

## **The treatment of scoliosis / by Robert W. Lovett.**

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# The Treatment of Scoliosis

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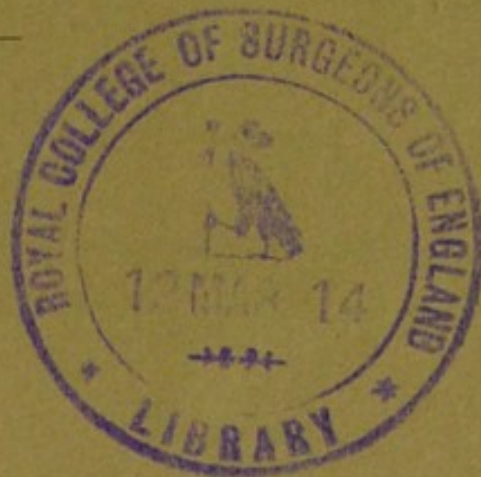
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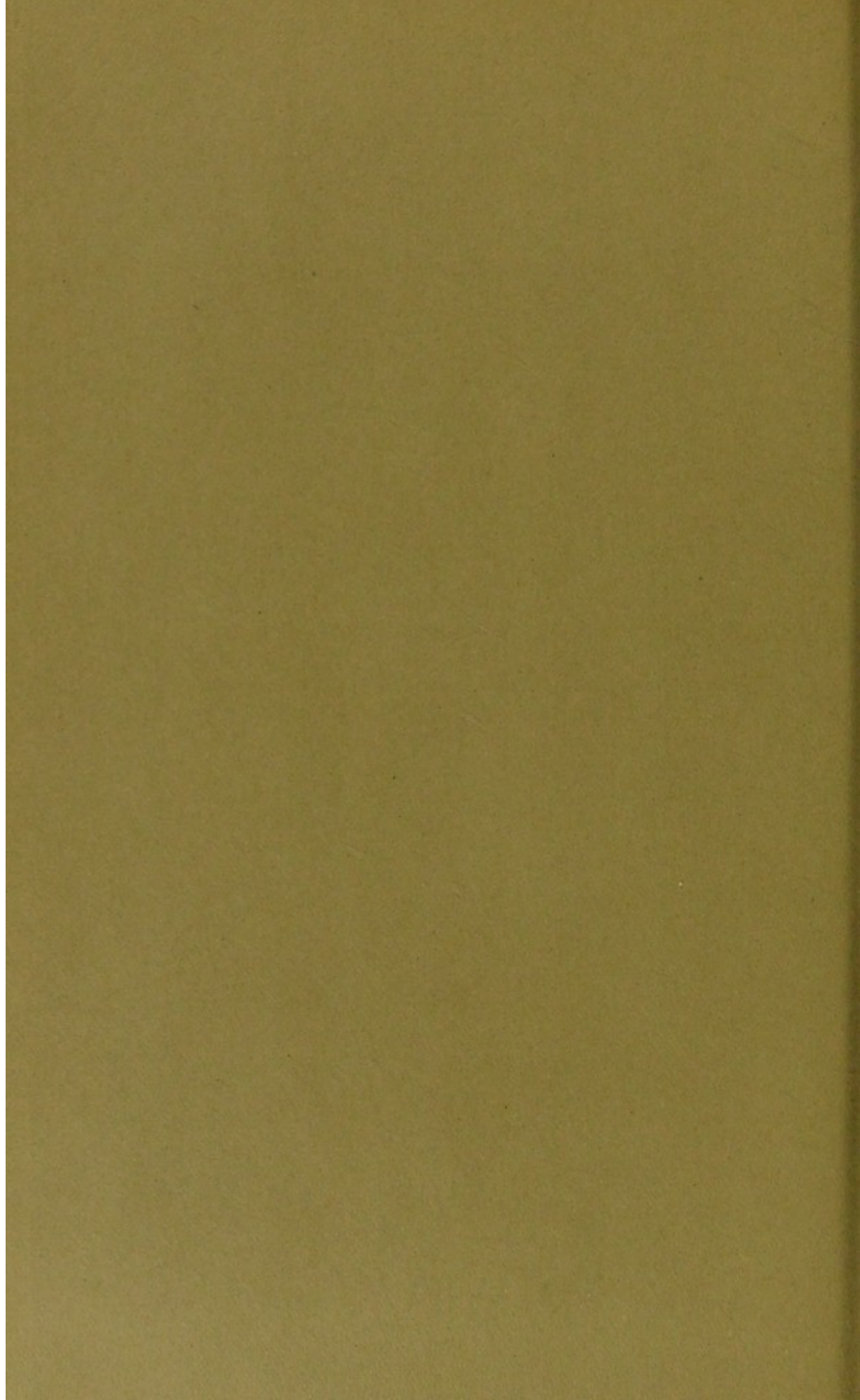
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## THE TREATMENT OF SCOLIOSIS.\*

BY ROBERT W. LOVETT, M.D., BOSTON.

THE presentation of a critical review of the modern treatment of scoliosis presents peculiar difficulties. The affection has been for many years the subject of extended and sometimes bitter discussion, but no weight of authority has been great enough, and no proof of achievement convincing enough, to unite surgical opinion. In a recent review of the literature of the subject, made as a preliminary to writing this report, it has seemed almost impossible to believe that the authors were discussing the same subject, so wide has been the divergence of opinion. This may be partly accounted for by the fact that the term 'scoliosis' is loosely applied to include two different affections, and partly because scoliosis seems to have been regarded, in the past at least, as an affection quite by itself, to which the general principles governing the treatment of other deformities were not applicable.

Under the existing conditions, therefore, it seems best to start with a somewhat elementary definition of our subject, and to proceed from this to a consideration of the basic principles governing our treatment. This method of procedure has been chosen because assertions based on clinical experience and on theory, published results, mechanical studies, pathological examinations, and new methods of technic, all exist

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in abundance. Further accumulation of these would seem to be probably less useful than a consideration and analysis of the principles upon which treatment rests, in the hope of securing possibly a better agreement on fundamentals as the basis of a more satisfactory superstructure.

*Definition.* We must first, therefore, arrive at a perfectly definite understanding of the terms to be used. The term scoliosis is a Greek word dating from the time of Hippocrates, meaning a bending, twisting or curving, and is used as synonymous with lateral curvature of the spine or its equivalent in other languages.

When we speak of scoliosis or lateral curvature of the spine as an entity we are really classing together two main groups which should be kept separate, or at least separately identified.

*Varieties.* These groups are (1) postural or functional scoliosis, and (2) structural or organic scoliosis. The other names given to the two different varieties by various authors vary widely, and the line of cleavage between the two groups in literature is ill-defined and variable. But as a matter of fact the division between the two is clearer than between most functional and organic affections of the same structure or organ.

In the first named variety, the postural, the patient has a structurally normal spine, but stands with the spine curved to the side owing to some defect in lateral balance due to some trifling anatomical bodily asymmetry, to be discussed later. The curve disappears on lying down, and the x-ray shows no structural changes.

In the second named variety, the structural, the vertebral column is primarily affected, and the lateral curve is due to this asymmetry of the structures composing the spine. The curve does



not disappear in recumbency, and the x-ray shows structural changes.

To call both of these varieties by one name, scoliosis, leads to confusion and contradiction, to widely differing statements as to ætiology, and to marked divergence of views with regard to treatment and its results. If we grouped together all sprains and joint fractures under the term of 'fractures' without regard to the presence or absence of bone injury, our classification and our treatment of these injuries would become confused, contradictory, and unsatisfactory.

In order to make the matter perfectly clear in the present discussion, therefore, let us designate as 'false' scoliosis the postural variety, and as 'true' scoliosis the structural variety, so that in the consideration of ætiology and treatment we may not be grouping under one name two conditions essentially different.

True scoliosis constitutes our real problem, of course, but in order to make that part of the subject perfectly clear, we must first discuss and remove from our field the less important question of false scoliosis.

#### FUNCTIONAL SCOLIOSIS.

We come then first to a brief consideration and definition of the minor form, functional scoliosis. This variety is also spoken of as postural or total scoliosis, faulty attitude, or, best of all, false scoliosis, a term used by some of the more recent German writers.<sup>1</sup>

*Diagnosis.* The identification of this variety is simple, and its diagnostic characteristics are four:<sup>2</sup>

- (1) The spine forms a single lateral curve,



in 90 per cent. of the cases convex to the left, for which predominance no satisfactory explanation has been given.

(2) In the ordinary standing position the left shoulder is carried higher than the right in left curves, and vice versa. This is because the bend to the left separates the ribs on the left, which carries the left side of the shoulder girdle higher than the right.

(3) In the standing position the right side of the shoulder girdle is twisted back in relation to the pelvis, and the left twisted forward in left curves, and vice versa. This is because there is no such spinal movement as a pure lateral bend, and every lateral bend is accompanied by a twist. This twisting of the shoulder girdle in a horizontal plane is an expression of this fact. Any bend of the spine convex to the left in the upright position is and always must be accompanied by a twist of the shoulder girdle backward on the right.<sup>3</sup>

(4) If the patient stands and bends forward from the hips until the trunk is horizontal the right side of the back will be slightly higher than the left in left curves, and vice versa. That is, the twist backward as seen in this position, in this type of scoliosis, occurs on the concave side of the lateral curve instead of on the convex, which is the case in the structural type. This is because the backward twist of the right side of the shoulder girdle, spoken of in the preceding section, is carried over into the forward bend position as a prominence upward of the right side of the back.

This phenomenon has been much discussed under the names of 'reverse rotation,' 'retro-torsion,' 'concave-sided rotation,' 'and paradoxical scoliosis,' but it is really nothing but the



natural forward bent position of any patient with left functional scoliosis. The phenomena of functional scoliosis may all be produced by having a normal child stand with one leg on a book, causing obliquity of the pelvis.

It may be desirable to repeat for the sake of clearness the four signs which designate functional or false scoliosis. In left curves they are a curve of the whole spine to the left, a high left shoulder, the shoulder girdle twisted backward on the right, and in forward bending the right side of the back is slightly higher. They are the diagnostic signs, and the absence of any one of the four will generally invalidate the diagnosis.

Functional curves remain as such or they may change to mild structural curves. There is no evidence that they are spontaneously outgrown. The ætiology of false scoliosis will be discussed with that of real scoliosis in order to avoid repetition.

*Treatment.* Cases of false scoliosis in the matter of treatment being a muscle problem, yield to muscle treatment—that is, they are amenable to gymnastics, and the prognosis for complete recovery under efficient treatment is favourable. The treatment consists in substituting a correct for a faulty attitude, which is accomplished by a set of exercises much like the 'setting up drill' of the army recruit. If stiffness to one side exists it is easily remedied by unilateral bendings.

Having thus identified this condition, which has done so much to fog the whole question of scoliosis, we may for the present leave it aside and pass to the consideration of structural scoliosis, which constitutes our real problem.



## STRUCTURAL SCOLIOSIS.

As synonyms for this name there are in common use the terms true, real, organic, fixed, bony, osseous or habitual scoliosis, or rotary lateral curvature of the spine.

As distinguished from the functional variety which has just been described, the structural variety is characterized by a change in the structures of the spine and thorax, manifested by a lateral curve of the spine associated with a turning of the vertebral bodies of each curved region toward the convexity of the lateral curve. This latter is the 'rotation' of scoliosis. We are dealing no longer with the persistent malposition of a structurally normal spine, but with a spine deformed by structural alterations in bone and soft parts.

This turning of the vertebral bodies to the convex side of the lateral curve is made evident by a backward prominence of one side of the thorax or lumbar region in the standing position, and still more evident as an upward prominence of that side in the forward bent position, and is to be accepted in even slight degree as evidence of the existence of true or structural scoliosis. The pathological changes associated with this grade of scoliosis, with which you are perfectly familiar—the wedge-shaped and twisted vertebræ, the compressed intervertebral disks, the deformed and displaced ribs, and the contracted soft parts—constitute factors that we must take into serious account in formulating our treatment.

*Ætiology.* Before proceeding to the discussion of treatment of this form, some mention of the ætiology of both forms, in so far as it bears on treatment, must be made, because in this re-



gard much confusion has been caused by the failure to separate the two conditions.

*Functional or False Scoliosis* is apparently caused by the faulty attitudes of children sitting and standing at school and at home, by some trifling anatomical asymmetry in legs, pelvis, spine, or skull, causing asymmetrical balance, by unequal vision or hearing, by occupations necessitating distorted positions, and by similar causes.

*Structural or True Scoliosis* in the matter of ætiology is very differently regarded in the last few years from what it was formerly, and the idea that practically all cases are due to static causes, to school positions and the like, has been extensively questioned. Insomuch as this matter bears directly on treatment, it must receive consideration.

Structural or true scoliosis may be roughly classed as being either mild, moderate, or severe. In the mild cases the deformity, although perfectly characteristic, may be so slight that we can easily concede that the changes present are no more than we might expect to find in a spine of normal resistance which had been held laterally curved during a part of the period of growth. These cases are most often the outcome of functional scoliosis, and are often spoken of as static.

In the remaining cases, however, the cases of moderate and severe degree, the changes are so marked or severe that we cannot regard them as the result of growth of a normal spine column held asymmetrically, but must look for an additional cause. Such causes are to be found most often in (*a*) congenital anomalies of the spine or its appendages, (*b*) empyema, (*c*) infantile paralysis, and (*d*) rickets. In addition



to these there is a class of cases where the deformity is so severe that one must assume a diminished individual resistance of bone to deforming causes, and yet evidences of rickets are not to be found. Some writers would assume in all such cases the existence of rickets to explain such cases, but in the absence of the accepted diagnostic signs of that affection it seems fairer to admit the fact, and assume an undefined weakness of bone for which we have as yet no name.

The practical outcome of the foregoing statement is that in the opinion of the writer one may assume that a short leg, *e.g.* will cause asymmetry in standing and postural or false scoliosis, and in some cases will cause mild degrees of true scoliosis, but that it is not a competent cause of moderate or severe scoliosis in an individual *with normal bones*. If the bones, however, on account of rickets or because of some similar condition not at present recognized, do not possess normal resistance, a short leg or any similar condition may be in such cases a competent cause of scoliosis of high degree.

This bears directly on the question of school as a cause of true scoliosis, and the views expressed are largely in accord with those of the majority of the recent German writers who participated in the discussion of the subject before the German Orthopædic Association.<sup>4</sup>

*Treatment.* In taking up for discussion the question of the treatment of true or structural scoliosis, it becomes evident that this condition has escaped that careful analysis which would have led to the application to it of those sound surgical principles which aid and guide us in the treatment of similar conditions in other parts of the body. There has not been the



direct attack on the essential deformity that has been made on knock-knee, bow-legs, club-foot, wry-neck, and similar deformities. Until recently the treatment has been an indirect, intermittent, and long-continued effort to remedy a bony deformity by muscular means. A surgeon would be thought very much behind the times who to-day endeavored to correct bony knock-knee or congenital club-foot by muscular exercise, yet many an up-to-date surgeon does not hesitate to advocate gymnastic exercise as the sole treatment of a bony deformity equally severe. The excuse for the use of gymnastic treatment under these conditions would be the fact that the results obtained by it were so very satisfactory that the practical outcome justified us in disregarding sound theory. But proof is wanting that this is the case.

Gymnastic treatment in apparatus is, however, advocated as the sole treatment for all cases by such an eminent authority as Schulthess<sup>5</sup>, and treatment by gymnastics and braces by an authority of such great weight as Lange<sup>6</sup>, but neither of these men has published, nor so far as I know has claimed, such results as claimed and published by Wullstein<sup>7</sup>, Schanz<sup>8</sup>, Sever<sup>9</sup>, Abbott<sup>10</sup>, myself<sup>11</sup> and others. Nor do I know of the publication elsewhere of results from gymnastic treatment which are convincing as to the efficiency of the treatment in moderate and severe cases. Still, one must not pass too lightly over the opinions of such weighty authorities as Schulthess and Lange, and must allow due weight to them.

If one makes no distinction between false and true scoliosis, and classes every lateral deviation of the spine as scoliosis, if he thus groups false and true scoliosis together and treats all cases by



effective gymnastics, the proportion of successful results will be large because of the predominance of the milder cases in almost any group. But if one uses the gymnastic treatment in a group composed wholly of moderate and severe cases of structural scoliosis, the results will be widely different from those of the first group. In this failure to separate the two varieties much of the contradictory evidence with regard to the results of treatment has arisen.

The reason for the unsatisfactory character of the results of gymnastic treatment alone in moderate and severe scoliosis is easily to be found in the fact that we are facing in it a bone problem, with which is associated a muscle problem of secondary importance. We have chosen to regard it in the past as a muscle problem, to be met by muscular therapeutics. We have expected muscular contractions and the positions induced by them to loosen up a spine in parts curved, stiffened and deformed by bony distortion. Moreover, assuming that we could accomplish this loosening up, we have expected the muscles to take up at once the task of holding this loosened up spine in the median line against oblique superincumbent weight, and in spite of unilateral bone deformity.

These expectations have not been reasonable, and consequently have not been fulfilled. The former, the loosening up of the spine, is far the easier of the two to accomplish, and many a case of fixed scoliosis has been made irreparably worse by being made more flexible by exercise and manipulation without the development of muscular strength to hold the improved position. Such cases sag into a worse position than before on account of their increased flexibility.

Let us harbor no illusions as to what we are



accomplishing by gymnastics in these cases. Tradition has governed us long enough. Gymnastics are of the greatest value in the milder cases and in the after-treatment of all cases. Let us not expect, however, by gymnastics alone to affect materially severe curves. Nor if we could loosen them up could we hold them straight by muscular effort until the bone had been reshaped in its growth. That gymnastic exercises given in apparatus which effectively locates the movement and the force would be likely to yield much better results is evident.

*Treatment by Braces.* The treatment of moderate and severe scoliosis by braces or corsets alone needs hardly to be discussed in these days. It is manifestly impossible to crowd to the side and to untwist a deformed and stiffened vertebral column by an appliance which merely has for a hold on the pelvis, for its base of support, a narrow space between the trochanter and the iliac crest. That such braces and corsets are still advertised and sold by instrument makers, and that they are bought by ignorant parents and applied to scoliotic children to their great detriment, is known to you all.

It is not to be disputed that such braces and corsets have a distinct use in connection with gymnastic treatment, in the after-treatment of forcible correction, and in supporting adults who are beyond the age for active treatment by other means.

Under the conditions specified the choice between a removable jacket, a corset, or a brace, will be determined by the facility of the surgeon with each.

*Forcible Correction.* From the time of the elder Sayre, who advocated for scoliosis the application of plaster jackets applied in mild sus-



pension, in several papers between 1875 and 1885, there had been sporadic attempts at the use of continuous mild corrective force in the treatment of scoliosis. Dating from the work in 1896 of Calot<sup>13</sup> who advocated at that time the use of forcible correction in the treatment of Pott's disease, these attempts became more forcible. Schanz<sup>13</sup> published in 1900 an account of an efficient technic in suspension, and reported results in 1902. In 1901 I reported results and described a technic where the patient lay on the face during the application,<sup>14</sup> and there were other papers written at about this time, but the great impetus to the treatment by forcible correction came from Wullstein,<sup>15</sup> who read a paper at the International Medical Congress in Paris in 1900, and who published his experiments, method, and results in 1902. He showed experimentally that bony scoliosis could be produced in young dogs who were kept for some months in a bandage inducing a lateral curve of the spine, and by the use of plaster-of-Paris jackets applied to scoliotic patients in an improved position, induced by the use of traction and lateral pressure, both of high degree, he secured results that were better than any previously reported. The work attracted much attention, and markedly modified the whole point of view with regard to "forcible correction," which began to gather a body of adherents whose number has steadily increased.

As a persistent advocate of forcible correction since 1901<sup>16</sup> I may be regarded as a partisan, but I turned to forcible correction only after many years of experience with the gymnastic treatment and because of its inadequacy as I saw it in my own practice and in that of others, and in the last twelve years as I have contrasted the



results of forcible correction in moderate and severe scoliosis with those of gymnastic treatment I have seen no reason to change my views.

The object of the corrective jacket being to force the spine into the best obtainable position, and in that position to apply a retentive plaster jacket, it becomes pertinent to inquire in what position and by what technic the best corrected position may be obtained.

The four positions which are to be considered are with the patient suspended and lying on the face, side or back.

*Application in Suspension.* Sayre's jackets were applied with the patient suspended by the head with the heels lifted from the ground, and he claimed<sup>17</sup> for them nothing more than support in an improved position. The jackets were removable, and exercises were done daily. The treatment was too mild to be effective, and although extensively used was not followed by very successful results.

Wullstein's method was also a suspension method, but he used 250 pounds of traction, and to secure this, the patient was strapped by the thighs to a revolving and tilting stool and lateral pressure was secured by pads running in from an upright frame on horizontal rods. These pads were incorporated in the jacket. Much greater force was used than ever before, and although unpleasant symptoms from pressure arose at times, the results were so good that the method was extensively used, and is still much in vogue on the continent of Europe.

Schanz used head suspension applied to the patient standing with the ankles strapped to the floor. The jacket was applied in strong traction, and as the plaster was setting, the sur-



geon's shoulder was pressed against the convexity, while his arms encircled the pelvis.

*Advantages and Disadvantages of Suspension Positions.* The use of strong traction in the length of the spine tends to straighten the lateral curves and to diminish the rotation, but without added lateral pressure sufficient correction is not obtained. Moreover, traction in the length of the spine makes it resistant to side displacement from lateral pressure, as a stretched spine is less easily displaced to the side than a slack spine. Wullstein found that he must diminish the traction on the head to get the best results from side pressure.

But the upright position is the one in which the patient will wear the jacket; the technic of application is in this position the simplest, access to the shoulders and neck is easy, and the lower part of the jacket can be accurately fitted to the pelvis. Under these conditions a close-fitting and presentable jacket can be most easily applied by this method.

*Application Lying on the Face.* The prone lying position had been advocated for the use of intermittent stretching in scoliosis prior to the introduction of forcible correction by several authors,<sup>18</sup> and was adopted by me when I first began the method. It has been used somewhat by others, and offers certain advantages.

In this method the patient lies on straps or a hammock running from end to end of a gas-pipe frame. The thighs are either flexed or extended. From the sides of the frame, cloth bands or metal pads on rods exert side pressure as desired, and rotation is controlled by the oblique pull of bands or by other metal pads.

*Advantages and Disadvantages of the Prone Position.* The spine in this position is slack



and easily displaced to the side and twisted, and the back is in view of the surgeon during the application, enabling him to see just what correction is being accomplished. But jackets applied by this method are clumsy, as it is difficult to fit the pelvis accurately, especially if the thighs are flexed, access to the chest and shoulders is not easy, and the front of the jacket is concealed from the surgeon's view.

*Application Lying on the Side.* A method has been devised by Rich<sup>19</sup> in which the patient lies on the side and is suspended by a sling passing around the convexity of the lateral curve, other slings hold the head and pelvis, and rotation is controlled by an oblique pull. The jacket is applied as a figure eight bandage, with the upper turn embracing the root of the neck, the lower turn the pelvis, and the crossing coming over the convexity of the spinal curve.

*Advantages and Disadvantages of the Side Lying Position.* The chief advantages of this position consist in the fact that the patient is suspended, and thus all parts are easily accessible. The figure of eight bandage fulfils admirably the mechanical requirements, and the body weight is utilized to straighten the spinal curves. The method is not applicable, except to children.

*Application of Jackets Lying on the Back.* Forcible jackets were applied by Z. B. Adams and R. T. Taylor with the patient lying on the back, but the method was not extensively adopted, although the access to the patient was easy and the results were good. It did not differ essentially from the prone lying position. In Taylor's method the spine was hyperextended, and in Adams's the patient lay flat.

Much interest has been manifested in a



method described by Abbott,<sup>20</sup> in 1911, in which the patient lies on the back with the spine flexed during the application of the jacket. In reading the original presentation of the method one must make allowances for the natural enthusiasm of the originator, but the method apparently possesses distinct advantages which must be discussed.

The patient lies on the back with the spine decidedly flexed, the back being supported by a slack hammock running from end to end of a gas pipe frame. This hammock is longer on one edge than on the other, the tighter side coming under the backward rotation of the chest. Corrective side pressure is secured by cloth bands running in from the side of the frame to pelvis, axilla, and apex of curve. Backward pressure on the side of the thorax rotated forward is secured by means of a broad band running from the side of the frame, over the front of the thorax and then directly down from the forward rotated side of the thorax. The legs are slung in a position of flexion on the trunk with knees extended. The low shoulder is raised toward the top of the frame by a band, and similarly the forward shoulder is pulled down toward the floor. The pelvis is also rotated as desired by similar bands. A large conical felt pad is placed over the concave side behind and immediately removed when the jacket has hardened, to leave a window which reaches from the middle line behind to the axillary line in front, and from near the top of the jacket to the waist line. The jacket is left high under the low shoulder so that the arm cannot be brought to the side, and is carried up well in front of the forward shoulder.

Forbes has advocated the application of jack-



ets with the patient lying on the back with the spine flexed and with a physiological scoliosis on the side reverse to the curve, induced by rotating the thorax toward the side of the deformity by means of the arms. In this corrected position a plaster jacket is applied and the plaster fenestrated. The method is apparently effective but still *sub judice*.<sup>21</sup>

*Advantages and Disadvantages of the Flexed Position Lying on the Back.* Lying in the position just described the spine feels to the hands more plastic and flexible than in the other positions, especially with regard to the correction of the rotation. By flexion, the articular processes are unlocked from each other,<sup>22</sup> a condition which must make the spine more plastic, and it is known that in the forward bent position a scoliotic spine becomes somewhat straighter.<sup>23</sup> The latter fact is probably because the vertebral surfaces most deformed are those which are habitually in contact in the upright position, and in flexion new and less deformed surfaces come into contact. In a similar way bony knock-knee disappears with flexion of the knee, being strictly a deformity of the joint surfaces in contact in extension, and not of those in contact in flexion.

Jackets as applied by this method, however, are unsightly and uncomfortable, the patient is obliged to walk with the trunk flexed, the arm cannot be brought to the side, and to allow the cutting of the large window the jacket must be made very heavy. The essentials of the method seem to consist in strong side correction made to the flexed spine, with the attempt made to rotate the forward side of the thorax back, using the prominent side behind as a fixed point.

*Summary of Conclusions as to Methods.* That



the suspension position can produce remarkable results has been shown by Wullstein and Schanz, that the prone lying position can bring about satisfactory results has been shown by Sever and myself, and that the flexed back lying position is attended by apparently effective correction has been shown by Abbott. It is probable that the particular technic employed is of less importance, as to the final result, than the skill and experience of the surgeon, the amount of force used, and the efficiency of the after-treatment. But after a trial of all methods it seems to the writer as if the method of Abbott offered on the whole distinct anatomical advantages and the greatest ease of correction, but the method must be regarded as being to a certain extent still *sub judice*.

*The Use of Windows in Jackets.* For some years it has been the custom with many surgeons to cut away the jacket over the collapsed side of the thorax behind and sometimes diagonally opposite in front, in order to allow the collapsed parts to expand through these windows. This allows the expansion of the collapsed parts through the force of respiratory effort, and affords a space into which they may be crowded by pads inserted diagonally opposite.

*The Use of Pads in Jackets.* An effective supplementary procedure in the use of corrective jackets consists in the insertion of pads, preferably of felt, of increasing thickness between the jacket and the convexities. The use of these implies, of course, that windows must exist opposite where the pads are to be inserted. Such pads have been generally inserted to push forward diagonally against the rotation in the back, but this is in effect to push against the end of a



closed oval ring, and although effective, is apparently less corrective, as shown by Abbott, than to push back against the front rotation, using the rotated part in the back as a fixed point on which to turn the thorax back into the larger window left over the concave side behind. Pads of increasing thickness are to be inserted every few days, and when there is no room for further pads a new jacket must be applied.

*Mechanical Objections to All Corrective Jackets.* In applying force to correct the lateral curve and rotation of the scoliotic spine we cannot apply such force directly to the spine, but we must apply the corrective pressure to the ribs. The ribs are loosely attached to the spine, and are, moreover, rather easily distorted themselves by pressure. We, therefore, must do without that direct application of force to the affected structure which we possess in the treatment of most deformities.

Secondly, to exert effective side pressure one must be able to press laterally not only against the apex of the lateral curve, but to exert counter pressure in the other direction at the top and bottom of the curve,<sup>24</sup> and this we cannot do by pressure against the thorax in high dorsal curves because we cannot reach as high as the top of the curve. To attempt to secure a higher level of side counter pressure against the root of the neck is to pull against soft structures overlying a nerve plexus, where strong pressure is not tolerated, nor can side pressure be exerted on the lumbar spine, consequently corrective jackets are not satisfactory in lumbar curves or in curves whose apex is as high as the upper dorsal region. In lower dorsal and dorso-lumbar curves they find their best application.

Thirdly, forcible jackets, by fixation and



pressure, cause atrophy of the muscles of the trunk and spine, and this fact has been much insisted on by the opponents of the method. But when the time has come to begin the after-treatment, such atrophy is quickly recovered from by the use of gymnastics and massage, and by the gradual rather than the sudden discontinuance of the support when the proper time comes.

That such jackets will prove detrimental to the general health is a fear which is not supported by facts, for the improved posture and the restoration of the viscera to a more normal position are more than enough to counterbalance the discomfort and the handicap of the jacket, in the great majority of cases. A gain in flesh and improvement in the general condition may, as a rule, be predicted from the application of a proper jacket.

Finally, the danger to life from the application of jackets may practically be disregarded. Alarming symptoms have arisen and in a few instances deaths have occurred as a result, but in these cases the use of force has been too great. With the use of judgment and moderate force no real danger can be incurred.

*After-Treatment.* The application of the forcible jacket is but the beginning of a long treatment; this first jacket is reinforced by pads until no more can be inserted, when a second jacket is applied and padded in the same way, and perhaps a third jacket may be advisable if it seems that further correction is to be obtained. After the removal of the second or third jacket, which will be at least two or three months after the application of the first, some retentive jacket or brace will be necessary to hold what has been gained, and this must be removable in order to



allow it to be taken off so that the patient may do exercises daily. Such exercises must be mechanically sound, vigorous, and given in sufficient dosage to develop the muscles which have been atrophied by the prolonged fixation, and in order to develop a set of muscles strong enough to maintain a correct position in standing. Such exercises must be continued for a long period, and the jacket gradually discontinued. If jacket and exercises are stopped too early a relapse will occur.

The period of active treatment will occupy from one to two years, and in cases due to infantile paralysis much longer.

*Permanence of Results.* As to the permanence of results, it can only be said that it is an accepted fact that bone in its growth follows the line of least resistance, and that growing bone can be reshaped, as evidenced in the treatment of club-foot, that the writer has shown by the x-ray that the bony curve may be materially straightened by jackets,<sup>25</sup> and finally that Schanz<sup>26</sup> has produced evidence that clinically so far as watched the results were permanent in the cases presented.

Such is a summary, from my point of view, of the present status of the treatment of scoliosis. Water can rise no higher than its source, and a summary cannot be more definite than the subject summarized. We have added to our resources in the last ten years the forcible jacket, and in so far we have gone forward. Let us hope that in the next ten we may find a better agreement among orthopædic surgeons as to the relative values of different treatments, and be able to record as great progress as we can already look back on in the matter of the treatment of congenital dislocation of the hip and infantile paralysis.



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