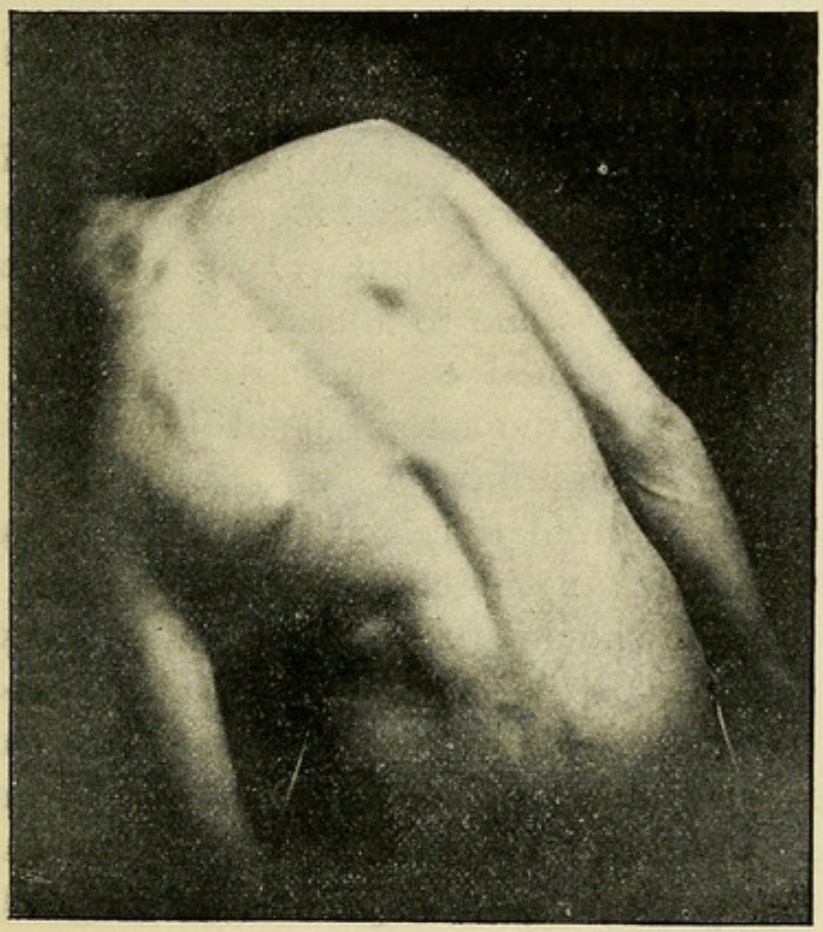

FIG. 1.—Voluntary Lateral Flexion.

though he cycles and plays football occasionally, his avocations are sedentary, and he has never trained nor gone in for gymnastics. He was seated on a rather high stool, round two legs of which and over his thighs a girth was passed to keep steady the pelvis. If the line of flexion were a regular

spheroid curve, measurement shows that the back of an average young man can bend in part of a circle, the radius of which is about three-quarters the length of the spine. The bend, however, is due to muscular action, as may be seen by observing the contracted state of the left *erector spinæ;* and the greater strength of this set of muscles in the lumbar, as compared with the dorsal region, probably causes the sharper part of the curve to be at the loin.

But an individual may, while standing or sitting, lean against a support. The first movement towards the side is evidently voluntary, or, what comes to the same thing, is due to muscular action ; but the trunk having gained the support, no longer needs such effort, and the lateral bend becomes static. The annexed plate from a photograph taken many years ago is from a model at not a very flexible period of life (32) and of sedentary pursuits. Her left arm and shoulder are placed against a wall, the side of the pelvis is drooped, and is made to approach the wall as near as possible. On this photograph a line was drawn from the root of the neck to the top of the *rima natium.* The curved spine from the vertebræ prominens to the top of sacrum measured 13·5 lines, the radius of that curve, supposing it to be circular, was twelve lines. Now as the model's spine measured from the same points eighteen inches, the real radius of her lateral curvation was sixteen inches. The dorsal and lumbar spine of an ordinary individual about middle age can therefore easily bend laterally in a curve whose radius is eight-ninths the length of the column.

Lateral bending to this extent by no means represents the full capacity of the spine for this species of movement, as may be noticed by any one watching some of our more athletic games, such as Rugby football for instance. Yet it is certain, however, that in ordinary avocations such

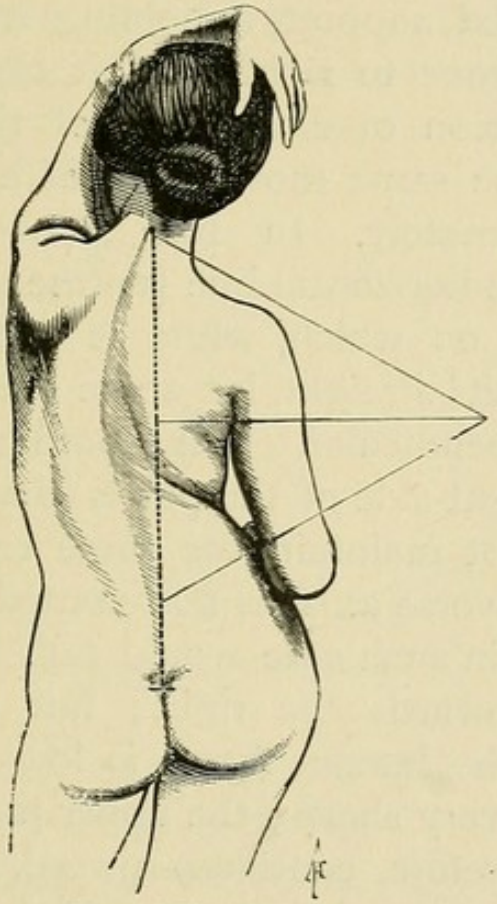

FIG. 2.—Lateral Flexion against support.

positions are only occasional, or even exceptional; yet, on the other hand, slighter degrees of sideways bending accompany the most common and necessary movements of the body: even in walking along level ground, more markedly in going uphill, still more in ascending stairs, the column sways

from right to left according to the foot on which the weight falls. Again, if the seat he is using be not quite level, or if he sit unevenly upon a level one, the spine must bend laterally,[1] always with the convexity to the side that is lowest. This may be more systematically studied by causing a model to sit with bared back on a plank and directly over a narrow-edged support, upholding it in such wise that it can rock to right and left, causing elevation and depression of either end of the board, and therefore the same movements of each side of the pelvis alternately. In No. 2 of the annexed diagram the horizontal line represents the edge of the board, on which, while it is horizontal, the individual sits straight, his spine being represented by the perpendicular. The board rocks so as to raise the right side of the pelvis (diagram 1). The spine cannot maintain the same relations to the pelvic transverse axis, as represented by the line A; the person in such case would fall. It bends over abruptly towards the right; but the centre of gravity in the human figure is low and this bend at the loin very sharp; the upper part of the spine cannot, therefore, continue onward, as in the line B, the direction of the upper limb of that curve (viz. to B); but the upper or dorsal spine must compensate the abruptness of that curve by a bend in the contrary direction. Now the right end of the board, having completed its full swing upward,

[1] Let me call attention to that wonderful statue called the Ilyssus, one of those on the pediment of the Parthenon, now in the British Museum (Elgin Marbles Series).

falls again. The plank becomes horizontal, and the subject sits on it upright and with straight spine (diagram 2); the rocking takes the contrary oscillation, the left side of the pelvis is raised (diagram 3), and the same conditions as are explained for diagram 2 are reproduced, but in an opposite direction. Thus the two divisions of the spine undulate on each side of a perpendicular line which, as it is the line of balance, passing through the centre of gravity, must always be preserved as

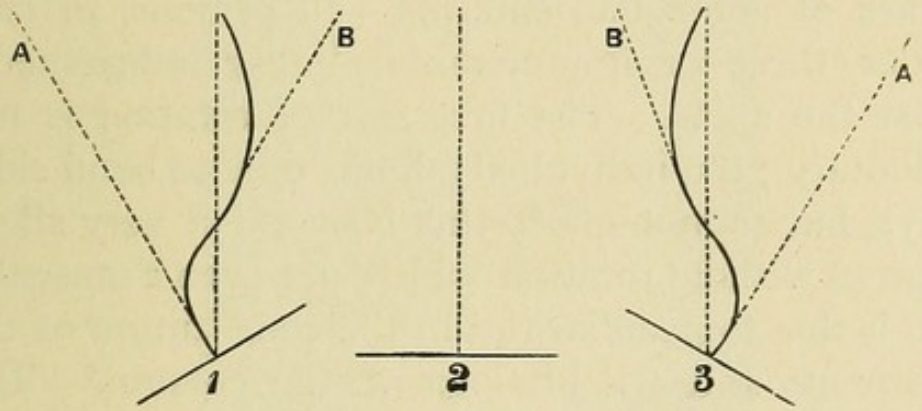

FIG. 3.—Diagram of Spinal Undulations.

the chord of any curves which the column may assume in all its erect postures.

All lateral bends of the spine—except probably in the slightest degrees—involve a commensurate amount of rotation, which always takes place in such direction that the anterior faces of the vertebræ look toward the convexity of the curve, while the tips of the spinous processes move into the concavity. This point, as will be seen in the sequel, is very important in the diagnosis and estimation of scoliosis; just now, however, it is more especially

my object to point out that the rotation of vertebræ is of two kinds. First, there is that integral part of every lateral bend, which the individual so bending could not, if he would, prevent. Secondly, there is intentional or emotional rotation, which all persons employ to a certain degree when they turn the body without moving the lower limbs, as in looking behind them suddenly or in any active exercise. For instance, a hunter hearing somewhere in the rear the music of a hound ; the shooter hearing a bird get up behind him ; the lady in her opera box becoming aware of some one entering—all persons, in fact, under these or innumerable similar inducements twist the spine. The first sort of rotation is not voluntary ; the individual intends only to bend sideways, but cannot effect this (beyond a very slight degree) without rotation, which, not even a muscular act, is due to peculiarities in the constitution of the ligaments and articulations of the column.[1] The second, or voluntary sort of rotation, worthy of considerable study, is present in very diverse degrees in different persons. Some people are much more flexible, lithe, or "willowy" than others—have, as it is commonly expressed, looser joints. I have taken much pains to obtain an accurate average measure of this sort of rotation power, as also to elucidate the muscles producing it. In this particular place I merely state[2] that many young subjects can turn the spine 60°

[1] See Appendix IV. and V.

[2] For more full estimate for, and for explanation of both sorts of rotation, see Appendix IV.

to right and to left—*i.e.*, taking both directions, can rotate the spine one-third of the circle.

These bends and twists of the spine can only be permitted by tension, compression, or relaxation of ligaments that bind different portions and processes

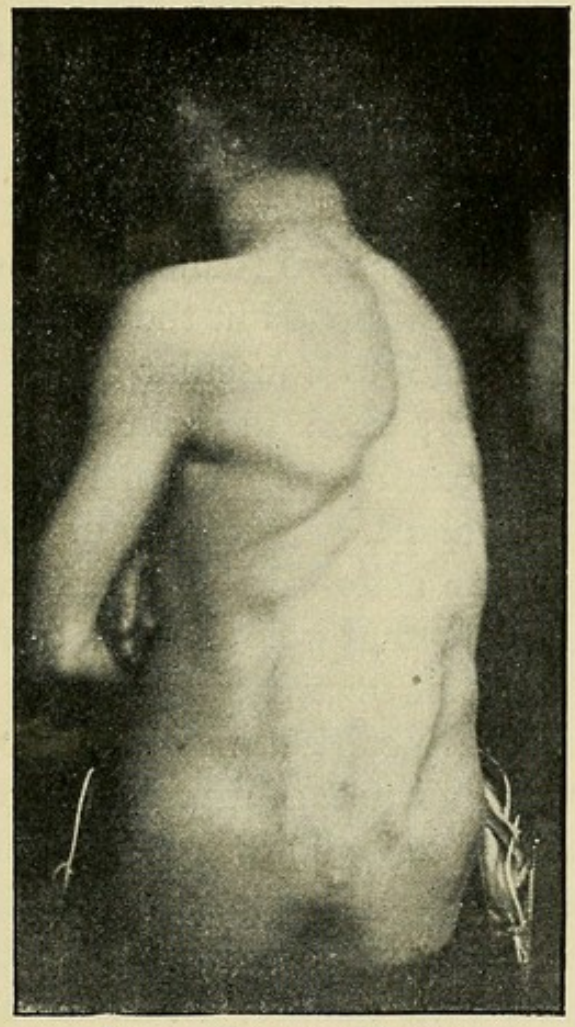

FIG. 4.—Voluntary Rotation.

of the vertebræ together ; when the particular posture that called temporarily for one or the other of those ligamentous conditions is abrogated, the state of compression, tension, &c., is at the same time eliminated ; the fibrous structures again assume, by virtue of inherent, elasticity their passive balance.

Let us, before going further, recapitulate very succinctly the substance of what has just been said.

The twenty-four bones of the spine, separately and collectively, are not endowed with any inherent power of movement; therefore, in order to change their position, either for the sake of balance or otherwise, they must be acted on by muscles or (in a single instance) by elasticity or resistance of ligaments, which, however, is only called into action by muscular forces. The primordial form of the spine is a gentle bend forward (concavity forward); the lumbar and cervical bends in the contrary direction are essentially due to muscular effort. The back of a recumbent person in complete unconscious repose reverts to the primordial form. Sideways bending, and voluntary rotation of the spine, are due to muscular action. But when muscles have put the spine into that position, the trunk may find a support in some extraneous object, by leaning against which the position may be maintained without further expenditure of muscular force. The inter-vertebral and other ligaments, however, continue to be tense, relaxed, compressed, &c., in the same way and to the same degree, as when the position was temporary and due to muscular effort. Any person may, however, keep up a sideways bend or twist by placing (of course by means of muscular effort) the vertebræ in such position as to render certain ligaments tense. The tightened ligaments then support the body-weight, and the muscle or muscles need no longer do the work; that is if the bend be compatible with equilibrium of the trunk.

CHAPTER II

CAUSATION

THE causes which produce lateral curvature of the spine may now be examined ; but in order to render the ensuing pages comprehensible, a few definitions are necessary. The spine is said to curve to the right when it is convex in that direction, to the left when its convexity is in the opposite direction. Rotation is named right or left according as what in health should be the front of the column faces towards the side from which it derives its name. A curve is named simple or total when it occupies the whole column from the last cervical to the last or penultimate vertebra of the loin ; it is called dorsal when the upper region of the spine is affected—that is, from the first dorsal vertebra downwards to the ninth and lumbar, when the curve involves the bones below the last named. Dorso-lumbar, double or S-shaped curve, is that form of the distortion in which the two segments of the column deviate in opposite directions, most commonly so that the dorsal portion is to the

right, the lumbar part to the left. The spine thus deflected therefore crosses the mid-line once, viz., at the ninth or tenth vertebra.

A time-honoured nomenclature describes the S-curves as primary lumbar or primary dorsal; but it may be doubted whether such distinction can be maintained in all its pristine rigidity. I have seen very many cases of total curvature almost suddenly assume, and thereafter maintain until cured, the S form. Moreover, as will be plain from the ensuing pages, many of the causes of curve operate equally and simultaneously on both divisions of the spine.

There is no such thing as a natural or physiological lateral curve of the spine.[1] The idea first promulgated by Sabathier is not only false but mischievous. Constantly in practice I see the disastrous result of a belief in this supposed "physiological curve," patients with considerable deformity of the spine being brought to me by mothers, with the history that several years ago such and such a surgeon had assured her that her daughter "would grow out of it," and that "everybody has, and ought to have, a certain lateral bend of the dorsal spine." About five years, and again about two years ago, disastrously deformed girls were brought to me, who had thus been told by a deservedly eminent, but on this particular subject a frequently mistaken, surgeon.

There are three special periods of life at which, more than at any other, spinal deviations are apt to

[1] See Appendix IX.

commence.[1] The first of these is between the sixth month and the second year, the next about the age of seven, the third somewhere between the fourteenth and seventeenth year. In making this computation, and in drawing inferences from it, or from actual cases, we must remember that the period of discovery always lags behind the moment of commencement by a period very different in different circumstances. Carefully tended and lovingly watched children will not so long retain an undiscovered deformation as do those who are a good deal neglected or little cared for.

The first of these critical periods corresponds with very considerable deposit of osseous matter in the hitherto almost purely cartilaginous nidus of the future bones, also with very rapid increase of size of those bones as a necessary part of body-growth. A child, for instance, in the first six years of its life grows three and a half inches a year. It is not difficult to see that any sideways weighting or balancing of the spine must almost of necessity modify such growth on one side or the other. A baby, as soon as it is able to sit at all, is constantly carried on the nurse's *left* arm. I have been for many years past vainly watching in friends' houses and in the streets for some one carrying such an infant on the right arm; but they are without exception carried in one constant and invariable manner. This connotes that the child leans its

[1] I omit congenital curvature as too exceptional to affect the statement, as also, but for another reason, those due to inflammatory troubles in the chest.

right side against the bearer's chest, thus curving and twisting the spine always in the same direction. When in the house the nurse takes the child upon her lap she still keeps it on her left side (the child's right towards her own body), her knee is rarely, if ever, as high as her hip, therefore, the seat of the child slopes, *i.e.* is higher on its right. Even if the stool on which she may place her foot does keep her thigh nearly horizontal, yet the baby, save in moments of excitement, is sure to seek a leaning-post against her chest, *i.e.* to its right side. I hope it will not sound farcical to allude to the manner of attending, or, rather not attending, to very young children in perambulators; they are generally put in straight enough, and after being a few minutes in the open air duly go to sleep, leaning their weight against the strap, which, to prevent their tumbling out altogether, passes round the waist; they thus incline all the upper part of the trunk towards the right. It might at first thought be supposed that such infants would lean in different directions on different days; but this is not so. I am very fond of even little children, so that my eye is always attracted to them, and I have very rarely seen an infant leaning to its left. It is probable that this constant choice of side arises from the mode of nursing; an infant soon learns that when dropping asleep on the nurse's arm or lap it finds its security on its right side; hence, it instinctively, when sleepy, leans in that direction, and as its slumber becomes deeper, droops over more and more. There are a few nurses who occasionally

put the infant straight, but it lolls over again almost immediately, so that she does not repeat her Sisyphus task very frequently. The fascinations, too, of shop windows, of passing acquaintances, &c., constantly distract her attention.

Thus the infant, from six months up to five or six years old, is very much in the habit of leaning its body over to the right, that is of so curving its spine that the convexity looks to the left. A majority, those who are strong enough to stretch and take free exercise in the latter part of this period, escape without harm, but a certain number suffer. The weakly ones very generally become crooked. Among this latter class are doubtless some with tendency to rachitic softening of bones; but, at all events, in the better-to-do classes these are a small minority. I have notes of many infantile cases, the oldest being five years and eight months, with different forms of dorsal curvature, in whom the shape neither of the head, teeth, nor epiphysal limb-endings gives the slightest indication of rickets, nor are the ribs at all beaded. Of the whole number are two showing evident traces of rhachitis, and a third is recorded as doubtful. These are all children of people sufficiently well-to-do to nourish their children properly. In hospital work and in Homes for Cripples the numbers would come out differently, and I am only speaking of the last ten years of my practice. Yet though the children be not rickety, their vertebræ are still largely cartilaginous, and are growing pretty quickly. It is hardly necessary here to describe what the effect

of such one-sided weighting and twisting on a growing bone, and more especially on growing ligaments, must be.[1] To this subject need only be added that I have more especially described the position as leaning over to the right because I can thereby make myself more readily understood. In reality, however, the infant's posture is one that could only be depicted by a very complicated series of phrases; it consists, although in part, of leaning over, yet in still greater part of a *twist* of the trunk, by which the left lateral half is thrown forwards; thus the child leans the right side of its own breast against the nurse, or gets the grip of the perambulator strap as much to its front as to its side, and therefore what looks like merely a sideways bend is also torsion and leaning forwards.

The curvatures which commence about the seventh year are quite as common as the above. At or about that year mere infancy is passing away; bodily life becomes more independent of external support and mental training begins. The circumstances, therefore, which may and often do give rise to curvature are different from those above described.

When following its own bent in playing and running about, sitting, rolling, or lying on the floor, in every imaginable position, a child of this age is laying no foundation for the production of a curvature; but after the seventh year of life this happy *dolce far niente* is no longer permissible. The child must now work; probably goes to a Board,

[1] See Appendix I and II.

high, or some other school, where the chief, or at least a very large, part of its work is writing. The commencement of this acquisition is for a child very difficult; it is, as we know, always done, even by left-handed persons, with the right hand, and the guidance of this hand to fashion the complicated lines and curves aright is a hard task. The arm, which has to perform a work of precision and delicacy, must work from a steady base, hence the shoulder girdle, with spine and trunk to which it is appended, is kept fixed and rigid. The former of these is much more readily fixed when curved forward, backward, or sideways, than when kept straight. Moreover, the young scholar, unless of robust frame, attains more completely the desiderated fixity of body by getting aid and steadiness by leaning on the desk or table. Hence the great majority of children while learning to write, and later while doing their exercises and themes, lean and curve their body in certain differing ways which each one learns for himself. Some whose right hand is uncertain and tremulous steady it by placing the forearm on the table, and working only with wrist and fingers. Others—and this posture is very common—sit almost entirely on the right buttock, throwing the left arm across the trunk (either close to it or at a little distance), leaning their weight on it and bending over to the right. The diagrams here annexed leave in an artistic point of view much to be desired; but they were jotted down rapidly from patients immediately before me, and as they give the posture and sway of the

body with fair accuracy, I prefer to leave them, lest by elaboration I lose their characteristics. The former of these represents the last-described position ; the latter, another very common awkward attitude that children assume. It is compounded of a forward stoop and a twist of the body, together with a serpentine bending of the spine. In such

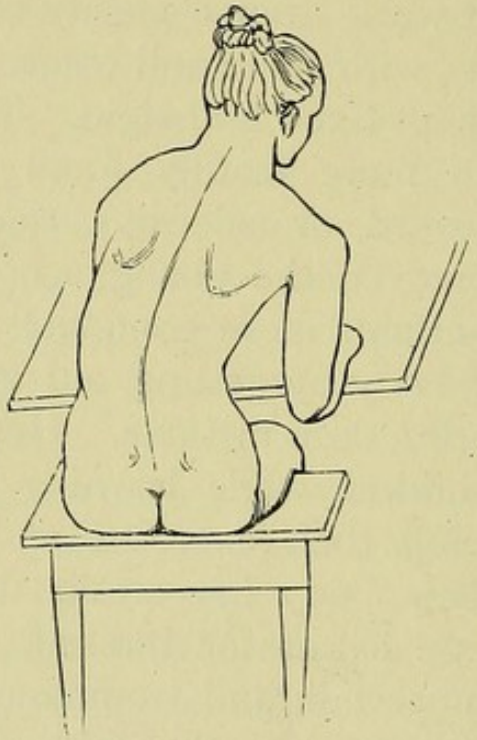

FIG. 5.—Child Writing.

posture, which, however, is not quite as frequently assumed as the previous ones, the right shoulder is thrust upward and backward, the left is lower and more forward ; the shoulders, however, vary their position a good deal, according as the child is writing at the top or bottom of the paper, but the curves of the spine, the root of the evil, remain. Another injurious posture is to sit with the right

side of the pelvis nearer the table than the left, to plant the feet fairly and evenly on the ground, to place the left forearm entirely on the table, but to

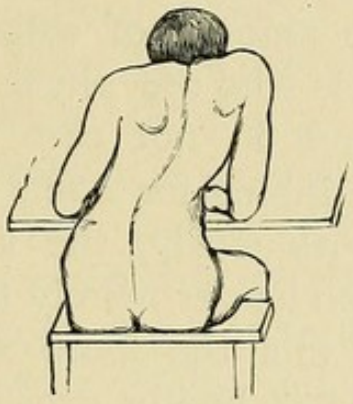

FIG. 6.—Child Writing.

bend the upper part of the trunk down, to twist it to the left, to stoop the head considerably forwards till it almost rest on the left wrist, as though to look between the paper and the writing fingers. These are the postures which I have found most usual, both with boys and girls ; but some children assume other bad positions, while some sit well and evenly.[1] It should always be remembered that defective vision, especially short-sightedness or astigmatism, very frequently gives rise to faulty positions in writing and also in other studies.

It is not difficult to perceive how readily the spine of a rapidly-growing child can and often is affected by the maintenance of one or the other of these positions for several hours daily, especially when it is also remembered that it is, save for robust ones, very difficult to immediately straighten

[1] See Appendix VIII.

out a long-continued crooked posture, more especially to untwist a rotated spine, for be it observed both the above depicted postures, more especially the last one, combines with the lateral deviation a very considerable amount of rotation. Therefore those young people who are physically less powerfully endowed, and do not care for active play, retain, in the beginning for a few hours only, then more or less continuously, the crooked posture, until it becomes no longer merely their position but their shape, and this the more surely the more rapid at the time is bodily growth. Herein lies one of the chief reasons why many children who sit badly at their tasks escape, why for instance the boisterous boy or romping girl hardly ever get a spinal curvature, unless from causes now to be explained, while the more delicate and quiet children, those who love sedentary rather than active amusements, frequently do so.

We now pass on to another causation. At page 9, we saw that if any one sits on an inclined seat, for instance on a board that is higher on the right side than on the left, the pelvis slopes in the same direction, and the spine must curve or the person would fall. But there are many conditions in child-life more frequent than sitting on a see-saw, which may impose upon the pelvis of a young person an oblique position. We may take as an instance the result of a former hip-disease, or, better still, some inequality in the length of the lower limbs. Such unevenness of growth is very frequent, its causes very various ; it may have been produced

by a blow or fall in early childhood, which, followed by no immediate result, was hardly noticed, has long since been forgotten, but which, nevertheless, has retarded growth at one of the epiphysal junctions, either of the femur, tibia, or both. The same retardation may have been caused by a more or less transient attack of infantile paralysis, or of epiphysitis. Occasionally the difference is not produced by diminished but by increased growth of one limb. Hyperæmia and hyperplasia about the joint end of a bone not unfrequently follows an injury or accompanies a slight inflammation. Often the history, cross-question as one may, fails to include any such causality, and it may be permitted to ascribe the inequality to some primordial difference in the division between somato-pleure and splanchno-pleure, out of which groove the original limb-buds sprout. We know in reality but little of this last condition ; it is, however, analogous to that which causes the features of some persons to be a little awry, or rather, I would say, which causes the features on one side of the face to be, in most people, just a little larger than on the other. Whichever of these conditions may be the cause, in any one case, the effect is the same, viz. that when the subject stands erect, one side of the pelvis lies lower than the other.

This obliquity influences the spine as follows : the upper end of the sacrum is no longer in the middle line of the body, for the point upon which the pelvis turns while the patient is standing, is one or other of the acetabula—the line connecting these

two cavities is about on a level with the lower end of the sacrum; therefore, when the pelvis slopes, that end of the bone forms, as it were, the pivot on which the higher portions move—towards that side of course, on which the crest of the ilium lies lowest. In other words, the true middle line falls on the lower end of the sacrum; its body and upper end sloping away to one side of it. More important still is the fact that the upper surface of the bone, that on which the lumbar spine stands as on a foundation, is laterally on the slope. The last lumbar vertebra has the lower part of its body so shaped that its axis must lie in a right line with that of the sacrum;[1] but the rest of the column cannot follow this line, because it is possible to stand with the whole trunk slanting (not bending) to one side. Thus the whole body is thrown over to the higher side of the pelvis, a manœuvre which is effected by bending the lumbar spine pretty sharply, with the convexity looking towards the side on which the pelvis is lower. For some considerable but indefinite time this curve is, as already stated, a mere position; neither ligaments nor bones are changed, as is evident from the fact that any means, which will restore to the transverse axis of the pelvis its proper horizonticity, will also restore to the spine its normal rectitude.

The outline, taken very accurately from a photograph, illustrates the former proposition. The

[1] Until the later phases of curvature are reached, when the bone in question may become very much altered in shape.

figure is that of a lad, fourteen years old, who at about two years old suffered from an attack of infantile paralysis, which almost entirely passed off, but left certain muscles weak and others contrac-

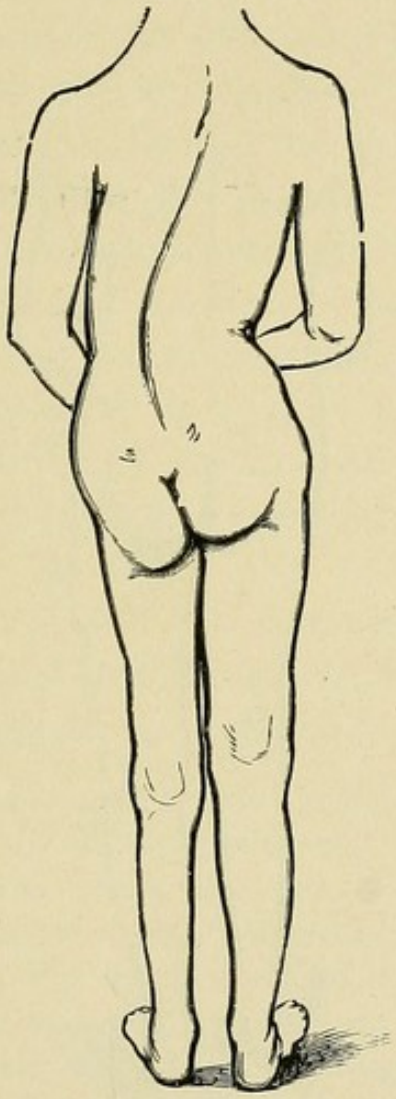

FIG. 7. Permanent Pelvis Obliquity

tured; this latter condition I have remedied, but no art can overcome the resultant deficiency of growth; the left leg is a little more than two inches shorter than the right, and as a consequence the

crest of the right ilium lies very considerably (about two inches) higher than that of the left, or in other words the transverse axis of the pelvis is very oblique. Therefore, the lumbar spine curves to the

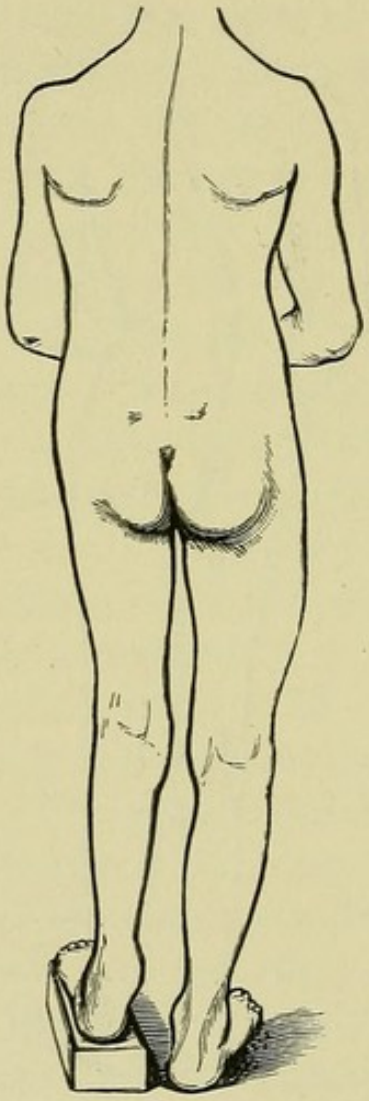

FIG. 8.—Obliquity Annulled.

left; but the curve has been prevented from becoming "fixed" by the care and vigilance of which, under my directions, this boy has been the object for a considerable time. The curve, therefore, has

not been allowed to affect the shape of the bones, nor even the tension of ligaments. The deformity has been kept in the stage of mere posture, forced upon the spine by the position of pelvis. This is demonstrated by the effect produced on this same boy by placing under the left foot a block sufficient to compensate for the shortness of the lower limb (two inches), thus rendering the pelvis horizontal, under which condition the posture of the spine is changed ; it becomes quite straight (Fig. 8).

This sort of oblique position of pelvis caused by some such condition as unevenness in limb-length, by a joint anchylosed in a bent position, simply inflamed and painful, or by any other defect which is continuous in its action, I have named permanent pelvic obliquity. In using the words continuous and permanent it is not my intention to say that such condition must last the whole of life ; many of them can be cured, as for instance :—

CASE I.—Florence H., aged twelve years and eight months, was brought to me 7th of December, 1887, with the following history. About seven years ago the child was observed suddenly to go lame, more especially after any walk a little longer than usual. The neighbourhood of the right hip was painted with iodine, and she was ordered to rest, and was better ; but any little extra fatigue brought back limping, and complaints of dull pain ; sometimes these returned without apparent cause.

The child was fairly plump and strong, but rather pale and with a worn expression. On examining for hip disease, I found doubtful or, at all events, very slight apparent lengthening of the right limb. At the upper part below the antero-inferior spine of the ilium, in front therefore of the neck of the thigh-bone, a swelling about two inches long by one

broad, tender on pressure, obscurely or very deeply fluctuating. All movements of the hip-joint free and painless. She was said to be very lame after walking a little and to suffer much pain. She had no starting of the limb at night, nor any nocturnal pain. I diagnosed an ostitis at the upper and outer part of the femoral diaphysis.

By very careful management further evil was not merely avoided, but she greatly improved, and on 9th May, 1888, it is noted that the child is very healthy-looking, has no pain, and has grown a good deal. The tumour has nearly disappeared; fluctuation in it very doubtful; but the limb is half-inch shorter than the other from lack of growth. There is in consequence, while standing erect, a slight curve to the right of the lumbar spine.

August 28th, 1888.—The right limb is fully three quarters of an inch shorter, and the curvature, when she stands upright without the heightened boot, has increased; but a block under the right foot straightens the spine; she was ordered to wear a boot half an inch thicker on the left foot.

December.—The inflammatory and painful state of the right hip has quite subsided; since the middle of October there has been no sign of swelling. The limb was making up its loss of length—it measured just half an inch short, but I advised her to continue the heightened sole.

August, 1890.—The child was brought to ask if she must still wear the high boot, but I found she had discontinued it in May last. The limb at above date was only a very little shorter than the other. The spine was still a little crooked, but when a block half an inch high was placed under the right foot it curved in the other direction. I permitted her to leave off the heightened boot, and instead to sit for a definite time daily (namely at meals) on a seat higher on the right side. A year afterwards when I again saw this patient she was quite well, both as to trouble at the hip and to crookedness of the spine.

Also that apparently causeless uneven growth of the nether limbs may, indeed often does, rectify

itself sometimes quite early in life, while in other cases only at the cessation of stature-growth, when, as I have frequently observed, the limb that grew quickest ceases its growth first. Yet though the pelvic obliquity and its cause may disappear, the resultant crookedness of the spine does not spontaneously do so, for when once a real habitual curvature is established, the body weight falling on a bent support, and certain other causes to be discussed in the sequel, tend to, and generally do if left alone, increase the curve more and more.

Another cause of a sloping pelvis I have named "habitual pelvic obliquity"; it is the result of a trick, hence frequently varies, although it is sufficiently constant often to produce decided lumbar curve. Many girls acquire the bad habit of standing constantly, or at least very frequently, on one and the same leg, generally the right, and of bringing the other thigh and knee, with very considerable adduction and some inward rotation, in front of the supporting limb. The position is, as I have said, very frequent with girls from about the age of thirteen or fourteen upward to twenty-three or twenty-five. A large proportion of those addicted to this attitude are troubled with too frequent and copious catamenia, and many have pain and tenderness in the region of the ovary, usually of the left one; in others no such troubles exist. It would therefore be improper to say that habitual pelvic obliquity is due to ovaralgia or chronic ovaritis, if we take this phrase to mean direct and constant causation; at the same time I have seen a great

number of cases in which the position of the lower limb and pelvis here shown was concomitant with such disturbance in the pelvic organs; moreover, a goodly proportion of such patients have told me,

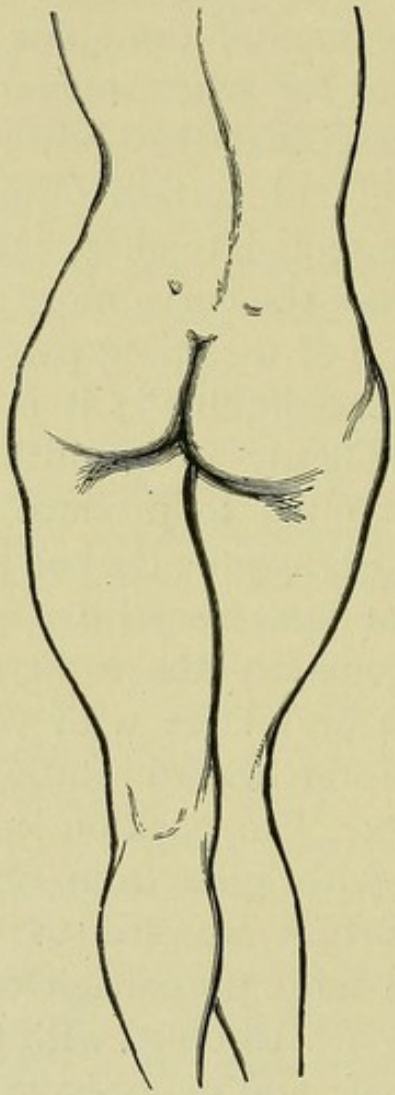

FIG. 9.—Habitual Pelvic Obliquity.

in response to questions, that the posture procured a certain alleviation of the sense of weight and aching at the groin. With the majority of patients, however, the position is a mere trick, which would

not injuriously affect the spine if the side were varied; if, that is to say, the body were supported equally often on the right and on the left limb; such is however not the case; as a rule, the girl stands always or nearly always on the same leg—the mode and pattern of female dress concealing the fault, which the male youth in trousers or knickerbockers would be laughed out of in a week or so.

But there is still another malposture of the pelvis and lower limbs which has not hitherto been observed by any surgeon, and which the use of a gauge, shortly to be described, has enabled me to discover. When that instrument was placed in position against the back of some patients, it was remarked that in a great many the pelvis lay to one side. I do not mean that it is in such cases oblique—it may or may not be so—but such obliquity has apparently nothing to do with the posture I am now endeavouring to explain, which is a total and bodily shifting over of the pelvis (oblique or horizontal) to one side, viz. to the left in the ordinary form of curve. This amesial condition may, as I shall show hereafter,[1] amount to an inch or more. Such position of pelvis connotes of course that the lower limbs are out of the perpendicular, that traced from the heels to the hips they slope to the left. It appears to me that this peculiarity has escaped notice because of a natural dislike both on surgeons' and patients' part to stripping the whole figure; but my instrument pointed out to

[1] Refer to Fig. 10, p. 33.

me without that unpleasant expedient this condition of things. Nor was I satisfied with the indication thus afforded: the entire novelty of the subject, and the fact that my gauge was also new produced in my mind a certain scepticism. I therefore always made use of a plumbline, and found that when my gauge, *i.e.* my scoliometer, gave this indication the lead invariably confirmed it. The position in question is in purely lumbar curves rather unusual, more common in simple total, and in the S curve is, as a rule, present, though its amount bears no very definite ratio to the severity of the dorsal deviation. In this form of curvature it has long been remarked that the upper segment of the trunk appeared not merely bent, but shifted over *en masse* to the right.[1] The aspect of such a back is not that of sloping or leaning over, but of being displaced in bulk, of being on a different axis to the lower segment. The matter may, perhaps, be more readily explained by comparing a mere slope of the spine to the usual obliquity or undulations of the earth's strata, and the appearance now attempted to be described to that sudden break or shifting of the strata which geologists call "a fault;" such shifting, or fault, affecting the pelvis and three or four of the lower lumbar vertebræ. The annexed diagram represents such condition. It was sketched rapidly from life, or rather the principal landmark was rapidly filled in and the sketch completed afterwards. The

[1] In this description the more usual form of curvature, dorsal to right, lumbar to left, is taken as the model.

straight dotted line represents the plumbline which was suspended from the last cervical vertebra. Had

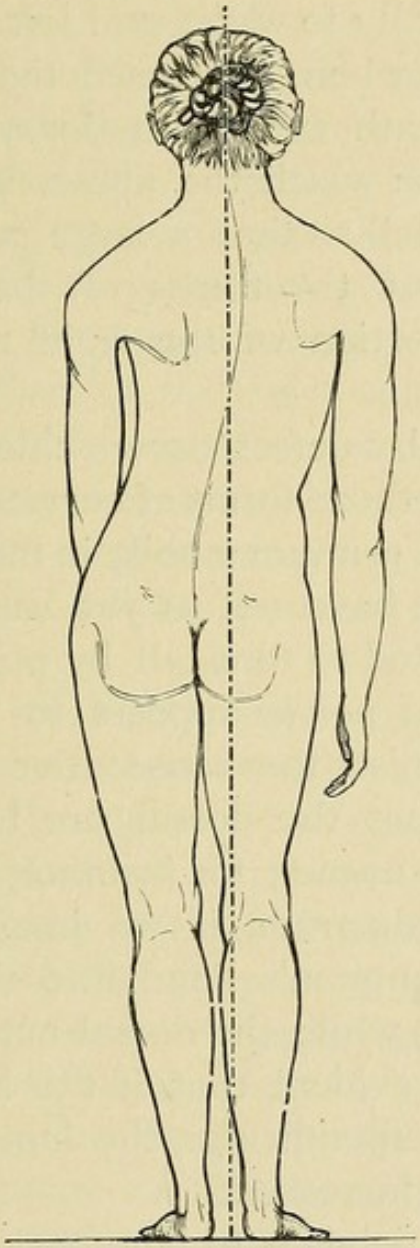

FIG. 10.—Amesial Pelvis. The Vertical Line has been unfortunately placed a little too much to the right.

the figure been straight it would have hung midway between the lower limbs, passed over the *rima natium*, and corresponded with the line of the

normal spine ; or had the spine alone been curved but the pelvis mesial, the two former conditions would have subsisted and the spine would have undulated equally to right and left of the plumb-line, the point where it crossed the column being between the ninth and tenth dorsal vertebra. In the woman from which the above figure was taken the plumbline fell so that a large part of the back and loins, about two-thirds of the pelvis and a considerable portion of the right thigh, lay to its left.

This particular defect occurs chiefly, though not quite solely, in those forms of curvature which have their origin and primum mobile in the dorsal region. Although these have not as yet been described, I may be permitted to forestall by pointing out that this position of pelvis appears to be assumed in order to minimise the consecutive lumbar curve, which, supposing the dorsal arc to be constant, must otherwise ensue ; for instance, referring again to the above diagram, if we imagine the pelvis pressed by a surgeon's hand into the middle line (the plumbline) while the dorsal curvature remains unaltered, it is evident that, if the head is to continue on the perpendicular, the lumbar curve must be by so much increased.

The amesial pelvis is to be occasionally observed in those young people who have been accustomed to sit in a bad position, namely in that given in Fig. 6, and in similar ones which affect the upper part of the spine (dorsum). Of course such a wry posture is quite easy while the child has a table

or desk to lean on, but on standing erect he cannot abrogate it without discomfort, and yet must provide for balance, and the easiest way is to shift the pelvis to one side. One other point with regard to this position of pelvis must be noted. In a future chapter it will be shown that the total, simple curve often somewhat suddenly changes into a S curve. The moment of this change corresponds with an equally sudden assumption of an amesial position of the pelvis. The obvious reason of the sudden change in the form of the curve is the low position in the body of the centre of gravity, which must be shifted to one side as soon as the total curve reaches a certain degree of severity. The lateral displacement of pelvis procures this necessary displacement.

Many curves of the dorsal region commence in rotation of the vertebræ brought about by certain actions, thus: The habit of carrying weights continually on one and the same arm—the amount of weight being of less importance than the length of time during which it is supported—that is, a heavy weight carried for a few seconds, and on rare occasions, has less influence than a lighter but still notable load carried frequently for long intervals. The greater stress of the burden falls on the glenoid end of the scapula, which is chiefly supported by the serratus; thus also in these curves, that muscle, with its so often mentioned rotating effect on the ribs, is a large factor in producing the deformity;[1] but besides this, in order to

[1] See Appendix V.

counterbalance the load by some of the body-weight, the erector spinæ of the opposite side is brought into play, and the dorsal spine is curved towards the side of the burden, so as to bring the column more immediately under the burden.

This is the reason why in the class of girls or young women who attend hospitals or are inmates of homes we find a considerable portion with left dorsal curvature: much of their early life has been employed in carrying their younger brothers and sisters on the left arm.

Also among this class of patients there are a very much larger percentage of rickety cases than among the well-to-do, and I have noted that most rickety dorsal curves are to the left. Part of the preponderance in that direction of these curves may be accounted for by this carrying, while very young, of infants; but it appears to me that the rickety tendency to left dorsal curvature is larger than can be thus explained. Also curves of a peculiar and unusual form are generally of rachitic origin, such curves as are low, beginning about the sixth dorsal vertebra, and take a sudden outspring to the left, returning almost as suddenly to the middle line.[1] Curvatures which implicate solely the upper four dorsal and the two lower cervical vertebræ are very rare, and very possibly originate in a slight degree of torticollis which has been neglected.

It may and occasionally does happen, that even so late as some time between the fourteenth and seventeenth year the pelvis of an individual be-

[1] Hunterian Museum, Pathological series, No. 2,099.

comes oblique either from permanent or from habitual causes (see p. 25), in which case the result —the curvature—affects primarily and principally the lumbar portion of the spine, but it is far more common that curves of this later period take a very different course. The period coincides with a life-phase, when the girl begins to lay aside childish things, when she puts up her hair and takes to graver matters, such as high, narrow heels, placed almost under the middle of her foot, to tight, stiff corsets, and other such solemnities. And it is a fact that almost all the curvatures beginning at this period of girl-life are dorsal to the right, and are firstly and principally marked by the symptoms of rotation, betraying themselves as a rule, to mother, dressmaker or maid by a thickened and heightened right shoulder. Not only is rotation the first and most notable sign, but is the cause of the lateral deviation. These two indeed are simultaneous, as throughout nature many effects are, or appear to our limited senses, simultaneous with their cause. Rotation of this sort and at this part of the spine is produced by the serratus magnus muscle,[1] called into excessive activity by the prevalent love for wasp-like waists, over-riding, and throwing out of play that which should be the chief breathing muscle—the diaphragm. There is no other way of accounting for the absence of this particular curve in hot or barbaric countries, where tight clothing is not worn, nor for the constancy (weight-bearing and rickety cases excepted) of dorsal curves to the right.

[1] See Appendix V.

A danger to which many young girls are exposed lurks in a spurt of over-rapid growth. It is impossible to account for the variable times of life at which young people chiefly grow. Some do so between ten and thirteen, while others wait till after fourteen, and not a few till the sixteenth year has been reached. Unaccountable as this choice of period may be, it certainly is hereditary from the mother, both sons and daughters following her, and not the father's, example. If there be abundance of vital power, no evil follows, but if this be deficient, or if the bodily powers be overtaxed by such rapid growth and the mental by hard study, if the subject become anæmic, languid, and constantly fatigued, the spine is very apt to assume a curve. Boys as well as girls may thus suffer, but they do so rarely, because they are not over-weighted with another function. If the period of over-rapid growth coincide with the time when the uterine functions begin to act, the danger is greatly increased, and it is an unfortunate fact that nearly all these fast-growing adolescents suffer from too profuse and too frequent menstruation, with abundant leucorrhœa in the intervals. All these conditions combined produce a feeble, languid condition of the muscles; those of the back find the task of upholding the trunk too severe, therefore they, avoiding fatigue, put the vertebræ in such positions as to enable their ligaments to assume part of the necessary work. To attain this end, the bones must be thrown into a crooked position in order to put those fibrous structures on the stretch,

and this crookedness must almost of necessity, in point of fact it always does, take place in two different directions, one at loin, the other at back. The two are simultaneous ; hence when this over-rapid growth combined with weakness causes deformation, the curve is S shaped. Neither the upper nor the lower is primary and neither is consecutive. The constitution of the ligaments, moreover,[1] thus set to work adds to the mere lateral deviation the inevitable rotary deformation.

[1] See Appendix VI.

CHAPTER III

DIAGNOSIS

THE reader will observe that in the foregoing, as also in this chapter, certain subtle, but quite appreciable, changes of form are described. No surgeon is likely to overlook a well-marked and fully-developed curvature; but when the fault has attained to such degree, has become striking and self-evident, it has already advanced far enough to render its cure protracted, and indeed to lead in many ways to serious evil. Thus I am led to speak of the three stages of lateral curvature.

FIRST STAGE.—As was shown in Chapter II., the trouble may begin in merely bad and awkward habits of sitting at lessons or at other avocations, or may be a posture, which, when the pelvis is oblique or other already-mentioned causes exist, is forced upon the spine by the necessity of equilibrium. It is therefore, until quite the latter end of this stage, due simply to muscular action. The clinical signs[1] will be more fully described imme-

[1] In this place only clinical conditions are mentioned; for the pathological anatomy of the three stages, see Appendix VI. and VII.

diately; here it need only be said that the line of the spinous processes is as yet quite straight. Crookedness of the figure, which nevertheless is quite perceptible, is capable of complete, though only temporary rectification by the patient's own efforts, even in the erect posture (until towards the end of this stage), also by recumbency or by restoring horizontality to an oblique pelvis (see Figs. 7 and 8), also by pressure with the surgeon's hands. As this stage goes on, if the patient get worse, that which hitherto was merely her position becomes her shape; the above means cease to rectify completely the condition. Then begins the SECOND STAGE, in the early part of which the line of the spinous processes is still as a rule straight, or may have so slightly deviated that the surgeon finds great difficulty in deciding whether it be crooked or not; yet asymmetry of the figure, such as will be described immediately, is very evident. No effort on the patient's part can do more than very slightly, a little later cannot at all ameliorate the condition; neither recumbency nor suspension produces any great change; pressure with the surgeon's hands makes only a certain difference. At the latter part of this stage, when the line of the spinous processes begins noticeably to deviate, such pressure will restore the straight line, but will not greatly, even if it do at all, modify the general asymmetry. By this time, if the deformation have commenced in only one region (dorsal or lumbar), the other portion of the spine will have participated, but in the opposite direction—the S curve is formed.

The THIRD STAGE cannot be distinguished by any sharp line of demarcation from the above; the curves are almost immovable by pressure with the hands. The advent of changes in the shape of the bones is to be judged by observing that the angles of the ribs become sharper on the right, more obtuse on the left side, also by noticing that on the left side of the loins the prominent line, there formed, becomes harder and less resilient, even under strong pressure. In rather severe cases the tips of the transverse processes may be felt on deep palpation just at the edge of the protruding line (the sacro-lumbalis).

Hence, as many, though by no means all lateral curves begin, not in both places at once, but either at the loins or at the back, it now becomes necessary, for simplicity's sake, to speak separately of lumbar and then of dorsal curves. It will be evident to one who considers the condition of the first two stages, that the earlier be the detection of curvature, the more easy and rapid will be its cure, provided suitable means be used. We have mainly in the earliest phase to do only with a faulty position. But a curvature is not often so rapidly detected. As a rule the nurse, or more often still the dressmaker, finds that she has to cut the skirt longer, in order to make it "hang even," or the bodice bigger, on one side than the other. The mother inspects her child's shape, and after an interval a medical attendant is called in. The earlier that this happens the better, but the more difficult will be the detection. This will serve as my excuse for

dwelling on the very A B C of the subject, and for pointing out, as occasion may serve, a few circumstances, which in my experience most frequently lead to error.

Patients in the infantile stage, or in the quite early part of the second phase of child-life, had better be entirely stripped—even the boots should be removed. The more necessary is it to be very gentle with these little creatures, to gain their full confidence, otherwise terror, undefined distrust or shyness will cause them to wriggle their flexible bodies, making the real form and condition quite undiscoverable.

In further advanced life other causes may render patients who have to remove parts of their clothing very fidgety, and then, too, it is most necessary to gain the confidence of the patient and as far as possible to eliminate any sense of shyness that may make her restless and unquiet. Having removed outer clothing and stays, she should be placed with the back to a window—cross lights and misleading shadows being avoided—the hair must be turned up and secured to the back or top of the head, the arms taken out of the chemise and underclothing, which must then be dropped to a level with the trochanters, just exposing the upper end of the rima natium. In order to prevent any anxiety as to these parts of the dress falling lower—an anxiety which causes embarrassing movements of both upper and lower limbs—the garments may be secured by passing round the pelvis and fixing by hook and eye a narrow (three quarters of an inch) band of elastic

webbing. The patient must be enjoined to stand with the feet together and the knees straight; but a mere precept is insufficient; the surgeon should pass his hands in front of the knees, outside the remaining clothing, to make sure that his request has been complied with. He then falls back a step or two, keeping straight behind the middle of the patient's back, which he now regards as a whole. Even now he should linger a little before coming to a decision, for, as previously said, the child can in this stage correct by her own effort the faulty condition, and she always does so for a little time; but soon fatigue comes on, and the back, straight at first, may be seen to almost suddenly collapse into its abnormal curves.

It must be permitted me to point out to those who are only occasionally called upon to make these examinations that a very common method is to at once pass the finger along the line of the spinous processes, and, if it be found not markedly and obviously crooked, to declare that there is no lateral curvature. A vast number of cases have been and are still being overlooked, and their treatment unfortunately postponed, owing to this prevalent error; for it must be remembered that owing to the direction of rotation this row may be quite straight, while, nevertheless, a considerable lateral curvature exists.

No! in order to detect a curvature, the surgeon firstly directs his attention to all parts of the dorsal aspect *except the spine*, and should avoid touching the patient until points about to be mentioned have

been investigated, such contact being apt to call forth uneasiness, one-sided muscular action, and other misleading conditions.

The surgeon should at first study more particularly the side outlines of the figure, and, if he have before him a case of primary lumbar curve to the left, he will see that this outline is very different on the two sides. On the right (concave side) the upper half of the trunk, which I will call the thoracic segment, has a rather full rounded outline, especially below, where it takes an increased inward direction to meet the outline of the lower half or pelvic segment at a well-marked angle. From this angle, or what we had better term the incavation of the waist, the line of the pelvic segment runs outward, more or less abruptly and decidedly, according to the severity of the case, whence it follows that what is commonly called the hip, but is of course the crest of the ilium, appears to protrude. If the pelvis be horizontal this protrusion is merely an appearance due to the soft parts having fallen into the space deserted by the transverse processes, they and the spinal muscles being carried forward by the rotary deformation. If the pelvis be oblique some of the projection at the hip is real.

The side outline on the left side varies a good deal in different cases; in some the incavation of the waist has almost, in some has entirely disappeared. Especially is this the case in young children; in others, though much less than on the right, it remains still marked.

Much of this variety depends on the degree of

tightness of the stays. In all cases the side outline of the thoracic segment is less rotund than on the right, and sometimes forms a concave line.

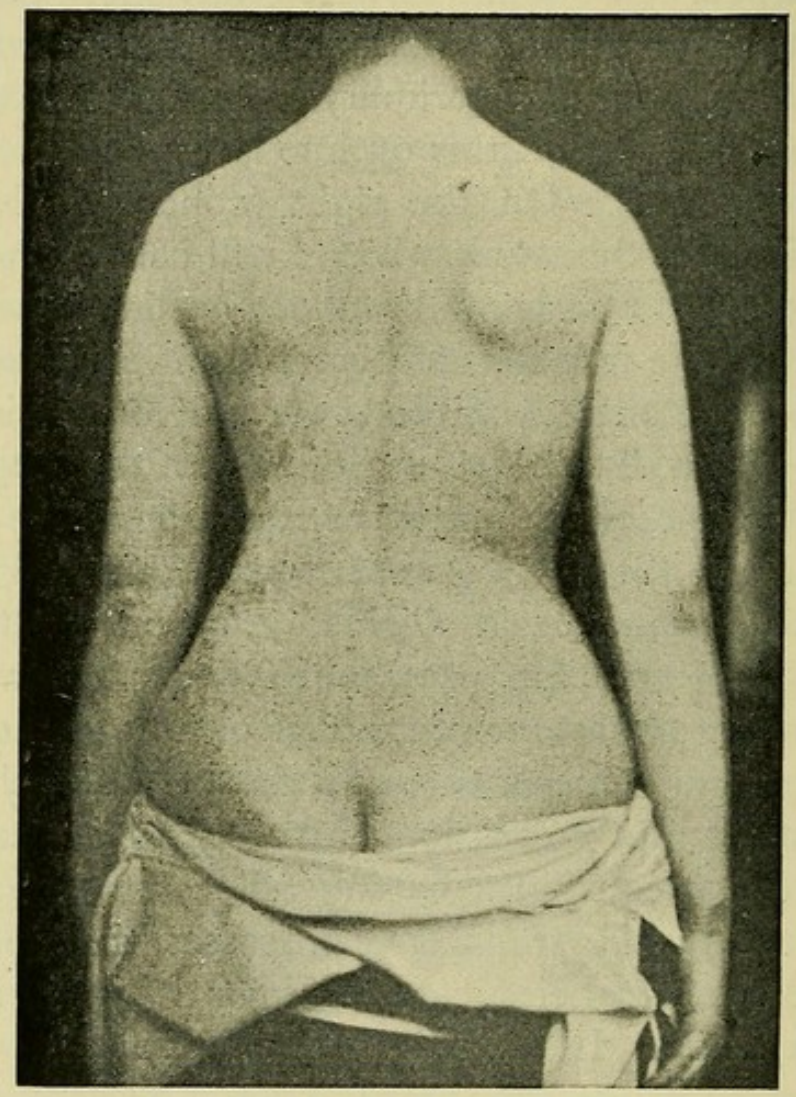

FIG. 11.—A Lumbar Curve to the left.[1]

On the surface of the back are also differences between the two sides; on the right, running from

[1] In this case there is also a commencing consecutive dorsal curve but it is the most characteristic example I have from which to demonstrate lumbar curvature to the left; the height of the scapula depends here in great part on

the entering angle between upper and lower halves of the figure, towards the spine, is a depression which marks itself out in a somewhat triangular shadow, the lower edge of which corresponds to the crest of the ilium. In many, especially in thin patients, that bone may be felt as a ridge on the lower boundary of the shadow. This depression appears to continue onward the incavation of the waist towards the middle line. In thin persons one may plainly see, that on the right of the lumbar spinous processes the parts are less full and rounded than on their left. Both these appearances are due to rotation; the right transverse processes, having moved forward, allow the unsupported soft parts to become depressed. At the earlier period of lumbar curve, when as yet no secondary dorsal curve has arisen, the surface above the tenth dorsal vertebra is symmetrical; but with this curve a forward stoop (kyphosis) of the dorsal spine is very often combined.

It seems well, in order that the reader may contrast one with the other, to subjoin here a figure of lumbar curve to the right. It is a better example of lumbar curve pure and simple than the preceding figure. The words which in regard to the previous illustration concerned the right side must now be transferred to the left. By carrying the eye as quickly as possible from one figure to the other a better idea of the deformation can be ob-

involuntary lifting of that very mobile bone at the moment of photographing; it is, however, also a little raised by the dorsal curve.

tained than by regarding one only. This lady only came under my care after the deformity had lasted a good many years, and she is no longer a girl The photograph also permits me to point out a condition which may be used to assist the eye. If

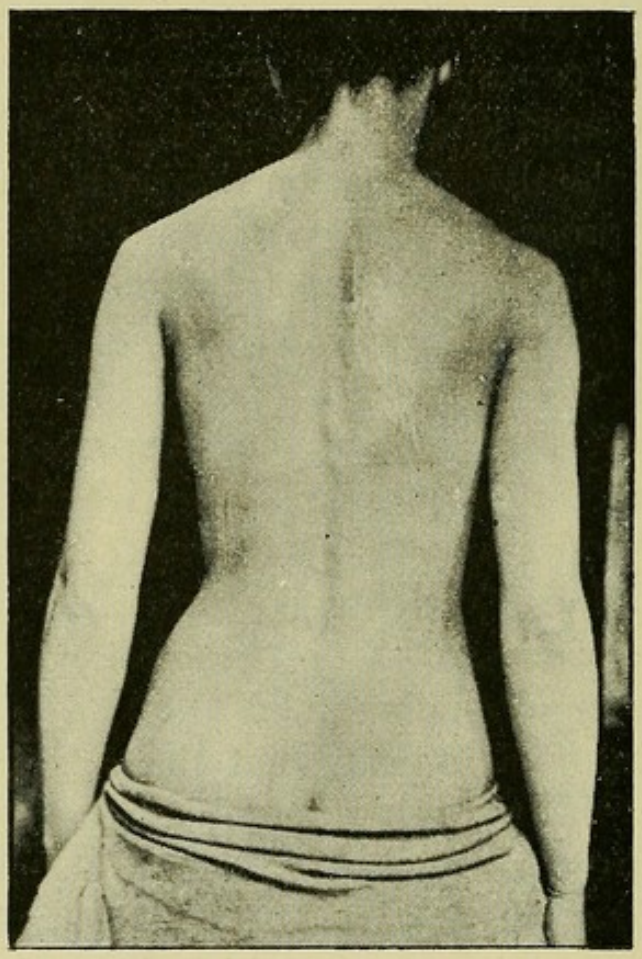

FIG. 12.—A Lumbar Curve to the right.

the patient hold the arms symmetrically[1] on her hips, it will be observed that triangular spaces are

[1] In the previous figure the patient did not hold her arms as directed ; in the one now referred to they are so placed, but the sleeve of the vest conceals the left hand.

left between them and the side-outline of the body. On one side (the concave) this triangle is much deeper than on the other, that is to say the measurement from the inside of the arm to the incavation of the waist is much longer on that side which is, or which will soon become, concave. Thus the space between the arm and the figure is bigger on one side than on the other.

Having observed all this by eye merely, without touching the patient, the surgeon should next investigate the straight or oblique position of the pelvis. In nearly every room there are certain horizontal lines which may be used as guides, such as the edge of a dado or wash-board, the straight side of a table or other piece of furniture. The patient may from the first be placed opposite, though at some distance from such a line ; the surgeon, being behind her, places the forefinger of each hand on the crest of the ilium on each side, and by stooping, kneeling, or sitting, as the case may be, gets the horizontal line on a visual level with one of his fingers, and then observes whether the other be also on that level, or whether it be higher or lower ; in the latter case he will find that the lower side is always that of spinal convexity, the higher of concavity. In some such instances, and in the case of young children, it is unobjectionable to let the garments fall a little lower, in order to observe the direction of the intergluteal fissure, which will be found to slope from below upward and towards the low side of the pelvis ; the sign is not essential to, but is confirmatory of, diagnosis.

The surgeon should next proceed to compare by touch the condition of parts on each side of the lumbar spinous processes, and will find that the somewhat depressed, or at least not prominent, part on the right is not exactly flaccid, but is at least considerably softer and more yielding than the elevated part on the left. This does not arise from muscular contraction, but from rotation of the vertebræ, which on the left (convex) side brings the transverse processes nearer to the surface, and thereby not only affords a firmer substratum for the muscles, but also brings hard, bony parts nearer to the investigating hand. At the same time the transverse processes on the right (concave) sink deeper away from the surface, thus withdrawing their support from the superjacent parts, which therefore become soft and less resistant.

And now, last of all, the surgeon may feel for the line of the spinous processes. In the less advanced cases, in which, nevertheless, the asymmetry just described is perfectly evident, he may not be able to verify any deviation. In other cases, in which the variation between the two sides is a little more strongly marked, the series of spinous processes may be traced as forming a very slight curve.

The diagnosis is now completely made out as far as the existence of lateral curvature is concerned, and as far as the unassisted senses will carry us; but the degree of rotation, of lateral deviation and of pelvic obliquity, has not yet been measured, nor has the presence or absence of amesiality of the

pelvis been verified.[1] This can only be done by one of the several instruments for the purpose. I believe my scoliometer, described in the ensuing chapter, to be far less expensive, much more easily used than any other and to be at least as accurate. Technical application of the instrument will be deferred for the present.

The total simple curve is distinguished from the above class of case by variations in the appearances, which may cause some difficulty of interpretation to any one little versed in this sort of examination, I place here close together for the sake of easier comparison two figures, the former that of a girl about seventeen years old with a total curvature to the left, the latter is that of a young man aged nineteen with the same deformation to the right; the scapula of that side, however, protrudes a little more than is usual in that amount of curve. Concerning these two I would simply remark that the conformation of the thoracic segment on the left of Fig. 13 is almost identical with that on the right of Fig. 14. Difference of sex renders comparison of the pelvic segments difficult. These observations on the above plates will suffice here, because it seems to me better to take my description of total

[1] To measure lateral deviation in the loins by a plumb-line let fall from the vertebra prominens is almost impossible, unless the spine have entirely lost its antero-posterior bends, for the line so placed is distant some inches from the skin in that region. In former years, that is before I devised the scoliometer, I placed my patient opposite a single window or a strong lamp, and used the shadow of the cord as the true perpendicular.

curve from a more marked example (Fig. 15), that of a child aged 6. The pelvis is oblique. Noteworthy is the slope of the rima natium from below upwards to the left. The side outline of the pelvic segment is on the right a long full curve; on the left two curves; the incavation of the waist,

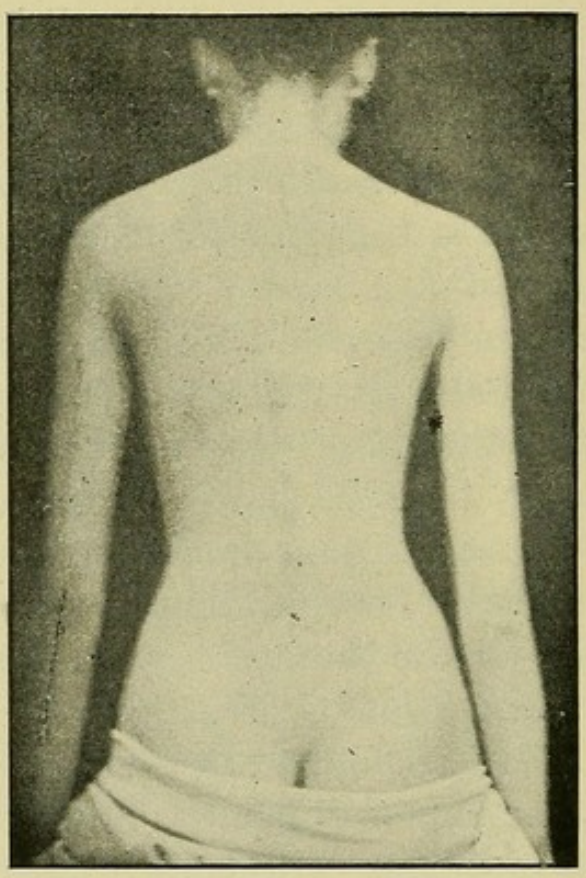

FIG. 13.—Total Simple Curve to left.

higher on the right, is also deeper. The outline of the thoracic segment is on the right concave: on the left convex, and meets the lower segment with hardly any incavation. On the surface the back is hollow and meagre on the right, full and rotund on the left; the right shoulder droops. The upper

outline of the shoulder, the line that leads from the setting on of the neck to the acromion, is short and round on the right, long and straight on the left. Had the child kept her left hand as near her body as the right a difference in its mode of springing from the chest (see p. 62) would have been much

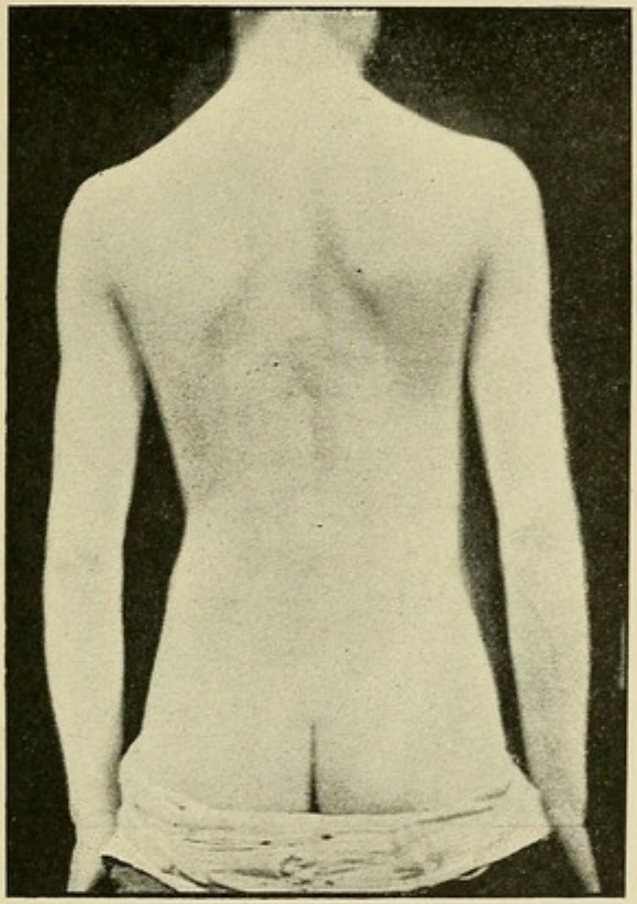

FIG. 14.—Total Simple Curve to right.

more noticeable. Even now it can be observed to be closer and more concealed by the upper part of the thoracic side outline than it is on the other side.

Curves in the dorsal portion of the spine are in many points of view more easy of diagnosis. They usually betray themselves to mother, nurse, or

dressmaker by an appearance commonly called "high" or sometimes "thick" shoulder. This is produced by that condition already so often mentioned, "rotation of the vertebræ," a movement in which the ribs participate.[1] In the Appendix it is proved conclusively, that this rotation is not,

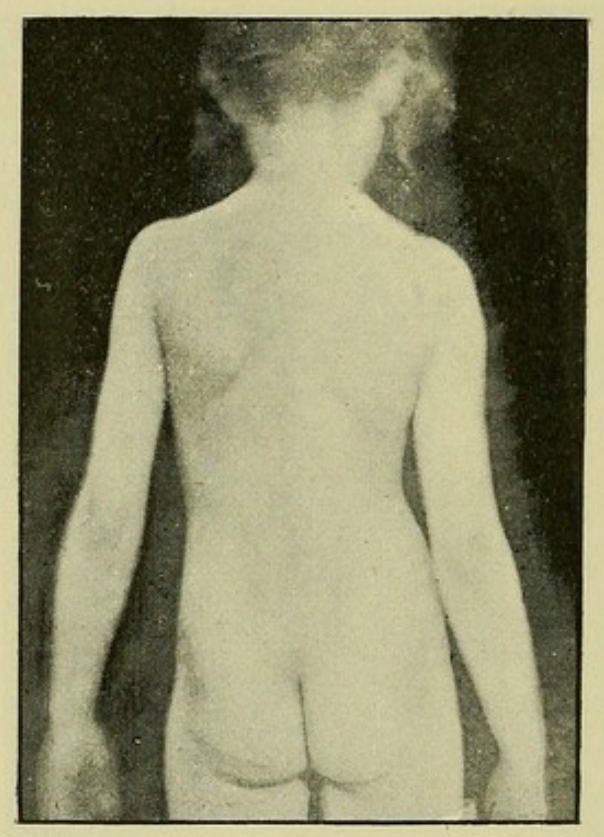

FIG. 15.—Total Simple Curve to left with Oblique Pelvis.

in the dorsal region, a primary movement of the vertebræ, which carries the ribs backward, but that the ribs being thrown back by certain fully explained forces, rotate the bones of the spine. In the loins one difficulty of detecting rotation is the shortness of the indices of such movement (the

[1] See Appendix V.

transverse processes), while in the dorsal region the ribs, by virtue of their greater length, indicate such rotary displacement, by displaying in a much more perceptible manner the resultant asymmetry of the back, that is to say not of the column itself, but of the parts subtending it on either side. Let it be remembered that in the usual form of dorsal curve the right ribs travel backward, the left ones forward,[1] hence results protuberance on the one side of the back and flattening on the other, accompanied by changes in the side outlines. These parts, and not the curve, if any, of the line of the spinous processes should first claim the practitioner's attention. Neither should the asymmetrical position of the shoulder blades, although the first thing to excite the attention of nurse, dressmaker, or mother, obtain from him, at this stage of his examination, more than its due share in a general survey of the figure. He will then note that on the right the side outline of the thoracic segment is, especially about its middle, somewhat round and full, and meets the pelvic segment at a fairly well-defined angle, from which runs inward a somewhat triangular shadow with apex at the edge of the sacro-lumbalis muscle, or even a little nearer to the spine. Thus the soft parts above the edge of the pelvis, being drawn somewhat inward toward the middle line, give to the lower segment of the figure an appearance as though its outline were fuller and rounder than that of the other side. The left side outline of the upper segment is too straight, or may indeed at

[1] Intrinsic changes of form of those bones come hereafter into consideration

this stage be concave; it meets the pelvic division in a gentle semi-lunar curve; indeed, the incavation of the waist, that which in French is called the cut (*taille*) is in some cases all but lost. The outline

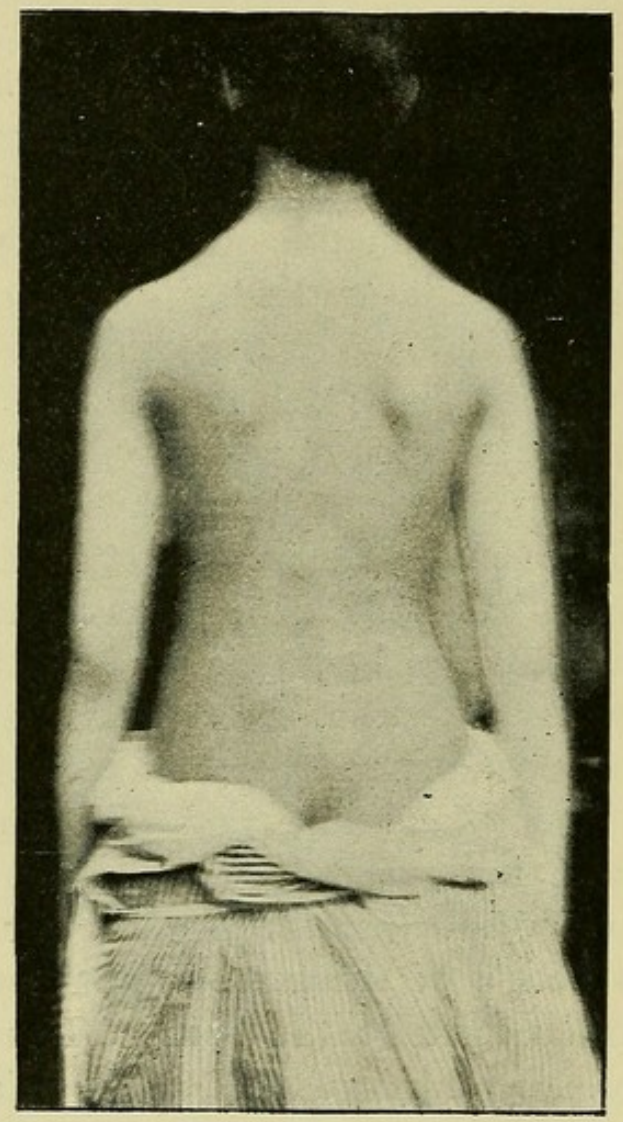

FIG. 16.—A Dorsal Curve.

of that lower part of the body looks, unless all the upper portion be excluded from view, a good deal smaller than on the opposite side. The arms, if allowed to hang straight and symmetrically by the sides, form guides to the eye in the same way as in

lumbar curve, but in addition their mode of springing from the shoulder should be noticed. Further on a figure showing this point much more markedly is given. Even in this less severe curve one may see that the right seems to arise close to the trunk, the left a little way from it.

The surface of the back is altered in a way that is very diagnostic; the whole right half is rotund and full—especially is such rotundity marked a little less than midway between the line of the spinous processes and the side outline. In length, from above downward, it reaches from the top of the shoulder to near the upper edge of that depression marked by a triangular shadow already often mentioned. In the earlier phases of the curvature its shape is that of the normal curve of the ribs. On the left side those parts which on the right are protuberant assume an exactly contrary form; they are depressed, and give the idea of a hollow, though here, too, at first the shape of the bones remains for a time normal—their position only is changed. The investigation of these effects of rotation may be greatly aided by standing on one side of the patient and bending the head over so as to look with one eye down the back, as one looks along a gun barrel. The eye should be on a level higher than the vertebra prominens, and of course, if the patient be too tall, the surgeon may mount on a footstool. Thus looking down the spine, he is to fix his attention, not so much on the spinous processes as on the parts to the right and left, comparing one with the other at different levels, which he can command by moving his head further

backward or forward in reference to the patient's body. He will then be able to estimate the relative distance, on each side of the base, of the scapula from the spinous process; the relative protuberance of parts between those points of bone and the amount of backward projection of the whole right side. When, many years ago, I drew attention to this mode of examination, I made careful outlines of patients thus looked down upon. The diagrams annexed are taken from those drawings. The upper one is from a symmetrical figure, the other four show, in increasing ratio, the backward projection of the ribs on the right of the spine (convex side) and the flattening on the left (concave side), also the gradual movement of the scapulæ outward.

The projection of the whole right side by rib-rotation can of course be seen by looking simply from behind at the patient's back; but the condition is often either masked or exaggerated by the position of the scapula. In the ensuing paragraph the change of place forced upon this bone by the altered position of the ribs will be described, but it, indeed the whole shoulder girdle, is very movable, and a young person may have a frequent habit of "hunching her shoulder," or it may be a mere posture of the moment produced by shyness or chilliness. Hence, a mere lifted shoulder must not be mistaken for a curvature of the spine, nor must the contrary error be made. When the surgeon has any doubt on this point he, having noted whether or no the lower angle of the bone project, should request the patient to lift her hands straight

up and clasp them above her head. This eliminates for the time the scapula altogether from diagnostic survey, and also bares the previously

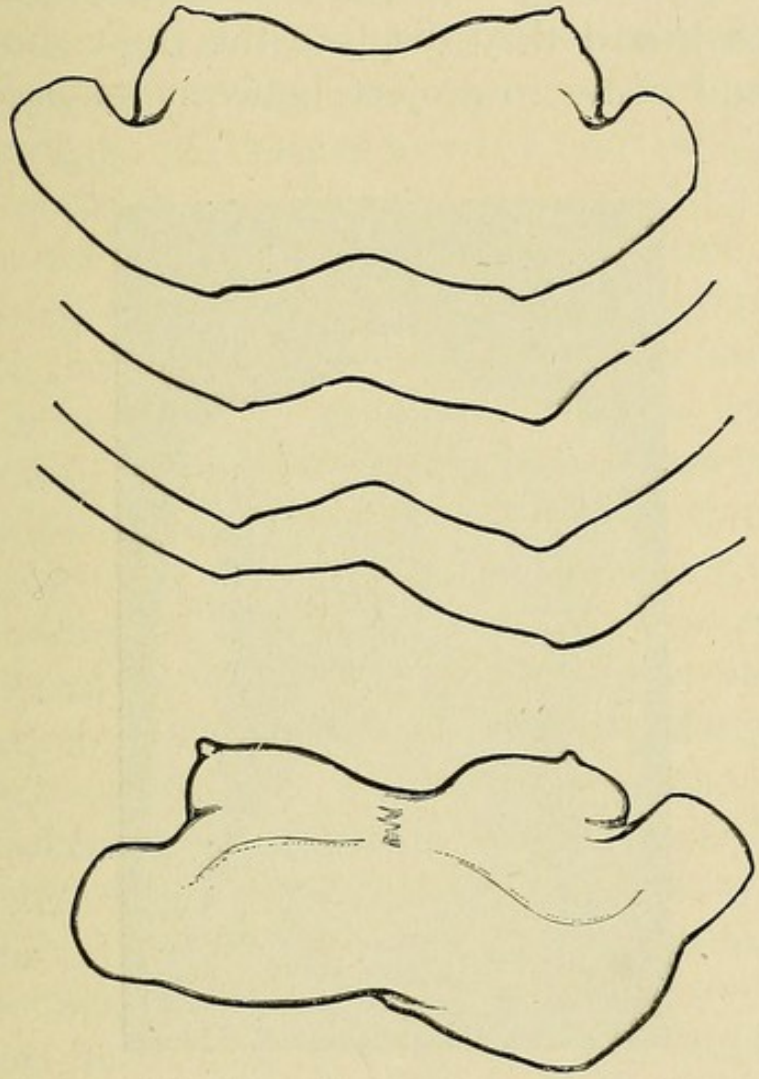

FIG. 17.—Diagram of Rotation. The chest, back, and shoulders are seen from above ; the head is omitted, as being in the way of this view. In the middle line of the back is the groove where the spinous processes might be felt, outside this is the posterior aspect of the thorax, a little further out the projection is the base of the scapula. The line beyond is the dorsum of that bone.

hidden parts of the upper ribs, whose relative backward projection on right and left can now be compared without the ambiguity that scapular faulty posture may involve.

The changes in the position of both scapulæ may now be studied, and for this purpose it is better to illustrate the position by a case more advanced than the preceding. As the ribs on the right side move backward they displace the right shoulder-blade, and come to project between its base and

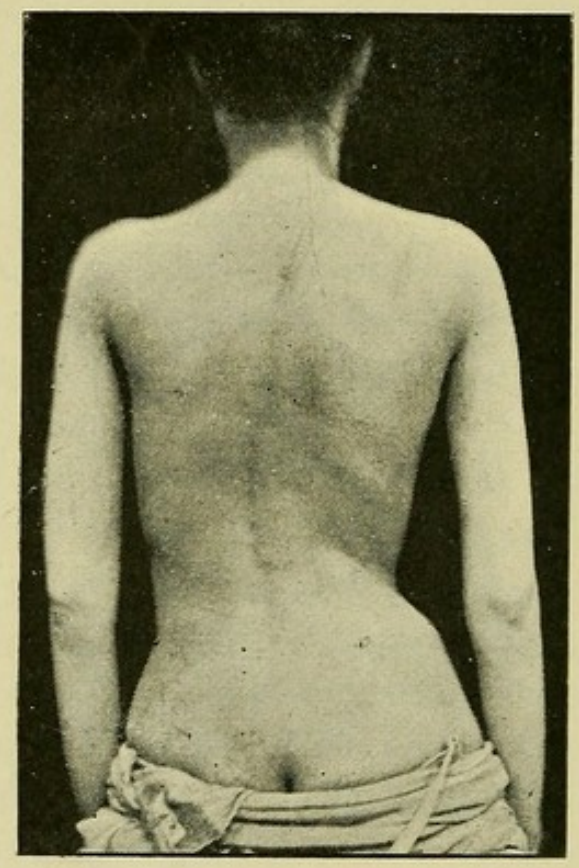

FIG. 18.—A more advanced S Curve.

the spine, the consequence of course being that the scapula must choose another part whereon to rest. It glides therefore outwards, *i.e.* further from the line of the spinous processes, and, in reference to the chest, lies more on the side and less on the back of that cavity. Moreover, since the right ribs

are constantly becoming more protuberant, they push back the lower angle of the shoulder blade and cause the whole bone, not only to be higher up on the chest wall, but also to be more horizontal, that is to say, to lie with its dorsum looking too much upward. Just the contrary takes place on the left side ; the ribs fall forward, and the left blade-bone must follow or lose the bed on which it lies ; but to follow, it must change its position by approaching nearer to the spine, sinking lower on the thorax, causing its dorsum to look too directly backward or even a little down (see Fig. 18), letting its base move more forward, the glenoid cavity more backward. In fact both scapulæ change, not merely their place, but also the direction of their surfaces and borders. The results are a right shoulder heightened by upward and thickened by backward projection, a left shoulder drooped and flattened by contrary conditions. To see these changes while still nascent in an early case is not very easy to an unassisted eye, because of the subtlety of the surface modelling ; but if the surgeon place simultaneously and symmetrically the palm of each hand on the scapulæ, he will perceive at once that the back of his right one looks too much outward and upward, that of his left one too directly back, *i.e.* not sufficiently in the two first-named directions. Viewed thus, the differences in even a slight case are well marked. Now also he should observe—measure if he will—the distance of symmetrical points of each base from a given spinous process, say the fifth dorsal.

This blade-bone position produces another asymmetry well worthy of note. Though in some early cases it is barely perceptible, in all severe cases it is strongly marked (see Fig. 19), but the patient must be kept from fidgeting with her hands. I allude to a difference of the manner in which the arms hang from the shoulder. On the right side it springs from very close to the chest; it is, if I may so call it, sessile. On the left the shoulder seems to stand out—to project—and the arm hanging from it to be pedunculated. The same idea might be expressed by saying that the right axilla is narrowed, the left one breadthened. A further result of the scapular position, assisted often by amesial pelvis, is somewhat singular. The arm (the right) that lies closest to the chest is least close to the pelvis, in fact may hang free of it. The other either rests on the "hip-bone" or hangs in front of it. Again, the contrasted postures of the shoulder-girdle bring the glenoid cavity of the right side forward and throw the left one back. Hence if one places the patient's hands, palms in contact, with elbows straight in front of the sternum, the right fingers protrude beyond the other ones—that arm in fact appears longer than the left. This was shown me by Dr. Murray, of Newcastle, when he was good enough to bring to me a young lady for treatment. He told me at the same time, that when suspecting there might be in any patient a dorsal curve, he formed by this test a conclusion as to whether it was desirable to bare and examine the back.

Having now thoroughly investigated the asymmetry of ribs, blade-bones and loin, the surgeon may turn his attention to the line of the spinous processes. I have reserved this matter to the last because, in fact, it should be the last, to which attention should be directed, and is also the last to manifest itself, the point on which diagnosis can be least securely founded. The term "lateral curvature" is in so far unfortunate as often misleading those, who have not especially studied this subject. Thus a very well known, largely practised and scientific man was (I believe he has now given up practice) accustomed to make the patients stoop forward that the spinous processes might project, and if they were not markedly deviated, to say nothing was wrong ; this, even, in spite of pronounced asymmetry.[1] No one with any sense of form could for a moment ignore that the girls from whom Figs. 11 and 13 were taken suffered from curvature ; yet it is extremely difficult to verify any deviation in the line of the spinous processes even when, as here, the aspect is represented on the flat, and when looked at on the round, as on the figure itself, anything like certainty as to this point would be to the acutest eye impossible. Unless prevented by treatment, however, lateral deviation of the line of spinous processes is sooner or later added to the rotary deformation, and having once begun, its progress towards very sharp bends, proceeds with considerable, often with great, rapidity. In a great

[1] I have frequently had afterwards to treat such patients when they in a little time found reason to distrust these dicta.

number of cases this event coincides with the commencement of the third stage. I am not sure, however, that the coincidence holds good in every instance, nor do I know, seeing that the opportunity for anatomical examination does not occur, how the point can be ascertained. We can only surmise from the fact, that until the lateral deviation has at least commenced, bony changes of form are absent, and that after such event the angles of the ribs—the only bones accessible to clinical examination—become rapidly sharper on one side and less acute on the other,[1] while the whole trunk falls into deformity, of which the annexed figure, requiring no skill for correct diagnosis, is a fair example.

I have not cared to damage the fine plate by drawing a line down the back, but it is hardly possible to obtain a clear idea of the degree of deformation unless the eye have some reliable guide. I would therefore beg the reader to place a piece of sufficiently fine sewing-cotton on the picture, stretching it between two marks made on the upper and lower edges, it will then be actually in the place of the plumbline dropped from the last cervical vertebra. This line fell over two and a half inches to the right of the rima natium ; the pelvis therefore is markedly amesial to the left ; and thus the right hip (commonly so called) is almost effaced, the left one being prominent. The crest of the ilium on each side stands nevertheless on the same level (pelvis horizontal). The junction of upper and lower segments of the figure is more obtuse, the space

[1] See Appendix VI.

between the body and the arms smaller on the right than on the left. The asymmetric modelling of the back is typical. It is hardly abnormal on the pelvic surface; the right loin is so hollow that the skin over it is pleated, the left is full, and

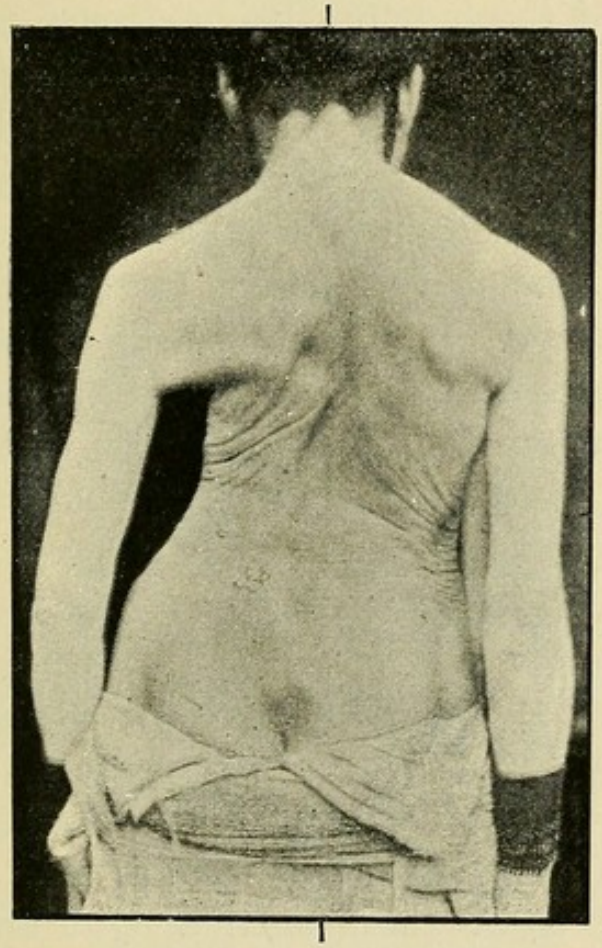

FIG. 19.—Severe Curve. The angles of the ribs exceedingly sharp.

projects markedly backward, especially along a line somewhat following the form of, but less curved than, the deviated spine. On the right side, on a level with the first lumbar vertebra, there commences by a sort of rounded point a cone-like backward projection, which, widening as it ascends, occupies

almost all the right posterior aspect of the chest about the scapular region. The projection, formed by the sharpened angles of the ribs, is more precipitously accentuated than a photograph, lit directly from behind, can show. The left side of the same region of the chest—the rib-angles being much effaced, and those bones being drawn forward—is very hollow, it forms indeed a kind of cavity, over which the unsupported skin hangs flaccid and festooned. The right arm depends as it were sessile from the thickened shoulder ; the left one, which may be said to be pedunculated, leaves a large gap between it and the chest ; also the shoulder joint itself, the glenoid cavity, lies much further forward and higher on the right than on the left side. There are, of course, several other points that might be noticed, but probably those already mentioned will suffice.

I add another example ; it is from a photograph taken before the method of engraving direct from such pictures was invented ; it is however reliable. At the time I had a consulting-room with a skylight, and this figure shows well how the projecting ribs on the right under such a light are strongly illuminated above and throw a long shadow downwards. In this case the pelvis is not amesial, hence a somewhat different side outline. The patient, being younger and less thin, shows no such flaccid folds of skin. The manner in which the arms are attached is the same in each case. The strong projection running from the left side of the pelvis to the most deviated dorsal vertebra must be left

unaccounted for, I have only very rarely met with a similar condition, but no other case in which it was so strongly developed.

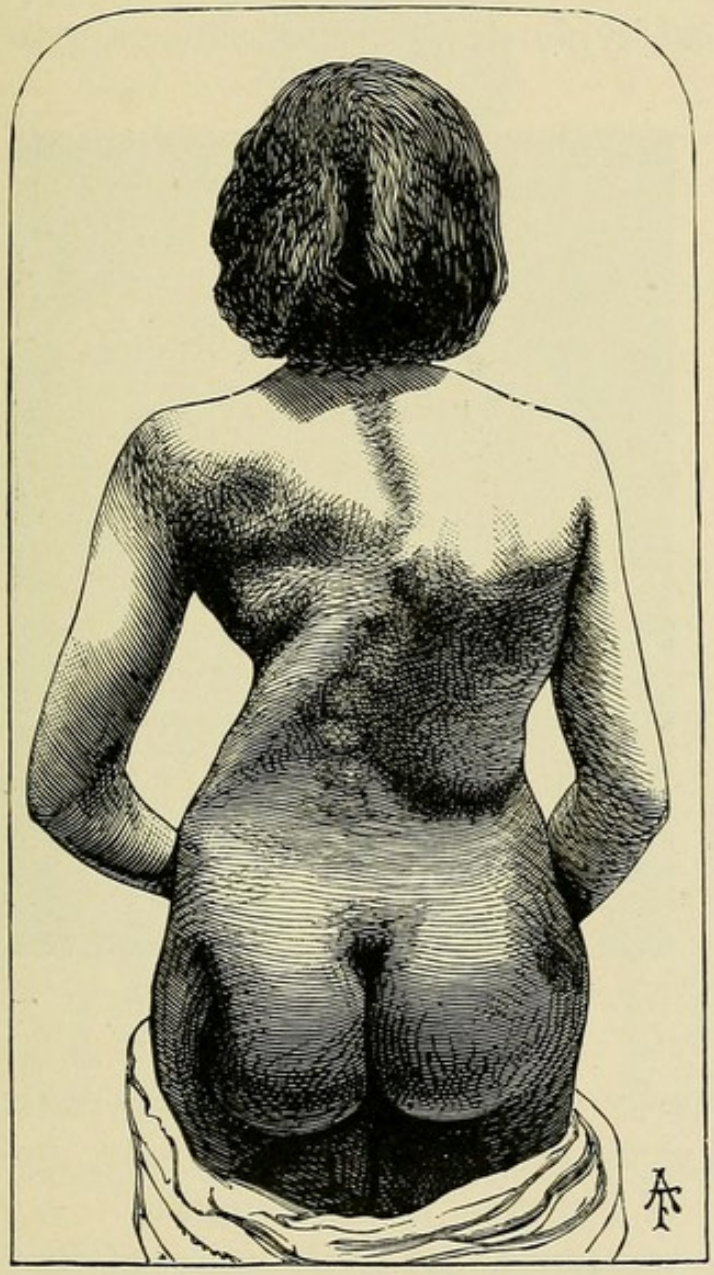

FIG. 20.—Severe Dorsal with consecutive Lumbar and Cervical Curvature.

The above descriptions, not it is hoped too long, serve for most far advanced cases of lateral curve ;

but occasionally another deformation is combined; of these the most common is such an example as is here portrayed. The case only came before me when far advanced, but from its history, and from my experience of some other cases, it appears that the dorsal kyphosis was superinduced upon a lateral

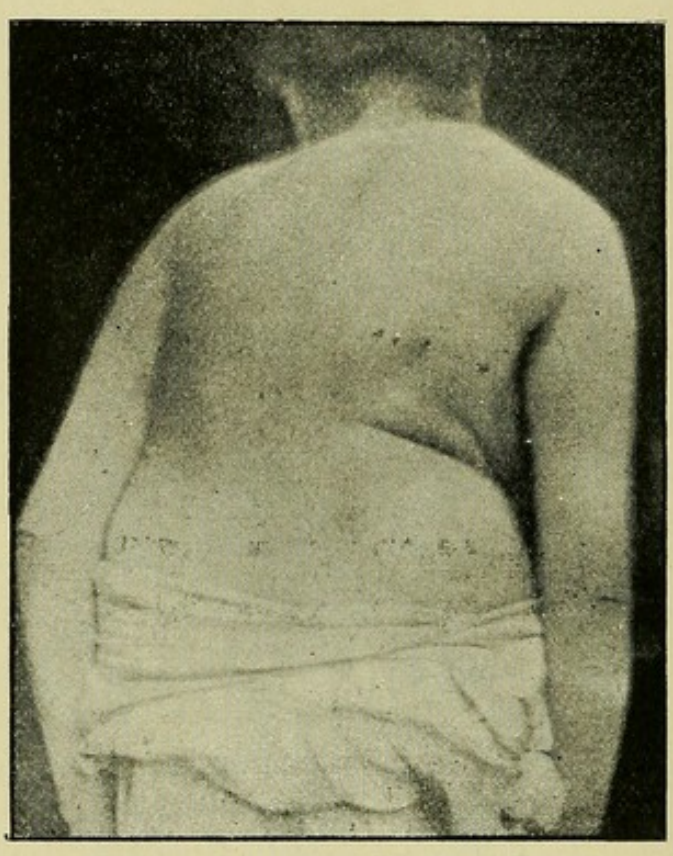

FIG. 21.—Lateral and Kyphotic Curve.

curvature by more prolonged and vigorous exercises than so weakened a spine could bear, and by the wearing of a heavy "spinal support."

More unusual is the conjunction of lordosis with lateral curvature. Though I have often seen such cases, I have no example that can be here reproduced. The deformity thence arising is very severe.

One more illustration, as showing the multitudinous forms which spinal curvature may assume,

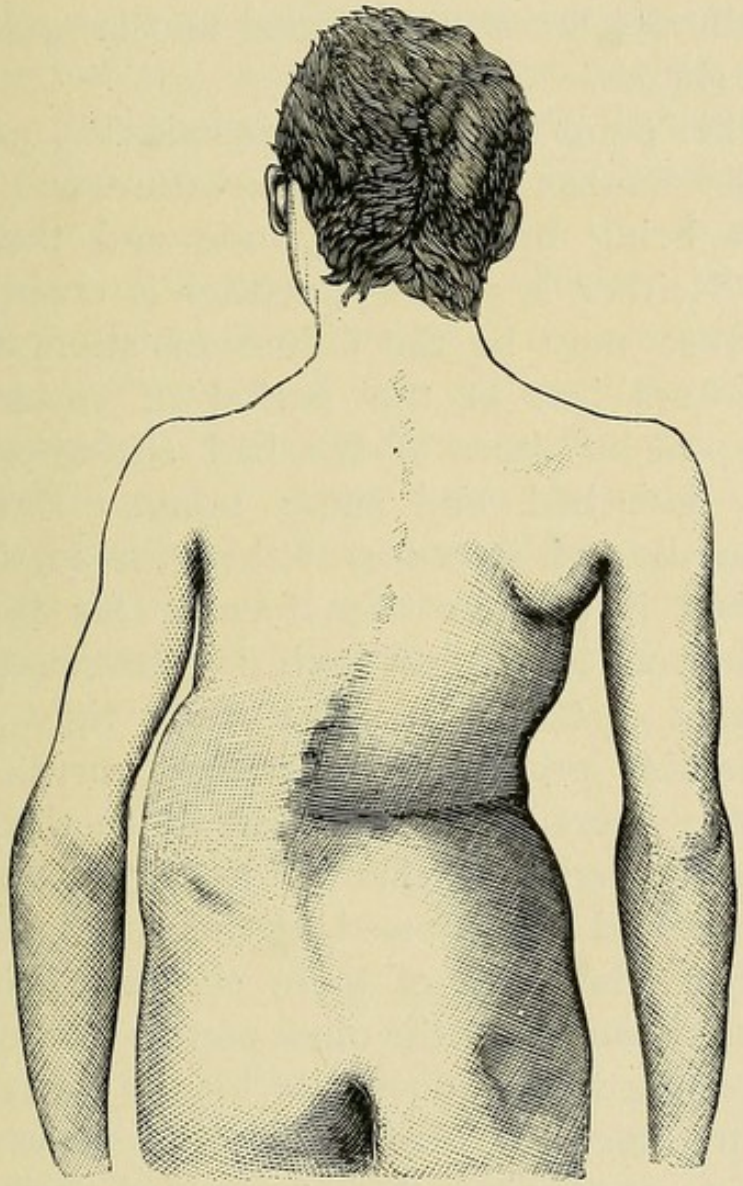

FIG. 22.—Left Lumbar and Low Dorsal Curve (Congenital?).

will be permitted. As a sample of engraving on wood it is very bad, but the outline, at all events —it is from a photograph—is reliable. The lad

said that his mother always told him he was born with a crooked back, which appears to me doubtful, for the form bears all the appearance of a rickety curve commencing in early life. Under such circumstances curvatures assume very irregular and strange shapes.

Another point in diagnosis remains. In certain cases the lumbar and dorsal curvature are simultaneous, being produced by one and the same cause. Neither is primary, neither is consecutive. Such cause may be the failure of strength that often occurs just at the period of most rapid growth, one or more of the bad sitting-postures already described, and some others. But in a large number of instances either the lumbar or the dorsal is primary—the former, for instance, when uneven length of limb is the cause; the latter from certain other postures or tight lacing, even pleurisy producing respiratory curve. It is impossible, therefore, to hold rigidly to the somewhat antiquated idea that all S curves begin in one region and are followed by deformation of the other; yet when one of these curves is the first (in point of causality), the other merely a secondary, condition, the distinction should, for the better direction of treatment, be made. I hold it, however, impossible to do this in such far-advanced cases as are depicted in Figs. 17, 18, 19, and 20; but less severe deformation can be thus differentiated, chiefly by observing the relations between the incavation of the waist on the two different sides. In a primary right dorsal, followed by consecutive lumbar, curve

the left side outline is crescentic, and the *taille* of that side is but very slightly marked, but what there is of it lies very much on a level with the better marked one on the right. On the surface in that region—viz. where the loin merges into the back aspect of the haunch—not much change has occurred. But if the curve be firstly left lumbar, the waist incavation of that side lies lower than the right one and is better marked, the side outline not being so regularly crescentic. On the right side the incavation is pretty sharp, and lies high. The posterior aspect of the surface haunch thus is more protuberant than the loin surface just above it, so that in rather severe cases the crest of the ilium is at the back often perceptible to eye and touch. Thus Fig. 11 is a case of simultaneous, 12 a primarily lumbar, 16 a primarily dorsal, curve.

CHAPTER IV

THE AUTHOR'S SCOLIOMETER

A LONG-DESIRED requirement is a means of measuring lateral curvature—of measuring, that is to say, the sideways deviation, also the amount of rotation, as well as the relative height of the two sides of the pelvis and of the angles of the scapulæ. The value of such an instrument is manifold. It not only enables the surgeon in slight, and therefore more or less doubtful, cases to verify or correct ocular diagnosis; but it also enables him to keep, with very brief writing, an accurate record of the progress of each case.

It is easy to obtain some approximate measure of the first of these conditions by means of a plumbline let fall from the vertebra prominens; but only approximate, because the line lies upon the skin in the dorsum and away from it in the loins. A wire or strip of lead passed part way round the thorax, from which a tracing can afterwards be made, is a very old device; it does not, however, measure rotation, but only the amount

of alteration in the form of the ribs. These simple expedients being recognised as insufficient, many attempts at the construction of some more perfect appliance have been made.

Some such instruments are exceedingly complex, so that, besides consuming a great deal of time, they fail by virtue of their complexity. Others are faulty in conception, and give no reliable results. Yet it has long appeared to me that it must be possible to construct an instrument that would measure at one and the same time torsion and lateral deviation at any or all elevations, also pelvic malpositions and height of shoulder ; at last I devised the one now to be described.

The instrument is of brass, and stands upon three nearly horizontal feet, the two hind ones projecting radially from the centre eleven inches ; the front one (*a*) is longer, viz. fourteen inches. From their junction at the centre a one-inch square tube (*b*) rises perpendicularly one and a half feet. In it slides smoothly and accurately a square rod (*c*), which is fixable by a clamp screw. This rod bears atop a horizontal plate (*d*), two inches broad by six long, projecting accurately over the longest of the three supporting feet. At the end of this plate, and at a precise right angle with its long axis, is a rule (*e*), fifteen inches long and scaled into inches and tenths. Sliding on each lateral half of the rule inward and outward, but fixable by a clamp screw, is a gauge six inches long (*f–f*). The horizontal brass plate has, moreover (*n*), along its long axis and beneath the exact

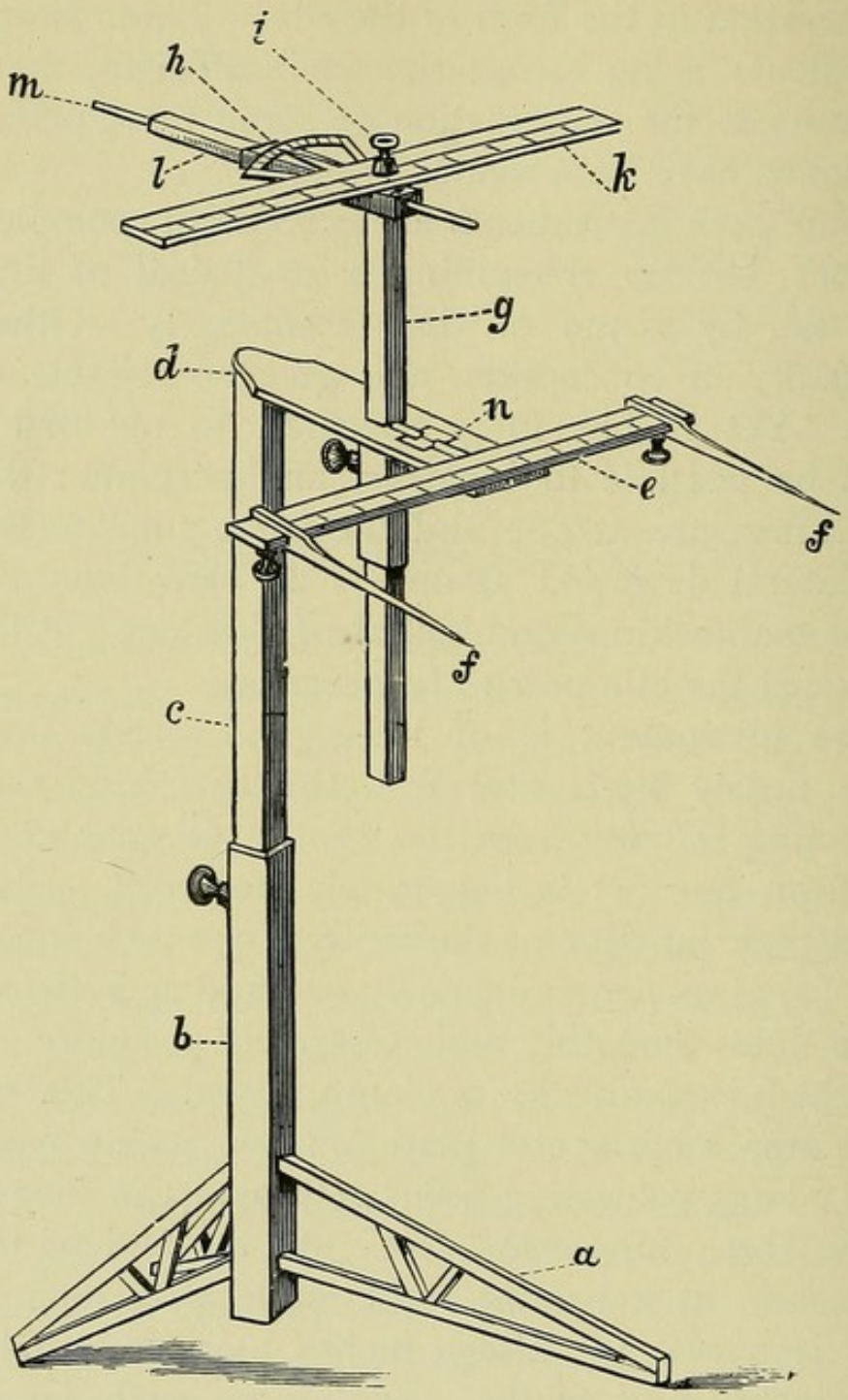

FIG. 23.—Author's Scoliosis Gauge. *a*, the long foot; *b*, lowest square tube; *c*, lower slide; *d*, horizontal plate; *e*, lower fixed rule; *f–f*, pelvic gauge; *g*, upper slide; *h*, sextant with indicator; *i*, clamp screw; *k*, upper revolving rule; *l*, bar sliding in socket; *m*, upper marking wire; *n*, lower marking wire.

centre of the rule, a slot which allows a wire to play in it in such wise that it can be thrust outward half an inch or more.

It will, I think, conduce to the comprehension of this instrument, which is really simple, though it seem complex in description, if I first explain how this first or lower part is used. The clothes being all removed from the upper part of the patient's figure, a dot is made with a skin pencil on the first and second sacral spine and one at each side outline on the crest of the ilium; then he is directed to stand with the knees straight and the feet together, and between these latter the longest foot of the instrument is guided till the lower rule is about two inches from his body surface; the slide is drawn out until the rule is on a level with the ink-blot on the sacrum; the little wire is protruded, its end just touched with a freshly-dipped pen, and again withdrawn. Now the instrument is slid further until the edge of the rule comes in actual contact with the posterior part of the pelvis; the gauge slides are brought inward and into touch with the sides of the ilium, care being taken that one of them is in contact with one of the pencil dots at that place; the wire is extruded until its contact with the skin makes a little dot where the middle of the sacrum should be if the pelvis were perfectly straight. The distance of the gauge from the pencil dot on the other ilium is measured.[1] This part of the instru-

[1] This is most expeditiously done with compasses, the distance between its points being tested on the rule.

ment indicates, therefore, the amesiality and the obliquity of the pelvis, and, moreover, measures accurately the degree of what obliquity may be present ; it must be remembered that whenever this latter condition obtains the first and second sacral spine must be out of the centre, for the whole ridge slants, its upper end having moved towards the side on which the pelvis is lowest.

An amesial condition or position of the pelvis and lower part of the figure is certainly present in a large proportion of cases. Its detection by means of the scoliosis gauge is as follows: When the instrument is so placed that the lower rule (*e*) is in contact with the pelvis, the surgeon sees if its centre corresponds with the middle line of the sacrum ; if not, he depresses the garments enough to expose the upper part of the rima natium ; then, placing his eye so as to get slide (*c*) in one line with the lower part of slide (*g*), he observes if that part of the body lies in this line or to one or the other side.

As yet only a comparatively minor part of the investigating power of this instrument has been explained ; the chief portion lies above the horizontal brass plate (*d*) that bears the fixed rule. Now in this plate, four inches from the edge of the rule, is fixed a socket and a clamp screw. In the socket a third square rod (*g*) plays up and down, being fixable by the screw—the top of the rod bears a horizontal square tube (*h*), which runs in a direction away from that of the longest foot, *i.e.* away from the plane of the patient's back when the

instrument is put in position. In this horizontal tube, and also fixable by a clamp screw, runs back and forth a square rod (*l*), perforated from end to end. At its extremity, nearest the patient, is a horizontal rule (*k*), which rotates glibly and horizontally on a little nut, and from the centre of which runs directly backward an indicator needle, four inches long, that plays over a graduated sextant of equal radius ; moreover, the quite smooth perforation in this rod carries a polished steel wire (*m*), one-quarter inch diameter, which quite fits the channel yet runs easily, and which is filed to a blunt point in front.

The mode of obtaining information from this part of the instrument is as follows : The skin over the middle of the second or third lumbar and the fifth, sixth, and seventh spinous process is to be marked with a dot by an aniline skin pencil, and the end of the wire is to be touched with ink.[1] Then, the instrument being brought into position as above described, the upper slide is drawn out until the revolving rule is on a level with the sixth dorsal vertebra. Here it is fixed by a turn of the clamp screw ; the surgeon then directs the patient to clasp his hands and hold them with the elbows straight over the centre of the hypogastrium, and pushes forward the horizontal square rod. If the back be straight, *i.e.* if there be no rotation of vertebræ, the rule, as it comes in contact with the posterior thoracic wall, remains square to the rod and the indicator rests at zero. But if there

[1] Any desirable vetebra can be selected.

be rotation, *i.e.* if one side of the thorax be on a plane posterior to the other, one end of the rule will be pressed backward, and when the rod has been pushed so far forward that the edge of the rule is in contact with the back, on each side of the spine, the indicator will mark on the sextant the amount of rotation in degrees and fractions. The wire is then pushed out, and the spot which it makes on the skin, and which is in the true perpendicular of the figure, will be a certain distance from the pencil-dot made over the spinous process of the deviated vertebra ; this distance, measured by compass and checked upon the rule, gives the amount of lateral deviation. The surgeon can then score in his note-book—rotation x degrees ; lateral deviations y decimals of an inch : these notes can be used for future reference in regard to improvement and effect of treatment.

If it be further desired to ascertain the relative level of the scapulæ, the patient is told to let the arms hang down by the sides—the angles of those bones may be touched with the blue pencil—the upper slide is drawn to a level of the lower mark, the rule pushed forward, and the distance between this and the higher mark measured with the compass.

It is scarcely necessary to add that, although I have for simplicity's sake mentioned only three dorsal vertebræ as the places for measurement, yet the instrument should be used for other parts. More especially is it valuable for gauging rotation at the loins, in which segment of the column that

malposition is very difficult to estimate by mere eyesight. In the dorsal region we can look down along the plane of the back (see Fig. 22) as far as the ninth vertebra, and thus form an estimate more or less inaccurate of the rotation ; but in the lumbar region we cannot thus see the parts in, as it were, a bird's-eye view.

The instrument is then valuable in several different ways : Firstly, it indicates accurately faulty positions of the pelvis. Secondly, it gives an exact mathematical measurement both of rotation and of lateral deviation. Thirdly, it gives these measurements in a manner which enables the surgeon to write down in figures a record of the progress of the case from visit to visit. Fourthly, in cases of very slight or of doubtful curvature it is a valuable diagnostic method.

Having experienced the value of mathematical aid, I would not now dispense with this instrument, which raises the appreciation and knowledge of every deflection of the spine almost to an exact science, and enables us to estimate, if it be desirable, the amount of deviation of every separate vertebra.

My cases have been thus periodically measured, and in some of those reported in this book the record as furnished by the scoliometer is appended. Certain of these are rather surprising, for instance that depicted at Fig. 19. Also the rotation of lumbar vertebræ in some cases is considerably more than what eyesight alone would lead us to expect.

As a means of recording cases I hold the scolio-

meter to be superior to the photograph, but the latter has certain advantages, as, for instance, letting the patient or the patient's parents see the progress, which they cannot judge by a mere reading of lines and degrees. The mode of lighting, the placing of the figure symmetrically to the camera and absolutely the same on each occasion of using it, are difficulties which, however, I have overcome by means of certain markings and bearings in my room. When the case seems by its nature or severity to warrant it I take records both by scoliometer and camera. Some results of this latter method have furnished illustrations to this work.

CHAPTER V

PREVALENT MODES OF TREATMENT

BEFORE entering on the subject of a treatment which I introduced more than twenty years ago, which has had many followers, and in my hands large success, it is necessary to cast a rapid glance at methods which in 1868 were the only ones practised, and at some others which are also used at the present day. At the date indicated there were two methods of dealing with curvature, the one by certain mechanism, the other by gymnastics.

The implement (Figs. 24 and 25), of which there are innumerable modifications—two only can be depicted here—is called a spinal support, because it is supposed to support the crooked spine. It consists essentially of a metal belt surrounding the pelvis, which bears at each side uprights terminating in crutch handles for the shoulders to rest in; at the middle line at the back is a lever—sometimes two, each a little aside of the middle—movable by rack and pinion, and supporting a metal pad; if there be two, the left one is opposite the lumbar, the right one opposite the dorsal prominence. The

object aimed at is this: the patient being placed in the machine, the steel belt is fastened round the pelvis; the crutch handles are placed under the axillæ; the uprights which carry them are then lengthened by screw or ratchet; the levers and pads are brought towards the middle line by the rack and pinion, with the intention of forcing the curves straight. The additional bands, one laced round the abdomen, one round the chest, are in-

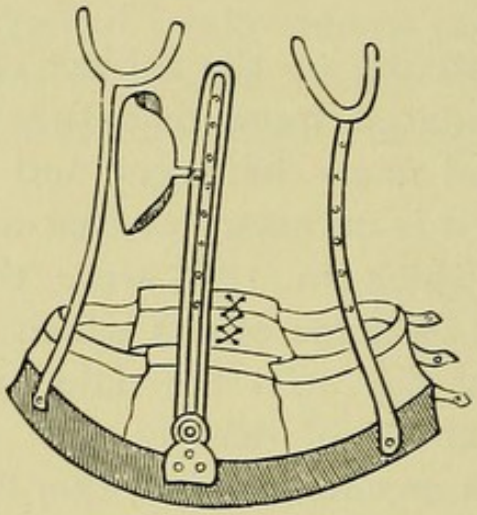

FIG. 24.—An Orthopædic "Support."

tended to keep the mechanism in place; also in many instruments straps pass from prong to prong of the crutch handles over the shoulders, with the object of binding them into those portions of the implement, a device of which more will be said immediately. Thus the girl who is subjected to wear such an appliance must do one of two things: she must either slip her shoulders out of it and, moving her trunk forward or backward, free it from the pressure of the pads, or she must be content to

have her body, *i.e.* her loins, chest and pelvis, move all in one piece, like a wooden doll. If she elect the latter, and if she have patience, endurance, and physical stamina enough to undergo such imprisonment, she will gain little or nothing. Probably my testimony as to their inefficacy may be vitiated by the fact of my never having used but one. Therefore it will be better to quote the opinions of some, who do or have employed them: "They are not

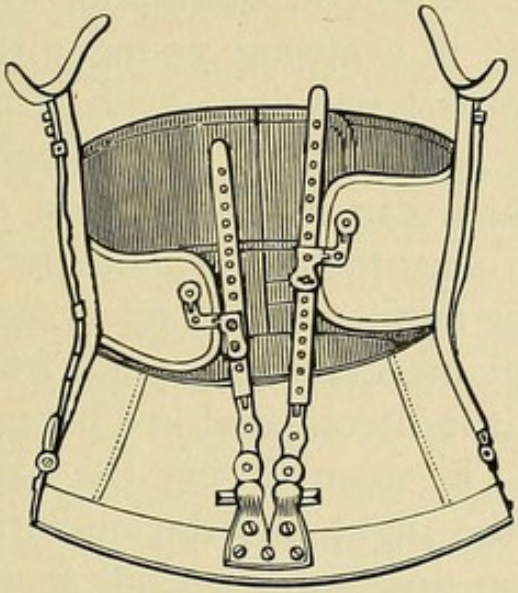

FIG. 25.—Another "Spinal Support."

adapted to the removal of the primary cause of curvature; they cannot therefore be employed as curative means."[1] "I have no hesitation in expressing my conviction that if these cases be submitted to treatment before any very obvious external deformity has occurred, they are generally curable within one or two years. In some instances, especially if an hereditary tendency to spinal curva-

[1] Little, *On Deformities of the Human Spine*, p. 379.

ture exist and the girl be of feeble constitutional power, a longer period may be required."[1] "When rotation has taken place appliances are useless." "The result of my experience is to convince me that where lateral curvature existed in any marked degree, and before it amounted to an external deformity, it is essentially an incurable affection."[2]

These avowals would be very sad if they referred to any other treatment than that by "spinal supports." The second quotation, which appears to mean, that if a strong young girl of healthy parentage be fastened into such a machine, she perhaps may be cured in about two years of a deformity which can hardly be said to exist, is a phrase which very truthfully characterises the uselessness of the appliance. It refers, be it observed, to the second mechanism, copied from the work in question ; it is intercalated in a paragraph recommending it to be worn during the day, sometimes also during the night, and the quotation following closely thereon sums up the result as above given.[3]

The inefficacy of all this class of instrument arises chiefly from the impossibility of securing immovably a metal hoop to such rounded parts as the haunch and abdomen. The hoop, however,

[1] *Adams's Lectures on Curvature of the Spine*, p. 327, 1st. edition.

[2] Brodhurst and Adams at Medico-Chirurgical Society, *Lancet*, January 23, 1886.

[3] Let it not for a moment be supposed that my words are dictated by any feeling adverse or inimical to any one of the gentlemen whose expressions I have quoted. I am writing not about individuals but about mechanisms.

is the foundation from which the levers play, and they can have no power unless it—that is to say their fulcrum—be fixed. Screwing therefore these levers and pads tighter against any protuberant point can only press upon that point with a power rather less than what will move the hoop and make it sit aslant. The hoop however cannot be attached to the skeleton, and even if such tightness of swathing can be tolerated as will prevent it gliding up and down on the skin, yet that skin itself and the subjacent soft parts are so movable over the bones, that screwing and forcing the lever and pressure-pads only lifts or depresses one or the other side of the hoop. Very many patients have been brought to me wearing these things, quite new and recently adjusted, and I have invariably found that by moving the uprights from side to side one shifted the metal hoop as described, or if one grasp that hoop very little force will rock it on the pelvis, when the uprights simply wobble on the patient's back. Thus the patient in almost every movement or action of her body always displaces the mechanism ; it is her trunk that governs the machine—the "support" cannot uphold the back.

But even these structural faults are less egregious than that of strapping the patient's shoulders into the crutch handles. Be it recollected that the girl's back, being crooked, is therefore shortened ; that this shortened back is fastened into a machine with a belt round the pelvis, and that the shoulders are strapped into two uprights which must, if they act at all, keep the spine at the same degree of short-

ness; then the orthopædists think to straighten it with screws and ratchets. A bow, which straight should be five feet long, may be bent by its string to a four-foot length; as long as the string and the woodwork hold, no power will straighten that bow. So to fasten down a crooked spine to its morbid shortness and then try to straighten is, to say the least of it, a very singular idea. Fortunately and mercifully all the bearings, straps, and hoops cannot act as they are intended to do; for if they did thus bind the figure down, and then squeeze the ribs to right and left, they would be even more potent for evil than they are.

Another implement tries simply to "take the weight off." There is a well-known mechanist whose implements aim at this. Dispensing with levers and screws, the thing consists of a hoop round the pelvis, to which is attached on each side a metal loop running from back to front so as to rest on the crest of the ilium. Standing up from the centre of the hoop are two flat steel bars, one on each side the spine, and two others quite on the lateral parts of the implement. These are connected at top, viz. the back and lateral uprights of either side, by a curved steel band, that passes across the scapula under the arm, and ends a little below and in front of the shoulder joint, forming a very coercive sort of crutch handle into which the shoulder is strapped, thus fastening down the spine to its morbid degree of shortness. Besides this there is another idea which would be very funny were it not also so sad. Of course no girl could or

would wear such a thing if the side irons stood out away from her waist or from other parts of her figure. Therefore they are bent and arranged to fit with considerable accuracy into all the abnormal hollows, and upon all the faulty protrusions of her side outline. Besides being strapped down very short, the back is therefore fixed into the model of its deformity, so as powerfully to counteract any efforts nature might otherwise make to remedy the distortion.

In 1880 Mr. Adams suggested the use of poroplastic felt cut into the form of a corset, and I believe priority in this idea belongs to him.[1] The felt, when thus cut and impregnated with shellac, is to be moulded on the figure during suspension. The idea is ingenious, and the appliance does not get out of shape in very slight cases occurring in small young people; but in any beyond a mere initial stage the power and weight of the trunk far outbalances the resistance of the material. Therefore, when a patient, who has worn such a jacket for a few days presents herself again, one always finds, not that the jacket has modified the back, but that the felt appliance has assumed all the morbid bends and projections of the trunk. Any attempt to obviate this yielding by strengthening the jacket with steel bands and hoops, encounters the above specified impossibility of securing a sufficiently immovable basis on the pelvis. Nevertheless, very slight curvature occurring in a patient, who is not too young, that is of an age to be thus immobilised

[1] *British Medical Journal*, 1880.

without loss of health, may be benefited by this appliance. It ought not to be used for growing patients with that necessity for free bodily exercise which youth implies; for elderly people, with the second recrudescence of curvature (page 156) it is generally unbearable.

A somewhat similar, but far better mechanical design is Dr. Lewis Sayre's plaster of Paris jacket and self-suspension. This latter device is effected by the usual tripod and system of pulleys arrangement, but only the headstall, without the axillary loops, is used. The patient, grasping the pulley-rope, draws herself up, hand over hand, some little height, then pauses, taking care to do so with the hand on the concave side highest.

In this position the plaster of Paris rollers are put on and allowed partially to set, when the patient is taken down, laid supine, and the jacket, being cut open from the front, is removed and handed to an instrument-maker, who turns over its edges the redundancy of the vest, fits it with lacing-hooks, &c. The jacket must be made of particularly good strong plaster, as it must be rather thin, and is to be put on during self-suspension every morning, and removed under the same conditions at night. The jacket must be occasionally renewed, entirely or in part, if the back improve. Dr. Lewis Sayre claims to have great success with this mode of treatment; it does not seem to have equal advantages in other hands. I formerly used it for a few patients; the first application certainly pro-

duces, especially in severe cases, considerable improvement, the back remaining while erect only a little more crooked than it is in suspension. But here the progress makes a halt, and, as far as my experience goes, does not get beyond that point. In hot weather the patients complain bitterly of the heat and discomfort of the bandage.

Dr. Lorenz uses also in a slightly-modified form suspension and plaster of Paris. The suspender (Beely's) is formed of two perpendicular struts bearing a cross-beam, like old-fashioned gallows. Above the arm which holds the headstall is a horizontal bar, so arranged that, when the former is in place, the patient can grasp the latter at the full stretch of her arm. The pelvis is kept fixed by a rod passing from one limb of the gallows and terminating in a belt, partly metallic, which surrounds that part of the body. The bandage does not reach as high as those of Sayre, and he fastens down its left side to a leathern thigh-belt (he calls this "Seitenzugverband"). Another, which he calls "pressure bandage," only differs from Sayre's in that he places pads of felt on the right anterior and on the left posterior part of the chest before applying the plaster. The bandage, being removed and dried, is padded internally on the contrary localities, viz. over the right posterior and left anterior aspects of the chest, the object being to leave the plaster over the first-named localities hollow, and by the subsequent padding to press the chest into those empty spaces. I will not deny that this ingenious device may in some cases succeed; but to wear such a

bandage, which with these reversed paddings, of course, does not fit, evidently requires some fortitude, as indeed do other parts of Dr. Lorenz's treatment. The girdle band (Gürtelverband) for lumbar curvature is shorter above than the Seitenzugverband ; it is put on while the patient bends her trunk powerfully to the left (to the convex side), and is also fastened down to the thigh by a thigh-belt and strap.[1] With these bandages Dr. Lorenz combines what he terms lateral suspension and methodical *redressement* of the spine. Two upright posts support a horizontal wooden beam, cushioned and guarded. The patient stands on a small step, passes her right arm over the cushion and disposes the posterior projection of the right ribs upon it ; then grasps in her left hand a handled strap, fixed near the floor on the far side of the cushion, so that her left arm is drawn over her head, the hand being rather below the level of the cushioned beam ; she then takes her feet off the step, so as to hang on the beam, pressing the rib-projection against it. On the chest of the patient thus suspended " he exerts powerful pressure in the direction of the right oblique diameter (*übt in der Richtung des rechten schiefen Diagonal-Durchmessers einen kräftigen Druck aus*). It is a most painful procedure. He says : " Certainly many weeks must past before the *redressement*, thus energetically carried out, is borne by the patient without suffering. . . . The extreme painfulness of the first attempts at *redressement*

[1] This seems to me to have no more action and to be much less bearable than my lumbar bandage, p. 100.

during which the spine loudly cracks at its junctions.[1] . . . It cannot be accomplished without tears." [2]

Gymnastic exercises are very conducive to health, and strengthen the muscles of the trunk and limbs; they therefore are often useful in cases of weak backs, as preventive of the tendency to curvature which that debility induces. Also, some properly devised movements are valuable aids to real treatment of curvature. But it is vain to expect benefit to a spine already curved from holding one arm perpendicularly upward and the other horizontally outward;[3] or from "Lying on back, simultaneous extension of arms upwards, outwards, and downwards, from a position with elbows flexed and close to the trunk (four times);" or: "Lying on back, arms by the sides of the body, hands supinated, slow full inspiration by the nose, slow expiration by the mouth (repeated four times)."[4] Surely,

[1] Very possibly the ribs, rather than the spine, crack at their joints.

[2] *Loc. cit.*, pp. 176, 177.

[3] A patient was exhibited on 13th of November, 1885, with severe curvature. She was ordered by Mr. Roth to maintain this posture (he calls it key-note position) for a certain time daily. On March 12th she was shown again, that gentleman affirming that her general carriage was much more upright. But Mr. Keetley, who on both occasions measured the patient, conclusively proved that the curvature was in no way altered. Such improvement of general health and strength as had undoubtedly taken place was the natural result of her having ceased to wear "a spinal support."

[4] These are two out of the twelve movements prescribed Art. "Lateral Spinal Curvature," in *Dictionary of Practical*

however, it is hardly desirable to waste space and time on such trivialities. All that the Ling-Swedish method can do (save prophylaxis) is to preserve and in some cases, especially after wearing "spinal supports," to restore a certain flexibility to the column.

Surgery. It is only fair to say that three of the exercises ordered have a little influence in strengthening the back-muscle, but none on the curve.

CHAPTER VI

THE TREATMENT OF LUMBAR CURVATURE.

THE treatment of lateral curvature varies considerably, according to the region of the spine it affects, to its severity, and to its cause, also according to the patient's age.

The simplest form, both in causation and treatment, is the lumbar, or the simple total curvature arising from obliquity of the pelvis.

Patients in the first septennial period are brought under treatment with very different degrees of uneven limb-growth, and very various degrees of curve —the exact period of consultation depends on the vigilance of the nurse or mother. I have had patients in whom the bend of the spine was, when first put in drill posture, scarcely perceptible ; after a few minutes or seconds a little fatigue supervenes and the signs of curve gradually become evident. Other infants manifest symptoms of crookedness at once. In whichever way the appearance shows itself, the cause must be sought. Firstly, the signs of rickets must be carefully looked for. Let us suppose them entirely absent. The feet should be

examined for valgus, &c. Even the boots should be looked at. The instrument described in Chapter IV. will immediately point out whether or no there is any pelvic obliquity. Let it be supposed that the right crista ilii be found about 0·4 of an inch higher than the left, and that there be left rotation at the third lumbar vertebra of 3°. The next object of investigation is the flexibility or want of flexibility in the spine. This is ascertained by taking hold of the pelvis just above the trochanters and moving it, the knees being kept straight, from side to side. At first the gyrations should be small in amount and slow; then, as the child gets accustomed and loses all distrust, they are to be increased, both in width and rapidity. The spine, meanwhile, is to be watched and its bend to left and right noticed. Then she is to sit on a chair or stool, and, while her attention is attracted by a toy or cake, the posture or condition of spine must be watched. Lastly, the seat is to be made to slope from left to right, and the action of the back under such circumstances also observed.

By these manœuvres the surgeon will have acquired the necessary basis for determining his treatment. If the spine be quite flexible, and nearly equally so in both directions, it is in these very young cases quite manageable without any retentive appliance—a mere change in the conditions of balance and a certain manual extension will have the desired effect, but not immediately. I am again and again asked by mothers, How long will it take to cure the spine? The only possible answer is to ex-

plain how and why pelvic obliquity causes the curve, which is not a malady of the spine itself; that the obliquity depends on uneven growth of the limbs; that all which can be done is to watch and obviate its effect on the back; that, if this be done, the spine will be, when the legs become of equal length, perfectly straight.

If the curve be pretty sharp, it is wise before letting the child dress again, beyond the underclothing, to counteract the effect of faulty position, which may have continued unnoticed for many months, and which may have caused some shortening of ligaments and perhaps of muscle. To do this the surgeon sits on a chair, and, placing the patient with his back towards him, he grasps between his knees the child's pelvis; then taking hold of each side of his chest, about the level of the eighth vertebra, he bends him down to his left as far as he can go, merely by his own weight and effort, then he adds a little pressure with his right hand, keeps him there about a minute, and repeats the manœuvre five or six times. The following measures are now to be ordered: the left shoe is to be heightened; in such slight cases it will suffice if the in- and out-door shoes have an additional thickness of leather put to the heel; later in the case, or if the inequality be greater, it will be well to let one thickness be also removed from the right one. It is not advisable, unless the obliquity be very small, to annul it at once, lest, as I have experienced, we produce some uneasiness that will cause the child to adopt a new malposture: a pelvic

obliquity of 0·4 or 0·6 of an inch should be only two-thirds corrected.

In sitting, the child's spine should, for a certain period every day, be made to bend pretty decidedly in a direction reverse to that of the curve. For this purpose I devised, more than twenty years ago, the "sloping seat"; it is merely a hollow wedge of wood placed on a chair with a sufficiently firm seat. To make out the amount of slope, there is in my consulting-room a stool with a ratchet and wheel movement, whereby I can raise one end of the board on

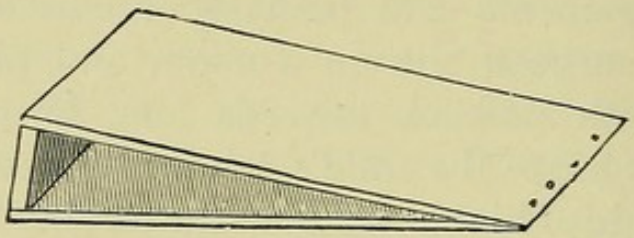

FIG. 26.—The Sloping Seat.

which the patient is seated to any desirable angle, and of course to either side. By placing the child on this, and turning the handle slowly, it is easy to ascertain the desirable amount of elevation. A carpenter can make in an hour a wedge,[1] the description in writing of which my patient takes away;

[1] Volkmann borrowed this idea, appropriating it by a modification, whereby the upper plane works on a ratchet, so that the slope can be altered. This is by no means an improvement, for the regulation of such an appliance must be much in the hands of the child's nurse. It is better to avoid giving her any haphazard choice in the arrangement of the height.

it runs thus : " Of half-inch deal, two boards fourteen inches by eleven, screwed together at one end, separated at the other by a cross-piece x inches high." It is well to cover it with plush or cotton velvet, so that in drawing the hand from the high to the low side it meets the rough of the pile. This sloping cushion, which is between an inch and two inches high, is not to be used all day, as some writers in quoting my works have supposed me to say ; such use would fatigue the muscles and do perhaps more harm than good ; it is intended to obviate ligamentous and muscular shortening, by bending the spine pretty sharply in the reverse direction ; from half to three-quarters of an hour, twice or thrice a day is enough.

For a slight and simple case, in a quite young child, this treatment will suffice ; but it should be watched, some difference in the rate of limb-growth, some spurt of growing in the spine may, from month to month, necessitate either its discontinuance or more stringent measures. In such patients it is better, if possible, and it generally is quite possible, to cure the curve without recourse to retentive appliances.

It will be well here to explain the action of these two devices. A glance at Figs. 7 and 8 will show how a shorter limb, by causing the pelvis to slope, produces a curve at the loins, and how this curve is annulled by placing a block under the shorter limb. Raising the heel of that side, or, if the shortening be considerable, heightening the whole sole, aims at producing this effect in a more permanent man-

ner. The sloping seat is devised on the principle of carrying a correction, or rather, as it lasts but a short time, an over-correction of the obliquity into the sitting posture. The accompanying engraving,

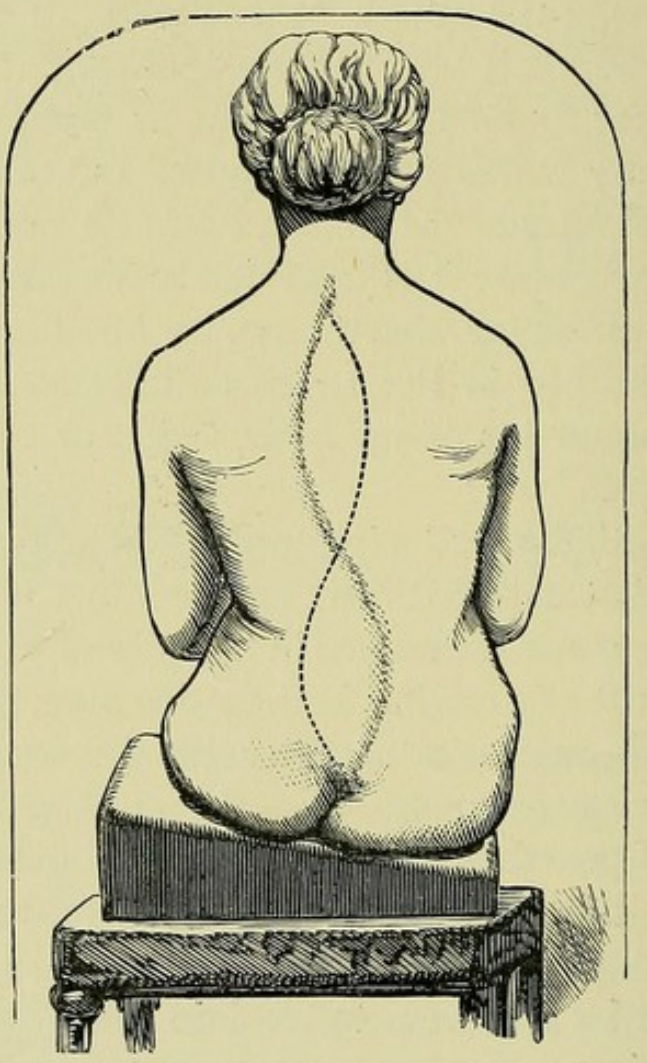

FIG. 27.—The Sloping Seat in action. The dotted line represents the direction of the morbid curve, the shaded line that which the artificial obliquity tends to produce.

published more than twenty years ago, is taken from one of my patients whom I had all but cured of a rather severe lumbar curve, with consecutive dorsal, represented by the dotted line. The figure

is placed upon such a seat as lifts the left side of the pelvis to a rather higher level than the right, when the spine, by the necessity of balance, tends to assume a curve in the opposite direction. Tends, I say, because all spines, notably those which, being in the second stage, are somewhat stiffened in the abnormal posture, cannot at once turn in the opposite direction; for these, certain further treatment, to be described immediately, must be employed.

Within the last fifteen years or so certain writers have denied the frequency of pelvic obliquity and its effect on the spine. The error is due to forgetting or ignoring that defect in standing that I have named "habitual pelvic obliquity" (see Fig. 9). It is a very frequent cause of lumbar curvature, but of course disappears when the patient is made to stand with feet close together and knees straight (drill posture); the consequent spinal defect, however (unless the case be quite recent), remains, and the surgeon who ignores the habit may well be puzzled. If, however, he watch his patient, fully dressed or otherwise, and put her at ease by some conversational skill, he need not long remain in doubt.

Older patients, sometimes even very young ones require more vigorous treatment by means of certain additions to the above methods.

In such cases also an appliance, which I have named the lumbar bandage, is to be adopted. It is a very simple contrivance, giving the patient, even young and irritable children, no trouble. Of

course, each one is to be made to a pattern cut in brown paper to the figure itself, but it is worn outside the underclothing, most conveniently over that form called a "combination garment." The bandage consists of a webbing strap, passing round

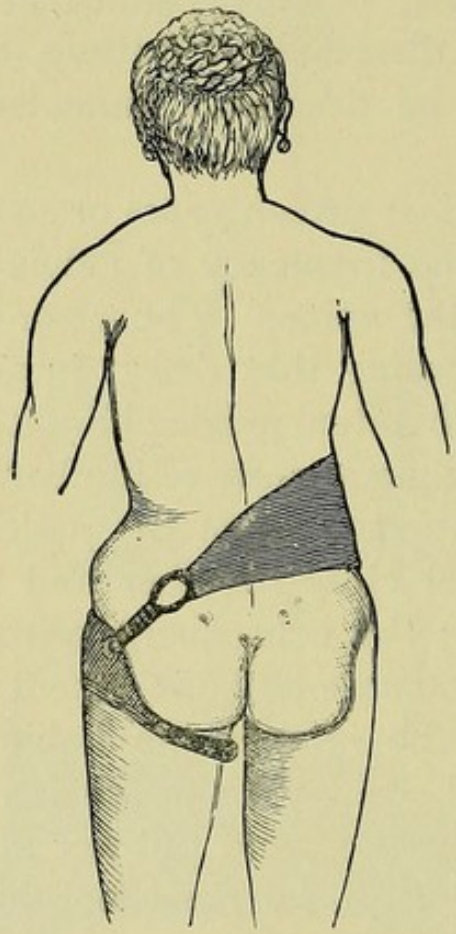

FIG. 28.—The Loin Bandage. In this figure the curve is to the right.

the upper part of the thigh, and made round where it lies next the perinæum by being drawn through an india-rubber tube, which again, is covered with kid- or wash-leather; this strap secures on the outer part of the ilium behind and upon the tro-

chanter a semilunar portion.[1] The leg-piece is merely a fixed point, from which the rest does its work. This rest consists of a well-fitting oblique portion, which is secured by a clasp to the back of the leg-piece; to the clasp is attached a webbing strap, which terminates in a strong india-rubber ring, and thence a piece of moleskin, jean, or coutil, cut to pattern, sweeps round the loin, breadthens considerably in front, terminating like the part behind on a ring and strap fixed to the front of the leg-piece.[2]

Between the ring and the clasp, a buckle, with an arrangement to prevent the patient tampering with it, enables the surgeon to place and keep the tension aright. In putting it on, the back ring, that seen in the figure, should be considerably tighter than that in front, by which means there will be no tendency of the hip-pad to ride forward.

In all but the first stage of curvature, some of the muscles, intervertebral discs and yellow ligaments, have undergone a certain amount of change,[3] and although the sloping seat and some other of the above devices have the effect of removing those alterations, yet their work is slow. For some years past I have been perfecting and using, if the severity of the case require, one of two more potent methods; occasionally, though rarely, both. If dealing with

[1] Some patients are better fitted by a trapeze, small end downwards.

[2] The shape of the front is shown in some diagrams (Figs. 38 and 39).

[3] See Appendix VI.

a curvature at the loins only, with no dorsal secondary deviation, one of these arrangements is very simple. An ordinary horse-girth is attached by each end to the two ends of a cord, so as to form a loop, the cord part of which is fixed by a hook to the wall. The girdle embraces the patient's loins on the convex side; when this is taut, the patient bends the body sideways, well down to the left, keeping the knees straight, and the surgeon placing his hand on the right side of the chest, on a level with the nipple, presses the body over with some little force. The girth, three inches broad, should be half on the ilium, half on the loins, so as to fix the pelvis as well as that region of the spine, a pad or folded towel being introduced between the girth and the underclothing, and the patient may either stand or sit. The latter posture is preferable, if the patient be feeble and find it hard to keep the knees straight, or if much force have to be used. It must be recollected that the object is to stretch contracted and shortened parts, and the power employed must be commensurate with the amount of deformity, and with what the patient may bear without pain. In this latter point of view, the first efforts are experimental and should not be carried too far. I have never had any injurious or painful results, and if the loin bandage be applied immediately afterwards, and no excess in walking or standing about be permitted, the very slight aching, which in a few cases follows, disappears in a very short time. In order to maintain the advantage thus gained, the patient is

directed to carry out the following manœuvre: A girth, similar to that just described, is kept in her bedroom or nursery, and it is secured to a hook in a like manner, only, if possible, the hook should be at a corner of the room, about four inches from

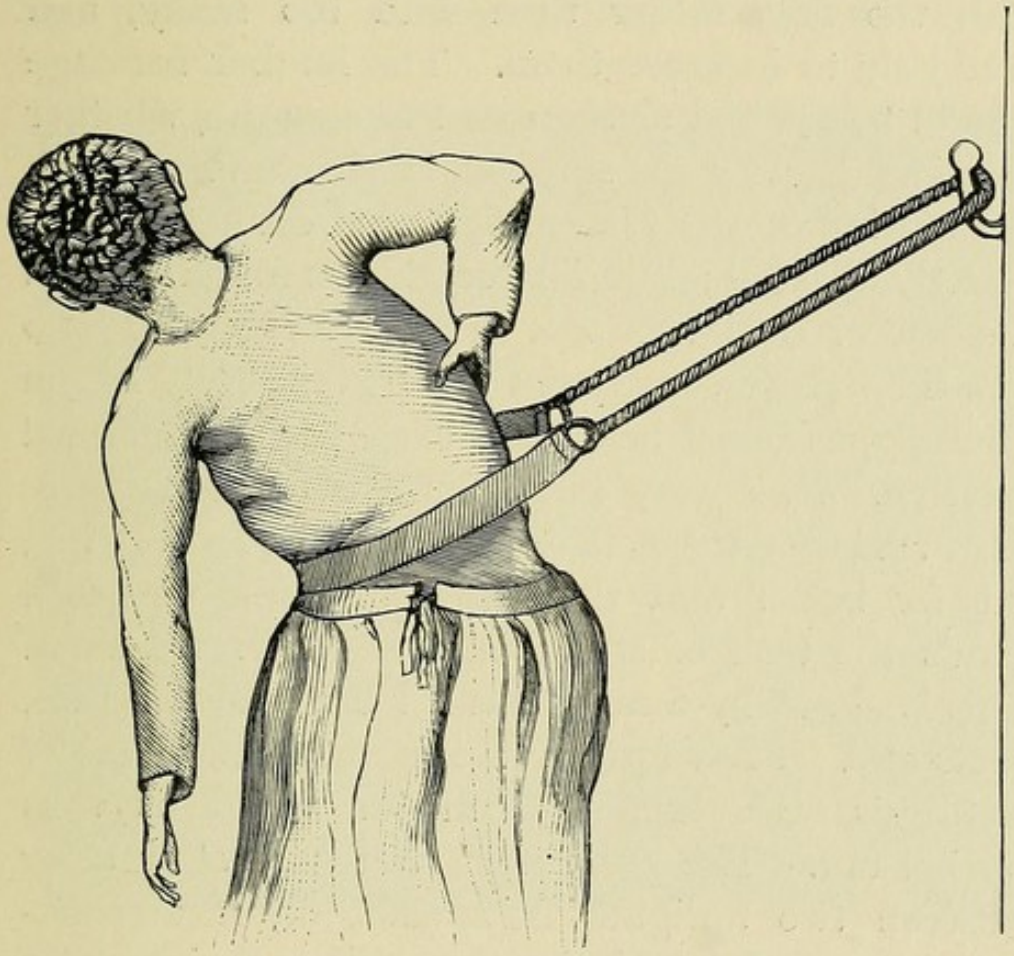

FIG. 29.—Exercise for Lumbar Curve.

a wall running at right angles to that on which it is fixed. She stands with her back against this wall, and within the girth, as above described; places her right palm, thumb backward, on her side as high as she can, keeping the elbow squared. She then throws the shoulders and trunk forcibly over to the left as far as she can, and, resting so a

few seconds, rises up again slowly to the erect posture. All this is to be done with the back against the wall, to prevent any forward or backward stoop. The number of repetitions must depend on the patient's strength ; it is better to begin with too few, rather than with too many, and gradually to increase them. The lumbar bandage should be applied as soon as the exercise, whether or no assisted by the surgeon, is accomplished.

Rotation of the lumbar vertebræ cannot thus be directly affected ; but I have always found that as the lateral deviation was gradually cured, so also was the former constituent of the deformity herein differing, as also I believe in causation, from dorsal rotation. In a very large number of moderately advanced cases, especially if the curve be increasing, it is far better that the surgeon take into his own hands the task of stretching the contracted parts. This is done by a mechanism I devised some six years ago. I have given the method the name of rachilysis, the lumbar form of which is thus carried out. The patient sits on a stool or chair between two uprights, bulkheads, or, if arrangements are conformable, between two opposing walls, into which the following can be fastened—viz., to one a pillar-ring about four feet from the floor ; into the other a hook holding a small single pulley about seven feet ; a ring about three feet from the floor, and between the two a cleet over which one turn fixes the cord immovably ; one loop of one-inch webbing softly padded for nine inches, and opposite the pad a stout cord ; one loop of three-

inch webbing, such as is described at p. 102, and one girth of like material with a cord loop at one end, an ordinary leather strap at the other; a double system of pulleys somewhat like the Astley-Cooper dislocation pulleys. These being at hand the patient sits as above mentioned on a stool or

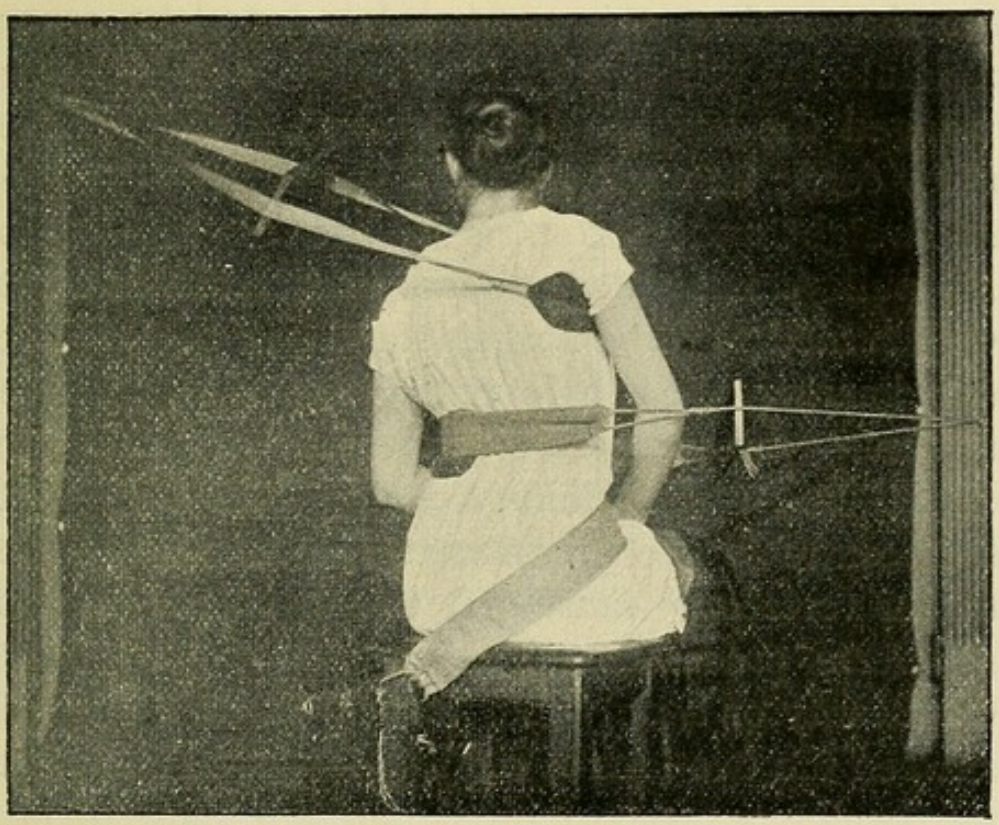

Fig. 30.—Lumbar Rachilysis.

conveniently-shaped chair; the cord loop of the girth being slipped upon the back leg on her left, the girth itself being carried round the back and right side of her pelvis, is strapped to the front leg of the stool on her left. The padded loop of webbing passed over her head and shoulders is laid smoothly opposite the most deviated part of the

lumbar spine—we will name it "loin-loop." The narrower webbing with cord, let it be called "lanyard," is placed so that the padding lies easily and smoothly in the axilla; the cord is carried through the single pulley on her left, and being pulled sufficiently tight, is secured in the cleet. Now one hook of the system of pulleys is hitched into the cord of the padded loin-loop, the other hook into the pillar-ring on her right. Thus roughly arranged the surgeon may somewhat tighten the pulley cord; he must see that the patient is placed not straight and symmetrically between the hooks and pulleys but a little further back, and she must be so turned as to be half side and half back to the wall bearing the single pulley and cleet; before tightening further a soft convenient pad must be slipped under the "loin-girth" in such wise that it concentrates the pressure to the left side of the lumbar vertebræ,[1] causing it to fall chiefly on the transverse processes. A rather long wooden strut (say twenty or twenty-four inches) is then slipped between the two laps of the loin-loop, and a shorter one (twelve or fifteen inches) between those of the lanyard, and then the desirable amount of tension can be applied. My pulley system is one made for me by Messrs. Salt and Son, of Birmingham; it contains four pulleys in each block, therefore multiplies eight times the force applied by my hand; in other words, if I pull on the cord with a force of one stone the pressure on the back is one cwt.

[1] This pad is omitted in the figure lest it should confuse the picture.

Such power should not be used at first; indeed, I never employ so much as to cause either pain or subsequent sense of fatigue; the amount, however, can soon be increased. The treatment should be employed at regular stated intervals, repeated with a frequency commensurate with the severity of the case. If these postulates are duly carried out the cure is regularly progressive, and compared with all other methods, that have come to my knowledge, rapid.

The simple total curve is amenable to treatment on the same lines; the loin-loop need not, however, be confined to that particular region of the spine but should be placed opposite the most aberrant vertebra, which usually is the ninth or tenth dorsal; also it is better to use a broader axillary lanyard, for which reason I use one made of three-inch webbing like the loops (lumbar and dorsal). These cases must, however, be watched, for I have noticed that the total curve may sometimes change almost suddenly, the upper segment of the spine taking on a contrary curvature. Such event, when it is a result of the rachilysis, is of favourable augury; a few applications of the pulley force after the mode described in the next chapter being all that is required to effect a cure.

CASE 2.—Miss L., aged twenty-four, has for some time been suffering from a curvature of the spine, and has worn for more than four years the usual form of orthopædic support. She came to me on the 5th May, 1866, and gave the following history.

About five years ago, she, being previously well and hearty,

began to lose health, and suffered pain in the back; these symptoms increased, menstruation became irregular, and all but ceased; appetite failed, breathing became short and difficult. She was taken to a practitioner near her residence, and he, on examining her, found signs of curvature, and sent her to London in 1861. The orthopædist whom she consulted told her that she must remain some considerable time in town, and wear an iron support. She did remain the greater part of a year in London; during which time the instrument was screwed up, at first thrice, then twice a week, and afterwards once a week. At the end of rather more than ten months she found herself unable to stay longer, or to afford further treatment. The instrument was very much tightened, so as to last longer without alteration, and she left London. At that time she was suffering more pain in the back; her health was much broken, and she was, when the instrument was removed, more crooked, although she says that when the scaffolding was tightly screwed she was a little taller. She had, however, lost health more rapidly; had become very thin; was very easily wearied; scarcely able to walk; her appetite was very small, and somewhat capricious; she suffered also considerable pain, chiefly on the right side. She continued to wear the instrument for some time in the country; but after a little more than two months her strength so failed that she was obliged to take almost entirely to bed and the sofa, leaving off the scaffolding. Her health now began to improve again, and as she shortly was enabled to get about, she became again desirous of improving the shape of the spine, and resumed the support, but found again that her health failed, and was obliged to discontinue it. After six weeks more she consulted me.

At the date above given I found her pale and weak; she could not sit up for more than a few minutes at a time; appetite bad and capricious; pulse small; menstruation irregular and scanty.

The following measurements give the curvature of the spine: A silk thread between the seventh cervical vertebra and the

middle of the sacrum crossed exactly over the ninth dorsal spinous process. The second lumbar spine was one and an eighth of an inch to the right, the fifth dorsal was sixth-eighths to the left. When she lay down the curve decreased.

In this case it was, I felt, necessary to be very cautious in the application of any treatment. I ordered therefore at first a seat, sloping only one and a half of an inch in fifteen, for ten minutes twice in the day, to rest on the back immediately afterwards, and to take steel wine twice a day—a steel and aloes pill night and morning.

May 18th.—She is better in health; the back has, of course, hardly altered, but the hardness and protuberance of parts on the right of the spine are rather less marked. A bandage has been constructed, and this was now applied with but little tension. To continue the sloping seat.

June 12th.—The health has decidedly improved, and the patient has gained flesh with rather remarkable rapidity; the back also is better, the improvement being chiefly manifest by the decreasing rotation, as seen in the greater equality of hardness on each side of the spine.

July 20th.—In the three or four visits since the former date there has only been to observe the gradual improvement in health and in the form of the back. A higher slope to the seat was instituted a fortnight ago; the tension of the bandage has been two or three times rearranged. The deviation was to-day carefully measured: second lumbar spine six-eighths of an inch to right, fifth dorsal a quarter to left. We have then gained three-eighths on the lumbar (primary) curve, and half an inch on the dorsal secondary curve. This, I may remark, is not uncommonly the case; the secondary curve yields first and most.

August 28th.—Again I leave an interval, in which there is nothing especial to remark; improvement during that time has been, however, more rapid. Health is now very good. Menstruation has occurred with perfect regularity in the last three periods. She has sufficient colour and plumpness; appetite good. Measurement gives the following result: the second lumbar spine lies so that the straight line

is a quarter of an inch from its left border, and touches the right edge of the fifth dorsal vertebra.

Oct. 2nd.—The patient may now be considered well. The line of silk touches all the vertebræ ; no transverse processes can be felt, but the parts on each side are equal in hardness and resiliency.

A note or two of cases with habitual and with permanent obliquity may be desirable.

CASE 3.—Miss F. H., aged sixteen, came to me July 19th, 1869, with lateral curvature. The girl is tall and largely built, sufficiently fat, but not strong ; has lately had chorea, o which traces are still left.

The spine was considerably curved both in lumbar and dorsal regions, the spinous process of second lumbar vertebra lying seven-eighths of an inch to the left of the perpendicular thread. While placed in drill posture, no inequality in the height of the ilia could be detected ; but it was difficult to make her stand straight : she always wrung the lower part of the body so that the left side of the pelvis lay anterior to the right. Suspecting some habitual malposture of the lower limbs, I watched her closely, and on several occasions detected her standing only on the right foot, while the knee of the left was advanced in front of the other and bent. She was strongly warned against this habit. The use of the sloping seat and a piece of cork on the left boot were prescribed. After a month a loin bandage was ordered, and tonics were given.

It is unnecessary to give long records : suffice it to say that the docility of the patient has enabled her to make rapid progress. On the 4th of April, 1870, a perpendicular line touched the right side of the second lumbar spinous process and the case was nearly well.

In December, 1873, I saw this patient on account of a severely sprained ankle, and when she had recovered I took the opportunity of examining her back. It was perfectly straight, nor could I by the most careful tests find any

deviation from normal form. Her figure was slim and remarkably elegant.

CASE 4.—Mr.——, aged sixteen, came to me October, 1869, with lateral curve, which had prevented his entrance into the Army. He was tall and slight, but of sound health. I found a long lumbar curve, which disappeared entirely on recumbency, and partially when he sat down. A further examination showed that, when in the drill posture, the right crista ilii was seven-eighths of an inch higher than the left. This measurement was taken on an upright staff, to which a rectangular movable arm was attached. He was then placed recumbent, and the lower limbs measured from the top of trochanter to the junction between femur and tibia on the outer side (easily felt in so thin a lad), and from this point down to lowest point of outer malleolus ; they range thus :—

	RIGHT		LEFT
Thigh	$17\frac{3}{4}$		$17\frac{1}{4}$
Leg	$17\frac{1}{4}$	A little less than	17

In this case the sloping seat and a bandage were ordered. In January, 1870, the permanent curvature was so far annulled that in sitting on a flat chair it disappeared Of course in standing (since in this posture the pelvis was necessarily oblique) curvature reappeared. An additional sole of cork was ordered ; he wished to avoid the appearance of a high shoe, and would only tolerate about a quarter of an inch, but even this diminished the curvature. Perhaps we must be content with such result. No surgical art can remedy the inequality in length of the two limbs ; but the spine was straight whenever the pelvis was not oblique—in other words there was (April, 1870) no morbid or permanent lateral curvature.

June, 1872.—The limbs were, by the natural progress of growth, referred to at p. 29, very nearly equal in length ; the spine was straight ; and he has passed the Army medical examination.

CASE 5.—Hon. Miss ——, aged thirteen and a half, was brought to me by her mother on account of projection of one

hip, February 4th, 1888. For some months an awkwardness in her gait and in her sitting posture had been observed. On examination, I found a very marked curvature of the lumbar spine to the left, and a certain loss of the normal anterior curve. A narrow strip of lead laid on the loins between the tenth dorsal and the upper part of the rima natium showed that the second lumbar vertebra had deviated very nearly three-quarters of an inch to the left. The rotation also was considerable.[1] The ilia were level, or nearly so ; but she had the habit of standing chiefly on the right foot. As the girl was healthy and fairly strong, I conceived that she would bear somewhat energetic treatment.

Ordered one thickness of leather to be taken from the heel of the right, and one to be added to the heel of the left, boots and shoes. The sloping seat to be used for half an hour three times a day. The lateral sling to be used in bed from her own retiring time till her mother or maid went to bed, and also in the morning from the time the servant got up till her own hour of rising. A loin bandage (p. 100).

February 29th.—Improved, but the loin stiff in the direction of left flexion. I instituted lumbar rachilysis, and prescribed the rachilytic exercise. In applying the former I forced, with all my weight, her body well over to the left. This was done once a fortnight.

April 2nd.—There is now considerable improvement. The strip of lead marks a deviation of one-third of an inch, and the spine was very much more flexible, and yielded better to the lumbar bandage, which had therefore to be shortened.

June 2nd.—The patient has continued the fortnightly visits, and is greatly better. The leaden strip lay now on the right edge of the second lumbar vertebra. My scoliosis gauge (now nearly perfect) marked a rotation of 4 degrees.

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[1] I was at this time devising my scoliosis gauge ; but the first constructed instrument was not altogether reliable. I therefore refrain giving the measure of rotation in the text. seemed to be about 7°.

September 4th.—Since end of June the patient has returned only once a month, and was at this date brought from the country. There was still some deviation and rotation, and the parts on the left of the lumbar spinous processes were still hard, the improvement less than in previous intervals, and I found the methods prescribed had been more laxly carried out. Rachilysis this time with pulleys, and a little lecture on the folly of supineness.

December 4th.—Very much better. She has grown a good deal, and the deviation very slight.

February 27th, 1889.—Really well; but recommended continued use both of the sloping seat and of the different height of shoes. To see me again in July, to guard against any relapse.

July.—She is still perfectly straight and well.

I could give many other cases of lumbar curvature rapidly—though most of them less rapidly—cured. The photographic illustrations of this little book are, however, already rather numerous; I do not wish to further overlay the work with plates.

I now record a case by photograph of one of total curvature.

CASE 6.—D. W., aged 5½ years, was brought to me 15th December, 1894, on which day I took the photograph (Fig. 31), which was also presented at page 54. The child was rather weakly, and had grown in the last few weeks considerably; and though she was anæmic, I could find no disease of any organ. She had been kept, for so young a girl, rather close at lessons, and had been learning to write. I advised cessation of all lessons save only learning her letters, and that her teaching should be done orally and by reading to her. She had, as the photograph shows, a well-marked total curve to the left with amesial pelvis. I ordered her the citrate of iron, and found it also desirable to modify her diet considerably, adding meat, an egg or fish to one

of her daily meals (she had only been having such food once in the day), and recommended more open air, either by letting her drive out, or, weather permitting, play out of doors. She was subjected to rachilysis weekly (with one or two exceptions) till the end of February. She was also treated by the wall-wedge and by the lateral sling and sloping seat; no support or bandage. At the above date

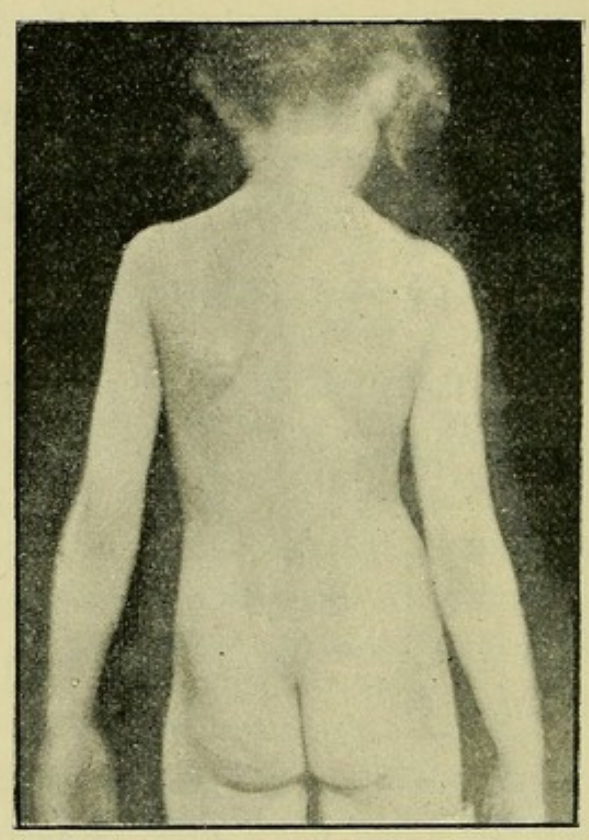

FIG. 31.—D. W., December 15th, 1894.

I found her sufficiently improved to allow intervals of a fortnight.

April 2nd.—Owing to regularity of attendance and to assiduity in carrying out my directions the child improved so rapidly that neither by scoliometer nor by camera could, at the above date, any deviation be detected. The photograph taken at the time has been engraved, and is here annexed. The child had grown, was much stronger and in better health.

Although the spine is now straight and the pelvis mesial, I considered it unwise to leave her entirely unwatched, and recommended that she should be brought to me monthly for the next few months, on which occasions I propose to use

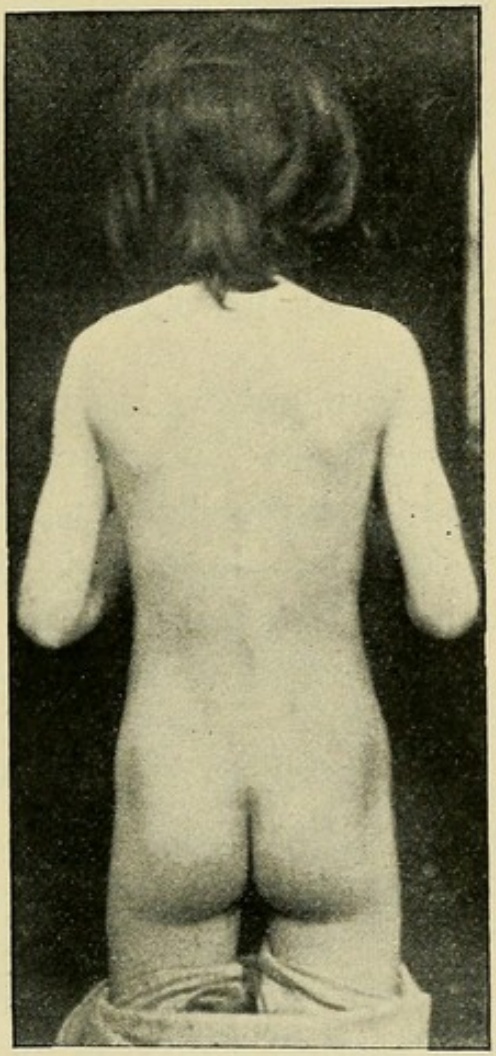

FIG. 32.—D. W., April 2nd, 1895.

rachilysis quite gently in order to prevent relapse. I also ordered a desk to be made such as is described at p. 118, sloping at an angle of 30°, and allowed her to learn writing for half an hour daily; the wall-wedge exercise to be continued twice a week for three minutes each time.

CHAPTER VII

TREATMENT OF DORSAL CURVATURE

DORSAL curvature, not arising from any thoracic disease, is to be treated on lines modified from those advocated for lumbar curve. But the modifications are considerable and of great, even of fundamental importance. Also, it must be observed that the cases differ greatly in degree and in every conceivable point, save merely the existence of curve; thus, in order to explain treatment, it is necessary to define the sort of case to which this or the other device is applicable. To give some idea of this great variety: the deformity may originate from one of several causes—may sometimes be chiefly marked by rotation, sometimes by lateral deviation; it may have been of slow and insidious progress, or of rapid, almost sudden development, or it may have been coming on slowly for some time, and then quickly culminate in changes of startling celerity. The patient may be of robust, sturdy build, or long, slim and weakly; the age may vary from that of an infant to that of a mature woman, even of a mother with children

seven or eight years old. The case may come under expert observation, when, as yet, such slight deformity exists that a practised eye only can detect it, or later when a marked and plainly visible protuberance may be seen, even through the clothing. Either may be in first, second, or third stage.

In a young person, a slight curvature which comes under skilled notice while in the first stage is curable with little difficulty if sufficient attention be given. After measuring and recording the degree of rotation and lateral deviation (see p. 75), and after verifying the stage of deformity, the chief essential is to discover, if possible, the cause ; and it need hardly be said that, whenever feasible, this must be removed or modified.

A permanent or habitual pelvic obliquity may be treated by the means already notified, for although the higher shoe and the sloping seat are more especially aimed at lumbar curve, yet their influence extends higher, and although the lumbar curve may be merely consecutive, yet these devices will be very valuable. One must, however, be careful not to mistake for dorso-lumbar S-shaped curve the not very uncommon simple curve to the left ; also as to more severe cases a note of caution must in the future be sounded.

Should one of the bad habits described at p. 20 be discovered, it must be corrected ; if it have been acquired at a flat table, a desk must be provided, and should the habit be that sketched in Fig. 5, and do not yield to the usual desk, it will almost

certainly do so to the use of a narrow one, so that the left elbow reposes on the table at a lower level than the right, the left hand only, as far as the wrist, being on the desk, which should be not more than ten inches broad, with an angle of 25°. If the trick be that which I endeavoured to show in Fig. 6, or if which the child, stooping down and to the left, sits as though trying to look under the writing hand, he should have a higher table, or a desk which, when placed on the table, stands so that its lower edge is at the height of the xiphoid cartilage; its angle should be 30° or 35°; it should be deep from before back, and he should never write at its lower part. This precept may be enforced by a low narrow ledge for the support of the paper about six inches from the lower edge. If the trick be carried very far and be inveterate, such desk may also slope sideways, *i.e.* be higher on the left side than on the right; an incline of 10° in that direction is sufficient to render the position in question all but impossible.

A child who has learnt a bad position in writing must always be watched and must never be allowed to sit or place his paper askew on the table. If these devices do not correct the evil habit, there should be screwed to the chair on which he sits to write two arms or branches, which, projecting forward, come in contact with the sides of the chest a little below the axillæ. The seat of such chair moreover must be sufficiently narrow to prevent the possibility of sitting to one side of it, and leaning over to either branch.

In the intervals of work, exercise should be prescribed; to weakly girls, of course, less than to the more robust. It is impossible to lay down any special rules as to the amount. A good run, driving a hoop, battledore and shuttlecock, especially with the left hand, or lawn tennis, are all good methods of exercise. The sort to be especially deprecated are those monotonous walks, trailing two and two, to which so many school-girls in large towns are condemned.

A young patient, considerably employed in writing, should avoid other fatigue to the back in the sedentary position, and she should do her reading and learning by rote in recumbency. To study while lying flat on the back is very fatiguing to both eyes and head, nor is there any intrinsic remedial virtue in that posture. Repose of the spinal muscles is the object, which may equally be gained in the supine position; thus I recommend such a patient to lie on the front of the body, and to have the book propped at a convenient angle and distance, while she rests the upper part of the body on the elbows. Some patients find that the rather sharp backward bend thus caused in the lumbar spine produces aching; this can be obviated by placing a cushion or rolled-up shawl under the abdomen, about the level of the umbilicus. Should rotation of the spine, therefore backward projection of the right shoulder, be pretty strongly marked, she should be directed to let that arm lie on the couch by her side, and to support the chin or forehead on the left hand, and this on the elbow. This

position, by throwing back the left shoulder, causes in reality the upper part of the trunk to be slung as it were on the left serratus.

I am often asked by parents for what periods at a time and for how long during the day the young patient should lie down. There is still a superstition that lying down is in itself a curative process. It is not so, however; it is only of value as preventing or avoiding over-fatigue of muscles. Indeed, strong, reliable muscles are one of the factors on which I rely for keeping the spine straight after I have made it so; perpetual recumbency for two or three years may perhaps—though I very much doubt it—cause a spine to be straight for the first few minutes after the patient is allowed to rise; but I am quite sure, having pretty often seen such result, that the back, weakened by such regimen, very soon yields again to curvature. The value of recumbency, therefore, is as an alternative to exercise, and the answer to the question above formulated must be framed according to our judgment of what amount of exertion the patient can bear without too much fatigue. Thus when the patient has finished her allotted task of writing or of musical practice, when she has completed her walk or played her set of lawn-tennis, she should, if the curvature be rather severe, immediately lie down in the above posture; patients less markedly affected may preferably sit squarely on an easy chair which permits of leaning well back, and which thoroughly supports the trunk.

Mothers, who bring growing and somewhat feeble

girls, constantly tell me that, in spite of all their rebukes, their daughters are always lolling, leaning on their elbows, &c. This in the maternal point of view may be very naughty and inelegant ; but it is the means, which nature teaches the girls to adopt as rest for their over-tired muscles, and I always, procuring the absence of the patient, beg the mother to let her loll and recline, to lean her elbow on the table, and to let her sit in the most unmitigated of easy chairs, only taking care that she do not always lean to one and the same side. One cause of boys being comparatively exempt from curvature is parental indifference to their ungainly sprawling. But another factor of great importance comes in. Very many such patients owe their fatigued and languid condition of muscle to too-frequent, prolonged, and profuse menstruation. With a really large proportion that function recurs every seventeen or twenty days, reckoning from the beginning of one to that of the succeeding period and lasting a full week, therefore the intervals may be of only ten days or a fortnight, during which somewhat profuse leucorrhœa frequently prevails. Of course it is unnecessary to say that this must be attended to, not only on account of the spinal condition ; but also because, in my experience, most who thus commence their woman's life, and are allowed to go on in this way, are comparatively old women by about their thirtieth year, and very often are confirmed invalids during the rest of their life.

The methods already described, if taken alone, can be considered curative only for slight cases, but

combined with the more potent remedies to be now discussed, they aid greatly also in severe ones. In cases that, although not as yet belonging to that category, are marked by rotation rather than by lateral deviation—especially if there be reason to suppose that carrying weight on one arm may be the first cause of the curve—certain exercises with the left arm are valuable. The first is this: The patient, standing in drill posture, lifts the left arm outward from her side to a right angle with the body, the palm looking downward. A weight of half a pound to two pounds is placed in her hand; she holds it in this position for five or ten seconds, and then slowly raises her arm, still kept straight, outward from the side, till the hand is immediately over the shoulder;[1] here it is kept a few seconds, and then the weight is allowed slowly to descend through the same arc and still with the arm straight. The number of repetitions, like the amount of weight, must depend on the size and power of the patient. A second method is to sit on a stool or low-backed chair, and with the right hand to take hold of a table or other firm piece of furniture, so that that hand lies in front of the left lower ribs. In the left hand is placed a dumb-bell, from a quarter of a pound to one pound in weight. The arm kept

[1] It will be recollected that the deltoid cannot raise the arm more than to lie in a line with the spine of the scapula; if more elevation be required that bone must therefore turn on an antero-posterior axis by action of the serratus, which gets its bearing and has its counter-action on the fifth to ninth rib inclusive. See Appendix V.

quite straight, and at a right angle to the body, is rapidly thrown from opposite the middle line in front, as near as possible to the corresponding point behind ; in front, the back of the hand should look upward, behind downward, and throughout the patient's face is to be directed to the ceiling. Another way of exercising the left serratus, less exacting but more constant, is to fasten round the arm, about the insertion of the deltoid, a strip of lead about one-tenth of an inch thick, a half to three-quarters broad, and ten inches long, or less, according to the size of arm. It should be covered with thin macintosh, to prevent lead absorption, and with silk ribbon long enough to go again round the arm and be tied. Some girls' arms are very cylindrical, and show none of the usual constriction about the insertion of the deltoid ; in such cases the bracelet will slip down, unless one puts round it, not tight enough to impede circulation, a stationer's india-rubber ring. This device may appear, at first thought, very inoperative ; but its constancy renders it much more potent than one would, without experience, conceive. I have cured many slight cases with it, and one or more of the already named devices, sloping seat or high shoe, as the case may indicate ; it is also exceedingly useful when the more potent means, to be mentioned immediately, have cured all but a remnant of rotation amounting to 2° or 4°, and those other methods of treatment are being gradually relaxed, previous to their discontinuance.

Another means of relieving the one shoulder and

throwing weight on the other, is that which I have named the shoulder-sling, and which is useful in moderately severe degrees of weight-bearing curve. The outline diagram represents it as in a case of right dorsal curve ; the triangular piece is made of

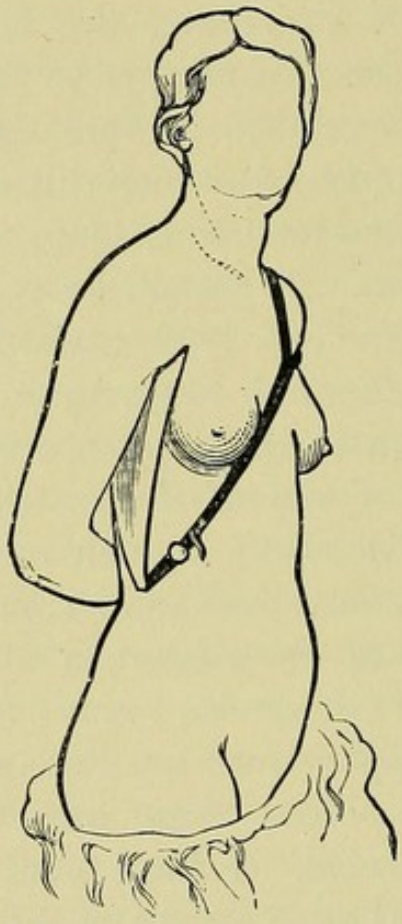

FIG. 33.– The Shoulder Sling.

very thin, highly-tempered steel of a V-shape, with cross-pieces for strength. The upper side of the triangle is made of a piece of strong webbing drawn through an india-rubber tube, padded and enclosed with wash-leather. The triangle is represented covered with some strong woven fabric. The left

shoulder is enclosed in a loop of webbing, from which run down, back and front, two webbing straps to the apex of the triangle. These straps are provided with buckles for regulation of tension and with strong india-rubber rings for elasticity. When first applied, this sling should only be used for three or four hours a day, as the edges of the axilla are somewhat sensitive to friction ; they soon, however, get harder, and the time of wearing may be increased ; if the dress do not hold it in place, a piece of three-eighths wide elastic passes from each angle round the chest. For girls whose curvature has been caused by baby-carrying, the sling must support the left shoulder. This device is only to be used when evidence as to the weight-bearing origin of the curve is plain and irrefutable.

The treatment of a greater degree of curvature not dependent, or at all events not solely dependent, on weight bearing, may include cases in which the dorsal rotation amounts to 8° or more, irrespective of lateral deviation, which is, however, very nearly always present when that degree of twist exists. We may take the cases to be in the second or in the earliest phase of the third stage. In the former, be it remembered, a certain shortening of ligaments has taken place on the convex side ; in the latter deforming changes of the bones is superadded. Here, before going further, I must point out that in such cases both the sloping seat and the heightened shoe may be unadvisable until by treatment the ligaments have been somewhat relaxed ; because if those of the loins will not

permit that portion of the spine to correct its curvature, when the pelvis is placed in an oblique position the body will maintain its balance by increasing the morbid curve of the dorsum; therefore, it is imprudent to order those devices without previous observation of their effect; nevertheless, patients in this far advanced condition are capable of being cured by elastic traction and enforced positions, as many of my previous cases show, but only after a considerable period. Other more rapid methods will be mentioned immediately.

In quite the earlier part of the second stage the patient may effect a good deal for herself, partly by the exercise shown in Fig. 29—which, however, only acts on the lumbar portion of the curve; also by the following: In the ceiling of a sufficiently lofty room two hooks or staples, about eighteen inches apart, must be fixed; from these hang down two strong cords, to which are attached rings of about three inches radius, made of iron or brass, about one inch in diameter; they are to hang so that their lowest point is about level with the erect patient's eyes. She stands evenly between them, and taking a ring in each hand sways herself to either side, and then by alternate traction with each hand sways her body in a circle, keeping the feet as nearly as she can on the same spot, face, chest, &c., always looking in the same direction. If this be attended to, it does not matter whether the circle passed through by the head be traced from right to left or in the contrary direction. As seen in the diagram, the figure is bent

in constantly different directions, the object being not to influence the spine by making it bend in a direction contrary to the morbid curve; but simply to loosen the tightened muscles and ligaments, now on the left, now on the right, *i.e.* in the concavity of dorsal and lumbar curves alternately. The adoption of this exercise into the

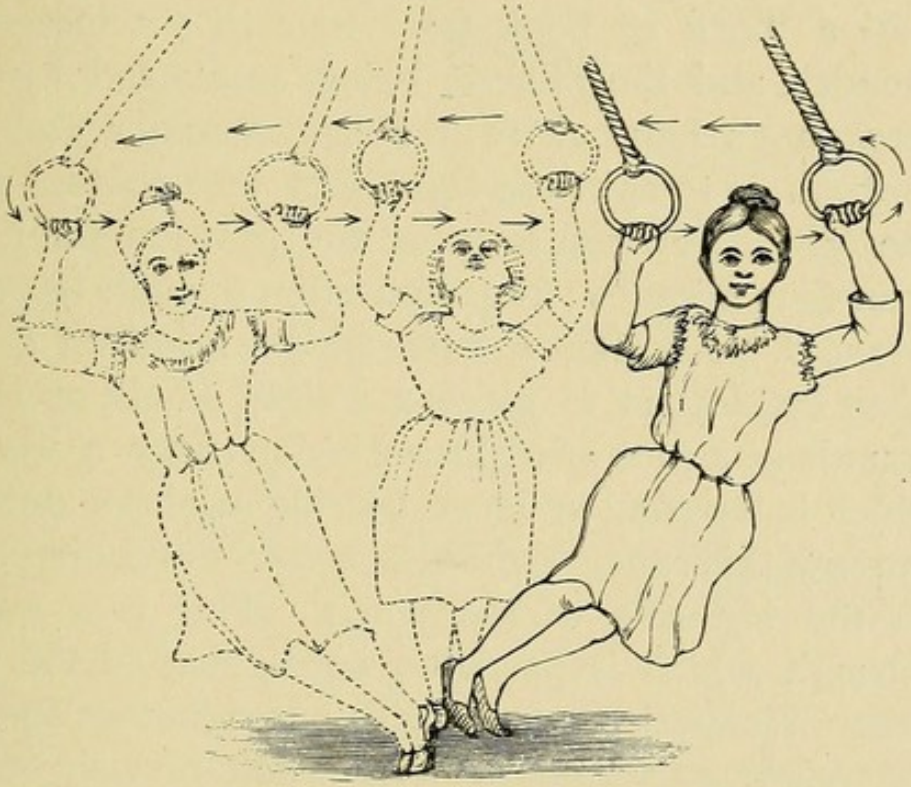

FIG. 34.—Ring Exercise for Stretching Contracted Ligaments.

surgery of Lateral Curvature is, I believe, due to Volkmann.

If the pelvis be amesial to the left (Fig. 10), some considerable assiduity will be required to overcome the condition; but if such be used, it can in general be mastered within a few weeks. Three, or even four times a day the patient must stand with her

left side against a flat, even wall, her hips and shoulders being at a right angle to it, and the outside of her left foot close to its base. The right foot at this period will be a few inches away, as otherwise she cannot stand. But now the nurse or attendant standing behind her puts her right hand on the patient's right side, just below or in the axilla, and places between her left hip and the wall a block or book from four to six inches in breadth, and the patient being supported by her attendant's hand, with the left shoulder close to the wall, is to shift the right foot into contact with the left. Few can support this position for more than four minutes; repeated often enough its effect is rapid. Another means, which, however, I less often employ, is to place a weight of six or eight pounds at a foot or eighteen inches from a wall to which is fastened a hook bearing a single pulley: through this runs a cord attached to a webbing loop on the left side of the pelvis. This is a pulley through which is passed a cord going to the loin strap. The patient stands with her right foot against the weight, an attendant pulls simultaneously on the left hand and the cord thus drawing the upper part of the body to the left and the pelvis to the right.

The next few devices are directed especially against rotation. The respiratory exercise is performed thus: Into two walls opposite each other, and not too far apart, hooks or staples are driven, and to each is attached a cord ending in an accumulator and cross handle. Midway between these staples the patient sits, in some cases on the

sloping seat, and the handle attached on her right is put into her left hand passing behind her loins, while her right hand, passed in front of the body,

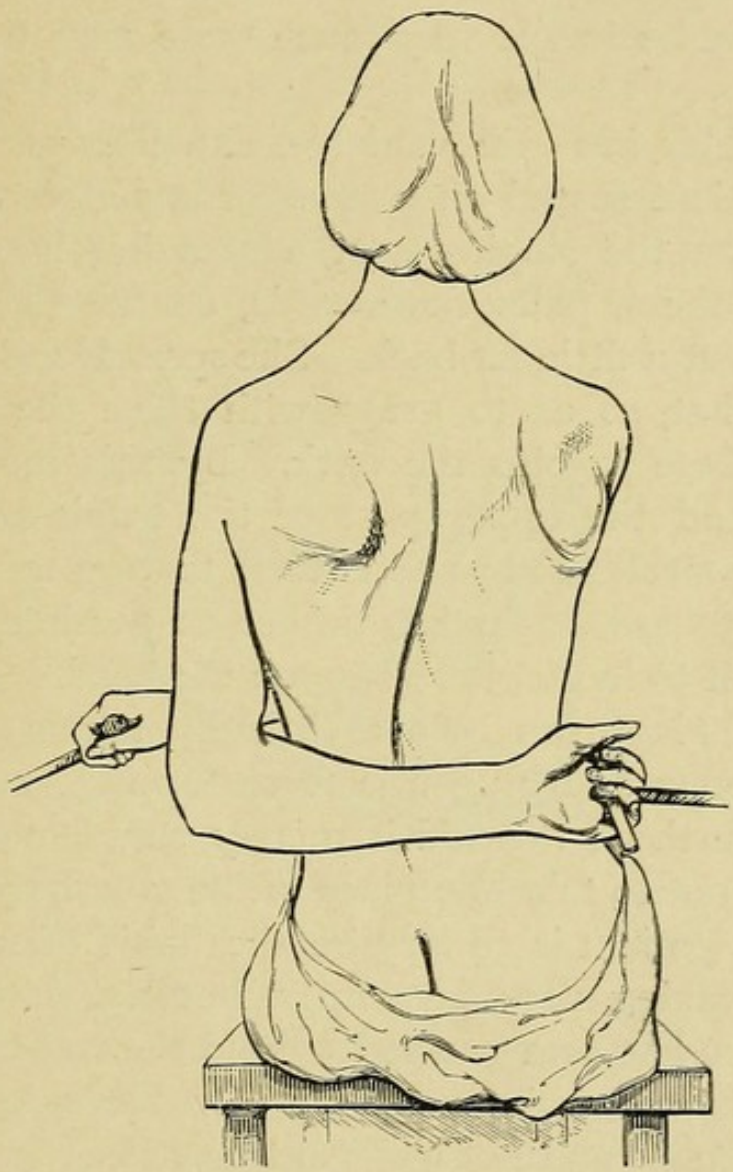

FIG. 35.—Left Respiratory Exercise.

grasps the handle attached to the staple on the left, the cords being of such length as to exert considerable traction on the arms. In this posture the patient is to take several deep and slow breaths,

the inspiration being longer than the expiration, and there should be, if possible, only four or five to the minute. If the posterior thoracic wall be watched during this exercise, the left will be seen to move backward very much more than the right side.

Slighter, but still valuable, exercises are these: the patient seated on a stool, or in certain suitable cases on the sloping seat, clasps her hands and places them, palm downwards, on the top of her head, but a little far back. She spreads the thumbs somewhat, so as to grasp with them the occiput just where it joins the neck. By this means the head and the upper part of the trunk are, as it were, consolidated; she is then to turn to the left, so as to see as far behind her as possible, taking care not to loosen her grasp on the head. A nurse or attendant can help a little by taking hold of the elbows and by gentle force turning her still a little further; this aid is merely supplemental to, and is not to take the place of the voluntary effort.

The patient is to acquire the habit of standing and walking very frequently, but not constantly, with the left arm crossed behind the waist-belt, so that the elbow is pretty close to the side, an inconspicuous and not inelegant position.

Very marked in its effect is that which I have named the lateral sling. I used this for some years as a loop, suspended by rope and pulley above the patient's head or couch; afterwards I modified the method, and it appears that, a little later, both Professors Busch and Volkmann hit

simultaneously on the same idea. The appliance as I now use it consists of four angle brackets, whose arms are ten and five inches long respectively ; the shorter arm has two screw-holes in it ; the longer has, close to the top, which is rounded, a larger hole ; into this hole fits loosely the screw end of a round rod, and to the screw is fitted a nut, the rod being shouldered for full-grown people at six inches, for smaller folk at four. The short arms of the brackets are screwed to the long side

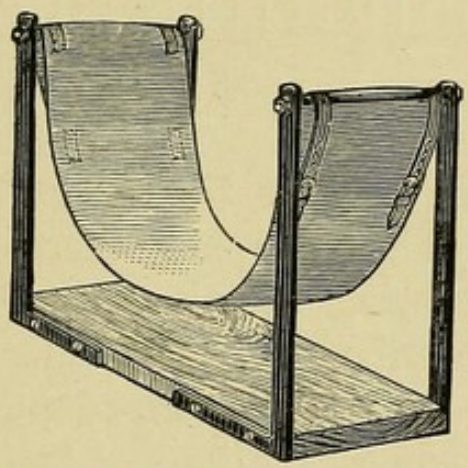

FIG. 36.—Lateral Sling.

of a common mahogany or firwood board, fourteen long by six, or for children by four inches broad. Tacked round each cross-piece is a piece of webbing, twenty-four inches long and either six or four broad. In this sling the patient places the right posterior part of the chest, as she lays herself down on the side, a little turned on the back, so that the most protuberant part, the angles of the ribs, comes into the most dependent part of the hammock, while the head is supported by a suffi-

ciently bulky pillow. Of course there is no necessity for the nudity which the plate indicates; on the contrary the usual dress should be worn with

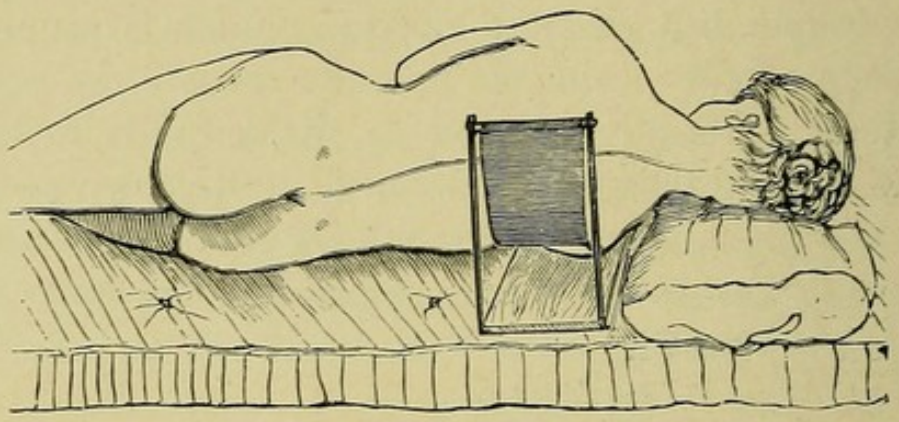

FIG. 37.—Lateral Sling in Action

the exception of stays, if they be either tight or rather stiff. The sling may therefore be used in the daytime, being substituted for the prone recumbency described at p. 119. Or with children the following method may be adopted:—The sling is kept conveniently by the bedside, and the nurse or maid on first rising puts it in position, and the patient lies in it till getting-up time. On first going to bed it is again so adjusted, and may be removed, generally without waking the patient, in an hour. It is so little irksome that young people generally, both morning and evening, sleep in it quite comfortably; but restless lie-abeds, who constantly turn about before settling to sleep, cannot be thus managed.

DORSAL RACHILYSIS.—The method to which I have ventured to give this name is by far the most certain way of curing spinal deformity. It is of

course not to be used alone, but must be combined with one or the other of the already-mentioned devices in order to continue and prolong its benefits during the intervals. It has the further advantage of not being at all painful, even quite little children bearing it without murmur or grimace.

It may be carried out in two ways, the choice of which depends upon the amount of curve, which may also coexist at the loins. If this be considerable, the form, which I call dorso-lumbar is the most

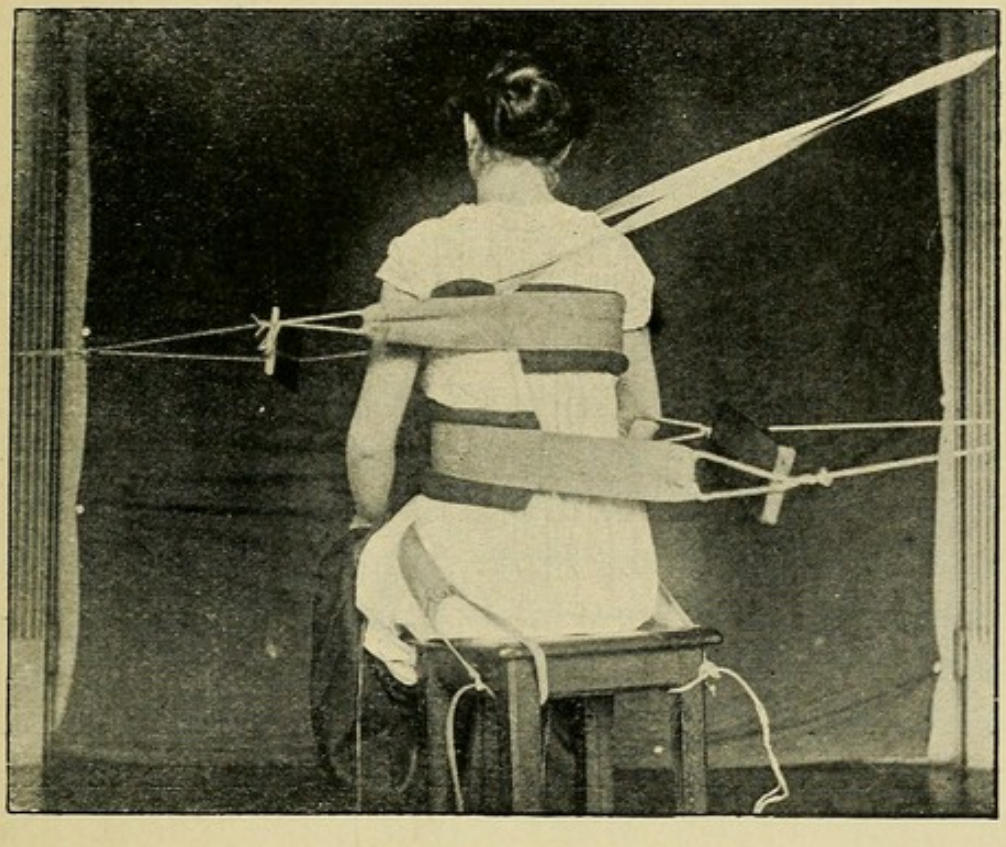

FIG. 38.—Dorso-Lumbar Rachilysis.

useful. The same rings, hooks, pulleys &c., are required as for the purely lumbar form (see p. 105), and in addition another cleet on the patient's right

just above the lowest ring, but reversed, so that it will hold fast a cord coming up to it from below.

The pelvic girth is properly secured to the stool-leg, a lumbar-loop is placed on the left of the loin, a rather thick pad being interposed between it and the site of the transverse processes. This belt must have attached to the middle of the cord-loop a loose piece of rope, the other end of which is passed through the lower ring on her right, drawn tight,[1] and fastened to the reversed cleet. A like loop without loose cord such as was described at p. 105 is passed over her head, and for the present hangs loose. The axillary lanyard is next arranged in its place, the rope passed through the upper single pulley, drawn sufficiently taut, and cleeted. The front lap of this is drawn forward by a strap secured to another wall in front of her, or the neck may simply be protected by a pad. The patient's position must be such that neither her back nor her side immediately confront these cleets, &c., but something between the two, that is to say the angle of the ribs, should face those fixtures. The loop of the dorsal belt is now hitched to the flight of pulleys on her left, and traction is made, while the dorsal belt is placed on the most prominent part of the curve, and a thick pad laid over the angles of the ribs ; then when a little more tension has been made a strut is slipped between the laps of both dorsal and lumbar belt, to prevent constriction

[1] In bad cases I use a simple pulley instead of the mere ring, sometimes even, if the spine be very inflexible, a system of pulleys ; but that is very rarely required.

and pressure on wrong places, and the requisite degree of tension is attained. In some severe cases it is desirable now to take another pull on the lumbar belt ; hence the occasional use of a single pulley or of a system also for that part.

The above describes the bare use of the mechanism ; certain variants are required in different conditions of curvature. For instance, when the lumbar curve is not strongly developed and is marked by only slight rotation, the loin belt may be dispensed with, when the pelvic girth must be put on, so as to fall more particularly on the left ilium. In cases where the upper limb of the dorsal curve is strongly accentuated, it is well, after having made the dorsal belt sufficiently taut, to pull again upon the axillary lanyard. In fact, details in the use of rachilysis should be adapted to suit all the varieties that occur in the form of curvature. Whatever may be the particular kind of method, the time should never be prolonged beyond the first sense of slight fatigue ; from three to four minutes' rest may then be allowed and one repetition given. Should the patient feel fatigue or back-ache during the same day, she should lie down for about half an hour, and on the next occasion the traction should be less prolonged. In all cases sufficiently severe to require the dorso-lumbar or rotation belt, to be now described, these should be immediately adjusted.

These belts or bandages were devised by me some years ago, because it was evident that spines, which had fallen laterally out of the perpendicular gener-

ally required to be upheld ; but I saw—as indeed has been already explained—that "spinal supports," so called, do not support the spine, and it was evident to me that so flexible and movable a thing as the human figure could not be really encased in rigid metal, and squeezed by screws into straighter form save by inflicting unendurable torture. Thus it was evident that the only contrivance that could help the muscles to keep the spine straight must be a combination of flexible and elastic materials. Nothing inelastic could adapt itself to the alternately expanding and contracting movements of a breathing chest while exerting pressure in both states of the cavity ; any rigid encasement must be either too tight when the chest is full, or too loose when it is empty. For many years past I have used two forms of bandage for dorso-lumbar curvature. The one here depicted bears the same name as the curve ; it is more especially potent in those cases which are marked by considerable lateral deviation ; lower part, leg and loin portions, are like the bandage shown in Fig. 29 ; the addition is a part carefully cut and fitted to the right side and shoulder ; its form is seen in the annexed figure. The lower edge lies on a level with the seventh or eighth rib, according to the case ; the power is got from the lower front and back angles by means of webbing straps provided with intercalated strong india-rubber rings, also with clasps and buckles. These, when fastened to the left side of the loin-piece, draw the convexity of the dorsal curve strongly over to the left, while the

loin-piece itself pulls the lumbar curve in the contrary direction. The upper strap in the figure marked in lighter tone, which passes from back upper corner of the chest-piece under the left axilla

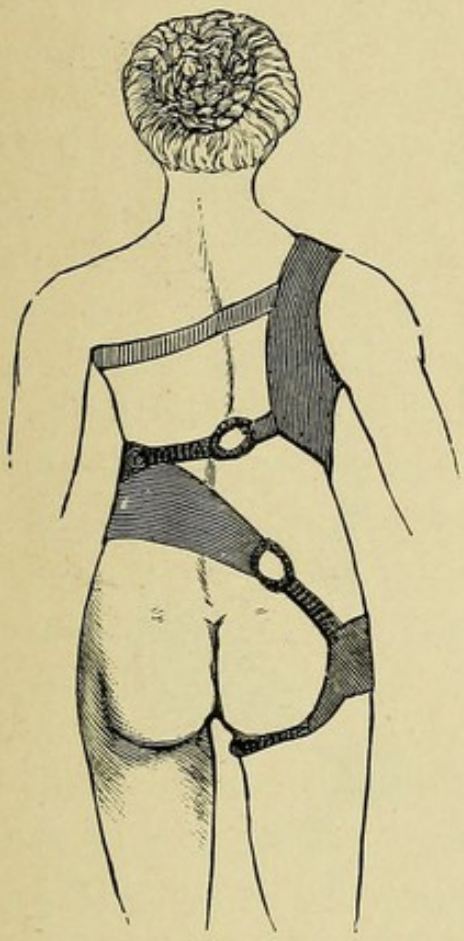

FIG. 39.—Back.

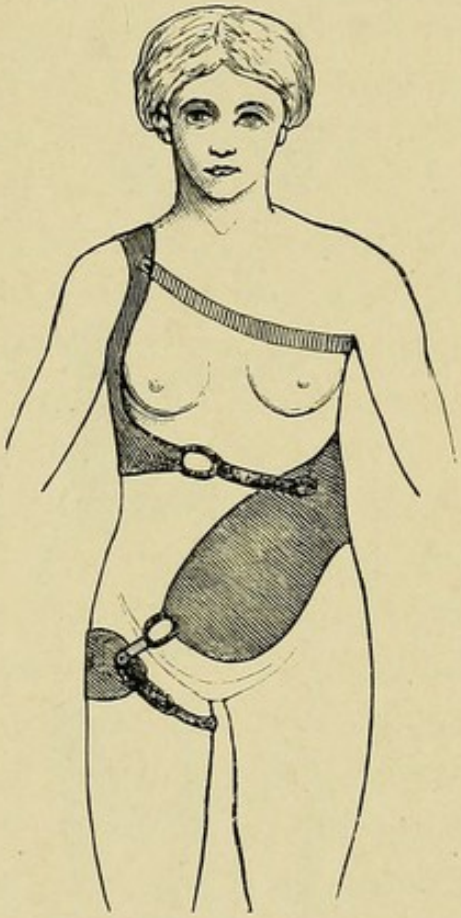

FIG. 40.—Front.

The Dorso-Lumbar Bandage.

to its front, is merely a piece of five-eighths or one inch elastic, exercising no power on the curve, but intended merely to prevent that part of the appliance slipping off the shoulder.

The "rotation bandage" differs from that just described by the disposition of the straps, and is

thereby enabled to act in a very different manner. The strap from the lower back corner of the chest-piece, instead of running directly across to the loin-piece, as in the bandage last described, passes across the back, under the axilla, over the shoulder,

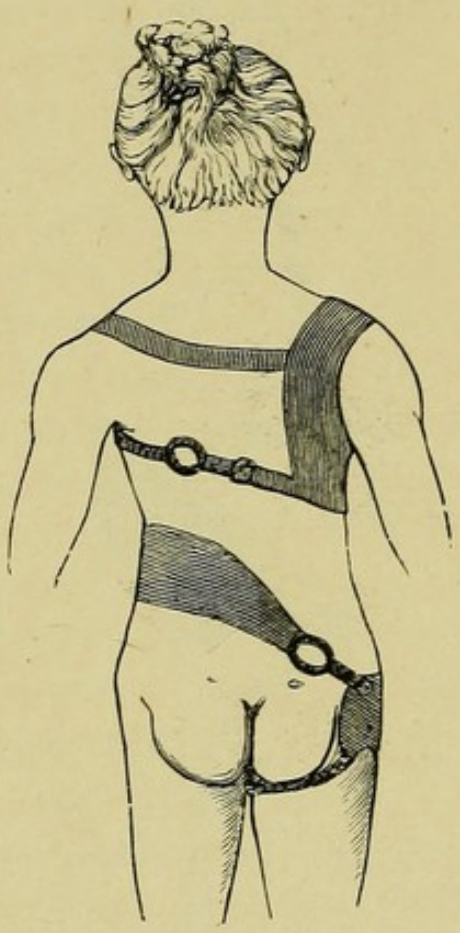

FIG. 41.—Back.

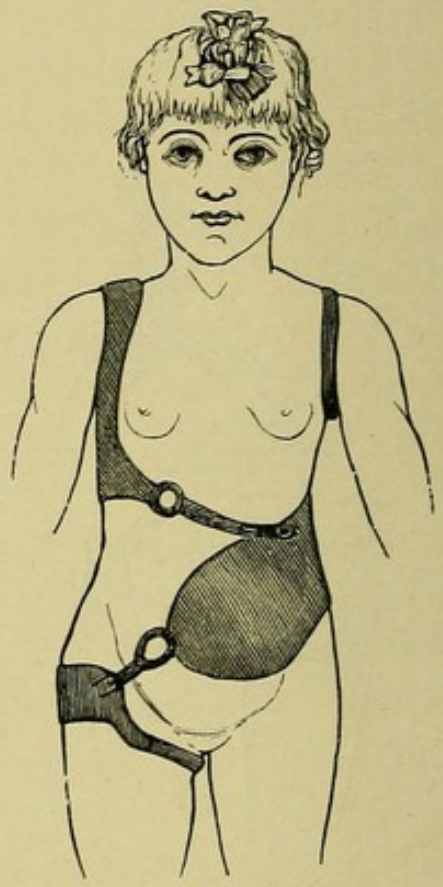

FIG. 42.—Front.

The Rotation Bandage.

and returns higher up across the back, to the back upper corner of the same piece; if the lower corner be not too high, it gets as much bearing from the chest, below and about the axilla, as from the shoulder.

In putting on this bandage, it is essential, the

leg and loin-piece being in place, to put the chest-piece well home, and to get the line, between the attachment to it of the two straps, perpendicular; then to fasten the rotation loop and lastly the strap, crossing the lower part of the chest. If the surgeon will watch his patient's figure while he is fastening this last strap, he will see it turn considerably, right side forward, left backward, and the belt keeps up this action all the time it is worn.

One or other of these two bandages is to be chosen, according to the condition of the case; in some instances rotation largely predominates over lateral deviation, in others the latter is the more pronounced deformity. In such cases it is well to begin as already said with the dorso-lumbar bandage. If rotation be equal to or more than the sideways bend, the last-described appliance should precede the other. It has, as well as the effect on the twist, considerable power on the deviation of the spine. Nevertheless, and although I can give no other reason than that of experience, more rapid progress is made, unless lateral devation greatly predominate, if rotation be first attacked. Whenever it may be thought necessary to change the bandage, this may be done in a few minutes by taking away all that part of the strap which goes to the left of the ring, save one or two inches, to which a clasp is sewn, as also one to the proper spot of the loin-piece. It then at once becomes a dorso-lumbar bandage.

These bandages are only to be worn during the day and never next the skin. The best garment for the patient to wear is the combination, and the

bandage can be put on between that and the linen ; but if the very usual knickerbocker-drawers, that do not come higher than the waist, be worn, the leg strap and pad will lie on these, and the side seam of the chemise may be opened for a few inches, permitting the pad to come through it, and the other parts can be worn outside that garment also. When rachilysis is repeated pretty frequently, I only use these adjuvants in rather severe cases—I do not employ them in quite young people, nor in slight curvatures, even when recourse to that more potent device is less frequent ; nevertheless these bandages exert a good deal of power over a considerable surface ; being elastic, their action is constant, and this latter form (the rotation-belt) can be actually seen to turn the spine at each inspiration. The dorso-lumbar belt owes its really considerable power to the fact that it acts in the direction of the radius and not of the chord of the curve. When employed in combination with rachilysis their degree of tension must be attended to pretty frequently, because the spine alters its curves so rapidly.

CASE 7.—Miss R., aged 17½ years, was sent to me by my late friend Dr. Cotton, October 12th, 1867, on account of the following conditions : During the last three or four months, she, having lost health, flesh, colour, and appetite, was taken to see Dr. Cotton, who found no signs of tubercle in the lung, but simply failure of vital power ; he also saw upon her one of the usual steel supports that had been ordered her by one of that persuasion, and made by a practised maker. On questioning her, the physician found that five months ago some apprehension had been

excited by a tendency to stoop, and she was taken to Mr. ——, who, ordering the usual mechanism, had seen her frequently ; to screw up the levers.

In my presence the scaffolding was removed, and I found a dorsal curvature to the right, not severe, plainly marked ; with those particular additions which I have always observed with backs that have for a length of time been supported by stiff instruments, namely that on first removal the spine remains in the same attitude, with a certain rigidity ; rotation being more marked than the lateral bend. After a time, and generally on a sudden, the back gives way and sinks into very considerable curves, and then the spine becomes again more flexible. There is considerable tenderness of the spinal muscles.

The patient is suffering under a morbid irritability ; she flushes very easily, and has fainted once or twice on very slight occasions. I therefore ordered no exertion by position or exercise, but simply that she should remain erect but very little at a time, until a less exacting mode of support could be made.

25th.—The bandage was applied on the 18th, and she has since sat up more, and walked about a little ; she is better generally ; irritability is much less ; the pain and tenderness of the spinal muscles have disappeared, or nearly so.

November 20th.—The back has improved each time that I have seen it (about every ten or twelve days), and now the condition is very much better ; her morbid irritability is gone, and although closely watching, I have seen none of the old transient flush. The tenderness of the spinal muscles has also quite disappeared. The sloping seat, rising one and a half inch to the foot, is ordered for her, which she is to use ten minutes twice in the day.

December 18th.—Still improving.

January 23rd, 1868.—During the last few weeks this young lady's improvement has been very rapid. There is now but very little lateral deviation ; the rotation, however, is to a skilled examination very evident.

March 2nd.—This case is to be considered well. The

patient's back is perfectly straight; she has gained health and flesh, her spirits are good, and she can take a fair amount of exercise.

April 17th.—I saw this patient again; the back remains perfectly straight.

CASE 8.—Miss F., aged 24 years, came to me, 12th April, 1869, with a well-marked dorsal curve to the right. She is tall and slender in build, and is thin; the limbs are not weak, but she has worn an iron instrument, with crutch handles, for two years and six months, and the muscles of the back are shrunken. A fortnight ago some of the steel broke, and during its repair both she and her friends were alarmed to see how little she could sit up; how her power of walking even a little way had diminished. The instrument was therefore not re-applied, but the young lady was brought to me.

I found the back excessively feeble, so that it could with difficulty support the trunk. The muscles on each side were shrunken, so that the spinous processes projected. The back, besides being weak, was very stiff; I consider this rather the effect of the treatment than of the disease. When told to sit quite upright for a time, and the back was watched, it could be seen to remain in good position for a minute or two, then it suddenly gave way, and the spine sank into more severe curves.

An oblique bandage, with a larger pectoral pad than usual for this patient, was ordered. Until the bandage was made she was to remain a good deal recumbent, and under all circumstances to lie down as soon as the back became fatigued. After a week the bandage was applied.

May 12th.—The difficulty of this case was not with the disease itself; the excessively weakened back barely permitted further management than the mild non-restraining support, and avoidance of fatigue. This debility by this date had a little decreased.

June—There was now more evident return of strength and the health had improved.

July.—Considerable improvement in strength, and the back

was straighter. She was now permitted to use the sloping seat a few minutes at a time.

October.—The case has greatly advanced towards recovery. The back is now fairly strong ; she walks a mile at a time without difficulty, and has walked two, but with fatigue. The same ordinances, with the addition of allowing her to ride on the wrong side of a steady old horse, and at a walk.

The rest of the case is not worth following minutely. The patient at the end of March, 1870, was considered well, but asked still to wear the bandage. I saw her again in May of the same year, and the appliance was discarded. She is quite well in health, the back being perfectly straight. She has become sufficiently *embonpoint*, and is a very pretty figure.

CASE 9.—Marion S., aged 9½ years, was brought to me April 6th, 1880, some defect and awkwardness having been observed by her dancing mistress seven months previously. The child had been growing very considerably.

She had a strongly-marked dorsal curvature to the right, with a rather advanced secondary lumbar curve in the contrary direction. She was tall for her age ; rather anæmic and weak ; her limbs were well formed ; there was no bending of the ribs, nor any other sign of rickets ; the lungs were sound, though she easily got out of breath.

I ordered the lateral sling to be used at night, and, for as long as could be managed in the morning, a dorso-lumbar bandage ; and that all lessons requiring writing should be restricted as much as possible ; others to be done in the prone position with a pillow under the abdomen. Iron internally.

June 4th.—She has now worn the bandage, and carried out the other recommendations for seven and a half weeks, and the back is certainly better, chiefly as to lateral deviation ; the rotation is less affected. She was ordered to go on in the same way, but, as she is also stronger, use of the sloping seat was promised at a near future ; also some modification in the direction of the force exercised by the bandage.

Observation of certain cases had impressed upon me the idea that a form of appliance more directly counteracting rotation must be devised.

July 3rd.—Adopted "rotation bandage" by a slight change in straps (see p. 138). She is to use the sloping seat.

August 1st.—The rotation bandage has acted excellently. Continue in same way.

October 4th.—Child very much better. The right shoulder much less prominent.

February 1st, 1881.—Greatly improved, more especially as to rotation; but it appeared to me that in future it would be better to begin by acting against this part of the deformity, and to use the dorso-lumbar belt afterwards against lateral deviation.

It would be tedious to follow in detail this case further. I saw her last after a long interval. I had ceased to treat the case actively at end of 1885, only seeing her occasionally to guard against relapse. In May, 1888, she was nearly but not quite straight. At that date I had perfected my scoliosis gauge. The patient was between seventeen and eighteen years old. While dressed she looked not at all deformed; but the bared back exhibited to careful examination slight asymmetry. The gauge showed at level of eighth dorsal vertebra $1\frac{1}{2}^{\circ}$ rotation, and 0·1 right lateral deviation; at level of second lumbar vertebra 0° rotation. The spot made by the marking wire fell on the spinous process of that vertebra, but possibly not quite in its middle.

I will now pass over an interval of three years, during which I was perfecting my scoliosis gauge, and cautiously trying, at first by merely manual pressure (p. 102), the principal of rachilysis. The earlier cases measured by the one and treated by the other device may be passed over. In employing the latter my motive was to accelerate the somewhat tardy effects of all devices hitherto used.

I shall not be obliged, in the next few cases, to enter into any other than a general description of the patients' build and constitution. The condition of back can best be gathered by reading the diaries of mensuration. Some of these cases are quite recent, as yet incomplete.

CASE 10.—Katharine L., aged 13½, was first observed to be crooked four years previous to consulting me, on October 7th, 1887. She had been treated by two practitioners, the one using exercises, the other orthopædic "supports." According to her mother's statement her back was at above date worse than it has yet been. She was a rather short, somewhat sturdy girl, looking in her clothes short from waist to shoulder in proportion to the length from waist downward. I removed a heavy instrument. After letting her repose for a time measured the deviations.[1]

At 8th dorsal vertebra : rotation, 9°, lateral deviation, 0·9
„ 2nd lumbar „ „ 4° „ „ 0·5

Used rachilysis, with loin girth and shoulder loop, by placing my hand on prominence of right ribs, and pressing them forward and to the left. Ordered rotation bandage and lateral sling.

November 21st.—Rachilysis has now been used five times.

At 8th dorsal vertebra : rotation, 7°, lateral deviation, 0·3
„ 2nd lumbar „ „ 3° „ „ 0·4[2]

January 6th, 1888.—Rachilysis, by manual force, used in all nine times.

At 8th dorsal vertebra : rotation, 6°, lateral deviation, 0·25
„ 2nd lumbar „ „ 2°, „ „ 0·3

[1] My instrument of that date was not quite identical with the present one. Its indications, though fairly reliable, were not quite so accurate.

[2] These measures were taken with the perfected scoliosis gauge.

Although improving, I was disappointed with the slowness, and I had made the arrangements for adapting pulleys, which were at this date used for the first time, in two periods of strong traction, three and two minutes respectively.

March 1st.—The pulley mode of rachilysis has been used six times ; the spine was very much more flexible.

At 8th dorsal vertebra : rotation 3°, lateral deviation, 0·2
„ 2nd lumbar „ „ 1° „ „ 0·1

May 31st.—Rachilysis has been used eight times since the previous report. The child has grown a good deal, and has a less thick, sturdy appearance.

At 8th dorsal vertebra : rotation 0°, lateral deviation, 0·15
„ 2nd lumbar „ „ 0° „ „ 0·0

Alteration of bandage to dorso-lumbar.

July 2nd.—The scoliosis gauge indicated no rotation either in the lumbar or dorsal region, a small lateral deviation about 6th vertebra not amounting to one-fourth of the decimal mark. She was told to continue the bandage till the end of August, by which time it will be worn out. The lateral sling ordered to be used till the end of October, when she is to see me again.

November 6th.—Katharine L. is now a sufficiently tall girl, well formed, without any trace of crookedness.

CASE 11.—Miss R. C., brought to me 14th January, 1889. The following notes were given to me by Mrs. C.—"The child is the elder of twins, the other being strong and well grown. They were born a month prematurely in July, 1876, and R. was throughout the winter at the point of death. In 1878 it was observed that she could not put the right heel to the ground (equinus). The foot was treated by stretching in a Scarpa's shoe, then by wire boots and double irons. In 1883 she suddenly failed, and was again dangerously ill ; had an inflamed and painful abscess on the foot. In March, 1884, took her to ——, who said she had a slight curvature of the spine, but would 'grow out of it.' The irons, &c., were ordered to be discontinued ; the sole of the right boot to be slightly thickened ; to have complete freedom of

body. In six months, finding her back rather worse, took her to the same gentleman, who told me the spinal curvature was of no consequence, and 'that everybody was or ought to be a little crooked.' She was taken back twice again, the last time in January, 1887, with like result, and always getting more crooked. After this she went through a course of massage and douches; then for more than a year wore a 'spinal support'; then had a long course of daily Ling-Swedish gymnastics. All this time she was getting worse, but, especially during the gymnastics in the last year, she has become much more crooked."

The case is one of severe S curve; the child is left-handed, of peculiar and difficult temper, and takes no pains to carry out instructions unless closely watched; she is fairly strong; the pelvis is greatly amesial to the left. I arranged for using rachilysis twice a week; ordered a high shoe to the right foot, that limb being short. Wall-wedge exercise and lateral sling.

January 14th, 1890.—Rotation right dorsal, 15°; lateral deviation, 1·4.

February 12th.—Rotation right dorsal, 11°; lateral deviation, 1·0.

March 12th.—Rotation right dorsal, 8°; lateral deviation, 0·8.

April 13th.—Rotation right dorsal, 7°; lateral deviation, 0·7.

May 9th.—Rotation right dorsal, 5°; lateral deviation, 0·4

July 8th.—Rotation right dorsal, 2°; lateral deviation, 0·1

August 15th.—Both rotation and lateral deviation, *nil.*

CASE 12.—D. L., aged 12, was brought to me by Dr. Curgenven, of Craven Hill Gardens, June 15th, 1894. She had on at the time a "spinal support" with side-pads, crutch handles, &c., and had worn it for two and a half years, during which time, her mother told me, the child had been getting steadily and continually worse. At the above date I had not arranged matters for obtaining photographs of my patients; the one here reproduced is the same as on page 56, but the child had improved considerably in the six weeks

between the time of consulting me and the date when the family went to their country house. The child was again brought to me October 14th, so that the figure does not fully represent the degree of distortion noticed on her first visit.

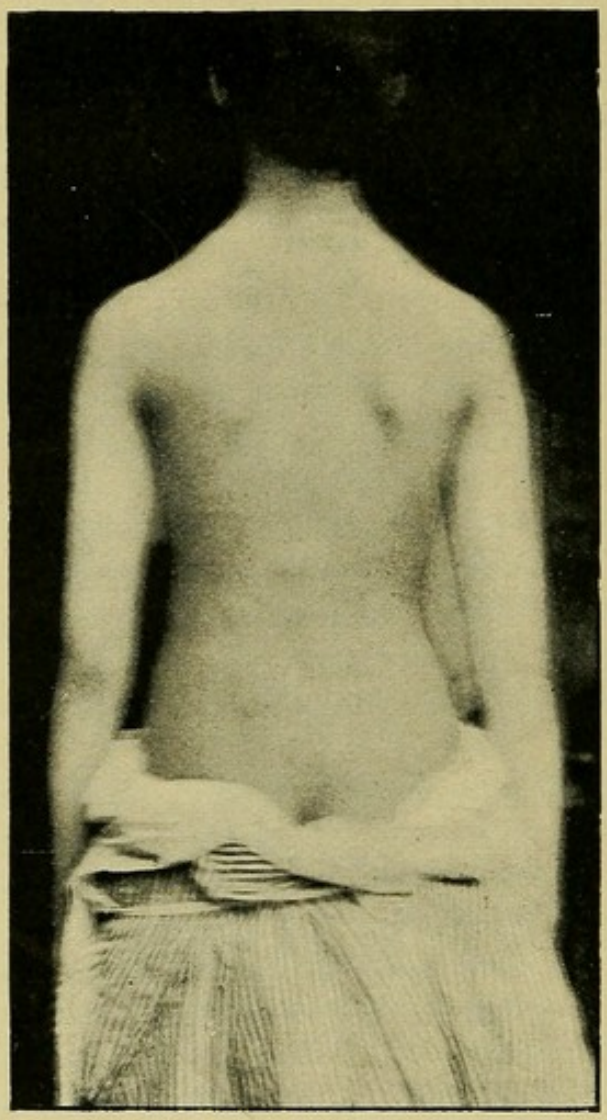

FIG. 43.—D. L., aged 12, October 14th, 1894.

After October 14th she continued to be brought to me twice a week with great regularity and on November 30th her condition was as the second photograph, and I felt justified in relaxing the treatment somewhat, requesting that she might be brought only once a week. Nearly a fortnight however elapsed—she had caught a severe cold.

December 11th.—Mrs. L. told me, much to my regret, that they were all going to their country place. Up to the present the rest of the history is that of interruption. The family returned on 18th January, and as the back had gone back a little in the five weeks of absence, she again came twice a week, my intention being to keep to that arrangement for a month ; but in the middle of February they gave a large ball and after that influenza attacked the whole family, all

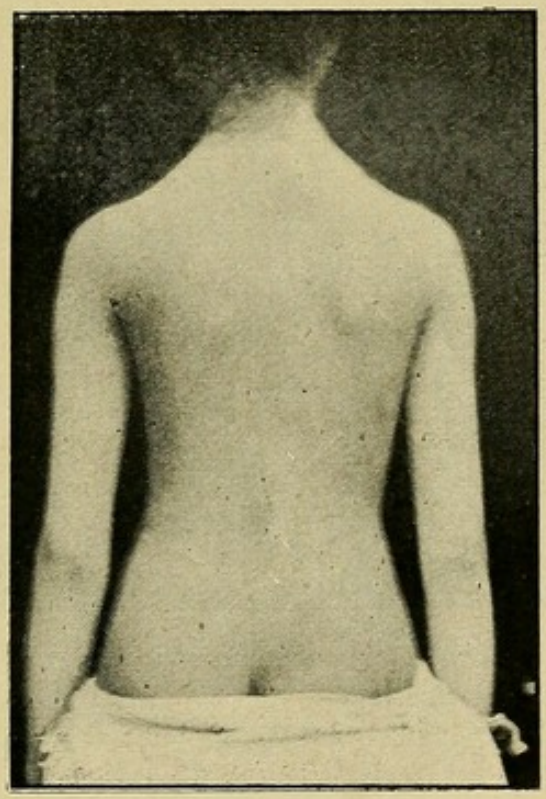

FIG. 44.—D. L., November 30th, 1894.

the younger members having sore throats and high temperatures, with frequent relapses, so that Dr. Curgenven felt constrained to send them all away.

It is a poor history, but the progress made during the only two months of regular consecutive treatment, the advance gained in four weeks in the present year, causes the conclusion to be by no means a lame one. From eight to ten weeks' regular treatment would evidently completely cure

her. It shows me that when better fortune gives a fair opportunity I shall be able rapidly to cure such cases.

CASE 13.—S. K., aged 16, came to me on May 11th, 1894. Her elder sister had a weak spine, and it was thought

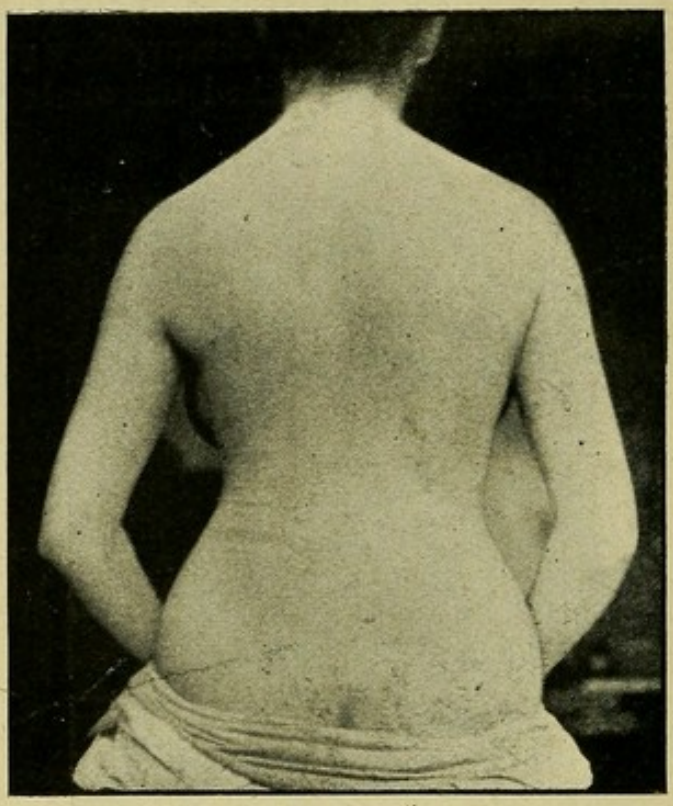

FIG. 45.—S. K., September 26th, 1894.

Of course, as the measurements prove, the back was when she first came much worse than the photograph of this date indicates.

to be crooked, and as I hear is so now. She (S. K.) has a well-marked S curve. My scoliometer indicated :

	LATERAL DEVIATION	ROTATION
5th dorsal vertebra	1·3″	7°
2nd lumbar „	0·7″	5°

I ordered and cut pattern for a rotation belt and arranged for rachilysis once a week. It would have been better if more frequent applications could have been managed, but her home is far north in England ; she is at school in town.

Her attendance was regular, but on July 26th holidays began, and she went home. Measurements were again taken at that date.

	LATERAL DEVIATION	ROTATION
5th dorsal vertebra	0·9″	4°
2nd lumbar	0·5″	3°

—that is, she is much improved.

September 26th.—Returned to school and to treatment. The annexed photograph was taken, and the same arrangements made as to her visits.

December 18th.—School holidays again interrupted the treatment. The photograph here reproduced was taken;

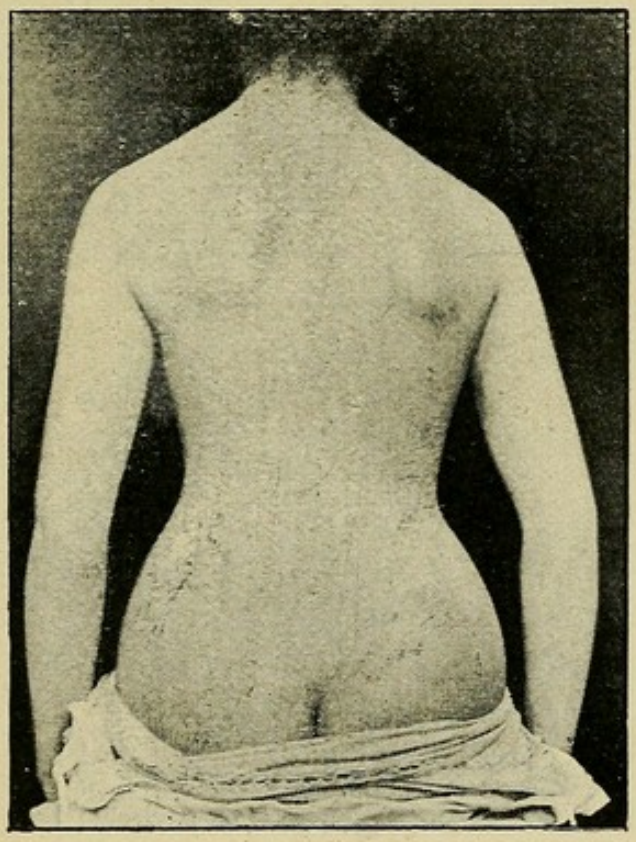

FIG. 46.—S. K., December 18th, 1894.

want of light necessitated that all the three windows of my consulting room should be uncurtained. Usually I admit light by the middle one only, directly behind the patient. This

caused a certain though slight change in the shading of the figure. Measurement by scoliometer—

	LATERAL DEVIATION	ROTATION
5th dorsal vertebra	0·4″	2°
2nd lumbar	0·3″	1°

December, 1894.—The girl is now of an age to leave school and her parents wished not to send her again ; but after some

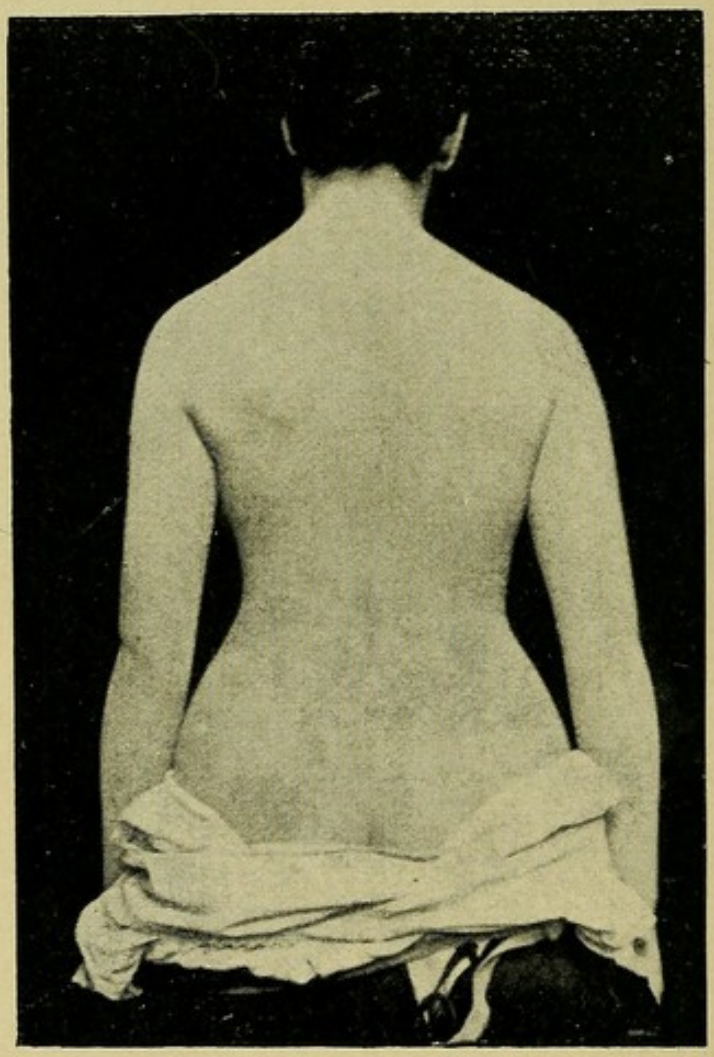

FIG. 47.—S. K., April 5th, 1895.

correspondence they concluded to leave her another term that she might be further treated, and she came.

January 18th, since which date, save one week on account of influenza, the treatment has been quite regular and she

has in consequence made steady progress. The result is given in this photo taken shortly before she returned home, April 8th, 1895 ; it is not absolutely and entirely straight, and the scoliometer shows 1 degree of rotation in the dorsal, none in the lumbar region, and no lateral deviation. I do not think that this slight amount would be detected by any but a very practised eye. The spine having become thus to all intents straight will in all probability right itself, and its very minute rotation can be of no detriment even if it continue.

CHAPTER VIII

PROGNOSIS AND HEREDITY

A VAST number of circumstances must influence the prognosis of Lateral Curvature. Among the most important is the stage which the deformity has reached before coming under treatment, and the period of time which the patient has taken to reach that stage.

For it is remarkable how various are the rates of rapidity with which the three phases succeed each other in different cases. In some, even though the deviation may have commenced quite early, say about the seventh year, progress is slow, while other less fortunate patients become rapidly much deformed. This rapidity depends in some instances on softness of bones, often ascribed to rickets. Doubtless in a certain number of such rapid cases, rhachitic malacia does exist ; but, especially among the well-to-do, only in a small percentage. I have again and again sought in vain for any of the well-known signs of such disorder ; indeed, my note-book contains five cases of remarkably quick defor-

mation, in which long, straight limb-segments with slender terminations and absence of rib-bending were noted. In all these instances, as in very many others, a rapid body-growth had preceded the discovery of the deformity. Hence we may infer, although there is no anatomical proof—for such opportunities very rarely occur—that just as the cartilaginous were becoming ossified into bony vertebræ, great plastic activity was in progress, and that at that special time an unfortunate position, adopted as the most restful, or as the easiest way of carrying on some avocation, was such as weighted one side of the vertebræ almost to the exclusion of the other ; therefore, on the weighted side, that of concavity, the vertebral body growing less, become thinner than on the convex side. Thus is laid, if I may use such term, an architectural foundation for crookedness.

Few cases, however, run thus rapidly into bony change, but remain in the phase of muscular and ligamentous contraction, including wedge-shaped vertebral discs, for a more or less considerable period.

Indeed, much crookedness may, for a given period, coincide with perfectly normal bones, for not every case with a pristine rapid progress and *à fortiori* not every slower case is destined to reach the third stage ; more especially with the latter, it happens that the progress of the malady may become naturally somewhat checked, somewhere between the nineteenth and twenty-fourth year, according to the period when growth ceases ; hence,

as is obvious, this cessation of deforming activity occurs under the more favourable condition the later in life has been the commencement of the evil and the slower its meantime progress. Unfortunately, however, this is very often not the end of the history. As long as youthful vigour persists, the uncared for spine retains much the same degree of malformity as it had reached when the pause set in; but, when that youthful condition has passed away, more especially if some acute or sub-acute debilitating disease have intervened, the spine will again yield, more or less rapidly according to the bodily weakness. I have notes of many such cases, the patients saying that earlier in life they had been known to be crooked; but that for ten or twelve years the distortion had not increased—even, they think, had decreased; and that then rather suddenly they had begun again to get worse. A debilitating illness may originate this backsliding; but marriage, or rather its result, pregnancy and childbirth, must be reckoned among the more usual causes of relapse; of course, the more frequent and the more rapidly recurring be these events, the more inevitable and the quicker will be the spinal changes of the mother. Moreover, many of those cases, which have been naturally or by treatment checked in a certain stage of the deformity, may continue, if none of the above conditions intervene, in that degree of crookedness until advancing age, I do not mean senility, brings on a sudden and extremely rapid deterioration, one which is often very difficult to check, because many of the

means we can employ in comparative youth are unbearable in age.

The prognosis of lateral curvature thus evidently depends on a great number of conditions : viz., on age, on the rapidity hitherto of its progress, on the presence or absence of rachitic symptoms, on delicacy of constitution and accidental illness, on heredity or non-heredity, and on the stage reached before it is brought to skilled notice. Although it is manifestly impossible within reasonable limits to describe all the combinations, in various proportions, of these many circumstances, we may indicate their general effect. Rickets has a grave import on the future of these cases. A very early commencement, between two and six, is not a favourable condition, more especially in dorsal curvature, whereas if the malady begin and be brought under proper treatment between seven and ten years of age, the circumstances, in the absence of rickets, are advantageous. A rapidly-increasing deformity is very grave, especially if it be let alone or inadequately treated ; but the conditions, on which that rapid increase depends—viz. deep and proliferating epiphysal junctions, are such as render an assiduous and well-arranged system of treatment particularly efficacious. Here, the reasonable assent and co-operation of the parents, together with docility and patience on the part of the subject, are of the highest importance. Of heredity, more will be said immediately : when it is maternal and plainly traceable, especially if the child be the last of a series rapidly produced by a weakly and

relapsed or relapsing mother, the prognosis is less favourable.

All and each of these considerations, as regards the future, are greatly modified by the stage attained when the individual is brought under skilled care. The first stage (unless in severe rachitis) is eminently curable; the fact of rapid development should be by no means discouraging. If parents and patient co-operate with the surgeon, not only can the progress of the deformity be checked, but its retrogression secured.

The second stage is also curable, but a longer time, greater perseverance, and a more potent form of treatment will be necessary; in fact a certain part of each and of every day must be devoted to the object in view, and at no time must the condition be so far forgotten as to permit the resumption of an old, perhaps almost disused, objectionable habit.

The third stage may or may not be curable, according to the age of the patient. It may seem bold to assert that when the bones have become altered in shape, a cure may nevertheless be possible; but in quite young subjects, say under ten or even under fifteen, if juvenile at that age, I believe this to be the case; I cannot prove it, not being able to dissect a patient first and cure her afterwards; but I have had to treat and have treated successfully several quite young subjects, so much deformed that I could not doubt the third stage had set in. In later life, say after eighteen or twenty, the third stage is incurable, though it may be greatly benefited.

An advanced third stage cannot be cured, al-

though it certainly can be considerably improved. The furthest development, that with absorbed discs and synostosed vertebræ, cannot probably be even improved. But this is very far from saying that such patients should be abandoned to their fate ; for though art may not be able to make them better, neglect can and does make them worse. By making worse, I mean to indicate that the deformity becomes more and more pronounced ; that pressure in false directions and abnormal positions embarrasses the functions of thoracic and abdominal viscera, whose untroubled action is necessary to health, even to life (see p. 198). Moreover, the spine, the intercostal spaces, the antero-lateral aspects of the abdomen, and also of the ilia, are often affected with peculiar forms of neuralgia, which become distressing after standing awhile or after any fatigue ; such troubles are more marked as the patients lapse into premature age, when great debility is apt to supervene ; they totter a good deal, get about with difficulty, and even seek some external support while standing. Yet though this is the tendency, it is not the invariable result of the deformity ; a certain proportion of such women are strong and sturdy, even though much awry.

The influence of heredity requires some careful study, for we have to consider it in three points of view : firstly, as to its reality, and if possible its percental influence ; secondly, the curability or otherwise of heredited scoliosis ; thirdly, the propriety or impropriety of marriage for young women with lateral curvature.

1. Women markedly crooked bring up to maturity healthy and perfectly straight children. I have seen many cases in which the daughters of such a woman have been tall and beautifully-shaped girls. The daughter, sometimes more than one daughter of a finely-formed mother, may be scoliotic. Thus there is great difficulty in asserting that the disease is hereditary; nor have we as yet sufficient insight to know whether we should include in the investigations the male side of the parentage or collateral relations, such as the father's or the mother's sisters. If we take, as I think we should, merely the mother's condition, I find heredity in 16·7 per cent. of my cases, inclusive of rickets, which disease is inheritable. If we exclude rickets I can only trace direct heredity from the mother in 5·5 per cent.,[1] which number is considerably smaller than that usually given, probably because I have included only direct maternal heredity. Yet if we take the highest statistic, Eulenburg, twenty-five per cent., it follows that lateral curvature is three times more often independent of parental fault than traceable to any such condition. Thus we should have to know how many child-bearing women in every thousand are scoliotic before any statistic can be sound. For the problem stands thus: to set up a true statistic we must know, *a*, the number of scoliotic children born of scoliotic

[1] These numbers differ widely from those of some other observers. Eulenburg, "Zur Aetiologie der habituellen Skoliose," *Berliner Klinischer Wochensch*, 1865, Nr. 18, traces heredity in twenty-five per cent.

mothers ; *b*, the number of straight children born of scoliotic mothers ; *c*, the number of scoliotic children and the number of straight children born of straight mothers. Such inquisitorial investigation as this is barely possible, and, in fact, we never are called upon to investigate in this sense ; still less to number the straight progeny, whether of crooked or of well-formed mothers.

Probably the influence of heredity is limited as follows : A strong woman with lateral curvature in the first or earlier part of the second degree, whose health is good, will have children as little liable, or not perceptibly more liable to scoliosis, than are the offspring of a straight woman. But if child-bearing be rapidly recurrent, more especially if such rapid recurrency cause loss of health and induce a relapse of increasing deformity, the children born of a woman in such state are more likely to become scoliotic than are the children of healthy mothers. And the children thus born of relapsed mothers will probably account for the percentage of inherited scoliosis.

2. The question as to whether the crooked child of a scoliotic mother is less curable than an equally deformed child of a straight mother must, I think, be answered in the affirmative, if by less curable we understand, not that they are incurable, but that greater and more strenuous efforts, with more constant supervision, must be used. Children born under the circumstances detailed in the last part of the previous paragraph are liable to lateral curvature because of the soft condition of their bones.

The cartilages, large in proportion to the osseous nucleus, are hyperæmic and proliferating, while the deposit and organisation of osseous granules are delayed. This condition favours the influence on the growing vertebræ of any unilateral pressure, or of any faulty position, but also, at the same time, the action of any real remedial measures. Also it is to be noted that the children of a scoliotic parent are generally watched with greater solicitude, in this point of view, than are the offspring of straight mothers, and that they therefore as a rule come under earlier treatment.

3. The surgeon is not unfrequently asked if a young woman, whom he may be treating or may have formerly treated, should be allowed to marry. The question is usually put with a view of eliciting whether or no the deformity, by altering the shape of the pelvis, may render parturition dangerous. The answer to a question thus formulated is this: unless the deformity be extreme, or unless a slighter amount of distortion have originated in rickets, the form and the outlet of the pelvis are not altered sufficiently to interfere with expulsion of the fœtus; and even very marked deformity, if it be principally dorsal, may coexist with a nearly or perfectly normal pelvic outlet. But we ought to look somewhat further than the safety of the parturient mother, viz. to the effect on her health and form of one or several births, and on the probable well-being of the progeny. Women who are greatly deformed are sometimes asked in marriage, and some of them even have large families without

any depreciation of health; and though this is, I conceive, somewhat exceptional, yet it is frequent enough to leave us no warranty to forbid marriage, especially if the deformity be not in the lower segment of the spine; the same reasoning applies with greater force when slighter degrees of crookedness are in question. But the state of the general health is of importance as great as the condition of the spine. For a feeble, anæmic, scoliotic woman is unlikely to bear several children, especially if the puerperal condition recur rapidly, without relapse; while a strong though crooked woman may do so. Moreover, the offspring of the former will incur much more risk of being deformed. These points will afford foundation for a prudent answer.

APPENDIX

I. On the Bones of the Spinal Column

The spinal column consists (omitting the sacrum and coccyx) of twenty-four bones superimposed on each other. Each bone may be divided primarily into a body, and backward projecting processes; the body is the most massive portion and supports by far the larger part of the superincumbent weight. The processes consist of an arch formed by pedicles and laminæ which enclose the spinal cord; thence project more or less obliquely upward and downward, the articular processes —sideways and backwards, respectively—the transverse and spinous processes; the function of the first set is to limit and direct movement, thus diminishing the chances of dislocation; the value of the last two is chiefly to afford many levers, surfaces, and projections for the attachment of muscles, while, in the dorsal region of the spine, the transverse processes also afford a second point of connection for the ribs.

In early life, however, the vertebra is not one solid and indivisible bone; but is made of a number of separable parts conjoined by cartilaginous bonds called epiphysal. Thus not to go into unnecessary details, the whole mass of the pedicles, laminæ, and processes are still separated

by a thin junction line from the mass of the body.[1] More important, however, for our immediate purpose is the architecture of the bodies themselves, whose first nucleus of ossification (we will call it the central nucleus) appears in its mid-parts abouts the eighth week of fœtal life (a little different in different regions); this gradually increases in size, but a large portion of the upper and lower surface of the general mass of each vertebral body remains cartilaginous during the whole period of bodily growth. About the twelfth or fourteenth year, four nuclei appear at both the upper and lower surface of

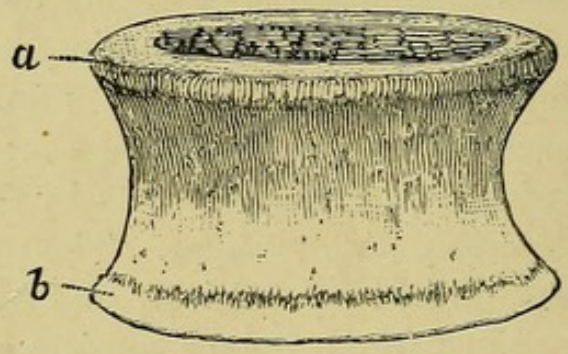

FIG. 48.—Ossifying Body with Epiphysal Plates.

the body. They somewhat quickly spread laterally, so as to form at about the sixteenth year two thin plates of bone separated from the general mass of the body by a layer of cartilage, which gradually gets thinner but does not disappear till between the twenty-sixth and thirtieth years of life. Thus till that period the body of each vertebra (I omit the little pieces that are formed from the nucleus for the pedicles) consists of a large central mass on both upper and lower surfaces of which are epiphysal

[1] The centres for the arches and processes assist in forming the posterior-outer parts of the body in proportions that vary in each region of the spine.

plates—three pieces in all. Growth of the bone in thickness takes place by increase of the central cartilaginous mass in the earlier years, and of this epiphysal junction in the later years of the above period.

Conjoined with this peculiarity in construction are certain differences, in the shape of very young vertebræ, from that of completely formed bones; thus the characteristic form of adult bodies in different regions of the spine, oblong in the neck, triangular in the back, oval in the loins, is less clearly marked; and, moreover, the articular processes, which in the dorsal and lumbar regions stand out as considerable projections, with surfaces facing in very definite directions—backwards, forwards, or lateral—are in the quite youthful spine much less prominent and the surfaces lie pretty horizontal—in fact, they preserve in those two regions the sort of characteristics which are found throughout life in the mid-cervical district.

It has been stated, and widely accepted, that the bodies of the lumbar and cervical vetebræ are thicker, those of the dorsal thinner, in front than behind. This statement, however, is true only for a certain number, not for the majority of spines. I have examined a great many vertebræ, and in by far the larger number have found no difference whatever in the thickness of their anterior and posterior portions.

The twelve dorsal vertebræ are distinguished by the attachment of the ribs, each one except the first and the two last, to the side of two contiguous bodies. Also each rib, except the eleventh and twelfth, articulates with the transverse process of the lower of the vertebræ, to which its head is attached.

II. On the Ligaments of the Spinal Column

The vertebræ, although superimposed, are not, save at the articular processes, in contact. Between any two of the bodies are interposed intervertebral discs which act as means of separation and as bonds of union. These substances, composed of concentric rings of fibro-cartilage surrounding a centre of softer jelly-like material, are easily extensible, but permit very little compression —that is to say that they allow this particular part of the column (the weight-bearing portion formed by the bodies) to be lengthened, but offer resistance to its abbreviation. Also binding the bodies together are the anterior and posterior common ligaments composed of white fibrous tissue. The former of these, broader at the lower than at the upper part of the spine, lies in front of the vertebral bodies, is more closely attached to the intervertebral substances than to the bones, and is composed of several layers, the more superficial fibres, being the longest, pass between their points of attachment over five or six vertebræ, the deepest only run from one bone to the next adjacent intervertebral disc. The posterior common ligament lies within the spinal canal on the hinder aspect of the bodies; with the exception of its situation, and of the fact that it is broader above than below, its properties are the same as those of the anterior. The laminæ are bound together by very strong bands of yellow elastic tissue (the ligamenta subflava); the peculiarity of this material is its great tendency to, and power of retraction, while even though considerable force be employed it can be but very little lengthened. So powerful is this retractile power of the yellow ligament, that it is said to "serve to preserve the

upright posture and to assist in resuming it after the spine has been flexed."[1]

The capsular ligaments and the interspinous are thin membranous layers which are unimportant for our subject. The supra-spinous is strongest especially in the loins, and guards against separation of those processes.

III. The Normal Antero-Posterior Curves of the Spine

The spines of quadrupeds are slightly curved from the last vertebra of the neck downward. Even those who occasionally sit on their haunches (squirrels, bears, monkeys, pet dogs, &c.) do not while in this position alter the form of the spine, though they change its direction. A few animals—for instance certain apes and bears—sometimes walk short distances on their hind feet; but even while in that attitude their spines still maintain a simple curve (convexity backward), which, though it may be altered in amount, is never abrogated, still less reversed. All these, whether going on all-fours, sitting up, or standing on their hind feet, have the thighs placed at an angle—generally a rather acute angle—with the axis of the spine. Man is the only mammal whose position in standing is such that the thighs lie parallel with the general axis of the spine, and he is the only one the axis of whose pelvis differs markedly from the general axis of the body, and who has a forward bend of the loins. The mutual position of parts thus succinctly given is not, however, congenital. A baby new born, and up to somewhere between the ninth and twelfth months of viable life, has a pelvis the brim

[1] Gray's *Anatomy*, p. 167, 11th ed.

of which lies at little more than a right angle with the general axis of the column, and it is not until he attempts to stand erect that the front of the pelvis descends. The sacrum instead of continuing onward, the line of the spine becomes very oblique, its lower end being projected backward. This change in the position of the pelvis is thus produced. The infant, still "muling and puling in its nurse's arms," keeps its thighs flexed upon the body—that is, much in the same position as do quadrupeds. When it stretches down those limbs, they drag on all the muscles and fasciæ which run down from the front of the pelvis to the femur—on the fascia lata—the rectus, pectineus, &c.; but principally would I accentuate the ileo-psoas which comes from the spine and ilium and runs over the front of the pelvis; also the ileo-femoral ligament, as the most potent agents in depressing the front of and giving a backward slope to the whole pelvis. The necessary effect on the loin has been sufficiently described in the text. The bend convexity backward of the dorsal region is no doubt in a great degree the continuance in after-life of the general bend of the infantile spine; but it is increased by the drag of the descended pelvis upon the abdominal muscles, which through the medium of the ribs act upon the spine. The neck bends convexity forward, as do the loins. This sort of bend is found in some quadrupeds as an occasional posture; but as a constant, or nearly constant position in man it is due to the erect attitude and the fact that the condyles on which the weight of the head rests are placed far behind the centre of gravity; hence the muscles behind this part of the spine are much stronger than those in front, and many of them are placed in their upper parts a good way behind the neck-bones; therefore they must of necessity cause the

bend in question. It may here be noted that the tendency of the head to fall forward, produced by the position of the occipital condyles, is to some extent counterbalanced by a portion of the weight of the shoulders being suspended to the occiput through the medium of the upper and anterior fibres of the trapezius ; thus, without any expenditure of muscular force, the upper limb acts as a counterpoise to the front of the head.

IV. On the Movements, especially on Rotation of the Spine

All movements—viz. flexion, extension, lateral movement, and rotation to right and left, also circumduction—can, under the sway of its muscles, be performed by the spinal column. It is not important for our object to define the muscles, which produce any of these except rotation. This may be either a voluntary or emotional movement, as when an individual turns round to look at some object behind him ; it is essentially a temporary or passing state, wherein contraction of muscle overcomes the *vis inertia* of the bones and, if carried pretty far, the resistance of ligaments. It is this with which we have now to do. But the muscular mechanism which produces this motion was to me for a long time a difficult problem. Neither the erectores spinæ nor the legion-named muscles that fill up the spinal groove, since they run almost parallel to and not across the axis of the column, can produce this result.[1] While

[1] The so-called *rotatores spinæ*—unimportant in size, and only found in a certain district of the spine—cannot possibly act in the

in 1867 I was studying this subject, and measuring the possible amount of rotation, I had one day before me, seated on a high stool, a girl about eighteen with the back bare. As at my request she turned round, I noticed a somewhat sharp line of muscular contraction —viz. the edge of the serratus magnus—running from the lower angle of the scapula downward and outward to lose itself over the lower ribs at the side of the chest. I have since taken much pains to elucidate this point, and have examined into the action of muscles in persons strongly rotating the spine; and quite lately have had the opportunity of doing so on the back of a young man aged twenty, whose photograph is reproduced here. It will be noticed that two lines run from the angle of the left scapula (he is turning to the left). The lower of these is the edge of the muscle in question; the upper appears to be the mark merely of a septum. All that part, not merely between the two lines, but also above the upper one, was hard and "corky," like the biceps of a schoolboy showing off his muscles. As soon as he ceased rotating, the serratus fell into relaxation again. Now this muscle is not the only rotator of the spine; the external oblique on the other side of the abdomen acts powerfully in this manner and in this direction. For instance, to produce the above position the left serratus and the right oblique combine; and the oblique antagonises therefore the serratus of the same side, not only in this action, but also in the respiratory function and in some others.

manner which their name would imply. Duchenne considered the semi-spinalis to be the chief rotator; if so, the loins and lowest part of the dorsal region are left out of count; moreover, it is more than doubtful that an electrician could convey a current to these very deep muscles without involving a great many others.

In order to form an idea of the rotating power of the serratus, the reader must remember the mode in which the ribs are attached to the spine. All the upper ten have a twofold attachment to the vertebræ—viz. by

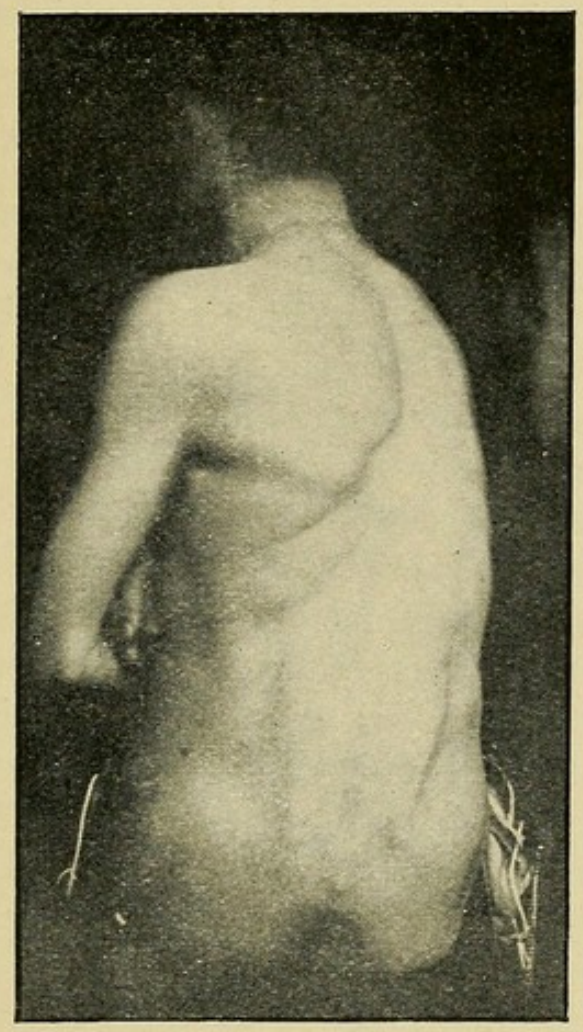

FIG. 49.—Rotating Action of Serratus.

their heads with the body, and by their tubercles with the transverse process. This mode of attachment gives to the ribs, when acted on by the serratus, the action of levers of the second order; the fulcrum is at the head, the power arm is the stretch between that point and the

attachment of the serratus, the weight arm is the distance from the head to the tubercle.

This turning action, though only directly exercised on the vertebræ of those ribs to which the contracting muscle is attached, is of course transferred in part to the bones below, according to their degrees of mobility. In thus considering this muscle as a rotator, it must be regarded in connection with the rhomboids as forming with them a wide, fan-shaped muscle, beginning at the lowest cervical and upper three or four dorsal spinous processes and sweeping thence round the side and front of the chest to its broad attachment at the ribs. In this view, the line of the base of the scapula may be looked upon as a mere intersection, like the lineæ semilunares of the rectus abdominis.

In another part a different function of the serratus will be examined; just now we will only discuss the amount to which the spine may be rotated by voluntary effort. In the studies I made of this subject about thirty years ago I used a mechanism, which was perfectly reliable, but which I need not now describe, because I have a simpler appliance which I have also used for this purpose (See Chapter IV.). "The Scoliosis-guage." By both these mechanisms the neck is left out of count; the innominate-bone—that is to say, a line connecting the posterior superior spines of the ilia—is taken as the basis, the upper part of the chest, omitting the shoulders and the blade-bones, as the index of turning. Therefore the degrees given below are measures of the angle which the upper part of the chest made with the transverse axis of the pelvis. I found that in persons about thirty years of age the amount of rotation is from 30° to 40° in each direction—that is from extreme right to extreme left; some could twist the

spine from 60° to 80°. Short, thick set, and obese persons are occasionally met with who can turn only about 22° or 24°. Slim young subjects between ten and sixteen years old could turn much more; occasionally even 60° in each direction, or 120° in both that is, they could twist the spine one-third of the circle.

V. On some Functions, especially the Respiratory Function of the Serratus Magnus.

The action of this muscle upon the scapula is two-fold. First, it keeps the venter of that bone flat to and against the posterior wall of the chest; when the muscle is paralysed, the base of that bone projects backward in a very well-marked and characteristic manner, while the fingers can readily be protruded between the thorax and the venter scapulæ. Again, the largest and strongest part of this muscle, arising close to the lower border of the fifth, sixth, seventh, and eighth ribs, gather together and are inserted into a special surface on the lower angle of the scapula. This large part of the muscle keeps that angle at its rightful distance from the spine, and (somewhat aided by the trapezius, see p. 171) prevents the shoulder from drooping by upholding the acromion and glenoid cavity. It is thus called especially into play when a weight has to be supported in the hand or on the arm as an infant is carried, or on the shoulder as a porter bears the burden of, let us say, a heavy portmanteau. Moreover, in lifting the hand and arm (forward or directly sideways) we use the deltoid till the limb is at a right angle with the line of the trunk; but beyond that the deltoid is powerless, the arm can only

be carried higher by turning the scapula round, as it were on a pivot, so as to give its spine a more perpendicular direction. This action is performed by that lower part of the serratus. In thus acting the muscle counteracts on those ribs from which it takes origin, and if we bear in mind the lever-like connection of the ribs to spine, it is evident that in proportion to the muscular force employed will be the tendency to rotation of vertebræ.

Many years ago Sir Charles Bell pointed to the inspiratory function of the serratus magnus, and named the nerve supplying that muscle the external respiratory.[1] The doctrine was received and taught for a long series of years without a doubt of its truth.

At the present day it is generally believed that the serratus has no such function as Sir Charles Bell ascribed to it, or at least that it is slight and unimportant, limited almost to slight lifting of the ribs in cases of severe dyspnœa. To decide in which of these two views lies the truth, requires some examination into the grounds of the recent scepticism. First, several surgeons have galvanised the muscle and its nerves without being able to feel contraction of its serrations on the ribs. Secondly, when, through certain diseases, the muscle has been paralysed, respiratory troubles have not been in most cases observed. Thirdly, in certain experiments on rabbits, even the highest degree of dyspnœa called forth no contractions of the serratus magnus, nor indeed of the two pectorals, sterno-mastoid, levator anguli scapulæ and trapezius.[2]

These facts must be taken to prove that Sir Charles

[1] *The Nervous System of the Human Body*, 1830.

[2] Traube, *Gesammelte Beiträge zur Pathologie und Physiologie*, vol. i. p. 165.

Bell, and those who for many years accepted his views, did undoubtedly exaggerate the inspiratory value of the muscle in question; but I conceive that an equal amount of error lies in the denial of all inspiratory function whatever. Traube's experiments on rabbits are open to many objections—the position of the scapulæ and the form of the human chest are so different to those of quadrupeds, that one hesitates strongly to accept the muscular action of the one as identical with that of the other; indeed, those experiments, by sweeping away the action in breathing of so many muscles, which in man are involved in that function, prove the unreliable nature of this assumed identity. That difficulties of inspiration should rarely have been observed in cases of paralysis of the serratus[1] proves indeed that the muscle is not essential to the act, even we may go so far as to say it shows that Sir C. Bell exaggerated its importance; but seeing that the breathing function is most complicated, the loss of a muscle, not like the diaphragm of prime importance, may surely be compensated by others.

Faradisation of the muscle has been much practised, sometimes with a therapeutic, sometimes with an experimental object. Duchenne,[2] being well aware of the doubts thrown on the respiratory function of the serratus, tested this muscle with the galvanic currents of two induction apparatus; the one, three or four times as strong as the other, was applied to the rhomboid in order to fix the scapula, the weaker one to the costal insertion of the serratus. He observed, "1, direct elevation of the entire scapula; 2, an upward and outward movement of the

[1] Oscar Berger, *Die Lähmung des Nervus Thoracicus Longus*, Breslau, 1875.

[2] *Electrisation Localisée*, p. 306.

convex portion of the ribs, whose curve seemed increased. During the experiment the subject made a noisy inspiration, which he said he could not control. I repeated the experiment while closing the mouth and nose, and he felt a great desire to breathe at the moment of the muscular contraction."

On the other hand, Berger tried this experiment on a patient, in whom, however, the muscle was a good deal atrophied, without producing any such phenomena, and suggests that in Duchenne's experiment the current must have passed over to the phrenic, as does also Henle ; a pure assumption, which, in regard to so careful an experimenter, is not tenable, and which a perusal of Duchenne's words shows to be also impossible.[1]

In stating some paragraphs ago that Sir Charles Bell and the anatomists, who succeeded him, exaggerated the respiratory function of the serratus, I have conceded quite as much to the more modern views as my observations and experiments permit ; for, having gone over the matter very carefully again, and as I believe without prejudice, the conclusion forced upon me is that the muscle takes an important part in the act of breathing, often but not always in actually moving the ribs ; constantly in antagonising the action of the diaphragm and of the external oblique abdominal muscles which but for the serratus would drag those bones in upon the

[1] Henle argues that the manifold views concerning the mode in which the serratus could act as a respiratory muscle is a strong argument against its possession of such a function ; yet he does not feel any uncertainty about the intercostals, although he says, three pages earlier, that some anatomists consider the external, some the internal inspiratory ; others have held the direct contrary opinion ; some have regarded the front of these muscles as antagonistic to the posterior part, and so on. (Henle, *Handbuch de Muskellehre*, pp. 101, 103.)

cavity of the chest. Duchenne found, both in the living and dead, that Faradaic contraction of the former muscle raised and expanded the lower ribs while the abdominal viscera were *in situ*, but depressed and drew them inward in eviscerated animals ;[1] the former effect is therefore evidently due to compression of the viscera from above by the diaphragm, and to their consequent lateral expansion forcing outward those lower ribs ; but the tendency of the external oblique is to draw those bones inward. This tendency is opposed by the serratus.

The reader will call to mind the fact, that the fibres in the lower part of the serratus are almost in the same line as those in the upper part of the external oblique ; therefore it is a more direct opponent of this muscle than is the internal oblique, but the constricting action of both on the lower part of the thorax is antagonised chiefly by the serratus. Moreover, at the termination of their rhythmic expiratory action in depressing the ribs, those bones are raised again by the serratus, not merely by an active contractile power, but also by tonic resumption of its previous length. It appears to me that the reason why so many observers have failed to feel any action of this muscle in breathing, is that they have felt for it on the ribs, where it cannot be verified, partly because their motion masks any such contraction, partly because so near its origin the muscle, unless in violent action, balls itself but little.

If, however, we strip the back of some thin but healthy person—a lad of twelve to fifteen years old is best—and telling him to breathe only very slightly beyond his usual very quiet respiration, watching his blade-bones the while, they will be seen to recede and approach the spine at every in- and expiration. This might be said to

[1] *Op. cit.* pp. 350-357.

be due to movements of the ribs; but, if with the finger and thumb the serratus be gently grasped, just as it passes outward and downward from the angle of the scapula, its gentle and rhythmic contraction can be plainly felt. If the subject be directed to stoop forward from the loins without bending the dorsal spine, a position which, by somewhat compressing the abdominal organs, hinders the descent of the diaphragm, these contractions of the serratus can be still more plainly felt.

The studies which I have made of the breathing function convince me, indeed, that it is not to be regarded as always carried on under all circumstances by the same muscles: different postures of the body, though impeding the action of one or more muscles, are not permitted by nature seriously to interfere with that vital act; but on the contrary, the very multiplicity of the muscles involved or capable of being utilised enables us to breathe, save under very strained and unusual circumstances, quietly and unconsciously, though certain circumstances may throw one or the other of the motors out of gear.

The most common circumstance that interferes with the action of that very important respiratory muscle, the diaphragm, is the ugly and senseless tight-lacing that many girls practise. Woman's breathing is normally more pectoral and less abdominal than man's, a provision no doubt for leaving the pregnant uterus undisturbed. If she by throwing the diaphragm out of action increase this peculiarity through compression of the lower ribs and abdomen with tight, rigid stays, she throws all the respiratory work on the thoracic muscles, chiefly on the serrati. Now the right lung is a good deal bigger than the left; hence the two serrati do not act equally—therefore tendency to spinal rotation. The primary right dorsal curve is quite or almost unknown among the Hindoos and

other inhabitants of climates too hot to permit of tight clothing. My contention is, that in spinal curvature commencing in and often almost confined to the dorsal region, the first fault is, not lateral deviation followed by rotation, but the reverse—viz. firstly, rotation by action of the serratus, followed by lateral deviation.

As an illustration, indeed almost as a proof of this view, the following case may be mentioned. It shows, not merely the rotating power of the serratus, but also the great sensitiveness of the spine to that power if it be constant or very frequent.

CASE 14.—Mr.——, aged nineteen, came to me on the 9th o. February, 1867, with a far-advanced dorsal curve to the right. He was by no means weakly, but on the contrary muscular, being used to strong exercise, more especially with the dumb-bells. Rotation was very marked, the right ribs and the lower angle of the scapula projecting very much backward ; but there was something very peculiar in the distortion ; it bore, markedly, all the characteristics of a weight-bearing curve, with the exception of a very characteristic feature—the strong development of the left sacro-lumbalis and longissimus dorsi. It is true that he confessed to using the dumb-bells rather more with the right than with the left hand ; but in all my previous cases I had always found such or similar work produce with the curve that muscular elevation. The condition was, to my mind, so anomalous that I re-examined all my minute records, my photographs, and my theory of lateral curvature. On his second visit I observed this peculiarity of attitude : he always stood with the right hand placed far back on the hip or on the loins, and threw his elbow as far back as possible. I kept him with me as long a time as I could spare, and standing as much as possible. He maintained constantly this attitude ; and, on questioning him, I found it was habitual. Thus, then, was my difficulty not only solved, but a singular proof added to my observations on the rotating power of the serratus. This position, by throwing back the base of the scapula, caused that muscle to drag upon the ribs ; and not only the absence of an extra burden, but the fact of his supporting the weight of the trunk on the right hand, precluded the extra development of the left erectores spinæ.

VI. The Mechanism of Passive Rotation of the Vertebræ.

A curious and inevitable relationship exists between lateral bending of the column and rotation of the vertebræ, and this not merely during the life but also after death. In 1879 and again in 1881 I instituted some experiments, not knowing at the time that they had been forestalled by Meyer of Zurich. On some minor points are differences between our results, but the most important ones tally. Having procured a fresh spine of a woman aged twenty-four, kept wet in a carbolic acid solution, I separated the ribs just outside the tubercles and cleared muscles, etc., away, leaving nothing but ligaments. The last lumbar vertebra was held firmly by a vice, and through the vertebral foramina of the axis threads were passed, which ran through pulleys on each side, four feet nine inches distant from and on a level with the twelfth dorsal vertebra; the other end of each cord was attached to a hook to which weights could be suspended, whose action on one side or the other would bend the spine to right or left. The whole spine measured along the side, just in front of the intervertebral foramina, was 22·75 inches long, from the transverse process of the axis to the lower edge of the body of the last lumbar vertebra, and was absolutely equal on both sides. When by means of the weighted cord the column was bent laterally, so that a plumb-line fell five inches away from the centre of its base (last lumbar vertebra), the convex side measured 23·65, the concave side 22·40, showing an increase of length on the convex side of 0·9, and a decrease on the concave side of 0·35 of an inch. It

was several months before an opportunity of repeating the experiment occurred, and the spine was that of a tall man, six feet two inches, thirty-six years old. The column, treated in the same way, measured on each side, 24·1—an unusual length: it was bent laterally as above until the plumb-line lay 6·5 inches from the centre of the base; the convex side then measured 25·3, the concave a minute fraction less than twenty-four inches—an increase of 1·2 inches on the convex side, and practically no diminution on the concave.[1] Meyer's results so far as this point is concerned, tally with mine, viz. that the intervertebral substances permit distension or lengthening, but their compressibility is very small.

Now, when either of these spines was bent sideways to a small degree, so that the pendent plumb-line stood away from the centre of the base only two inches or less, I perceived no rotation or twist of the vertebræ; but when the lateral bend exceeded this amount, torsion immediately commenced.

The results of these experiments and the deductions to be drawn are of great importance, but before stating them I must disavow any claim either to originality or priority. My first experiments, those above detailed, were made without a knowledge, which doubtless I ought to have possessed, of Meyer's work; they led me to the same deductions, which, however, in their broad outlines, are his property not mine; while certain portions,

[1] Meyer got some strange differences between bending to right and left. My attention was not specially directed to that point, and I can only say that, working as above described, with the weight, I found no such differences. Meyer bent the column by manual force, which can hardly be reliable, since such force might in part be rotary.

not I conceive much less important, have seemed to escape his method of experimentation or his acumen. It was Meyer who first pointed out, that the cause of the connection between lateral bend and torsion depends on the essential differences between the qualities of the ligaments which connect the bodies and those which connect the arches and processes [1] of the vertebræ—on the resistance of the former to compression, *i.e.* to being shortened, and the especial tendency of the latter to retraction ; [2] hence, when the spine is bent laterally, the part which declines to be shortened takes up its position on the longest part of the curve the (convexity), while that part, which loves to retract itself, seeks the shortest face of the curve the (concavity) : hence, in bending the spine sideways, the anterior face of the bodies must of necessity move towards the most convex part, which they can only do by rotating on their axes ; while the arches move towards the concavity, and thus may be in a straight line while the anterior, or rather what normally should be the anterior, faces of the vertebræ form a wide gyration.

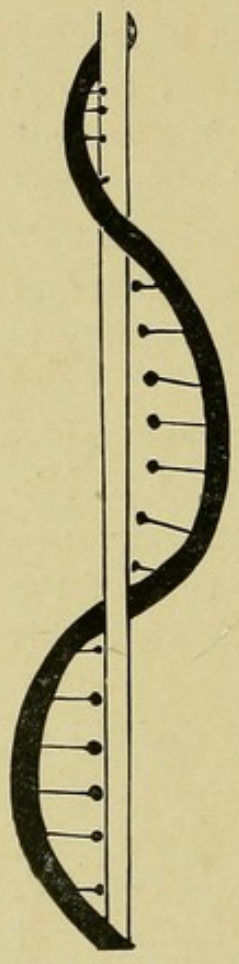

FIG. 50.—Diagram of Spinal Twist and Rotation.

With regard to this gyration, the singular number is correct only, when there is but one lateral deviation ; but if there be two or more in opposite directions it is evident that there must be an equal number of rotary changes,

[1] I refer by this latter term more especially to the supra-spinous as it exists, strong and resisting in the bones. [2] See Appendix II.

also in reversed directions. Thus the spinous processes representing nearly a straight line, the bodies will of necessity be coiled round that line spirally as in the annexed diagram where the two parallel lines represent the axis, from which the black dots (tips of the spinous processes) are but little removed, while the broad black line (the bodies of the vertebræ) coils round it corkscrew fashion ; the plan being a left curve at the loin, a right one in the dorsal region, and again a left one in the neck.

VII. On the Anatomical Changes corresponding with the three stages of Curvature.

First Stage is only a position which is not abnormal in extent, but only in persistency. It exhibits, therefore, no anatomico-pathological changes, and leaves no signs that can be detected *post mortem*. Towards the end, however, will have commenced some of those structural alterations now to be described.

Second Stage.—That which began and till now has persisted as merely a posture has been for a given period maintained by muscular action—that is to say, certain muscles have kept themselves in a state of more or less constant shortening. After a time those muscles cannot resume their normal length without causing an uncomfortable sense of stretching and fatigue ; the patient therefore only feels straight when yielding to this altered condition of muscles—that is to say when he really is crooked. Hence the position, at first only assumed while standing, is after a time maintained also in sitting, subsequently even during recumbency. The muscles, at first merely contracted, become by degrees slightly

contractured—that is to say, their fibrous and connective elements (sarcolemma, septa, and fascial sheaths) shorten themselves to the new position, though never to the same degree as in anchylosed limbs; they can (*post mortem*) be again extended to their normal length by traction with the hand. On the convex side, the lengthened muscles are pale, thin, weak, and badly nourished.

Meanwhile, the ligaments alter much in the same way as those fascial constituents of the muscles. It has been already explained (p. 183) that during any temporary flexion of the spine, the invertebral discs become a very little thinner on the concave, thicker on the convex side of the column; but if this bend be maintained for a lengthened period, these discs, which bear compression badly, lose to a commensurate extent their elasticity: in the convexity they remain thick; in the concavity, instead of permitting or aiding, as they ought, the approximated sides of the vertebræ to separate again, keep them bent in their abnormal proximity. Later, however, in severe cases, the sides of the discs in the concavity become very much thinned, sometimes to such a degree that the bodies of the vertebræ, at their edges, come into actual contact. It is a natural consequence that in the shortened and hardened condition of one side of the disc, the relaxed and softened condition of the other, and the *centrum pulposum* should move away from the median parts towards the convex side—that is, from the compressed towards the laxer portion of the disc.[1]

The anterior and posterior common ligaments also suffer changes, as Nicoladoni was the first to point out.[2]

[1] Certain writers consider that this lateral position of the pulpy centre is a *cause* of the curve, evidently an untenable theory.

[2] *Die Torsion der Skoliotischen Wirbelsäule*, 1882.

These bands are sufficiently broad to be affected on their opposite edges in different manners. When the column is persistently bent laterally, that edge which subtends the convexity is kept on the stretch, while that on the side of the concavity is relaxed ; the former, therefore, like all continuously stretched white fibrous tissue, becomes thin, wasted, and disintegrated ; the latter, while shortening itself to its approximated insertions, becomes thicker and stronger. Bouland found the anterior common ligament thicker and firmer in the concavity of the curves, and at the same time tightened like a tendon, while on the concavities it had become thin and blended with the periosteum.[1] Also both these ligaments have a tendency to shift their position on the faces of the bones from the convex towards the concave aspect of the curve. This change of course affects firstly the more superficial and longer fibres which pass, from point to point of attachment, over from three to six vertebræ. It is indeed evident that if the bones interposed between two such points deviate to one side those long fibres must, representing the straight line between the points, come to lie in the concavity of the curve as a bow string lies in the curve of a stretched bow. In a very restricted autopsy I had the opportunity of making, I could feel rather than see, in that small dark room, that the edge of the anterior common ligament stood some distance from the opposite vertebræ, and that its edge was thick, hard, and tight, the sensation, conveyed to my finger, reminding me of Gembernat's ligament in femoral herniotomy. The ligaments of the arches undergo a similar change. Of these the most important is the elastic yellow tissue of the pedicles and laminæ, which, owing to their inherent contractile quality, very quickly shorten

[1] Eulenburg, *loc. cit.* p. 141.

on the concave side of the column, while they are stretched and somewhat atrophied on the convex side. Thus the clinical second stage of curvature corresponds pathologically with organic shortening of muscular and ligamentous structures in the concavity of the curve, lengthening and weakening on the convexity.

THIRD STAGE.—A certain time after, in some cases almost simultaneously with the commencement of these changes in the soft parts, modifications in the shape of the bones usher in the third stage. These modifications affect primarily and principally the vertebræ and the ribs. My constant watchfulness for some opportunity of examining anatomically a young subject with curvature in the very beginning of this stage has not been rewarded; I cannot therefore say which of these sets of bones change first, or if they do so simultaneously; nevertheless in our description the vertebræ may have precedence. I shall take as an example a far advanced case, as the alterations can be thus more easily appreciated, but it must be understood that what is about to be described is the result of a gradual process: more rapid when the subject is growing quickly, much more slow when increase of stature is almost at a standstill.

The changes in the vertebral bodies are caused by unevenly distributed pressure, which results partly from rotation, partly from lateral deviation. In a spine thus deviated, the superincumbent weight falls chiefly on that side of the bones which subtends the concavity. The vertebræ are at this phase of life largely composed of cartilage, and are engaged in the process of growth. Now pressure in a given direction hinders, while absence of pressure favours growth; hence when this unilateral pressure has continued a certain time, the bodies of the

vertebræ, growing less on the concave than on the convex side, become wedged-shaped—thinner, that is to say, on the side of the concavity, thicker on that of the convexity. This alteration may proceed while the vertebral body is, with the exception of an osseous

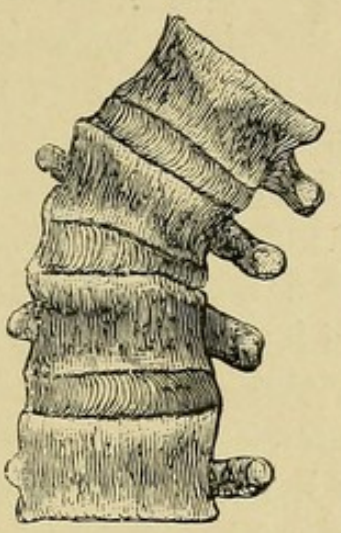

FIG. 51.—Front View of Vertebræ. Discs strongly, bones slightly wedge-shaped.

nucleus, entirely cartilaginous ; or if the curvature have delayed its advent to a later period of life—that is till after the appearance of the epiphysal plates—the change will be effected by one-sided growth at the upper and lower epiphysal junctions, just as a genu valgum is produced by overgrowth on the inner side of such junctions at the femur and tibia.

If the intervertebral discs have become so thin that the edges of the vertebræ in the concavities come in contact, small osteophytes are formed in the neighbourhood which may unite the bones. In severe and old cases these edges may be joined by actual synostosis.[1] But while pressure from above downward checks growth in those directions, it does not hinder, but rather aids

[1] *Hunterian Museum, Pathological Series*, 2099.

increase both in the lateral and antero-posterior directions. Thus the left (concave) side of a scoliotic vertebral body is not only thinner but also both deeper from before backward and wider than the norm. This, of course, gives to the bone a very unsymmetrical appearance. But it is not merely appearance which leads to our conclusion on the above causation ; nature gives us anatomical proof, in the position of the opening for the basic vein or veins. This, or these—for there are usually more than one, lie no longer in the middle of the posterior surface, but considerably to the right. Of course it is not for a moment to be imagined that the opening has shifted its position in a bone not otherwise changed : therefore, the only explanation is that the body has grown laterally very much more to the left of the openings than it has to their right. Indeed, in far advanced cases, like that shown in Fig. 52, this left-sided growth is evidenced on the posterior face by an entering angle (in which lies the emunctory opening) at the line of junction, between the wide-growing and the high-growing part of the bone. On the anterior and antero-lateral aspect (concavity side) of some scoliotic vertebræ, oblique striæ may be observed : they probably indicate that the osseous fibres have been twisted while soft, during and by the rotation ; or they may be marks left by an overtight and shifting anterior common ligament.

The arches and processes are also the site of very remarkable changes, the causes of which, after having described them, I shall attempt to elucidate. On the left (concave) side the pedicle takes a less backward course and runs more transversely than it ought to do ; it is short and stunted ; the lamina is long but narrow, the articular process shrunken in all dimensions. (See Fig. 52.)

On the convex side the pedicle is long, strong, somewhat hypertrophied, the pedicle broad but rather short. In consequence, the spinal foramen is wide from before backward on the left, but narrow and long on the right side.

I would now especially invite the reader's attention to the very remarkable changes which affect the processes—transverse and spinal. On the left (concave) side the transverse process runs in nearly its normal direction, only a little too far backward. On the right (convex) side that process takes a greatly backward direction; it is thin at its root and altogether less strongly developed than on the left side. In consequence of these varying directions, the vertebral groove on the right side is deeper, but more especially narrower, than in the normal vertebra, while on the left side it is considerably widened. The root and first part of the spinous process is straight; but at about half its length it takes a bend towards the right, a bend which is the more marked the earlier in life the curve began.

Let me now beg the reader to examine carefully Fig. 52, and to trace in his mind the sort of force which, while producing rotation, has also caused these alterations in the shape and the direction of arches and of processes. The questions to be solved stand thus: It has been shown[1] that the vertebræ of a laterally bent spine must, by virtue of the different qualities of its ligaments, rotate. But it was also shown that the spine, especially its dorsal part, is during unequal performance of certain functions or actions rotated through agency of the serratus, using the ribs as levers. Now if the former were the true account—that is, if the vertebra were rotated by ligamentous forces—it would drag with it the rib backward (for those bones are of course thus

[1] See Appendix V.

displaced), and that rib would of necessity resist, or rather most of the muscles attached to it (such as the abdominal, oblique, recti, and others) would do so. The principal tractile agency is the transverse process of the right (convex) side, which, being still in the yielding semi-cartilaginous condition of early life, must by that force be deflected forward—in other words, must

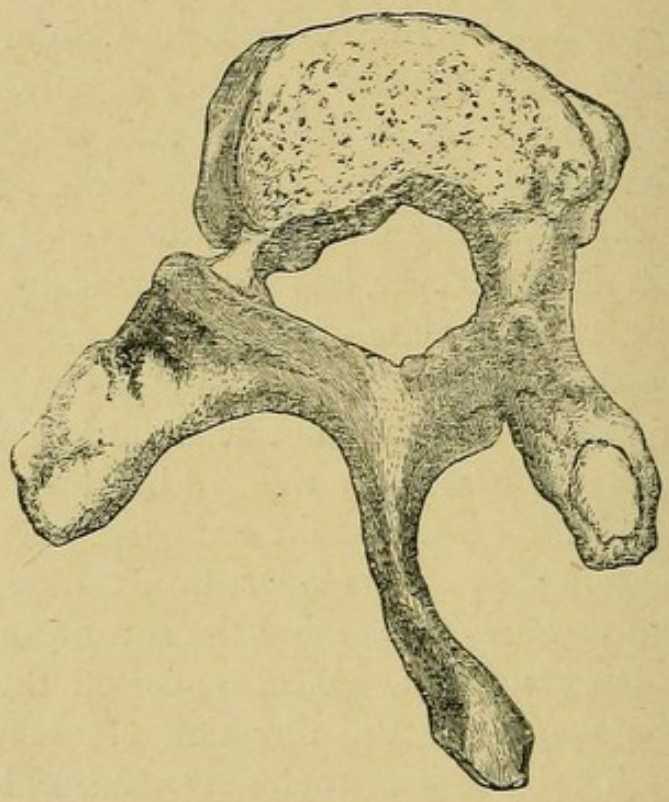

FIG. 52.—A Scoliotic Dorsal Vertebra (after Lorenz).

come to be in an abnormally transverse position—and the vertebral groove of that side must be widened; also the transverse process of the left (concave) side in pressing its attached rib forward must be forced into an abnormally antero-posterior direction; but any one who will study Fig. 52 will see that the direct contrary is the case. And in order to eliminate any idea that preconceived notions may have guided my pencil in the

drawing, I have traced the figure from a work by one quite opposed to my view, that the ribs rotate the vertebræ, viz. from the book of Dr. Lorenz ; only Dr. Lorenz's figure represents a bone from a dorsal curve (convex to the left). In order not to produce any confusion, since I have always taken my description from right curvature, I have reversed his figure, thus making it a vertebra from a right curve.

To follow, then, this argument still further, let us suppose that the rib works, as just stated, after a lever-like manner, in rotating the vertebra. Such force acting on the still soft transverse process must press it inward towards the middle line and would thereby compress, *i.e.* shorten the lamina, while lengthening by traction the pedicle : thus the vertebral groove of that side must be narrowed. But the muscles, *e.g.* the right rhomboids and trapezius attached to the tip of the spinous processes, would resist the rotation and thus bend those points of bone to the right. I must say it appears to me impossible to look, as I have done, at a number of rotated vertebræ without coming to the conclusion that it is *not* the vertebræ which rotate and carry back the ribs, but the ribs which travel backward and turn the vertebræ round. Moreover, we shall see directly that the right ribs, those on the convex side, are sharply bent ; if the rotating vertebræ did, in their revolving course, drag the ribs backward, the resistance must inevitably unfold the angles, *i.e.* flatten the bone instead of crumpling and sharpening those angles as the rotating force in reality does.

A most complicated and difficult study is presented by the varying position and shape of the ribs on the right and left side ; the former are chiefly due to the displacement of the vertebræ. We will defer for the

present speaking of their backward projection on the right side, which is connected with rotation, and fix our mind for the moment on the mode in which lateral deviation—the pure sideways bend—affects the course of the ribs. On the convex side, those which are attached to the upper limb of the curve must of necessity take an upward, those on the lower limb a downward course; thus they diverge, the intercostal spaces are wide, and the length of the thorax, on the side outline, from the axilla downward, is much increased. On the concave side, the reverse is the case; on the upper half of the curve the ribs run downward, and on the lower upward; they converge and the lateral wall of the thorax is shortened. If the ribs were mere passive outgrowths from the spine, without other attachments, this would be all that need be said; but as they are bound together, upheld by some muscles, depressed by others, the simple change of position, above indicated, is the merest rudiment of the complicated derangement of form and place which affects the ribs. To attempt description of them in detail would be out of place in a work like this, which, aiming at scientific accuracy, would yet avoid such minutiæ as, however interesting to the investigator, would tend to obscure the practical points of the subject. Moreover, the position of the ribs varies in regard to each other according to the amount of curve and to its place in the column; thus, in some subjects, we find the upper, and in others the lower ribs chiefly affected; while in long and severe curves the whole number may be involved, the upper one making protuberant the root of the neck on the right side, the lower one (tenth) lying in the iliac fossa; while on the left they may all be crowded together within a very small compass. However they are placed, the side of the thorax in the con-

vexity of the curves is rendered, not only long, but also narrow, the latter change being in great measure due

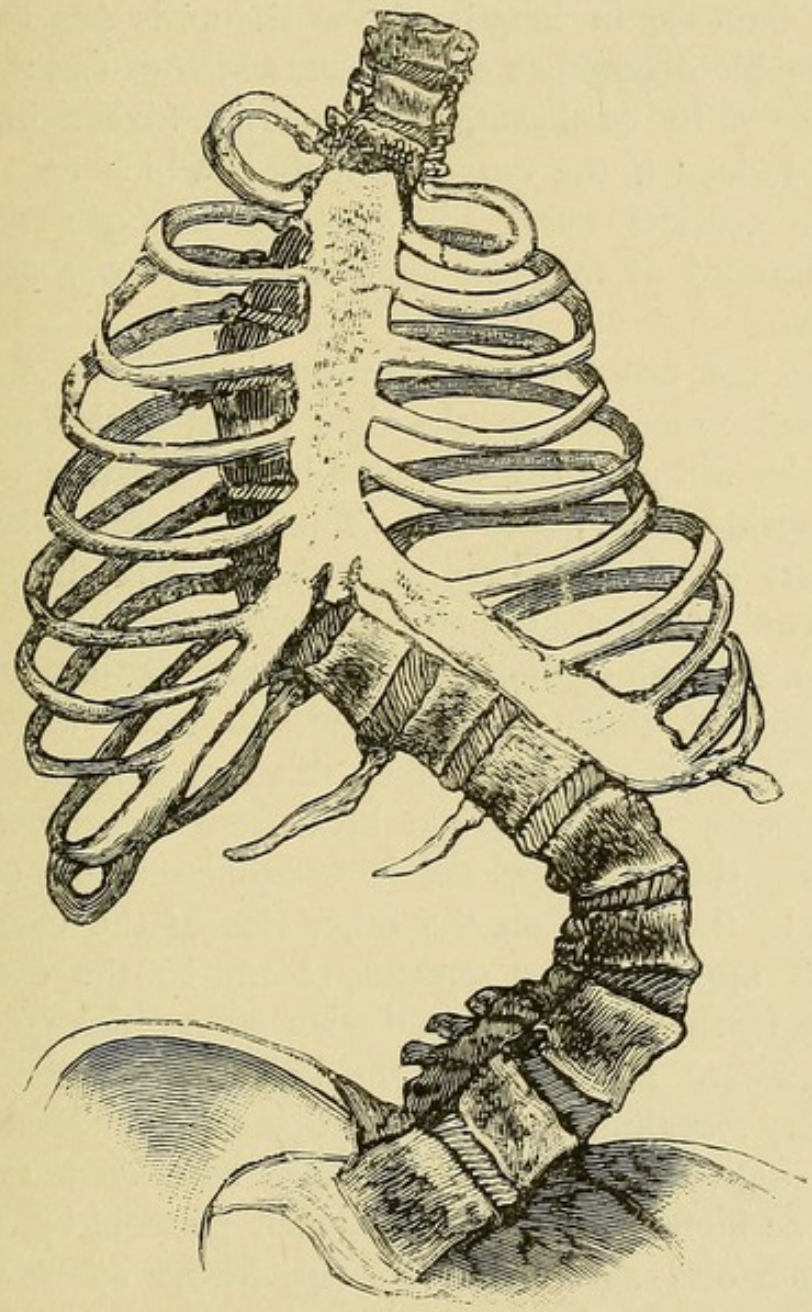

FIG. 53.—Scolioti Skeleton.

to encroachment on its space of the vertebral bodies. Thus there is in the College of Surgeons' Museum a distorted skeleton, in which the space between the

anterior (now lateral) part of the spine and the bodies of the fifth to eighth rib inclusive, averages only three-eights of an inch.[1]

The increase in length of the thorax is due to the considerable divergence of the ribs, which causes the inferior ones to be lower, the superior higher in the figure: indeed if the curve be high, in which case consecutive cervical curve will exist, the first rib runs so much upward as to cause fulness at the lower part of the neck.

These are not the only changes in position, for the transverse processes on the right (convex) side are, as the reader will recollect, deflected by the pressure of the ribs considerably backward. This connotes that the first part of those bones, from the head to the angle, must run in an abnormally backward direction. But in thus deflecting those processes, the ribs also rotate the vertebræ, thus acquiring a still more backward course—indeed in severe cases this first portion of the ribs appears to run straight back from the spine. In assuming this posture, much resistance is of course offered by the bones on the other side of the chest, by muscles opposing the serratus, chiefly by the external oblique, by the diaphragm, and other parts which counteract backward movement of the body of the rib. The necessary resultant of the two forces is a very sudden bend at the angle, which is rendered sharp to a degree which would be incredible had we not such patients before us and such also as in museum specimens as is above referred to. At the same time the ribs on the other (concave) side are straightened, in all probability by pressure of the rotating vertebræ. The angle becomes almost lost, the bone assuming a comparatively slight

[1] Pathолog. Series, No. 2,099.

curve from the head nearly to the distal end. In severe cases this distal end is bent inward more or less abruptly to meet the cartilage, which is likewise bent sometimes pretty sharply. In such instances the sternum also is oblique horizontally, the left edge being considerably in advance of the right one; also it slopes from above down-

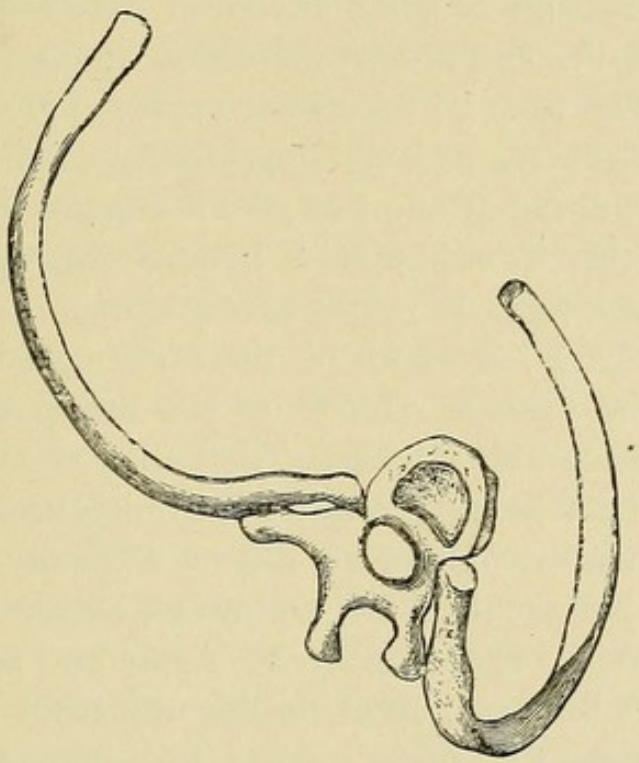

FIG. 54.—The Fifth Thoracic Ring (after Lorenz).

ward, its lower end being much to the right while the notch of the maubrium is in the middle line.

It is to be noted that the oblique diagonals—the lines traced on each side from the angles of the ribs, or from where the angles should be, to the ends of the bony ribs on the other side—are very different in length, while normally they ought of course to be equal. The line which runs from the place of the angle of the left ribs to the end of the right ribs is very much shortened, while

that which passes from the angle of the right to the end of the left ribs is excessively long. Again, if a line in the true antero-posterior axis be drawn through the vertebra, very little of the thorax lies on its right while a very large portion of that cavity is placed on its left side.

But such changes involve a further alteration in the shape of the chest, which is no longer symmetrical. A horizontal section of a far advanced case would present a most singular and almost incredible appearance, whose general form may be somewhat gathered from Fig. 54. Having, however, had no opportunity of making such section, I will not attempt to give a diagram on supposititious grounds, although I believe myself to know perfectly the form it would present.[1]

A necessary sequence of these changes is displacement of the viscera. Those of the thorax suffer little, until a considerable degree of deformity is reached, and then they become very much more misplaced than is, I think, generally believed. But a difficulty arises in forming a judgment of this condition, because the landmarks have also been removed. Again and again I have heard physicians say, when finding the heart beat below the left nipple, that the organ is not displaced; and, with regard to the chest wall, this is true; but that wall itself is out of place. In June, 1882, I had the opportunity of examining a girl, aged nineteen, who, after a short illness from pleuro-pneumonia, died of exhaustion and apnœa. She had a most severe lateral curvature. I was forbidden

[1] I would again remind the reader that cases of curvature vary considerably as to place and severity; hence the form of the anterior parts of the thorax differs greatly. Thus in some persons the sort of sternal obliquity mentioned in the text is absent; moreover, the costal cartilages are much bent in some, very slightly in other cases.

to, and could not remove any part. During life the heart-apex appeared to beat in the right place, but on removal of the anterior chest-wall the displacement to the left was very striking. A cord stretched from the chin (head held straight) to the pubes, passed over the right lung about two-thirds from its outer border, leaving one-third between it and the outer uncovered edge of the pericardium. The right lung, though, as regards the anterior thoracic wall, still in that side of chest, was to the left of, and lying on the left side (now anterior) of the bodies of the vertebræ. It was deeply marked by the ribs, was small, and somewhat solid. The left lung was large—its emphysematous condition may have been the result of independent disease. The diaphragm was high on both sides, chiefly on the right. The right side of the chest seemed almost entirely occupied by the bodies of the vertebræ. At the apex of the curve, the inter-vertebral ligament was absent or nearly so, and three of the vertebræ, very rough and uneven, appeared anchylosed. I could feel, rather than see, in the small dark room, that the left edge of the anterior ligament was thick and tight, its edge between certain of the vertebræ feeling very sharp and hard. I detected nothing morbid in the abdominal viscera, except that the liver was very convex, almost conical on its upper surface, thick from above down, and had two very deep sulci impressed by ribs, but the examination was made under great difficulties and closely watched. It may be difficult to affirm what may be the symptoms resultant from such disturbance of place. One thing we find at the Cripples' Homes, that if any inmate, thus deformed, be attacked with bronchitis or pneumonia, it goes very hard with him or her; and some die with a much less amount of disease than would be fatal to a well-formed person.

Also patients with severe curve, when they get to middle life, are nearly, though not always very fragile ; they age quickly and slight ailments affect them severely. Many are almost incapable of even a small amount of exertion, such as ascending ten or twelve stairs, breathlessness and severe palpitation of the heart being thereby induced.

VIII. German Views and Statistics on the Production of Curvature by Bad Position in Writing.

This subject has been studied with much zeal in Germany and Switzerland, where scholastic institutions, being more than here under governmental control and superintendence, offer greater facilities for thorough investigation. Thus before me now lies a small publication by Dr. Felix Schenk [1] who devised an ingenious though extremely complicated apparatus for ascertaining the position of writing children. Here can only be quoted the most essential of his results and opinions. After recording observations, he remarks : " Thus it has been shown with all desirable exactitude that every schoolchild has in writing his own peculiar position. Of two hundred scholars, one hundred and sixty assumed such a posture that relatively to the pelvis the upper part of the body leaned over to the left, its weight being thrown on the left elbow, sometimes with, sometimes without, a twist of that part of the trunk. Six scholars exhibited, while writing, no lateral bend of the body. The remaining thirty-four leaned the trunk usually a very little towards the right and generally sat very upright, but twisted the body quite strongly to the left. In this posture the

[1] *Zur Aetiologie der Skoliose*, &c. By Dr. Felix Schenk, Fabrikant Orthopadischer Apparate in Berne.

right fore-arm appeared to support very little of the body-weight. All these different posture peculiarities were reflected very plainly in the configuration of the thorax.

"The one hundred and sixty who leant over to the left had all a more or less strongly marked simple C-shaped curve (convexity to the left).

"Those without any inclination to either side were straight, as regards lateral deviation of the spine, and the others (thirty-four) who twisted their bodies to the left and leant over to the right had that form of scoliosis which we find described everywhere as the usual one —as the true habitual lateral curvature—namely, an S-shaped scoliosis, with particularly well-marked curve to the right in the dorsal region and a correspondingly heightened shoulder.

"According, then, to the outcome of my researches, it is wrong to distinguish this form of lateral curvature as the most usual, for the thirty-four cases thus distorted are confronted by one hundred and sixty C-shaped simple left curvatures (*scoliosis simplex totalis*)."

He then goes on to say, that these postures are assumed in order to avoid supporting any of the body's weight on the right arm, so as to leave it free for the movements necessary to the act of writing, and says: "All these movements can only be well fulfilled when the writing arm is not burdened by any part of the weight of the body."

How different is Volkmann, who describes the position of writing school-children thus: "While writing, the right fore-arm and the hand which wield the pen, lie entirely on the table, while only the left hand at most, sometimes merely the fingers, rest upon it. The right shoulder is inclined forward, the left one thrown back. The anterior surface of the thorax lies oblique to

the edge of the table; but in this position the right shoulder lies rather higher than the left. The dorsal spine bends rather strongly to the right, and the more strongly, the greater be the weight which the pupil throws on the writing arm."[1]

IX. The Non-Existence of a Physiological Lateral Deviation of the Spine to the Right.

The foundation of the erroneous belief in a natural and healthy dorsal curve to right was laid by Sabatier in a sequel to the third volume of his work on Anatomy. He says that "in the neighbourhood of the second bend of the aorta, about the level of the third dorsal vertebra, the spinal column presents a curvature (concavity to the left) more or less evident in some subjects, in others only marked by a slight flattening. The curve generally extends from the third to the eighth or ninth vertebra, and is produced by the pressure of the aorta." He, however, expressly states that in many subjects he has not found this curve, and that it appears to occur only in those who in childhood had been weak and delicate. This curve, he believes, explains why so many cases of dorsal scoliosis are convex to the right.[2] Guided by the indication in the last sentence, this description was seized upon, as affording a long-sought-for explanation of dorsal curvature, yet the sinister course of the aorta was by many not considered the efficient cause of this so-called normal deviation. Some, for instance Struthers,

[1] Pitha and Billroth's *Handb. der Allgem. und Spec. Chirurg.* Vol. ii. Abth. 2, p. 703.

[2] *Mémoire sur la Situation des gros Vaisseaux à la suite de l'Anatomie de Sabatier*, tome iii. p. 406.

ascribed it, and dorsal curvature generally, to the asymmetrical position of the thoracic and abdominal viscera.[1] Others, and among whom Busch is the most noteworthy, thought that the greater use of the right arm was the efficient cause.[2]

Whatever view they may take of its causation, most writers of this class seem to entertain no doubt of the existence of a physiological curve, and speak, indeed, with far more assurance than did Sabatier himself; nor have they taken notice (with one exception) of a most important word in his description, namely flattening (*aplatissement*) of one side of the bodies. This exception is Bouvier, who, writing in 1858, makes certain observations so important that they must be here reproduced :—

"I took up the subject a score years ago, and, in a not yet published work, studied this curvature of the spine in a new point of view.

"Firstly, its existence is more general in the adult than Sabatier believed, particularly if those cases in which it is only represented by a sort of flattening of one side of the spine be taken into account, as he himself seems to have done. One hardly finds one case in a hundred, beyond twenty years old, in which the spine is perfectly symmetrical on the left and right sides, but under that age it is otherwise. The nearer to the time of birth, the more instances of complete rectitude will be found, and one sees no curvature in very young children, not at least unless they bear traces of rickets."

[1] *Anatomical and Physiological Memoirs*, 1854, p. 47, pointing out that those of the left weigh 15 ounces more than those of the right side. Von Bühring considered it accounted for by the pulsation of the heart. (*Die seitliche Rückgratsverkrümmungen*, &c., 1851.)

[2] *Loc. cit.* p. 131.

After some observations, to be quoted hereafter, the author goes on to say :—

" What, then, is in truth this lateral flattening, already mentioned by Sabatier, and constituting the first stage of curvature? It is a change in the symmetry of the vertebræ which precedes even curvature properly so-called." [1]

Volkmann particularises this so-called normal curvature more closely. He says : " After the seventh year the dorsal portion of the vertebral column begins, almost without exception, to bend itself a little to the right, and to this bend are added little compensatory curves of the lumbar and cervical region in the opposite direction.[2]

It is very difficult to have to differ from such authorities, more especially from the last, but I must say that his assertions, especially the latter ones, go quite beyond what is demonstrable—at all events, one would like to possess, by way of substantiation, some account of his mode of mensuration, or at least of observation.

I next take the averment of Mr. William Adams, who says : " In the course of my experience in making post-mortem examinations during the twelve years (from 1842 to 1854) that I filled the office of Demonstrator of Morbid Anatomy at St. Thomas's Hospital, I habitually examined the spine after eviscerating the body, and remarked the great rarity instead of the frequency of any lateral deviation." [3] Of course such an assertion must claim every consideration ; yet I fear it cannot possess great weight ; firstly, because it is merely a contradiction

[1] *Leçons cliniques sur les Maladies chroniques de l'Appareil locomoteur*, pp. 373, 375.

[2] Pitha-Billroth's *Handb. der Allgem. und Spec. Chirurg.* Vol ii. Abth 2, p. 703.

[3] *Lectures on the Pathol. &c., of Curvature*, &c. p. 17.

of such authorities in anatomical examination, as Sabatier, Bouvier, Busch, Volkmann and others; and secondly, because there is, most certainly in a great many eviscerated bodies, an appearance of a deviation to the right: but I never saw, nor could I, with the utmost care, ever find (save in subjects affected with distinctly morbid curves) any, even the slightest suspicion of a compensatory and contrary curve in the regions above and below the central dorsal where this appearance is to be found.

During a large portion of my connection with the Charing Cross Hospital, I have taken every available opportunity of examining this matter in eviscerated bodies; for it must be noted that this supposed physiological curve is far too slight to be detected during life by any deviation of the spinous processes or of other parts. For nine years (from 1875 to 1883, inclusive) I took notes of every investigation. They were burnt in a fire that occurred in my then residence and that destroyed most of the papers that were kept in that room. The outcome, however, was this: (1) a certain number were of scoliotic people, known during life to be deformed; (2) a certain number were found in the post-mortem room to be deformed, without any traceable knowledge of such during life, deformed, that is to say, to a degree far beyond the supposed physiological curve; (3) a goodly number were perfectly straight; (4) the spines of a certain number appeared to deviate to the right in the way described by Sabatier and Bouvier. Now I cannot, for reasons above stated, give actually reliable numbers for each of these categories; but I had just taken out, and had been looking over all my notes on the evening of the fire, and am sure that I am not far wrong in saying that they related to 480 subjects: among these were

three belonging to the first and second category, say 0·7 per cent. of spines plainly and undoubtedly deformed. Concerning the other numbers, my memory serves me better, and I think I may say almost with certainty that there were 177 bodies, or 36·8 per cent., perfectly straight, and close upon 300, that is to say just 62·5 per cent., in which an appearance of deviation existed.[1] Whenever such condition was detected, I always, unless prevented by pressing avocations, dissected clean the bodies of the vertebræ as far back as the insertion of the ribs. When this was done, I nearly always found that the appearance of a lateral bend was still more marked than before dissection; but on more rigid examination, I ascertained this to be produced by that flattening (*aplatissement*) to which both Sabatier and Bouvier allude, and indeed I take it, that in his description the latter has given what he more than suspected to be the true explanation of this supposed physiological curve. For I found that the eye looking from full front at a column thus cleaned, naturally takes the most prominent part of each body to be the centre of the bone, as of course it is when the vertebræ are quite symmetrical.

The eye is herein, therefore, an untrustworthy guide; for if with the tips of each index the sides of the apparently deviating vertebral bodies be felt, they will be found perceptibly flatter on the left than on the right. A certain portion of the substance on the left side seems to be missing, to have been worn or absorbed away. Now the bodies of the dorsal vertebræ from the second to the tenth (in some subjects only to the ninth) inclusive, are more triangular in form than in any other region of the column; each one culminates forward in a rounded

[1] The bodies of infants under five years old were not taken into account.

corner, which, when the bones are superposed on each other, as in life, form in the fore-front of the spine a blunt crest, and is that which the eye follows when tracing in the eviscerated subject the rectitude or otherwise of the spine. But the flattening down of the left side of the vertebral body removes that rounded corner a little away from the median line towards the right; the ridge, therefore, which, as above explained, is the line followed by the eye, lies to the right of the middle line;

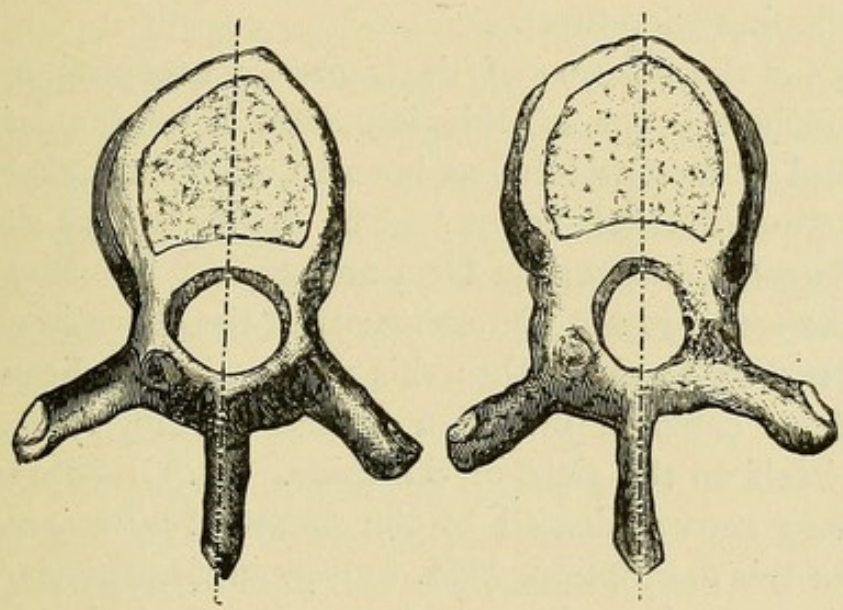

FIG. 55.—Normal and Flattened Vertebræ.

hence, the spine appears, but only appears, to be convex in that direction. In three cases of marked physiological curve (?) I had the fifth and sixth vertebræ removed, and found this flattening in all, and *no other marks of deformity;* the openings for the basic veins were central. The shape of one of these vertebræ in contrast to that of a symmetrical one is given in the figure. I would then without fear of error affirm firstly, that in a large number of adult bodies, eviscerated and examined from the

front, there is an appearace of lateral curve to the right; secondly, that in such cases the appearance is deceptive, being produced by a flattening of the left side of the bone; thirdly, that if a more pronounced curve be found than can be accounted for by such cause, or even by an unusual amount of flattening, such curve is not physiological, but pathological, and that if, when the most deviated bones in such cases are removed, other abnormities are to be found (unless, perhaps, in the case of a young subject chancing to die at the commencement of a developing curvature).

But can the position of the aorta be accepted as the one efficient cause of this left-sided flattening of the vertebral bodies, which has been so widely mistaken for a deviation of those bones? The theory is very simple and plausible, but certain facts are against it. Bouvier, for instance, says: "The concavity of the curve is sometimes turned to the right; this peculiarity has been observed in cases of inversion of the viscera, the aorta being itself on the right of the spine. M. Grisolle some time ago communicated to the *Société Anatomique* two cases of this description, MM. Petrequin, Desruelles, and Brechin have since then published four fresh instances, and there are others. Nevertheless, this coincidence is not constant; Beclard saw the spinal concavity to the right, although the aorta was on that side.[1] In a case noted by M. Desruelles, there was no arch of the aorta, and yet the normal curvature was in its usual direction. At other times, while the aorta maintains its normal relations, the curve is to the left. Beclard observed this

[1] Scheele has comparatively recently published two instances of transposition of the viscera. In one there was no deviation of the spine, in the other the column deviated to the left. (*Berliner klinische Wochenschr.*, 1875, pp. 29, 30.) Author's note.

in a left-handed subject ; I myself have seen similar instances, but the subjects were not all left-handed." [1]

The only possible conclusion is, that neither the position of the aorta nor right-handedness is essential to this flattening on the left side of the vertebral bodies.

The causation of that condition is, however, of less importance than its supposed consequence. Both Sabatier and Bouvier consider it to be the direct cause of right dorsal curvature, by producing a certain left-sided weakness of the spine ; the latter, however, insists strongly on the fact that this appearance is not to be found in quite young people, that is to say at the age when curves commence. The idea, therefore, of a physiological curve is an error, founded on mistaken observation. As, however, this error has in my experience frequently led to disastrous results, it must be permitted me further to point out that, even as accepted and described by its most zealous partisans, such curve is quite insufficient to give the slightest external sign of its existence. Therefore, even if a "physiological curve" did exist, it would be a sad error to attribute a visible lateral curvature to such cause.

[1] *Loc. cit.* p. 374.

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THE END.

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