An essay on the general principles of the treatment of spinal curvatures / by Heather Bigg.

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THE TREATMENT OF SPINAL CURVATURES

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AN ESSAY

ON THE

GENERAL PRINCIPLES OF THE TREATMENT

OF

SPINAL CURVATURES

BY

HEATHER BIGG, F.R.C.S.Ed.

ILLUSTRATED BY THE AUTHOR'S PHOTOGRAPHS AND SKETCHES

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THE TREATMENT OF SPINAL CURVATURES

SECTION I

Primary Principles and Definitions

This volume constitutes another instalment towards the completion of the comprehensive work I have undertaken on 'The Deformities, Debilities, and Deficiencies of the Spine.' Some previous parts, like that on "Caries," already published, deal with singular and particular affections of the spine only. But here I purpose to treat of generalisations, and to pass in review those broad principles that must underlie the successful treatment of all lapses of the spinal column. For as broad and general principles govern the accidence of the spine into deformity, so do broad and general principles dictate its treatment towards recovery. It is these general principles that I now propose to consider.

Preliminary programme.—And in so doing I shall first of all recount those simpler mechanical prin-

ciples that have always been admitted as applicable to perversions of every part of the body, including the spine itself, and I shall lay down certain definitions. I shall then trace the history of the treatment of spinal curvatures from the earliest times to the present day, not for the mere sake of historic anecdote, but solely to display the origin of mechanical principles, and to follow their evolution onwards to modern perfection. I shall briefly touch on the centuries that have elapsed from the time of Hippocrates until the date at which Andry wrote his 'Orthœpedia.' I shall consider with gradually increasing detail the diagnostic discriminations that led Percivall Pott to separate carious from ordinary curvatures. Then, leaving caries altogether on one side as a disease about the treatment of which there is little modern dispute, I shall pursue the evolution of the treatment of lateral curvatures by mechanical appliances. I shall describe Le Vacher's original instrument, together with the advances made upon it by my predecessor Sheldrake. And having thus reached the beginning of the last century, and a point that has since been covered by my predecessors' case-books, I shall describe the improvements made by my grandfather in association with Sir Astley Cooper, and the still further improvements made by my father in association with Sir James Paget. At a date which I have fixed as **1870**, because that was the time of the commencement of my own work, I shall, after recounting certain adjunctive treatments which at that period held some reasonable grounds for usage, describe in full my own personal methods of treatment. I shall give also my own personal experiences of certain other new and alternative treatments that have been vainly and

unsuccessfully tried during the last thirty-five years. And I shall conclude by a careful comparison between the established mechanical method and those modern systems of treatment which have obtained at various recent periods an ephemeral vogue. Such, then, is the fairly full programme to which this volume will be devoted.

Preliminary principles and definitions.—All errors of the spine, whatever their origin, whether from disease or disorder, are mechanical in results; and all treatment of such errors must also be mechanical in method and in intent. These facts have invariably been indicated by theory and proven by practice. If I reassert them as truisms at the outset, it is because I intend also in the following pages to substantiate them by indisputable evidence. And if by chance they do not seem at first sight clear, it is perhaps because what is quite intelligible about a single bone or single limb may not seem so evident when a number of bones are jointed together as they are in the spinal column, and when their deviation or derangement involves also changes in position of such other appended parts as the head, the ribs, or the pelvis. Therefore, as it is easier to lead from simple premises to fuller deductions, I will begin by illustrating the principles of mechanical treatment and the uses of mechanical appliances in the simpler instance of a single bone.

Definition of the term "appliance."—Supposing, for example, the fibula to be fractured at such a spot that there is no material displacement of the two portions of the bone. The appropriate treatment will, of course, be to keep the parts so completely at rest, and so freed

from all strain and motion, that healing and consolidation may take place. Now, this may be done in two quite distinct ways. Either the patient can be placed recumbent on a firm mattress and the parts can be packed into complete quiescence by some such means as sand-bags; or, on the other hand, a splint of any modelling material, such as of gutta-percha or of plaster bandages, may be moulded to the limb so as to retain the embraced parts in undisturbed rest. But between these two methods there is a vast distinction. In the first instance, the mattress and the sandbags are in no way attached to the body, but are simply imposed around it as safeguards against movement; if the body stirs the packing does not stir with it. On the other hand, in the case of the splint that is made of some material moulded to the limb, such a splint is directly attached to the body itself; if the body stirs it stirs with it, and, being directly applied to the body, it follows the body in its movements. From this distinction arises the definition with which I wish to commence, and it is this, that anything attached to the body for surgical purposes, no matter of what material it is composed—whether of wood, as in an ordinary fracture splint, or of steel, as in an ordinary truss, or of plaster of Paris as in an ordinary hospital splint—constitutes what may be distinguished as an **appliance.** And, in contradistinction, anything that is used to influence the body mechanically, but is not actually attached to it—such as, for example, a spinal couch or a Sayre's tripod—may be discriminated by the term **apparatus.** But an appliance, to use the French equivalent, is practically an article of apparel, that is to say, it is attached to and is worn on the body.

Definition of a passive appliance.—Reverting again to the example I have selected of a broken fibula in which there is no displacement of the parts, it is obvious that any such appliance, as a plaster or gutta-percha splint, that is moulded to the limb with the sole intention of keeping all the parts in quiescence, is a purely passive one. It does not aim at any change of shape in the part to which it is applied, nor at the exercise of any directing force. It is simply intended to keep everything at absolute rest. A **passive appliance** may therefore be defined as anything attached to the body for the purpose of keeping the part to which it is attached in perfect quiescence.

Definition of an active appliance.—But if—and I will still take the example of a broken fibula—the fracture is such that there is material displacement of the parts of the bone, then it is obvious that not only will quiescence be needed for the healing process, but also that some force or power, no matter how gentle, will be required to be exercised for the purpose of keeping the replaced parts of the bone in their proper juxta-position. Now, it is immaterial whether the force exercised be small or great—whether by the mere adjustment of a pad or by the exercise of strong traction—the appliance that is intended to exercise force of any description is no longer passive in intent, but, on the contrary, can be best designated as an **active appliance.** Such an appliance is intended to induce some change of shape from the abnormal to the normal, or, in other words, to overcome such perversion from the natural shape as is commonly known as a deformity.

The obvious difference, therefore, between an active

and a passive appliance is this, that whereas a passive appliance is intended to take a complete and diffused hold of all the parts concerned and to keep them quiescent and unmoved, an active appliance is intended to do precisely the reverse, and to alter the shapes and relationships of the parts it embraces. It is clear, therefore, that in the remedy of deformities the appliance that has to be used must be of the active kind.

But before considering the appliances that are of service in the treatment of the spine, it will be best for simplicity's sake to still give examples of appliances as used for single bones or single joints.

With respect to passive appliances there is little to be said, because their construction is so simple and their uses are so evident. The example I have given of a plaster bandage splint adapted to a fracture of the fibula in which there is no tendency to displacement, is a familiar one. Again, the gutta-percha gauntlet moulded to a sprained wrist is an equally familiar instance of a passive appliance adapted to a joint.

But active appliances require a little more consideration, because there are principles involved that are not, on the face of things, so simply apparent. Every active appliance must be divisible into three distinct parts. In the first place there must be obtained the primary hold from which the force of the appliance may act. In the next place there must be obtained a counter-hold, through which the force may act. And lastly there must be between the two—that is, between the hold and counter-hold—the actual force that compels the desired change of shape. When one bandages an ordinary wooden tibial splint on to a curved tibia

for the purposes of straightening, the procedure seems so much a matter of common sense that the mind does not stop to analyse the mechanical principles involved, any more than an ordinary workman, in lifting a heavy weight with a crowbar, pauses to think whether he is using a lever of the first, or of the second, or of the third order. Still, notwithstanding this, the mechanical principles are there. Only in simple matters they are disregarded, and are very often, as in the case of the workman, unknown. But such disregard, which is immaterial in the use of a crowbar, would be impossible in the complicated construction of a steam-engine. And, similarly, whilst no theoretical explanations of principle seem required in the use of a common tibial splint, they are nevertheless very necessary in explaining the construction of the more complicated appliances that are of service in curing cases of lateral curvature. And yet in both the simple and the complicated appliances the same precise principles are involved. But as it is my purpose to start from what is quite obviously simple in order to make clear what is less so, I will, before going to the subject of the spine, analyse the mechanical principles that underlie the use of so ordinary an appliance as a tibial splint.

This, probably the simplest instance of an active appliance, consists of a plain straight piece of wood and a roller bandage. It is true that some kind of padding is invariably placed between the splint and the limb to which it is applied, in order to safeguard the skin from injury ; but this padding is of no more theoretical consequence than whether the piece of wood itself is painted or polished or covered with leather. The piece of wood, which is of sufficient length, is placed against the inside of the knee and the inner ankle—that is

to say, against the two extremities of the concavity of the tibia. The bandage is rolled tightly round both wood and leg over the convexity of the tibia. The three factors essential to all active appliances are, if the adjoining figure (Fig. 1) be viewed, quite evident. The "primary hold" is taken by the splint against the two extremities of the tibia, the "counter-hold" is taken by the bandage over the curved promin-

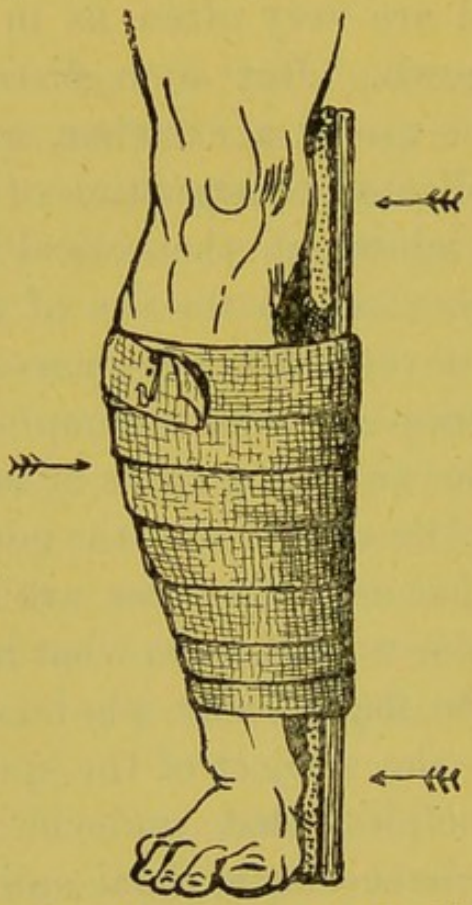

FIG. 1.—Diagram of a tibial splint.

ence of the tibia, and the "active force" between hold and counter-hold is exercised by the pull of the bandage over the prominence of the bone, as well as by (in a well-made splint) a bow-like spring in the wood itself. It will be seen then that all the theoretical essentials of an active appliance are satisfied even in so simple a thing as the ordinary tibial splint.

Having made the necessary definitions, and having explained the principles that underlie the use of both

passive and active appliances, and having also given illustrations of these principles in quite simple cases, I may now proceed to consider these two distinct types of appliances as adaptable to perversions of the spinal column.

Passive appliances of use for the spine.—The best known passive appliance that is adapted to the spine is the splint worn for either the very rare instances of fracture or the very common instances of caries. In both of these instances the aim of the splint is the same, the parts having to be kept in absolute support and quiescence until healing has taken place, whether this be by the natural process, as in fracture, or by the elimination and reconstruction of diseased bone, as in caries. A similar splint with a similar intent, the recuperation of the injured parts, is also worn in ricks and sprains of the spine.

There is little that need be said about the principles which govern the use of such a splint. Its object is self-evident. It has to take as diffused and complete a hold as is possible on all the parts whose least movement would disturb the injured spot, and not the slightest active force has to be employed. On the contrary, positive rest is the end whose attainment is sought.

The use of such a splint in cases of caries is no longer a matter of controversy, as almost all surgeons are practically at one upon this issue. It is true that there were some, like the late William Adams, who preferred unsplinted recumbency during the early stages of caries, but, as I shall afterwards show, without proper reason. For, as I have already explained, although a mattress and packing may be practically considered

to constitute a splint so long as the body could remain absolutely motionless, yet, being unattached to the body, they fail to follow the body if it is in the least degree restless, and they, therefore, cease to be efficient. When, therefore, absolute quiescence of the trunk and spine is required, this has always been best attainable by a passive splint.

The material of which such a splint has been made has varied a good deal during the past century. Steel was recommended both by Sir James Earle and Sir Benjamin Brodie during the earlier part of the last century, and the latter surgeon sent his cases to my grandfather for the purpose. My father, before the middle of the century, had introduced leather as the material, and a little later gutta-percha for the same purpose: both these materials were adopted by Sir James Paget. Sayre, as is well known, preferred plaster-of-Paris bandages. And at various times stiffened felt, starch bandages, and other materials have been tried for the purpose. But of whatever material such a splint may be constructed, it is to be remembered that it is simply a passive appliance, intended to maintain and not to in any way alter shape. My own methods of construction, together with the forms best suited to injuries of the various parts of the spine, have been duly described in the chapter of this work on Caries.*

Active appliances of use for the spine.—When one comes to consider the active appliances that are of service in deviations of the spine, their intent is quite

* This has already been published as an advance chapter, under the title 'Caries of the Spine,' by Heather Bigg (Messrs. J. & A. Churchill, London, 1902).

different. Quiescence is no longer sought for. On the contrary, their object is to attain such beneficial alterations of shape as may remedy the deformities to which the spine and its appended parts are liable. Now, as I have said, every active appliance must have the three distinct parts that I have already indicated in even so simple an appliance as a tibial splint. These essentials of activity must be (1) the basehold or fixed point from which any employed force can act; (2) the counter-hold through which such force can be exercised; and (3) the force itself, of whatever character it may be. And it must further be stated that two great primary principles govern the mechanical treatment of all the spinal curvatures that it is desirable to submit to active straightening. The first is that the weight of the upper part of the body should be removed as far as necessary from the spine, or (as it may be otherwise put) that the burden of the spine may be up-buoyed and taken from it; and the second is that those parts of the body which are attached to the spine, and which err with the curvature from their correct position, should be gradually pressed back into their place.

These things being so, the plans both of the construction and of the action in an appliance intended to actively correct lateral (or other) curvatures can be forecast.

The *basehold* has first to be obtained, and this is taken by means of a metal band round the pelvis, which is kept in stable position by bands or belts closely fitting in their investment to the swell of the hips.

The *counter-holds* will, from what has been said, have two distinct purposes. The ones that are intended to buoy the weight of the trunk will be taken by some

form of crutch-pieces under the arms at the armpits, so that when these are elevated the trunk can be slung by the arms and its weight be thus removed from the spine. The counter-holds that are dedicated to restoring the displaced trunk into position will be taken by plates or slings of some material that can be actively brought to bear upon the errant parts of the body, such as the ribs or the hips.

The *active forces* that are brought to bear between the hold and the counter-holds may be of various kinds, such as those exercised by screws, racks, springs, or elastic bands. But of whatever their nature, their intention is quite clear. The uplifting or buoying forces will be directed towards taking the weight of the trunk from the spine, and the replacing forces will be directed towards restoring the errant trunk and spine into proper position.

Such, then, are the general ideas that govern the scheme and action of the modern appliances that are actively serviceable for the remedy of spinal curvatures. I do not propose at this point to give any descriptive details, for the simple reason that it is my intention to begin at the very commencement and to trace the evolution of the perfected modern appliances from the cruder ones of centuries ago, illustrating them as I go along. If one may use a simile, the modern appliance is very much in the position of a modern nobleman in the peerage. For the ordinary purposes of every day it may be enough to look out the precise name and titles that pertain to him, but in order to inquire how he has arrived at his dignities it is necessary to trace back his ancestry and to find out what part each one has borne in adding to the accumulation of family honours. So it is with the modern "spinal appliance."

It is not a thing of brief growth like the plaster of Paris or the gymnastic system. And although I might immediately describe and illustrate it here in the perfection to which it has after centuries attained, there is so much to be gained and so much to be learnt by tracing the evolution of its principles and the development of its construction from the original sources that I elect, therefore, this latter method. And if any reader has a predilection for avoiding what I believe to be a necessary historical account, all that he has need to do is to skip the next two sections.

SECTION II

Evolution of the Principles of Treatment from 400 B.C. to 1800 A.D.

Classification and methods of Hippocrates, 400 B.C.—Hippocrates, four centuries before the Christian era, was the first to classify spinal curvatures and to describe their methods of treatment. His classification took no cognisance of causes, and for the simple reason that these were then uninvestigated and unknown. He therefore distinguished curvatures by their direction only, dividing them into anterior, posterior, and lateral deviations. Such a classification is, of course, entirely artificial, depending, as it does, not on any indication of origin, but on a mere record of results. Still, from the mechanical point of view, it is not altogether incorrect; for just as the compass must point in one of four directions, so the spine must similarly lapse, and pervert the body in one of four planes. And in like manner mechanical restoration of shape must be effected in one of the same four planes. Hence, although the orthopædic classification of Hippocrates is as artificial as the botanical system of Linnæus, still it is in some respects of such service that it has continued in use even up to the present day.

And, as will be seen, the methods of treatment that were originated by Hippocrates also divulged certain

great principles which still are, and must always be, the foundation of the treatment of curvatures of the spine, although his plans of practising them were by apparatus of extremely crude construction.

The two following illustrations demonstrate the methods advocated by Hippocrates. By one plan

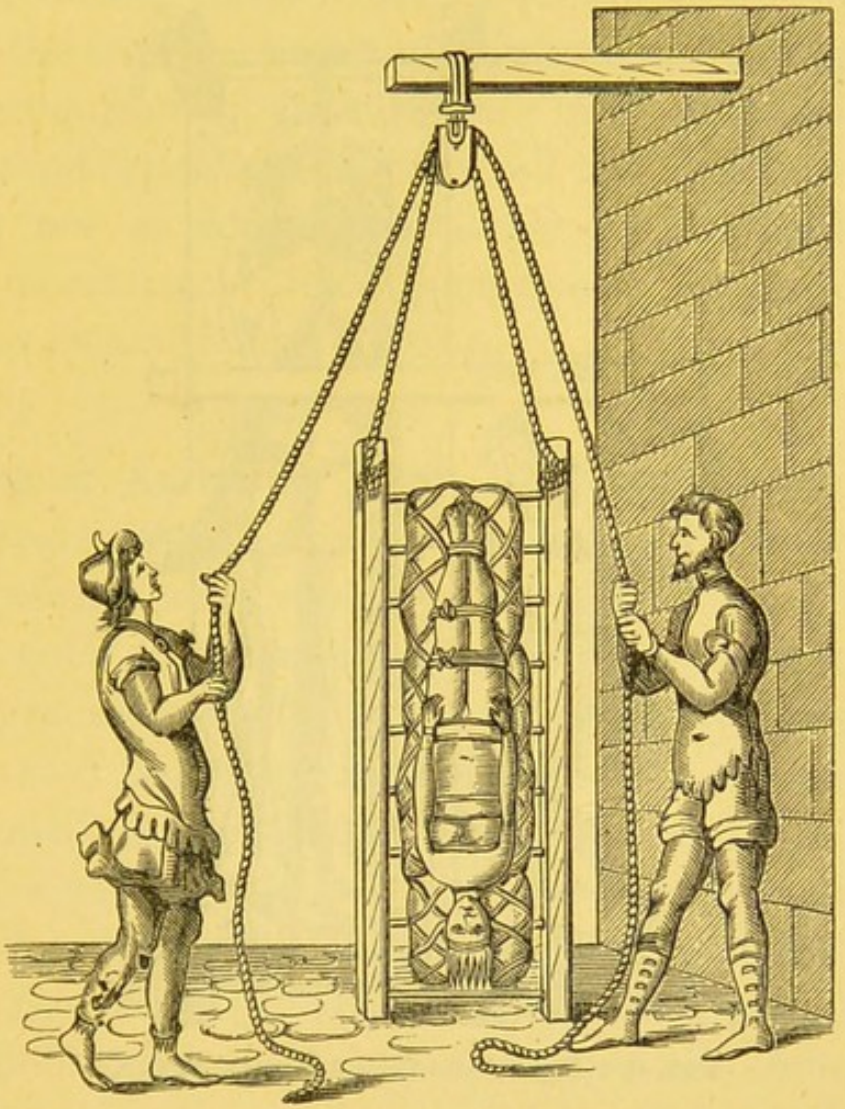

Fig. 2.—Apparatus for the treatment of spinal curvature (after Hippocrates).

(Fig. 2) the patient was suspended by the head or the heels on an ordinary ladder, which was then drawn by pulleys from the ground, and allowed suddenly to drop with a shock to earth, the effects of suspension being thus exaggerated by succussion.

By another plan (Fig. 3) the apparatus was made from an ordinary table. The patient's spine was ex-

tended by traction exercised in one direction by loops under the armpits, and in the opposite direction by a band over the hips. The way is obvious by reference to the illustration. Whilst the spine was so extended, direct force was applied by means of a lever over the prominent and errant parts of the trunk. If the table

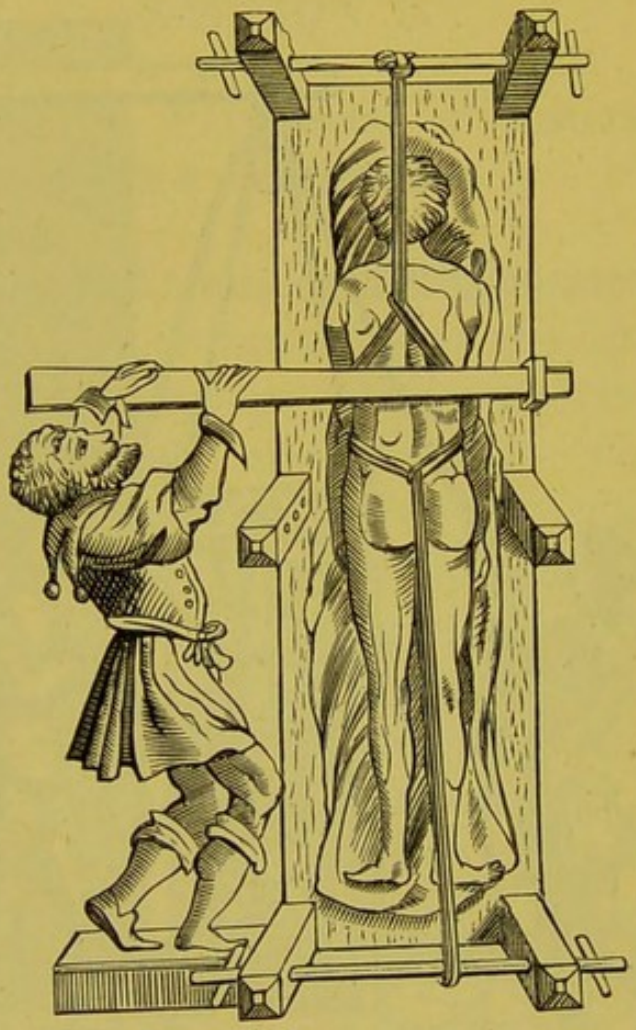

Fig. 3.—Apparatus (after Hippocrates).

was placed vertically, as shown in the cut, then, in addition to traction, suspension also came into play, as the weight of the body was dependent from the arm-slings. But if the table was placed horizontally, then traction solely and simply was exercised.

Now, it is to be noted that several essential principles had already been grasped by Hippocrates as indispensable for the mechanical straightening of the spine.

There is the use of gravity by **suspension,** although the force of gravity was unenunciated till the time of Isaac Newton. There is the use of direct **traction,** that is to say, the separation of the two extremities of the spine in just the same way that a piece of string is straightened by pulling its two ends apart. There is the use of **direct active force** over the errant prominences of the trunk. And finally, there is the exaggeration of suspension by **succussion.** And although this latter method is perhaps obsolete, all the three previous principles are as sound and as serviceable to-day as when Hippocrates wrote of them twenty-two centuries ago on his island home of Cos.

Methods of Ambroise Paré, 1579.—For many hundreds of years the treatment originated and authorised by Hippocrates was implicitly regarded as academic, and, with such slight modifications as occurred to subsequent practitioners, it was substantially followed. The next real landmark in treatment is not therefore reached until the sixteenth century, when Ambroise Paré produced his monumental compendium of all that was best known in the surgical practice of his time. In it he figures (Fig. 4) and describes a method of treating deformity of the spine somewhat similar to that of Hippocrates, whose teachings, indeed, he appears to have closely followed. A table as before constitutes part of the apparatus, and on this the patient was pronely placed whilst *traction* was exercised on the spine by means of iliac and axillary slings. But active direct force, instead of being applied to the body by a lever, was directed to be made by the gentler method of *manipulation*, thus foreshadowing those forcible and

fingered procedures that are sometimes included in the practice of massage.

But it is rather important to note that both Hippocrates and Paré gave these plans for the use of powerful direct force to the spine under the heading of "Dislocations." I am, therefore, strongly of the belief that they regarded the angular curvature caused by caries as a dislocation (as indeed in the broad sense it

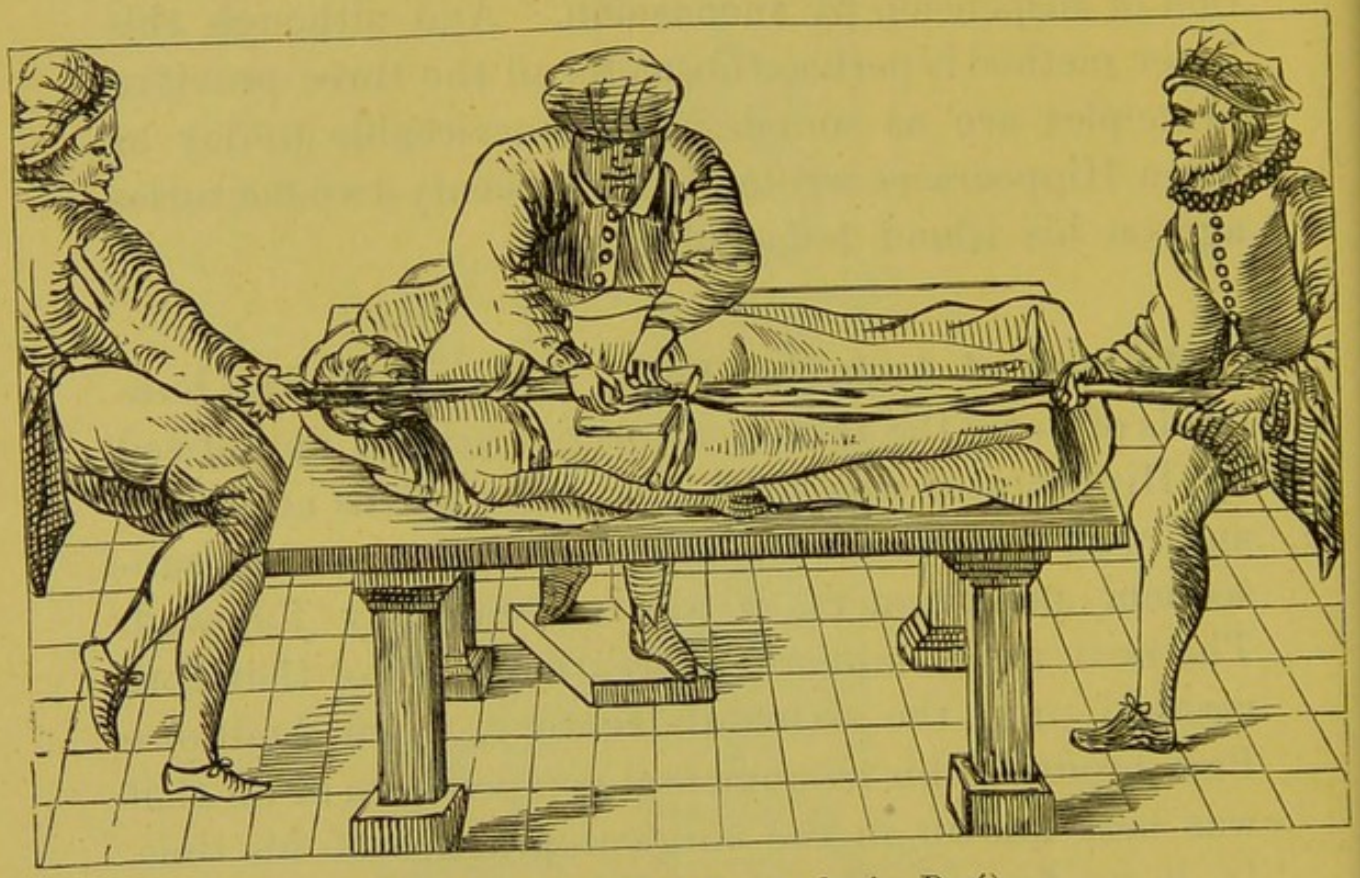

Fig. 4.—Apparatus (after Ambroise Paré).

almost is), and I am further of the opinion that the enormous force that could be exercised either by the lever or by the hands was probably intended to *fracture* the prominent vertebræ back into their places. Indeed, this probability becomes almost a certainty when one reads Paré's instructions for the subsequent application of splints with recumbency, as though what was done on the table was done once and for all, and the case was subsequently treated as one of actual frac-

ture. If this be so, here again one has the premonition of the practice by breakage that has recently had a vogue on the Continent, notwithstanding its barbarism.

And this view seems rather strengthened when one finds in altogether another part of Paré's work a most remarkable chapter on "Amending the Deformity of such as are Crook-Backed." Here, although he does not describe any differences between the various kinds of curvature, but classes them all under the single category of crook-backed, still, he discriminates them by their varying origins. Indeed, he is the first to forecast a

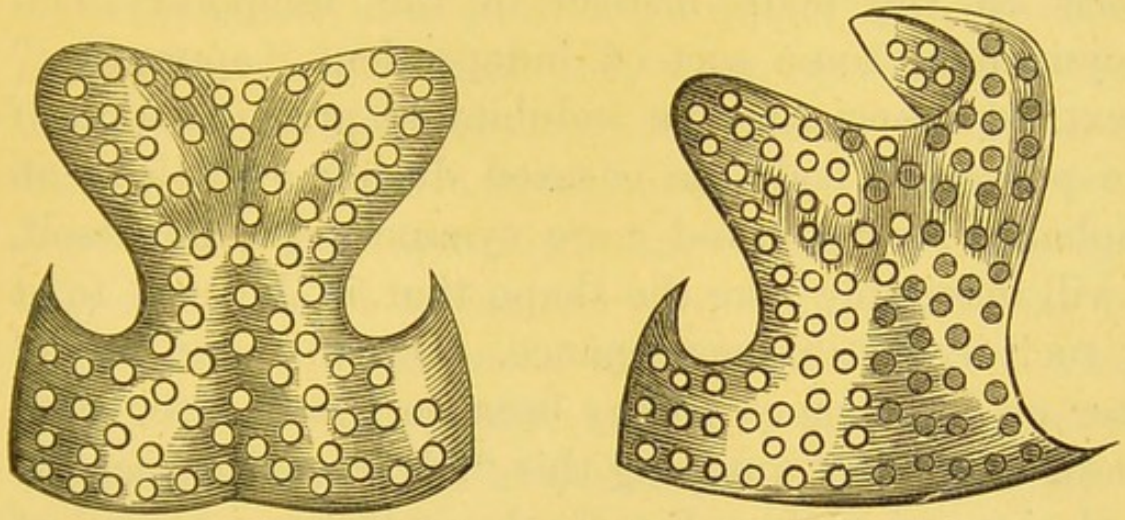

FIG. 5.—Splints (after Ambroise Paré).

classification by causes instead of by results, for he states that some were due to "conformation in the womb" (*i. e.* congenital), some to "misfortune as a fall or bruise" (*i. e.* carious), and some to "becoming crooked in process of time" (*i. e.* acquired, as in the lateral curvature of girls); and, further, he indicates faulty garments and "undecent" postures as probable causes of curvature. "The remedy," he writes, "for this deformity is to have breast-plates of iron, full of holes all over them, whereby they may be lighter to wear, and they must be so lined with bombaste that they may hurt no place of the body. Every three

months new plates must be made for those that are not yet arrived at their full growth, for otherwise by the daily efflux of more matter they would become worse. But these plates will do them small good that are already at their full growth." And he gives the accompanying illustration of these plates (Fig. 5).

Now, in these few pregnant sentences Paré reveals a new set of ideas that were to be added to those of the past, and which are of such soundness that they have endured unaltered to the present day. In the first place he proposed the permanent use of an "appliance" worn on the body instead of the temporary employment of some sort of independent "apparatus." Next he enunciated the indubitable principle that if the perverted body be encased during growth in an appliance stronger and more symmetrical than itself, it will inevitably take the shape that is dictated to it by such irresistible governance. On this point I shall later on have much to say because I have discovered a new method of applying this "advenient" or accommodative principle. Finally, he indicates a period of three months as being the longest interval that should be allowed to elapse between the readjustments of a curative appliance, a dictum that tallies precisely with my own experience. On one point only I have good reason for differing from him, and that is when he practically asserts that a curative appliance is of no value to an adult; this I not only deny but shall be able later on to disprove.

Paré did not, however, claim the method of treatment as his own invention. He simply recorded his experiences of its efficacy. It is most probable that, in those days of expert armourers, and when men had for centuries been accustomed to wear protective vest-

ments of steel, many ingenious mechanicians had devoted their attentions to the task of moulding the deformed body into proper shape by the dictation of skilfully made steel splints **to which the body was compelled by "advenience" to come.** Indeed, for more than the next couple of centuries the treatment of curvatures by appliances remained very much in the hands of the expert mechanicians of the time, whose plans seem simply to have been adopted by surgeons when their success had been proved by incontrovertible experience. Many of these mechanicians obtained European reputations for the cures they affected, and that, too, when newspapers were unknown and advertisement had not been invented. But as they left no written mementoes of their work their names and reputations have often come to light only in the most accidental ways. Recently, for example, the publication of the Verney Papers, which cover the period **1653** to **1657,** makes clear the skilled reputation of a mechanician of the name of Skatt, who resided at Utrecht, and to whom people flocked from all parts of Europe on account of his mechanical skill in the cure of curvature. Yet this man was entirely unknown to surgical science, and is only now unforgotten because of some stray allusions in a set of family records.

The establishment of treatment by appliances.—It is quite clear, however, both from Paré's writings as well as from other sources, that the treatment of spinal curvatures by mechanical appliances had become an established procedure during the sixteenth century, and it is also equally clear that the designing of these appliances was relegated rather into the hands of such

skilful mechanicians as the armourers of the period than attended to by surgical scientists. But as the success of the method became more and more diffused, so professional attention became more and more directed towards it, and during the next century or so men of recognised status began to adopt it as a special branch of practice. Still, even then there was no community either of intent or of principles. Each practitioner adopted what seemed to him after experiment to be the most efficient method, and these methods frequently appeared to run in quite diverse directions. The truth is that the comprehensive treatment of bodily deformities as a special branch of surgery had not been even thought of, nor had a master mind appeared which could grip the vast importance of such a subject or could lay down in some precise work the general outlines of its pursuit.

Andry's 'Orthopædia,' 1741.—At last in **1741** this work appeared. The book, which is rare, has probably been read by comparatively few surgeons of the present day, and yet it gave both birth and name to an entirely new branch of surgery, which has now come to be recognised as so special that nearly every large general hospital has a separate department devoted to its pursuit. The 'Orthopædia' is a medical as well as a literary curosity. The greater bulk of its pages, such as those that concern the beautifying of the complexion, of the hair, the eyebrows, the eyelashes, the gums, and the lips, and which discourse upon the prevention of freckles and pimples, might presumably have been written as an advertisement by a modern Bond Street masseuse. But within this trivial husk was the splendid grain that has since born such

marvellous fruit. In penning his chapters on the "Means of Correcting and Preventing Deformities in Children" Andry was laying down the outlines of a new province in surgery. Not that what he wrote either startled or revolutionised the surgical ideas of his own time. But no really great book ever acts so immediately. Bacon by his 'Novum Organum' subverted the whole philosophy of the past from Aristotle downwards, and yet not by any instant revulsion, but rather by the slow and gradual permeation of his supreme ideas. And so in a lesser degree was it with Andry. He planned and laid the foundations, but left the superstructure to be completed by others. His work had the two special attributes that must always be found with an author who exercises lasting influence. In the first place he originated a new idea, that of aggregating the treatment of the deformities of the body into one single branch of surgery, and it mattered little whether this should be confined to the deformities of children, as he originally intended, or whether it should comprise the deformities of adults, as it has at present grown to do. And, in the next place, he dealt broadly with principles, leaving details almost entirely out of consideration. For example, he devotes a careful chapter to affirming the importance of *stays* in the prevention of spinal deformities, but he gives no description of the stays themselves. Then again he emphasises the service of whalebone supports in the treatment of spinal curvature, but he gives no particulars of the way in which such supports should be constructed, although he probably refers to those invented by Glisson in the previous century. And, again, when dealing with bony curves of the legs he recommends a splint; but instead

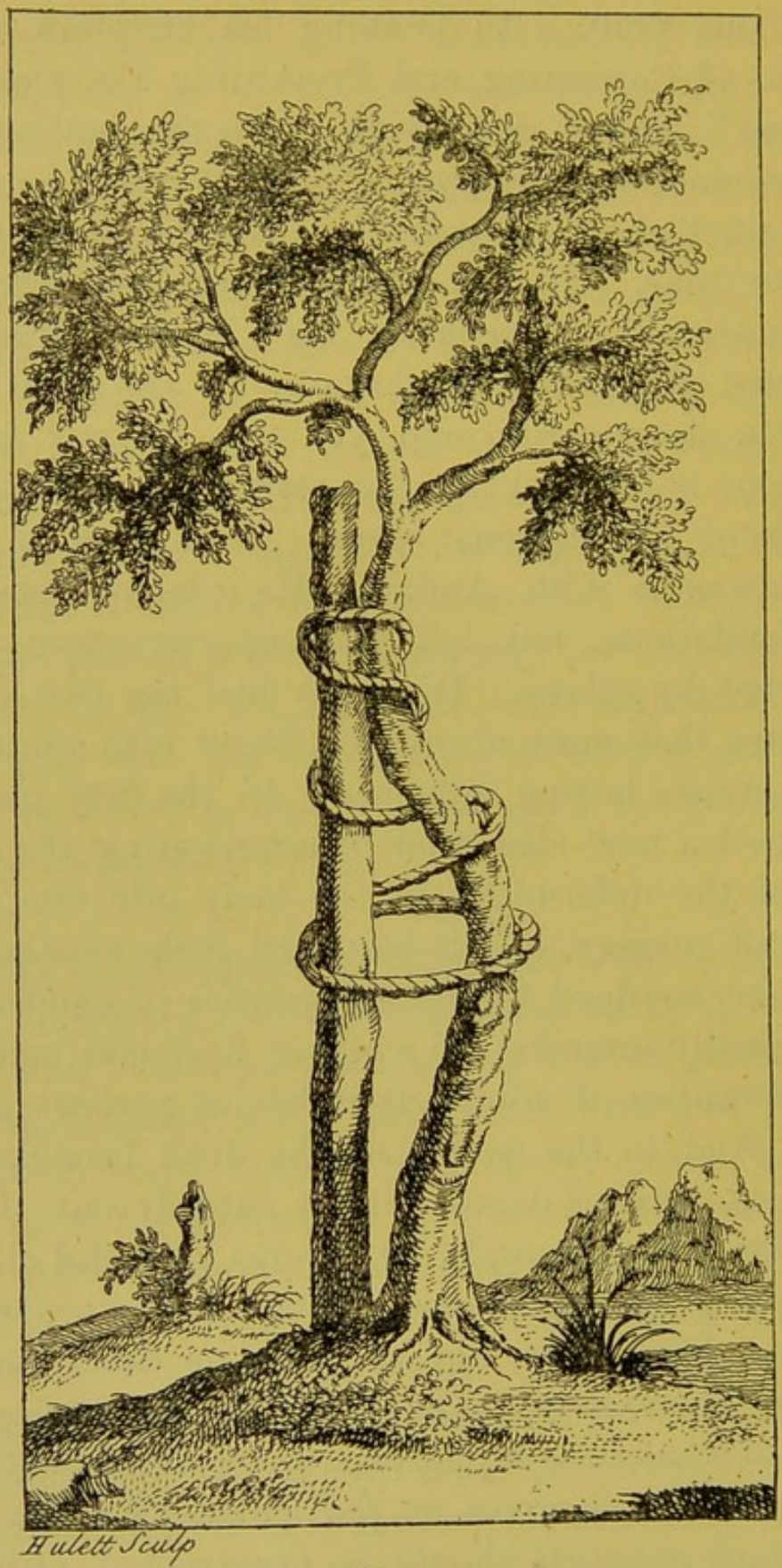

FIG. 6.

Fig. 6—Plate reproduced from Andry's 'Orthopædia,' 1743 (English edition of 1747), where it is inserted to explain that in straightening a deformity "the same method must be used for recovering the shape as is used for making streight the crooked trunk of a young tree."

of giving a drawing or a description of the splint itself, he is contented to illustrate its principle only, that **of bringing a distorted part into straightness by slinging or bandaging it to something stronger and straighter than itself,** and he gives the figure of a crooked tree bound by rope to a straight stake, a figure which is here reproduced (Fig. 6), and to which I shall later on again have occasion to refer. Indeed, although he persistently describes the benefits to be derived from the use of appliances, he only gives one single figure in his whole book of the way in which such an appliance should be constructed. In the origin of all new sciences this method is exactly what is wanted. The master-hand, like that of the old Italian painters, puts in the outlines and the broader effects; disciples can be trusted to fill in the subsequent details. Andry created the orthopædic ideal, but he left this for later generations to perfect.

Percivall Potts' Tract, 1779.—Now, Andry marked an epoch in the history of spinal curvature by a work that was large in bulk and diffusive in comprehension. The next epoch was marked, in precisely the opposite way, by a tiny pamphlet that was particular in its minuteness of detail. Up till nearly the end of the eighteenth century no distinctions between the causes and kinds of spinal curvature had ever been definitely recorded. It is true, as I have shown, that Paré must have been aware of such differences; still, spinal curvature, as a deformity, continued to be viewed, under one generic name and class, as spinal curvature only. It is somewhat startling at the present day to think that a case of caries and a case of common lateral

curvature of girls could ever be confused together as similar. Still, so it was.

But at last the first step towards differentiation came. In **1779** Percivall Pott published a pamphlet, or, as he termed it, a tract, entitled 'Remarks on that Kind of Palsy of the Lower Limbs which is frequently found to Accompany a Curvature of the Spine, and is supposed to be caused by it.' It consisted only of thirty-nine very small pages of very big print—indeed, of scarcely so much copy as would make a respectable article in one of the current medical journals. And yet it was so remarkable, in the accuracy of the new observations it contained, that it has given its author's name to the disease it described.

This pamphlet of Percivall Pott's is separable into several points for consideration. In the first place, he gives an account of his observations of the symptoms of the disease, and of the post-mortem appearances of the affected parts. He points out that the palsy, or paralysis, always affects the legs, and that it is not a true palsy because the affected muscles become rigid rather than flaccid. He next notes that the curvature is always antero-posterior, and that its amount bears no relationship to the amount of palsy produced. He describes most clearly the characteristic pain, attitude, and respiratory embarrassment of a carious patient, and he gives in detail the condition of the vertebræ as revealed by autopsy. All these things he recounts with such absolute accuracy that if nowadays there is a great deal that could be added to his description of spinal caries, there is, at all events, not one sentence that could rightly be excised from his careful records of the conditions of the disease. And, what is more, these were all original and of his own noting, and in

no way "cribbed," as so common nowadays, from the work of others. Hence, indeed, the permanent place that this tiny pamphlet has assumed amongst the classics of medical literature.

But whilst one notes with admiration the fidelity of his description of the disease itself, one is bound also, by the light of modern science, to dissent from his explanations of treatment. It may at once be said that he was misled both in his premises and in his deductions. He states that a Dr. Cameron, of Worcester, informed him of several cases in which the discharge of an issue, or the bursting of an abscess in the back, had caused the paralysis of the lower limbs to entirely disappear. By the light of modern science we know that these cases were evidently ones of "suppurative" caries of the vertebræ, in which an abscess had first of all worked backward so as to cause nip-pressure on the spinal cord, and had then burrowed its way to the surface, where its bursting had relieved the cord from impingement and had thereby allowed the paralysis to clear up; and, further, the same result would have been attained whether the abscess burst in the back, close to the affected vertebræ, or in so remote a part as the groin.

But Percivall Pott was not aware of this relationship between the cause and the effect, and he therefore immediately jumped at the conclusion that any discharge, whether deep or superficial, or whether due to disease or to artifice, provided always that it was by the side of the affected spine, would, by mere counter-irritation, cure the paralysis. After due experiment, he lays down his most recommended procedure to be the following. First of all he made with caustic an issue about the size of a walnut on each side of the

affected part; then (to quote his own words), "when the eschar begins to loosen and separate, I cut out all the middle and put into each a large kidney bean. When the bottoms of the sores are become clean by suppuration, I sprinkle every third or fourth day a small quantity of powdered cantharides on them, by which the sores are prevented from contraction, the discharge increased, and possibly other benefit obtained. These issues I keep open until the cure is complete—that is, until the patient recovers perfectly the use of his legs, or even for some time longer."

As to the results of his particular treatment Percivall Pott is completely frank. He states that many of his patients died, and that he thereby obtained his opportunities for post-mortem elucidation. On the other hand, many made those remarkable recoveries from paralysis that are now well known to occur in cases of caries when the pressure on the cord is released. But there are two things further to be noted. One is that during treatment the patients were kept in bed, and that therefore *recumbency* played a no unimportant part in the treatment. And the other is that in cases of "cheesy" caries, which form a fair average of the usual run of carious cases, there was (until laminectomy had been devised by Victor Horsley) no other plan for diminishing the tumescent growth that pressed on the cord more likely to prove beneficial than strong counter-irritation in its neighbourhood. But Percival Pott was ignorant of the important distinctions between "dry," "cheesy," and "suppurative" caries, and it is evident that, although he drew faulty deductions from cases of suppurative caries, he happened to hit by hazard on a method that was not unserviceable in cases of the cheesy type. Once imbued with the

idea that violent counter-irritation was a most potent remedy, he saw prospects of its success in further directions, for he almost concludes his pamphlet with this sentence, "I will take the liberty of adding that it appears to me worth while to try what a large and free discharge, made for a length of time in the vicinity of the distempered part, might be capable of doing in the very beginning of what are called scrofulous joints, which, when arrived at a certain point, baffle our art, and render a painful and hazardous operation absolutely necessary." But to pursue this speculation further is unnecessary. Violent counter-irritation has faded from ordinary surgical practice as completely as cupping and venesection, but whether this be for good or ill it is difficult to say.

The separation of carious from other curvatures.— If I have dwelt at some length on the pamphlet of Percivall Pott, it is not so much because he left, as a surgical heritage, the first precise account of a specific disease, as because he once and for all separated the curvature caused by that disease from the common category of other spinal curvatures.

In a few brief lines of summation he pointed out that the particular palsy he had studied never arose from ordinary lateral curvatures, whether congenital or acquired, but that it was always associated with an angular curve which was "never to either side." It was, therefore, a distinct disease that was to be dissociated from other curvatures and was to be differently treated.

As a matter of fact spinal caries during its acute progress does not require treatment by any active force at all. It is not, then, to be regarded as a curva-

ture that has to be straightened, but rather as a diseased condition of the bones that calls only for positive passive quiescence of the parts until healing and consolidation have been completed.

When the disease is gone, and when deformity alone (if any) is left, then such deformity requires precisely the same active treatment as do any other curvatures that have to be straightened. But at this stage the case is not to be regarded as one of caries, for the caries is gone; it is to be simply viewed as a curvature left as the result of caries. Whilst, however, the disease is existent, and it is in this "first stage" that it is almost invariably met with for treatment, it is not to be regarded in the light of a spinal curvature at all but in the graver aspect of a serious bony disease. Indeed, the major consideration has to completely swallow up the minor one. Therefore as I am now dealing with the reduction of spinal curvatures, and as spinal caries in its acute stage is not to be included in this category, I propose to eliminate it altogether from further reference here, unless in some way intercurrent to the subject. And I may do so the more readily because I have already published a particular work that is devoted to its description and to its treatment.

Summary of principles evolved by A.D. 1800.—Having thus cleared to one side the consideration of those affections of the spine that require only such passive treatment as is afforded either by a moulded splint or by recumbency, the ground is quite open to follow out the evolution of those active appliances that by successive inventions and improvements have in the present day reached such perfection as to be infallible agents in the reduction of spinal curvatures. But

before passing to the mechanical details of their construction it is first necessary to have a clear idea of the principles on which they are intended to act. Now it is to be noted that in recording the methods of the great classical authorities to whom I have previously referred in this section I have indicated the principles involved (by a distinction in the type of the letter-press). I will now summarise these principles, and it will be seen that they all resolve themselves into two distinct procedures—(1) that of stretching the spine straight, and (2) that of pushing the spine straight.

Now, as to stretching the spine, this principle was pursued by **suspension** of the body, which was slung either by the head, the arm-pits, or the heels (Hippocrates). Or it was pursued by **traction,** the hips being drawn by iliac slings in one direction and by axillary slings in the opposite direction (Hippocrates and Paré).

And as to pushing the spine straight, there was the method of **direct force,** either by a potent lever (Hippocrates) or by the more sensitive method of manipulation (Paré). But I have given reasons for presuming that these two plans were actually employed to fracture the spine back into its place, a method not only too barbaric to meet with acquiescence in the present day, but also only applicable to the angular curvatures left by caries. But there was also originated the continuous method of drawing the body straighter by means of slings or **bindings** drawn into tightness against some sort of frame or splint more rigid than the body itself (Andry). And again, there was the exercise of **spring force,** obtained from stout strips of whalebone imbedded in a textile cuirass, which was fitted to the body (Glisson and Andry). Finally, there is indicated the method by which the growing body was bound by accommodative

"**advenience**" to come to the shape of a metal cuirass, which was modelled into greater straightness than the body itself (Paré), a method the importance of which has scarcely been realised in modern times, and on which I shall have much to say when I reach the section devoted to my own modes of treatment.

These, then, are the definite principles which were evolved by the best thoughts of the greatest men through twenty centuries, and they are ones which nothing can possibly subvert. And these also are the principles that have to be embodied in any ideal active appliance for the cure of curvatures. The spine itself has to be stretched, and if a firm hold is obtained on the hips and an equally firm hold is taken either at the armpits or, if necessary, at the head, and if these two holds are separated by any mechanism, then it is obvious that the principles of both suspension and traction will be brought into play. And again, the trunk has to be restored to its place, a thing that must be attained by some direct force exercised over its errant parts, whether this be by the power of either lever, rack, spring, or sling, or by such general arrangement of the encasing shape of the appliance that the body is compelled, or rather persuaded, to come into the desired position of amelioration. But the appliance that nowadays fulfils all necessary conditions was not immediately arrived at. Like any other piece of mechanism, it had to pass through its "Puffing Billy" stage before it could reach the perfection of a Great Western mailer. And it is to this evolution from first efforts into ultimate excellence that I propose to devote the next section.

SECTION III

The Evolution of the Appliances for Treatment, 1768 to 1870

Preliminary remarks.—The original invention, from which all the modern appliances for the treatment of spinal curvatures have been step by step evolved up to their present-day perfection, is the one that was devised by Le Vacher, in **1768**. Whether he obtained his sources of inspiration from some previous inventor is neither now determinable, nor is it material. Appliances for the persistent daily treatment of spinal curvatures were, as I have shown, in use long before his time. They were in vogue from the middle ages, as witness the metal cuirass of Paré (**1597**), the whalebone splints of Glisson (**1650**) and the steel back-support of Heister (**1739**). And whilst some of these previous inventions have come down in record to posterity, doubtless many others, as in the instance I have quoted of Skatt, have escaped description altogether. But the essential point is this, that whatever was invented before the time of Le Vacher was connected by no continuity of idea. Each clever designer made his own independent experiments and produced something that had no direct relevance to other things, equally clever, that may have been invented elsewhere. But with the invention of Le Vacher this ends. He

produced an appliance of which I shall presently give an account, and he not only published its description, but he had it recorded in the 'Memoirs of the Royal Academy of Surgery of Paris.' And although in those days it took some lengthy time for the ideas of one country to permeate into other lands, still, so great a reputation did Le Vacher's appliance attain, that it was first of all copied and then improved upon elsewhere. The result was that both in Germany and in England these improvements were worked out by independent thinkers, and the two best known were originated in the same year, **1794.** One was by Schmidt, of Marburg, and the other by Timothy Sheldrake, of London.

Now, it so happens that Sheldrake was, over a hundred and twenty years ago, the founder of the practice of which I am the present possessor, and from his time onwards I have a field of reference that is accessible only to myself. The elder Sheldrake was a voluminous writer, and his works on deformities, and especially on those of the spine and club-foot, are of some repute even in the present day. The younger Sheldrake took my grandfather into partnership. The latter was succeeded by my father, whom I in turn have followed. But this genealogical statement would be of little value were it not that it has led to several things.

In the first place, a set of carefully kept case-books, dealing with the treatment of deformities for over a century, has been handed on until it has come into my possession. These at first were little more than records of mechanical designs and constructions, but for the last sixty years or so they have been kept in pages of double columns, one of which has been devoted to mechanical details and the other to the expressed opinions of the

medical men who sent their cases. Such a series is probably unique. And whilst it may be a matter of interest to be able to look back to pages that were penned before Nelson won Trafalgar or Wellington fought Waterloo, it is something of far greater value to be able to refer to the recorded views of the greatest surgeons of the greater part of the last century.

And in the next place, during this period a collection of half-size models was maintained, to which all the new inventions that were introduced for the treatment of spinal or other deformities were regularly added. This collection, originally intended only as a private one, was first shown as a whole in the Great Exhibition of **1852**, and was last exhibited at the meeting of the British Medical Association at Cambridge, in **1880**. It was for several years lent to the Parkes' Museum of Hygiene, but is again in my possession. Like the case-books, it constitutes a complete and lengthy record of over a century of inventions.

Lastly, during the same period a library of orthopædic literature was formed, to which were added, not only all such works as were currently issued, but also, as they could by chance be purchased, any works of the older authors which bore on the same subject.

The materials I have therefore at my command for reference are tolerably complete. I may say at once that I do not propose here to take any wide cognisance of the published works of others. These in the early part of last century were extremely numerous, a thing that was probably accounted for by the fact that Percivall Pott had strongly brought the subject of spinal curvatures before the public and the profession. And yet if one takes the trouble to plod carefully through these works, one finds in many books very little that was

new, but rather that the changes were rung over and over again on some of those past methods of treatment whose principles I have detailed in the last section. There was, as it were, a seesaw of opinions without any particular progress. But it is quite different with the evolution of the appliances themselves by which treatment was effected. These, as I can follow them through the case-books and the collection to which I have referred, show the evolution of advancement in clear and well-defined steps. And it is this evolution that I shall now proceed to trace.

Le Vacher's appliance.—The appliance of Le Vacher was invented in **1768.** It consisted of two distinct parts (Fig. 7). There was a well-fitting corset or cuirass made of textile material and appropriately stiffened, so that it really differed very little from Glisson's whalebone splint of **1650.** But attached to the middle line of the back was the piece of mechanism known to-day as the "jury-mast," and from this the head was suspended by means of a "cap and fillet." Its principle was purely one of extension by traction and suspension conjoined. The cuirass was intended to obtain a grip on the hips, the fillet a hold on the head, and by the mechanism of the jury-mast the head and the hips were separated. There was, as can be seen, no provision for the application of direct force over lateral deviations of the body; and yet for very many years this appliance held in Europe the dominant reputation of being the best for the indiscriminate treatment of all kinds of curvatures.

Fig. 7 is "a side view of Mons. Vacher's machine as described in the 'Memoires de l'Academie Royale de Chirurgie à Paris'" (1768). Fig. 8 is a side view of T. Sheldrake's improved machine (1794). Fig. 9 is a back view of Henry Bigg's still further improvements (*circa* 1827).

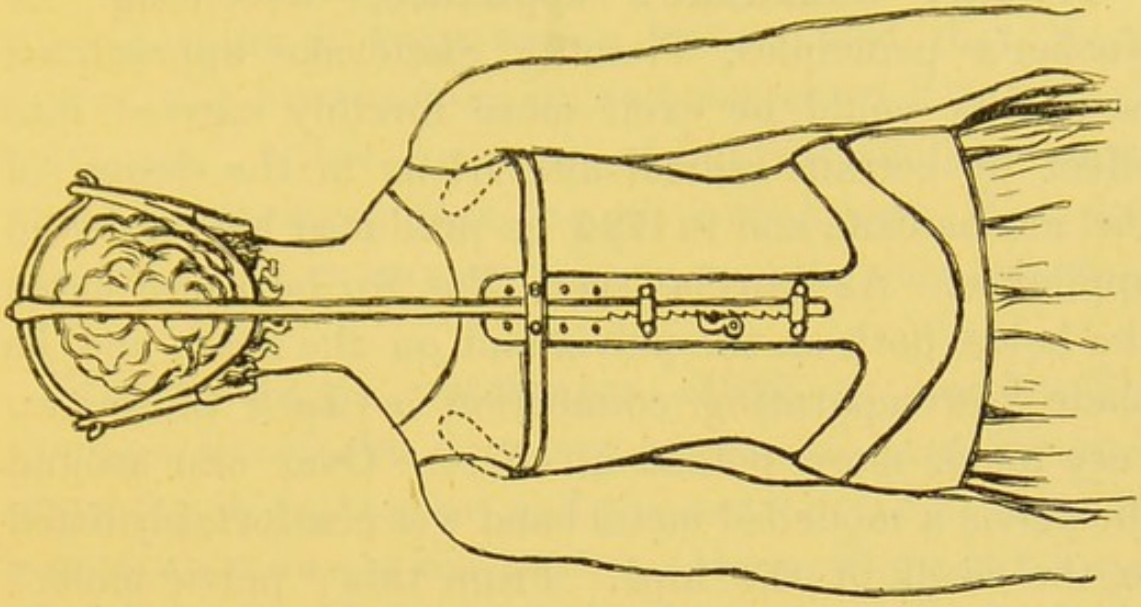

FIG. 9.

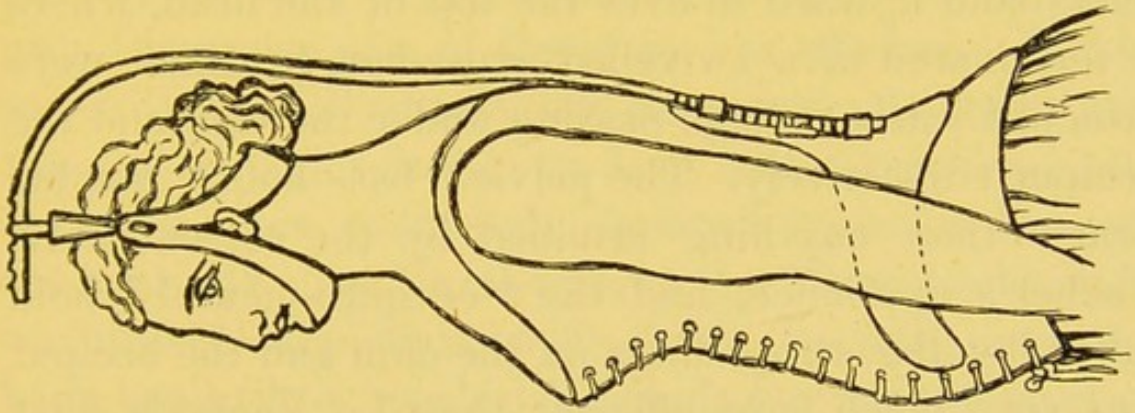

FIG. 8.

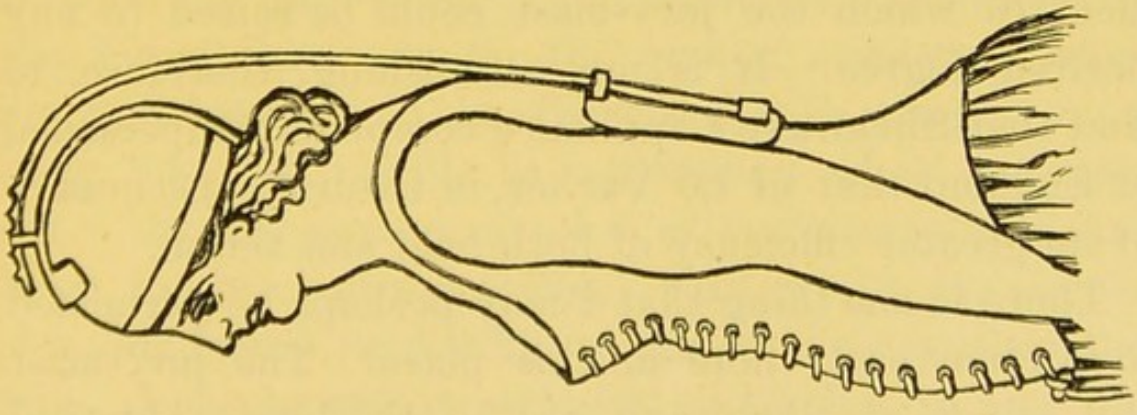

FIG. 7.

Timothy Sheldrake's appliance.—Accepting Le Vacher's principles, Timothy Sheldrake appreciated how they could be even more forcibly carried into effect by certain radical alterations in the design of the mechanism, and in **1794** he produced his improved appliance. As can be seen (Fig. 8), he accentuated the holds both on the pelvis and on the head, and he made the separating connection between those two very much more potent in effect. Over and around the pelvis a modelled metal band was comfortably fitted to the swell of the hips. From this "pelvic band" arose a metal "back-band" which extended upwards along the course of the spine as far as the dorsal region. The jury-mast continued the line of the back-band upward to over the top of the head, where it terminated in a swivelled cross-bar, to which were attached leather slings passing under the chin and the occiput respectively. The pelvic "base-hold" was far firmer than anything attained by the corset in Le Vacher's appliance, and the "occipito-mental" hold taken by the strap-slings on the chin and the occiput was very much more efficient than Le Vacher's fillet and cap. And further, the power of exercising the principle of extension was rendered much more fully available, for there was a "racked" arrangement by which the jury-mast could be raised to any desired degree. It is not astonishing, therefore, to find that Sheldrake's appliance completely superseded in England that of Le Vacher, in natural consequence of its greater efficiency of both hold and action.

There is one thing that I may perhaps be permitted to intercurrently note in this place. The jury-mast and slings of Sheldrake are so absolutely identical with those that Lewis Sayre professed to have invented

as adjuncts to his plaster jackets eighty years later, that I think it may safely be assumed that Sayre filched the previous design and converted it to his own purposes. Other instances of Sayre's similar annexation of previous ideas are so well known that they release me from any scruple in making this assertion.

Henry Bigg's appliances (1827 et seq.).—The younger Sheldrake does not appear to have invented anything in particular, and the next notable improvements were due to his partner, Henry Bigg (who was also my grandfather), and who practically laid the foundation for all the modern mechanical methods of treating spinal curvatures. He saw clearly that extension by the head might be imperative in cases in which only the upper part of the spine was affected. But he saw with equal clearness that, where only the lower portions of the spine had to be dealt with, extension could be much more adequately obtained by holds beneath the arm-pits. Taking, therefore, the general scheme of Sheldrake's appliance as his basis, he prolonged the back band till it reached upwards beyond the level of the axillæ, and he added to it the arm crutches that are shown in the adjoining illustration (Fig. 9). Such an appliance could, of course, be used either with or without the jury-mast. And after fair experiment it was found that in by far the greater number of cases the jury-mast could be dispensed with altogether, a thing that can readily be understood when one considers that the greater number of curvatures originate below the level of the axillæ. Still, whilst the simple idea dominated (and it did so for fifty years) that the spine could be pulled straight by traction in just the same way as a piece of string can be tensed into

straightness by drawing upon its ends, the appliances of Le Vacher, of Sheldrake, and of Henry Bigg seemed in their particular degrees to satisfy these supposed requirements. Gradually, however, the sense arose that something more direct in purpose was needed than mere traction on the head or on the arms. The result was Henry Bigg's next invention of two appliances that I shall presently describe. These were by no means arrived at immediately, but it is unnecessary, as indeed it would be tedious, to trace the transitional stages that led to their perfection.

The distinction between lateral and mesial appliances.—But before describing these two new appliances I must revert for a moment to a point on which I have already previously dwelt. I stated that whilst the classification and diagnosis of the various kinds of curvature could never be rightly made by their directions of lapse, yet that it is none the less a fact that their mechanical replacement can only be viewed in this way. For just as the spine can only deviate from natural truth either forwards or backwards, or to one side or to the other (and, of course, in combinations of these directions), so also its replacement must be either in the antero-posterior or in the lateral directions (and, of course, in their combinations). Or as it may be more simply put, both the lapse and the replacement of the spine and trunk must take place either in the mesial or in the lateral planes. And it may be added that the mechanism required to control the body in these two different planes is distinctly different in detail. Hence was foreshadowed the need for two distinct kinds of appliance, the one to control curvatures in an antero-posterior direction, and the other to control curvatures

that distort the trunk to one side or to the other. And these two appliances, which have much in common with each other as regards general hold, whilst they materially differ as regards particular detail, may for obvious reasons conveniently be considered as being of either the **mesial** or of the **lateral** types.

Henry Bigg's appliances (*continued*).—It was these two distinct appliances that Henry Bigg first invented. Their construction is shown by the illustrations (Figs. 10 and 11), and was as follows. In the first place, however, it may be stated that the hold on the pelvis was obtained in the same way in both appliances, and by a method that was a very distinct improvement on that previously employed. For whereas Sheldrake had taken his hold on the hips by the modelled steel band fixed to a corset, as shown in the previous figures, and whereas also such a hold was fairly adequate to act as a base-hold from which the jury-mast could obtain its power of extension, still, it had no lateral stability and rocked on the hips in almost any direction. Henry Bigg, therefore, designed a pelvic base-hold that was free from these objections, and he utilised it both for his mesial and for his lateral appliances. This base-hold consisted of a band of metal which completely encircled the pelvis at a level of two inches below the iliac crests, and the two ends of this band were fastened in front either by a metal slide or by a buckle and strap. Attached to this primary pelvic band were two steel semicircular bands which reached from the sacrum behind to beyond the iliac spines in front and passed over the iliac crests into the dip of the waist on either side. When carefully fitted this completed base-hold caused no pressure

on any of the bony prominences of the pelvis, for it rested entirely on those parts of the hips that were well covered with muscle. It was, therefore, as comfortable as it was stable. Having described the base-hold that was common to both the new appliances, there only remains to add the superstructure that was distinctive of each.

In the **mesial** appliance (Fig. 10) a steel back-band arose from the base-hold and extended along the course of the spine to beyond the level of the axillæ. To its upper end were attached crutch pieces which slung the trunk at the arm-pits. These crutch pieces were originally made of a single strip of metal, which could be elevated into extension by the screw attachment shown in the figure. Later on the crutch-pieces were made in two separate parts, so that one of them, if necessary, could be placed at a different level from the other.

The **lateral** appliance (Fig. 11) had a back-band similar to the preceding one, but the essential invention was that its crutch-pieces were semicircular in shape and were directly supported by steel rods extending along the sides of the body, with a sliding mechanism by which they could be elongated upwards, so as to produce extension on the spine in all parts of its course below the axillæ. These lateral rods were afterwards known as "lateral uprights." To render the whole frame more rigid a band of metal known as the "cross-band" extended transversely across the body at the level of the axillæ, and was attached by screws to the back band and to the two lateral uprights.

Figs. 10 and 11 represent the two appliances invented by Henry Bigg for antero-posterior and for lateral curvatures respectively (*circa* 1830).

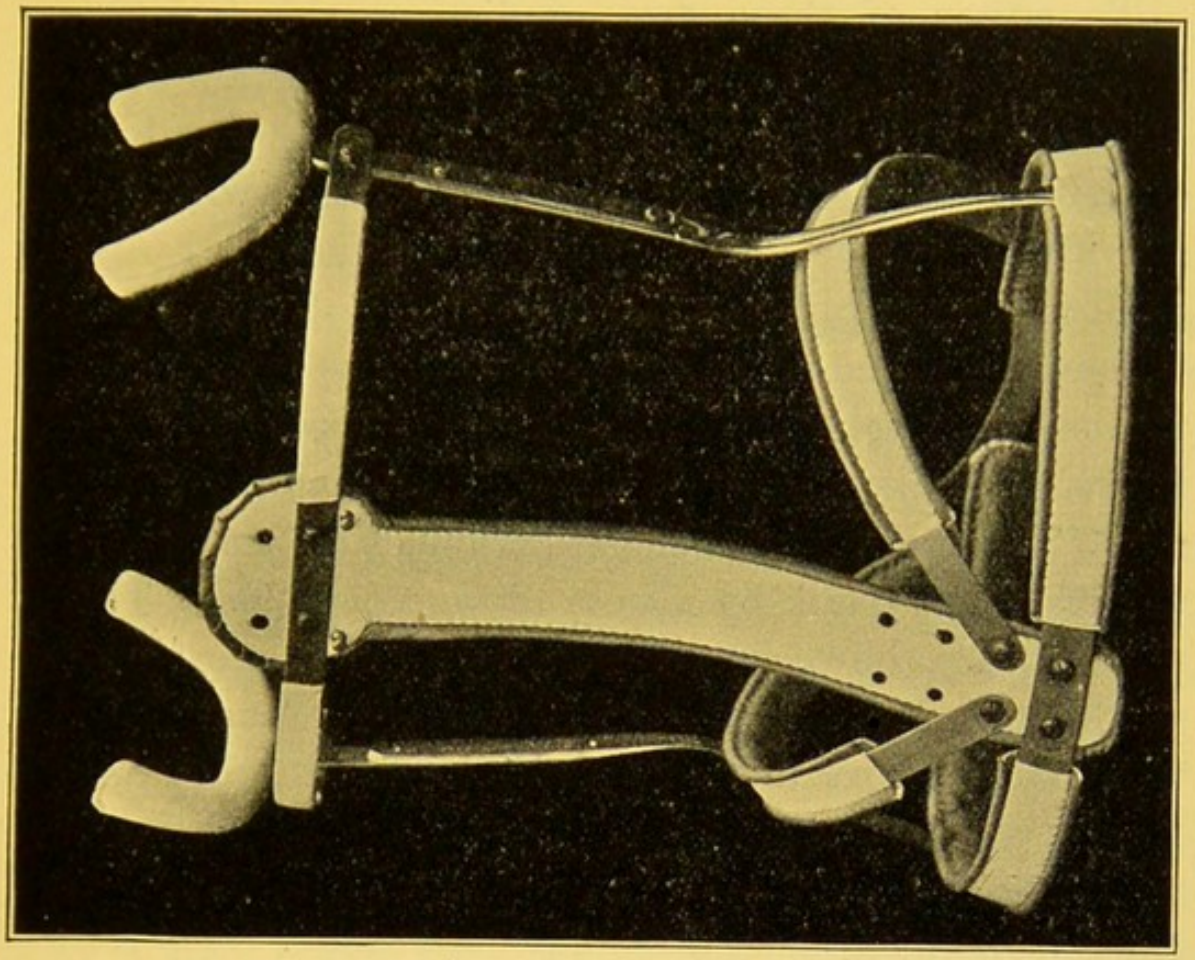

Fig. 11.

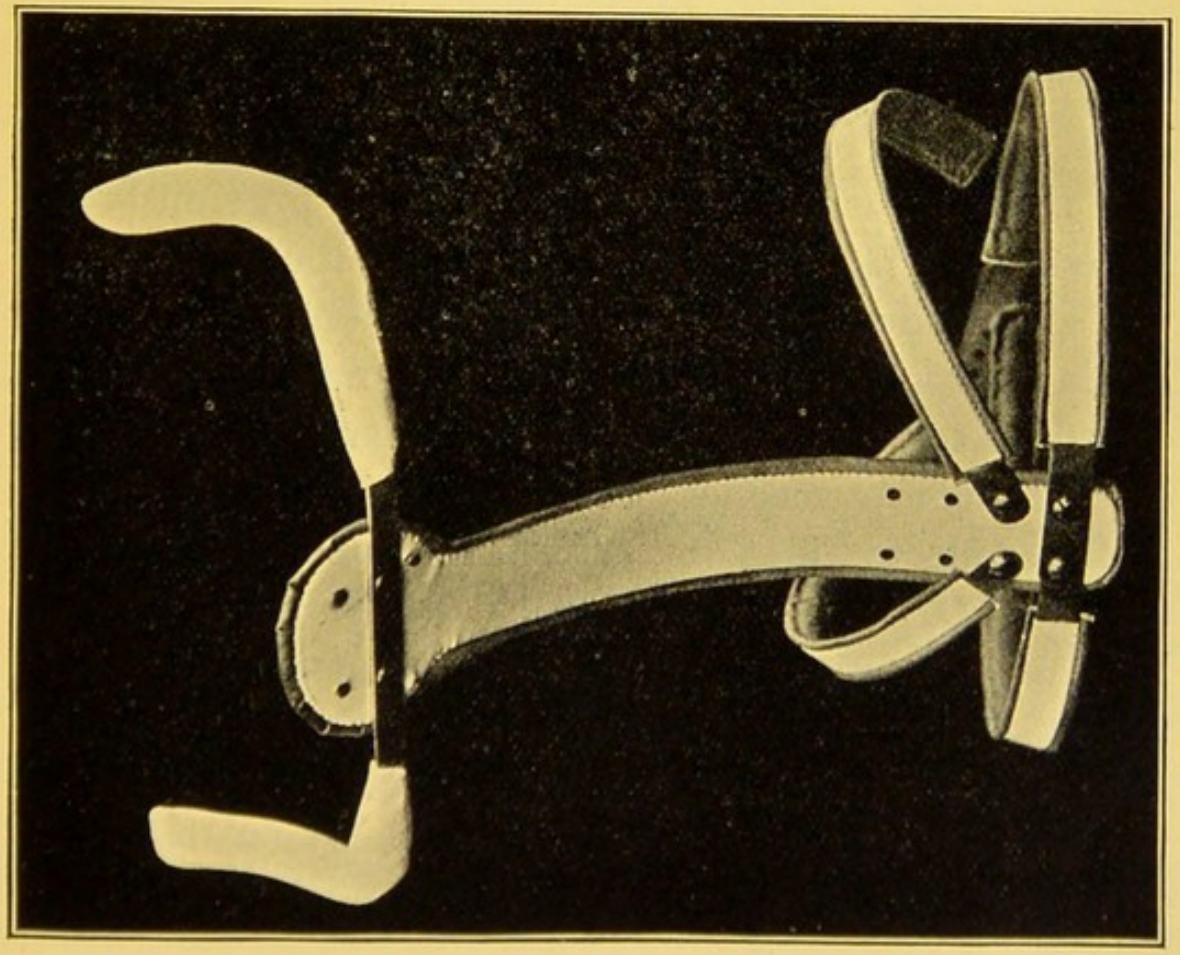

Fig. 10.

To either of these two appliances the jury-mast was attachable at will, but, as I have said, it had become recognised that extension by the head was quite unneeded except in those cases in which the cervical or upper dorsal spine was affected.

Both these appliances were adopted by Sir Astley Cooper, who sent many hundreds of cases to my grandfather for mechanical treatment. Moreover, it was probably at his suggestion that the first attempts were made to obtain the beneficial action of direct force on the distorted trunk by means of metal plates. These plates were, however, merely attached to the framework, and without the intermediation of mechanism that could exert any direct active force; they were, therefore, rather the precursors than the representatives of a method that was within a little time to be fully developed.

Heather Bigg's appliances (1840 et seq.).—Henry Bigg left no published works, hence the record of his inventions can only be gathered from his case-books and from the models to which I have previously referred. My father, Heather Bigg, on the other hand, was a voluminous writer. He commenced his career in the forties, and from that time onwards he produced a series of books which completely covered every branch of mechanical treatment, and which were finally collected into one systematic volume, under the title of 'Orthopraxy,'* a work which first comprehensively embraced the entire field of orthopædics, and which, although written entirely from the mechanical standpoint, was nevertheless the prototype of those

* 'Orthopraxy: A Manual on the Mechanical Treatment of the Deformities, Debilities, and Deficiences of the Human Body.' 1st ed., 1865; 2nd ed., 1869; 3rd ed., 1877. Messrs. J. & A. Churchill, London.

modern systems of orthopædic surgery which have succeeded it. In this book can be found numerous illustrations of the various appliances introduced at different times for the treatment of spinal curvatures. It is not my intention to reproduce these here in bulk nor to pause over pettier details, but simply to trace onwards the inventions by which the present perfected appliances were evolved from the cruder forms of the past.

Taking the two previously described appliances—the mesial and the lateral—at the point at which his predecessor had left them, Heather Bigg introduced three most important improvements (Figs. 12 and 13).

Improved base-hold.—In the first place he improved the base-hold. This had been formerly taken by a steel pelvic band which was held in position by two semicircular metal bands passing into the waist over the iliac crests. But it had been found that the base-hold so constituted was still inclined to oscillate on the hips, and that some more comprehensive grip was therefore needed to attain better stability. This was accomplished by using strong textile material carefully modelled to the whole of the swell of the hips. In the case of the mesial appliance it took the form of a belt which was attached to the back-band behind by buckles and webbing straps. With the lateral appliance very firm webbing was shaped by gores to the hips, and this pelvic webbing was laced up in front when the appliance was adapted to the body.

Reduplication of the back-band.—His next improvement was a simple one. The back-band had

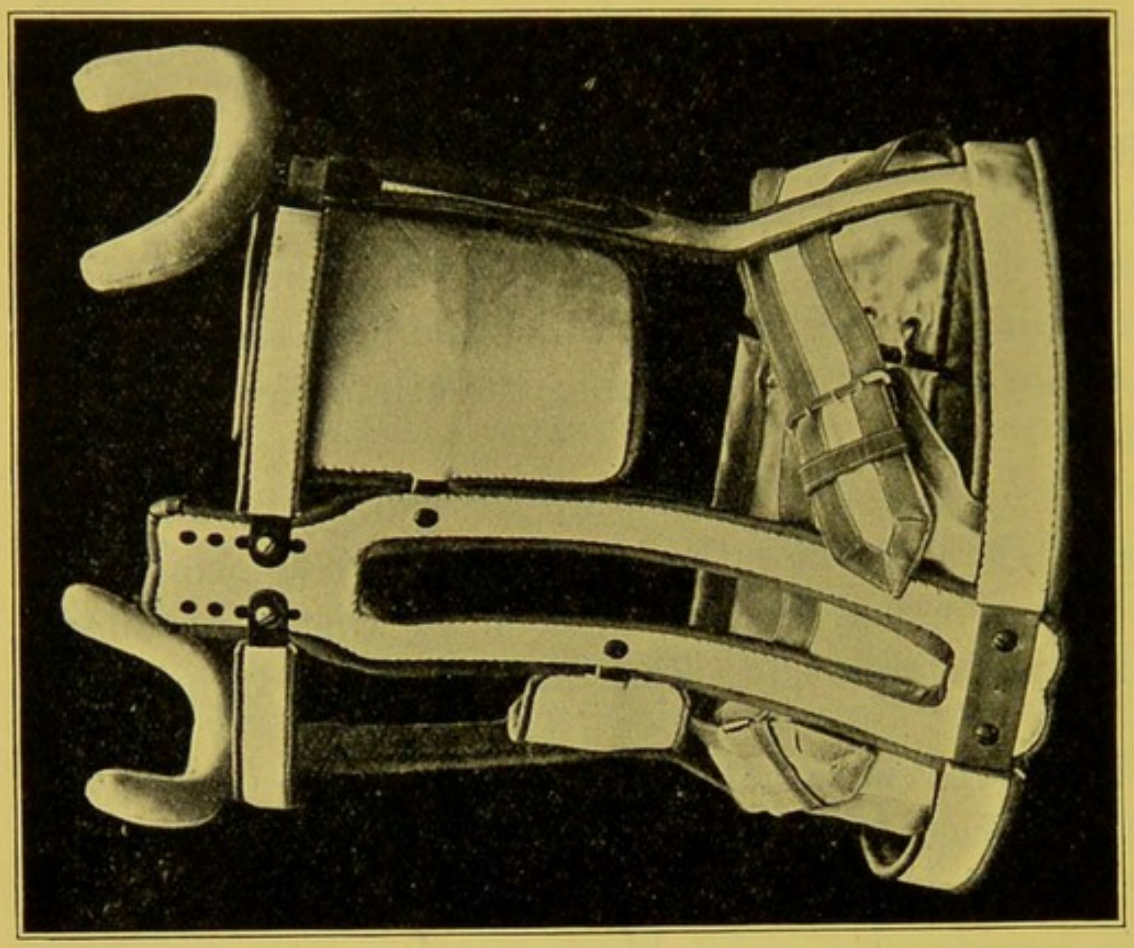

Fig. 13.

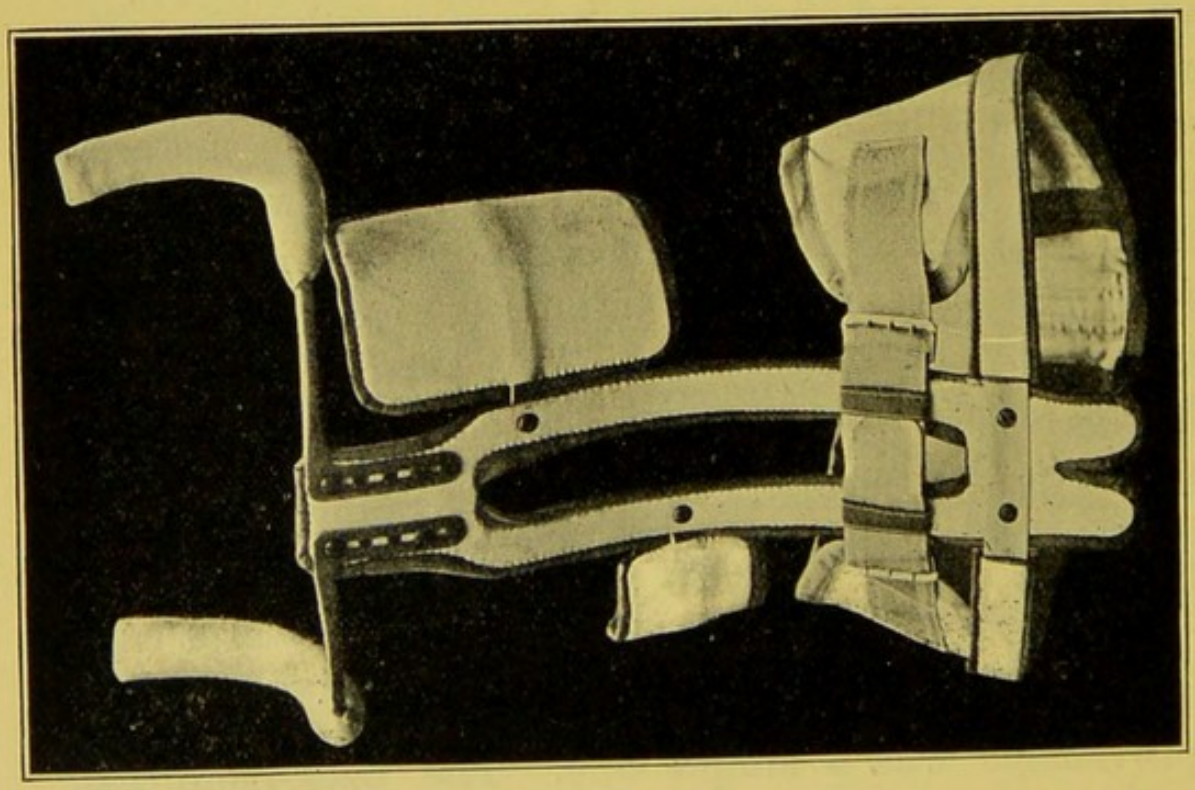

Fig. 12.

hitherto been formed of one single piece of metal running upwards over the spinous processes. It was therefore not only liable to grate upon them, but was in addition incapable of obtaining any real grip on the vertebræ. He therefore substituted for this single band a couple of bands resting over the transverse processes, which latter, being covered by a natural padding of muscle, could tolerate any necessary and accentuated pressure without inconvenience. Moreover, such pressure could be directed so as to grip the vertebræ and exercise directive power over any rotatory lapse. I do not propose here to discuss the causes and results of vertebral and costal rotation; these will be considered at their proper place. But it is worthy of note that this reduplication of the back-band constituted the first direct attempt towards countervailing it.

Application of direct support.—But his most important improvement of both these appliances (the mesial and the lateral) was the free addition of metal plates by which direct support could be brought to bear on the errant parts of the trunk, either on the scapulæ, on the ribs, or on the loins. I have used the word "support" in lieu of the word "pressure" advisedly, because the plates were merely appended to the back bands without any pronounced attempt at the exercise of active force. Still, when one considers that up till then stress had been wholly laid on the efficacy of traction and extension for straightening the spine, it will become at once apparent that an attempt

Figs. 12 and 13 represent the two improved appliances invented by H. Heather Bigg for antero-posterior and lateral curvatures respectively (*circa* 1847).

to stay the trunk from deviation, even by simple support to its lapsing parts, was a very distinct advance in procedure. And what is more, it paved the way towards the application of direct active forces for the replacement of the trunk, a matter I shall next have to discuss.

The application of direct active forces.—The previous appliances, with their fixed plates, had no provision for the exercise of active force upon the trunk. They were supports only, and, in the language of the present day, their effect was static rather than dynamic. Although, therefore, they prevented further lapses into deformity, they scarcely effected the restoration from deformity into straightness. But already the application of those active forces which could be both governed in direction and regulated in strength had been shown by Tisphaine and Scarpa to be of pronounced service in an entirely separate deformity—club-foot. There seemed, therefore, no feasible reason why the same forces should not be of equal service in restoring to shape such deformities of the trunk as were due to curvatures of the spine.

Now, it may be stated at once that the trunk loses its symmetry rather in lateral than in antero-posterior or mesial curvatures. There may be very marked deformity after caries, but it is generally without lateral deviation. On the other hand, after the commencement of so-called lateral curvature, there may be very marked rotatory displacement of the ribs, of the loins, and of the hips, and yet very little obvious curvature displayed in the spine itself. These things being so, it is best to review the application of direct active force with respect to the "lateral" appliances

first and to leave its adaptation to the "mesial" appliances for subsequent and minor consideration.

The application of rack-force. — As a piece of mechanism a rack is a lever made to move by a screw. The two terms "rack" and "screw" are so associated with certain instruments of torture (which can be seen by anyone for sixpence at the Tower) that they are naturally repellant; indeed, a certain unfair advantage was invariably taken of this unpleasant connection by those who, for their own ends, opposed the theory of mechanical treatment. But as a piece of mechanism a single rack can produce any desired pressure in the direction in which its lever moves. And a still more important fact is this, that by a combination of two racks a "universal joint" is formed, and the lever attached to these conjoined racks **can exercise any desired force in any and every direction.** It is not surprising, therefore, that so convenient and potent a piece of mechanism should have been introduced as an active agent into the construction of spinal appliances, the more so as it had already been proved to be entirely efficient in the "Scarpa's shoe" employed for the cure of club-foot. After some preliminary experiments, it took very little time to perfect an appliance on similar principles for the cure of spinal curvature.

Its construction was as follows (Fig. 14): There was, as in the previous appliances, a base-hold taken round the hips by a broad "pelvic band," localised in position either by "iliac bands" (as in the earlier appliances) or by a "pelvic webbing" (as in the later ones). The crutch pieces were made to slide up or down to a desired level on their lateral uprights, which terminated below at their attachment to the base-hold

in either single or double rack-pieces. If the latter were employed it is obvious that the uprights could be moved in any and all directions. Again, plates intended

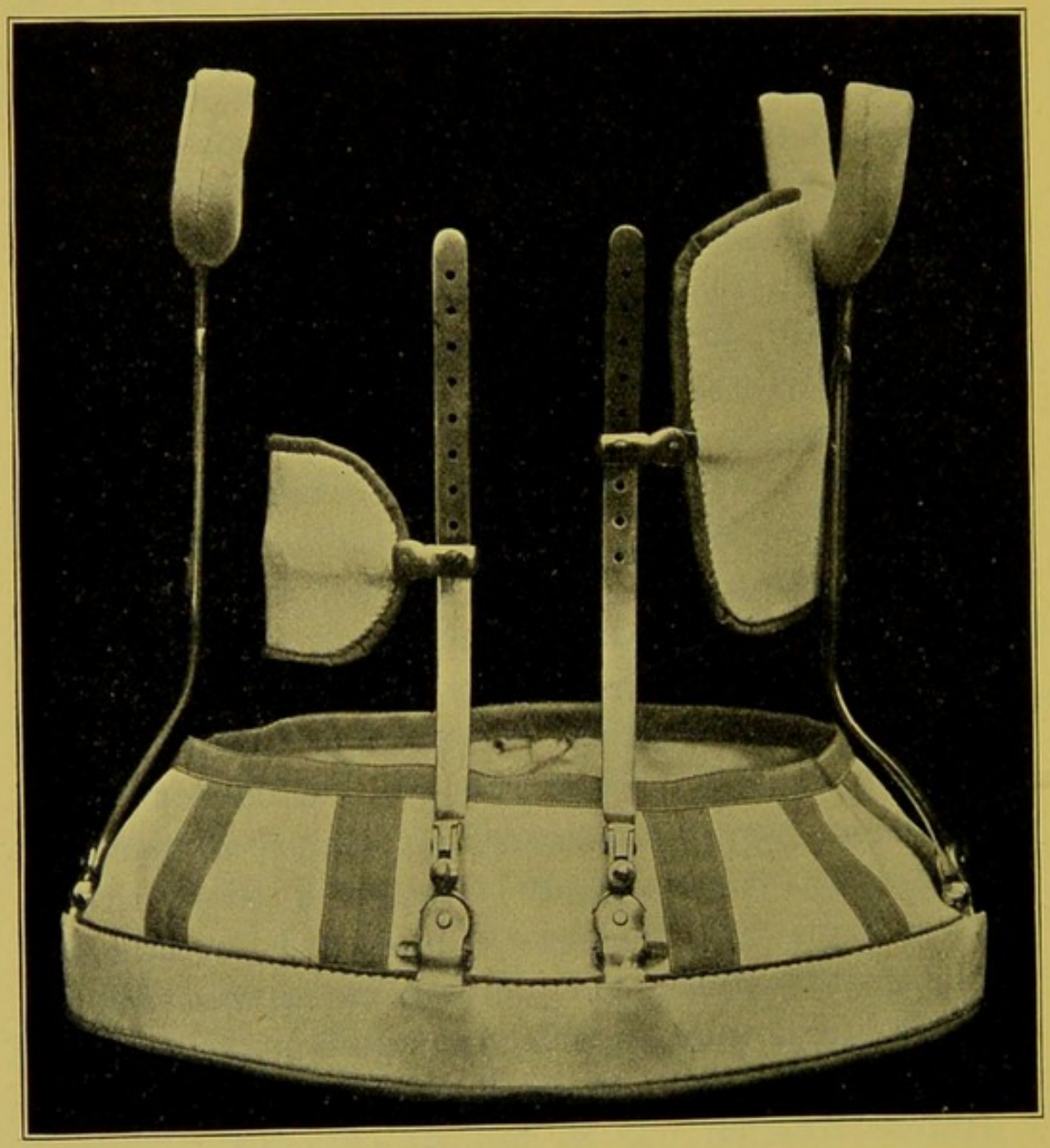

Fig. 14.

Fig. 14 represents the lateral appliance invented by H. Heather Bigg in which the active force of rackwork is employed (*circa* 1849).

to bring direct active force to bear upon the errant parts of the trunk were arranged so as to slide up or down into any desired positions, and were carried by levers or back-bars terminating below, at their attach-

ment to the base-hold, in double rack-pieces. Here, again, the plates could be made to assume any position and to exercise any desired amount of active force in all or any directions. It will be seen at once that this appliance satisfied completely the conditions that were required for the exercise of active force, and that it afforded any desired power exerted in any desired direction and over any desired area. It was the best appliance that had ever hitherto been introduced for the purpose, and for quite forty years it enjoyed a paramount reputation. So certain was it in action that it could even to-day be used with a perfect assurance of beneficial results, and indeed would be so were it not that another and simpler mechanical method has been devised of fulfilling the necessary conditions for cure.

This rackwork appliance was originally invented by my father in conjunction with Mr. Tamplin. It was adopted forthwith by such specialists as Brodhurst and Adams, as well as by such leading consultants as Fergusson, Hewett, Paget, and Erichsen, and it is figured in almost all the older works on general surgery. Indeed, from the "forties" to the "eighties" it constituted one of the standard methods of treatment. Still, it was held to have certain minor drawbacks. It was somewhat heavy, weighing from three to four pounds, but as the whole of its weight was borne on the pelvis this was scarcely felt. Indeed, the weight of anything estimated by balancing it in the hand as against wearing it upon the body has quite a different ratio. One's ordinary winter clothing rolled up into a bundle would be found rather a heavy burden to carry in the hand even for half an hour, whereas worn on the body from morn till night it causes no appreciable

irksomeness. Again, the appliance was, owing to the rackwork, rather irregular in form and could not be neatly concealed beneath a close-fitting bodice; still, this was a trivial consideration in comparison with restoration of shape. But its main drawback, in my opinion (and this is based on some considerable experience of its use in the earlier days of my practice), was that it might, if the pressure was over-forced, rather compress the ribs back into place than gently re-rotate them. I may perhaps best illustrate my meaning by simile. Supposing one had a model of the faulty figure in damp clay and one were to put pointed pressure upon any prominent part, this part might be thumbed into contour by a process of indentation, which, however, would be quite a different thing from broadly grasping the whole model and gently twisting it back into proper form. And so with this appliance. If the ribs were very soft and the pressure on them was too pointed, they were rather squashed back into shape than restored unaltered into their places. Still, in adult cases where the bones were firm this did not apply, and further, even in cases where the bones were very soft, there was no danger of crinkling them up if the restorative pressure was exercised by experts. Hence it was necessary that the "key" which worked the rack movements should only be used by the surgeon, and it was further necessary that a very persistent supervision should be exercised, a thing that was difficult when the patient lived at a distance.

The appliance I have just described was, of course, constructed on the design of the lateral type, and it was the first and the best of its kind for all general cases of lateral curvature. Endless variations and com-

plications of rackwork were introduced, but although these may have sometimes been of service in particular cases, their origin seems to have been due to the desire of the public for something that was novel rather than for any real superiority over that held by the original appliance. Figures of some of these variations are to be found in my father's work 'Orthopraxy.' One of them I append (Fig. 15), which shows the introduction of rack mechanism into the appliance of the mesial type, but I am inclined to doubt that it had value, because I hold the view that a lateral curvature must

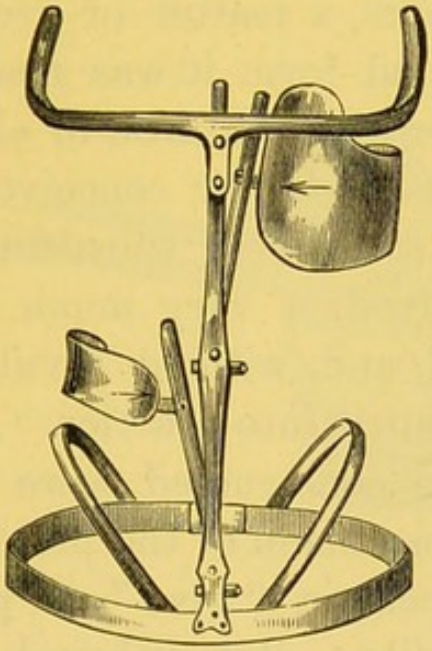

FIG. 15.

Fig. 15 represents the force of rackwork adapted to a mesial appliance.

be dealt with in one way and an antero-posterior in quite another. Still, a combination of the two methods may occasionally have proved of service, and, at all events, it was very frequently attempted.

Application of spring-force to the mesial appliance.—Now, whilst the lateral type of appliance was being completely revolutionised by the introduction of rack-force into its construction, so also the mesial appliance was undergoing changes which led to the

recognition of an entirely new method of obtaining active and regulated power over a perverted body. The lateral appliance, as I have said, had become by the necessary massiveness of its rackwork somewhat heavy as well as somewhat irregular in shape. In consequence of this latter result, it could not be concealed by corsets, but had indeed to be worn in lieu of them, and, therefore, showed through the dress. Now, the mesial appliance, which was much less massive and comprehensive in construction, could be entirely concealed beneath ordinary corsets, and this in itself was, to sensitive patients, a matter of great consideration. Still, in its original form it was made of heavy and rigid metal, either of actual iron or else of soft untempered steel. But my father conceived the idea that if the finest sword steel were substituted for the metal previously employed, a very much greater lightness could be attained, and, without divulging this notion, he immediately put it into practice. As a consequence the appliances so constructed were about a third of the weight of those made of the previous material, and also they had a certain "give" or pliancy instead of the previous rigidity. But although they gave somewhat with the movements of the body, still, the steel, being at sword temper, always resumed its own form. Hence no matter how much it might yield to strain, it invariably reverted to its proper shape and, moreover, tended to draw the body with it. It was the observation of this latter fact that led to another new question of the greatest importance, and it was this. If the body had yielded in one direction, could not spring force be

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Fig. 16 represents the spring mesial appliance invented by H. Heather Bigg, which is entirely composed of spring-tempered steel. Figs. 17 and 18 are diagrams of its action (*circa* 1860).

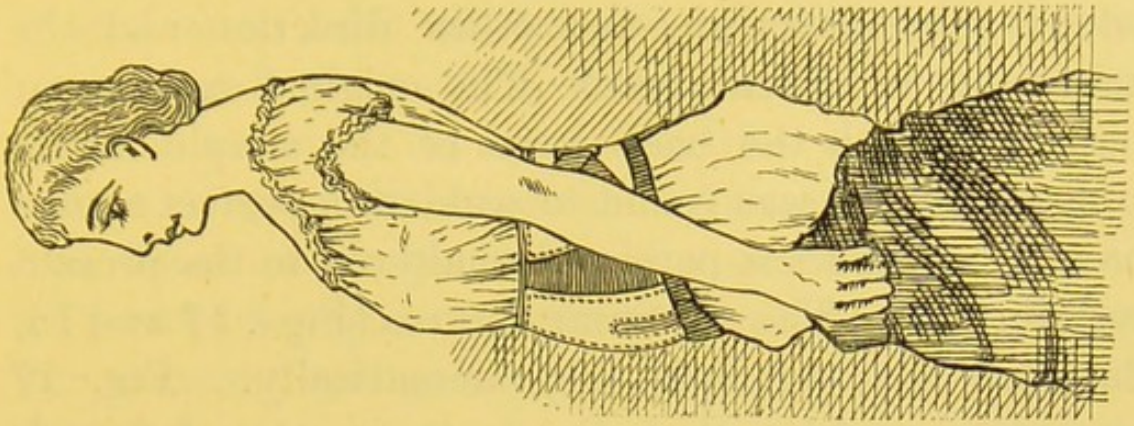

FIG. 18.

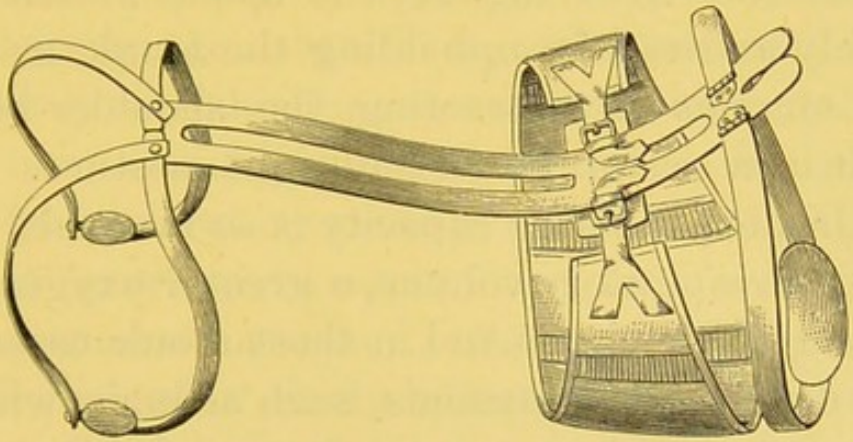

FIG. 16.

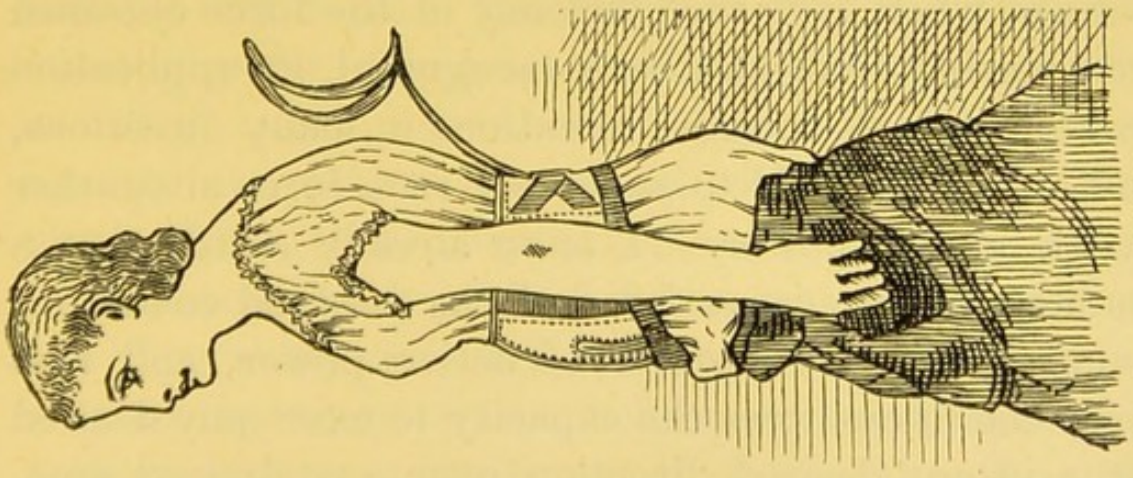

FIG. 17.

so arranged that it should draw the body with persistent gentleness into the other direction and the perversion so be remedied? The original experiment was made with the back band of the simple mesial appliance, and it was found to yield such perfect results that the method has persisted unaltered to the present day (Fig. 16). The adjoining figures (Figs. 17 and 18) illustrate the principle diagrammatically. Fig. 17 represents a girl with a direct atonic stoop forwards and with alar separation of the scapula. The spring appliance is in position except that the arm crutches have not been placed beneath the armpits. When this is done, as shown in Fig. 18, the spinal muscles are immediately assisted in upholding the trunk, and the scapular muscles in retracting the shoulder-blades. The result is a restoration of upright posture. And not only this, but the lung capacity is so increased that, with greater respiratory volume, a greater oxygenation of the blood takes place. And in those atonic cases that are often dependent on anæmia, such anæmia will frequently and for obvious reasons disappear. Or, as Sir James Paget once humorously expressed it to my father, the anæmia had been cured by "taking steel outside instead of inside."

Now, when once the efficiency of the force obtained from spring steel had been recognised, its application was pushed by various inventions in many directions, and it began slowly to supersede rack force altogether as an active power. I have already stated that a double-racked lever satisfied all the essential conditions required for the exercise of active power, and that these conditions were the capacity to exert any desired force in any desired direction over any desired area. It was now found that a spring-tempered rod or band

could be attached to the base-hold, and could be so "set" as to fulfil all the same conditions, and, moreover, that it did so in a more persistent and a more equable manner. It was, therefore, no longer necessary to employ the somewhat cumbrous mechanism of the double rack piece, and in consequence the use of rackwork began to be discontinued as the mechanism for exerting spring-force became gradually more perfected.

Without going into the transitional details of the experiments that were continuously made with the mesial appliance, I give illustrations of the designs that were ultimately reached (Figs. 19 and 20). It will here be seen that the mesial appliance, which was primarily intended for antero-posterior curvatures only, was now modified so as to be of service in slight or incipient lateral curvatures, and that plates carried by spring levers were superadded to it so as to control and counteract rotation. A considerable popular prejudice had, after thirty or forty years' beneficial usage, been nurtured, by those interested, against the rackwork appliances. The prejudice was not a surgical one, because, until spring-force had been brought into service, no better means of treatment was known than that by rack force. But the fair sex—and they constitute by far the greater number of sufferers from ordinary lateral curvatures—were naturally biassed against an appliance that could not be concealed from view. Now, these new appliances of the mesial type could be completely covered in beneath ordinary corsets, and they were, moreover, very light, and the pressure exerted by them was much more comfortable, the springs having a resilience that was absent in the rigid rack-lever. Hence these new appliances were

far more acceptable to the patients themselves, and, indeed, were of such slight inconvenience in wear, that my father, in writing specially on their advantages, and taking the previous method by rackwork into contrast, felt justified in designating the new method as "the gentle treatment" of spinal curvatures. The accompanying illustrations represent designs that were invented during the "sixties," and they were first

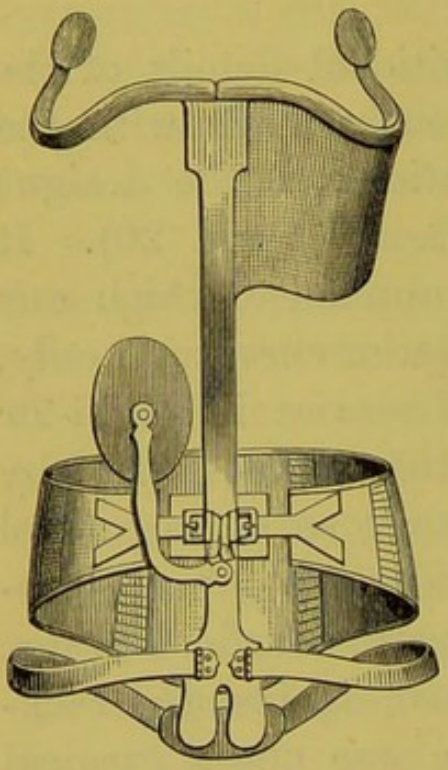

Fig. 19.

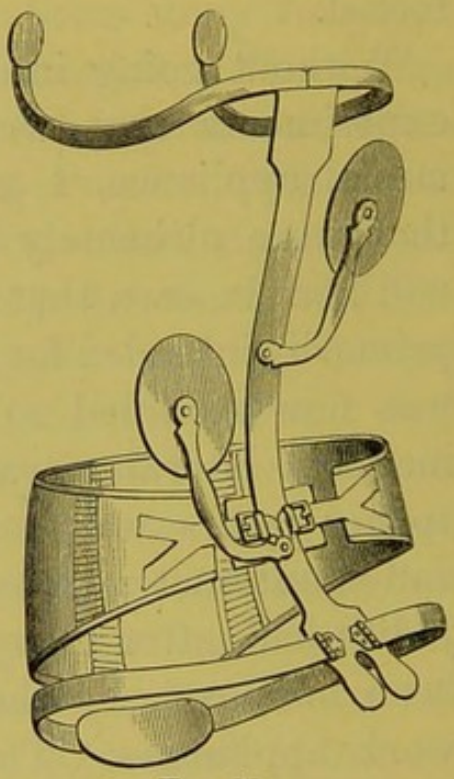

Fig. 20.

Figs. 19 and 20 represent the spring mesial appliance with spring-borne plates for the control of early lateral curvatures.

figured in 'Orthopraxy,' third ed., 1877, from my own drawings.

Application of spring-force to the lateral appliance.—Now, as a matter of fact this modification of the mesial appliance for the treatment of lateral cases was in the nature of a compromise. There can be little doubt that for lateral cases, no matter how incipient, the lateral appliance is the proper one for usage. But

in the "sixties" such an appliance, with its rackwork and its bars, was beginning to be considered as somewhat cumbrous. Hence it was that the modified mesial

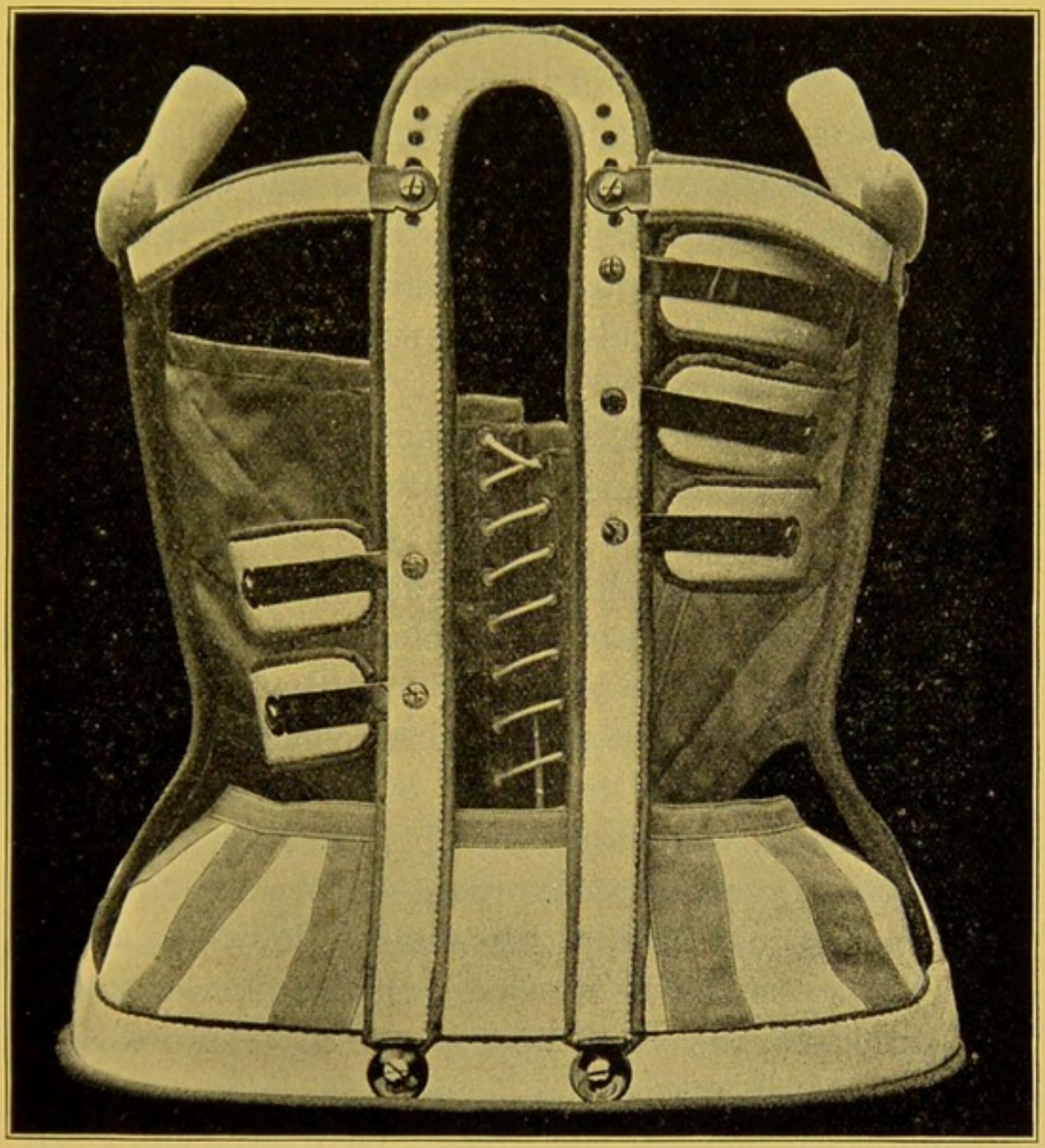

FIG. 21.

Fig. 21 represents a lateral appliance composed of spring-steel and with spring-borne plates.

appliance, with its spring-borne plates came, on account of its lightness and its capacity for concealment, to be adopted in the early stages of lateral curvatures. I

am of the opinion that, generally speaking, this was an error in practice. Many cases, it is true, were cured, especially where frequent supervision was possible. But some cases were merely checked, and others proved so intractable to this lighter method that they continued to lapse, a thing that would have been impossible with an appliance of the lateral type. Hence it became gradually evident to those who made curvatures their special study that the next necessary steps in invention would have to be towards obtaining for the lateral appliance the advantages which had been introduced into that of the mesial type—that is to say, lightness, ease in use, and capacity for concealment. Nor did it take so very long before those ends were attained.

In the first place, all the old rackwork disappeared, and the general frame of the appliance was constructed of sword steel, a step which reduced the weight to at least a third of that of the previous constructions and caused its reckoning to be in ounces instead of in pounds. Next, as is shown by the illustration (Fig. 21), the necessary plates took their force and direction from spring "carriers." And finally, the whole appliance was so embodied in a corset that, when worn, it had precisely the same appearance as if an ordinary corset was being worn and it could not be in any way distinguished beneath the dress. Or if preferred, the whole essential framework could be worn underneath an ordinary corset, which practically came to be the same thing as a method of concealment. In this way, then, the lateral appliance was not only made capable of the exercise of spring force, but its previous drawbacks of weight and unsightliness were entirely removed.

Recapitulation.—Such, then, were the appliances for the treatment of spinal curvature that were in use in **1870.** As I have shown, they were evolved step by step from the primitive appliance of Le Vacher, and in a distinct succession of improvements onwards. The mesial appliance had by then attained for its purposes such perfection of design and such complete reliability of action, that it has practically remained unaltered to the present day. The lateral appliance, at this period, was used in two kinds. The one that embodied rack-force as the active power still held favour with the older orthopædic authorities, as with Adams and with Brodhurst. On the other hand, the newer lateral appliance, in which spring-force was the remedial power, was gaining persistent acceptance. Both kinds of force had their value in particular cases, the spring-force in the earlier stages, and the rack-force in those very severe cases that nowadays are rather rarely met with. That some discrimination was needed between them was recognised by the leading consulting surgeons of the period. Only to instance one example—Sir James Paget sent all his cases to my father, leaving it to him to report on the power that seemed most suitable. And Sir James Paget did this during nearly thirty years. Indeed, during many years, so great was his practice in this one respect alone, that (as our case-books show) he sent on a common average a new case a day. In fact, what Sir Astley Cooper was to my grandfather Sir James Paget was to my father. These two great representatives of unbigoted thought covered together a period of at least sixty years; where the one left off the other began. Neither of them would have adopted a treatment that was otherwise than valuable in its efficacy.

If they had tried a dozen cases or so experimentally, and had then discontinued the method, their abstinence alone would have been an argument of its inefficiency. But when two such men as these, year after year, and decade after decade, adopted a treatment which they had by long experience found to be the best, then, at all events, this goes to show that the mechanical inventiveness of a century was certainly not exerted in vain, and that a method had been evolved that was definitely and incontrovertibly successful.

SECTION IV

Adjunctive Treatments—1870

Other treatments—In tracing onwards the evolution of the mechanical appliances needed for the treatment of curvatures, I have selected the date **1870** as one at which I might conveniently make a pause, because it was in that year I first myself began the special study of deformities. From that time onwards, therefore, I do not need to draw from the records of my predecessors, but rather to recount my own personal experiments and experiences. Before, however, continuing to describe those appliances that are of the best service for curvatures, I propose to refer, in some detail, to certain subsidiary methods which had been established by **1870** as being of such efficiency that they had assumed, in consequence, a prominent place in any proper scheme of treatment. Those methods, which I may appropriately term "adjunctive," are worthy of immediate and attentive consideration.

On the other hand, there have been from time to time introduced certain alien methods of treatment which have been foisted forwards as exclusive and indiscriminate remedies for every kind of curvature. They have usually waxed with their novelty and with much advertisement into some dominant acceptance for a comparatively short period. And they have invariably

waned after the fair test of trial into deserved obscurity. Of such a sort are the Sayre's method and the gymnastic method of treatment. And although these may necessarily hold some place in the history of spinal curvature, even if it only be that the failure of their faulty principles may become by contrast an index of those principles that are sound and correct, still, their consideration, which must of necessity be critical rather than deliberative, may be most wisely omitted from the current records of right treatment, and may be relegated to later sections, when the comparison of all the various treatments can finally be passed in review.

These things being so, I propose in this section to describe certain accessory plans of treatment that have proved of some value, and that are adjunctive in service to the mechanical methods. In the next section I shall continue the narrative of the evolution of spinal appliances as it has progressed in my own hands. And I shall devote the final sections to a comparative review of all those modern treatments that have, rightly or wrongly, had any vogue since the year **1870**—that is to say, during the last thirty-five years.

The adjunctive treatments.—These are those treatments which may be regarded as auxiliary to the treatment by appliances. Some of them are dependent on the changes of shape that can be provoked either in the straight or curved spine by intentional irregularities of the base on which the body rests, either in lying, or in sitting, or in standing. And some of them are due to direct forces. And, what is more important, some of them are capable of being used whilst the patient is asleep, and when the appliance

that is only worn during the waking hours, has been removed from the body. Hence by such means treatment can be made continuous both by night as well as by day. But, as it is difficult to generalise on these adjunctive treatments beyond these preliminary points, I will proceed forthwith to describe their usages in particular.

Couch treatment.—The simplest treatment by couch is that of mere recumbency in a supine or prone position on a hard level backboard or mattress. This is a very ancient treatment, so much so that in past generations a backboard was to be found in nearly every nursery. Indeed, even ordinary straight and healthy children were made to lie down supine for an hour or two a day, under the impression that truth and erectness of form were thereby secured. And with those who suffered from incipient curvature this plan was even more strenuously pursued, so much so that children and growing girls were kept recumbent for so many hours during the day that the treatment almost became identical with that which is necessary in acute caries. The idea on which such a method was founded was the supposition that the spine yielded into curvature almost solely on account of its inability to support the weight of the body. Hence by persistent recumbency on a couch this provocation was presumed to be removed, whilst if the recumbent body was kept supine on a firm level surface, such as the backboard (or failing this, the floor), it was imagined that the deviating parts of the body would settle back by mere subsidence into place.

Now, although this conception has been by experience exploded, not only on account of its error, but

also because the spine can be quite adequately dealt with by such appliances as allow the patient to walk and run about as freely as is desired, yet I am of the opinion that in all cases of spinal curvature, or even of spinal weakness, an hour's rest in recumbency after the mid-day meal is of advantage. Hence I invariably recommend it as an oasis of simple rest in the middle of the day, and do so without regard to the particular position in which the patient lies. I advocate an hour's repose on a sofa or outside a bed as being most desirable, and if an appliance is being worn it is quite unnecessary to remove it for this purpose. The fact is that the muscles of a deformed spine cannot, in consequence of the deviation of the bones which constitute their muscular origins and insertions, be acting evenly. Some, therefore, are doing more work than they would under normal circumstances perform, and are, therefore, more liable to fatigue. Hence it is extremely desirable that they should have, half way between rising and bedtime, some definite amount of rest for recovery from overstrain, although, as I have said, it is quite immaterial in what particular position this rest is taken, or whether the patient lies on the back or on the side.

But whilst this hour's rest in the middle of the day only aims at recuperative repose and is independent altogether of any prescribed position, it is quite a different matter when one comes to consider the ameliorative posture that can be assumed by the body during the eight or ten hours devoted to sleep. For in this instance a dictated pose may possibly be of distinct service in helping to unfold a curvature, and this during a time when, it must be remembered, the curative appliance is no longer being worn on the body.

Ordinarily everyone sleeps with a pillow, and on the side. And, moreover, the greater number of people sleep on the one side only. Some cannot sleep with their faces to the wall, some cannot sleep on the left side, and so on. Now, if the body of a perfectly straight girl be disclosed whilst sleeping on the side, it will be found (Fig. 22) that the spine droops and "sags" between the pillow and the mattress which respectively uphold the head and hips, and that consequently a state of curve is induced. If, therefore, any girl is suffering from a single lateral curvature, it is quite obvious that if she lies on the side of the convexity of that curvature it will be exaggerated by posture. And it is equally obvious that if she lies on the side of the concavity of such a curvature (or, to put it in other, simpler, words, if she lies on the side of the prominent hip), the curvature will be by posture temporarily ameliorated or even obliterated. And it is scarcely, at all events at first sight, to be doubted that the latter posture must be of some beneficial effect. I am, therefore, in the routine habit of advising that patients who suffer from single lateral curvatures should, if possible, always sleep on the side of the prominent hip. The way of enforcing this selection is well known. A cotton reel is tied into the side on which it is undesirable to sleep by a couple of tapes, one passing round the waist and the other round the leg. As a cotton reel is an irregular and unpleasant thing to lie on, the patient, even in sleep itself, will unconsciously elect the opposite side of the body, and will repose in a position that tends to unfold the curvature.

With double lateral curvatures the maintenance of a particular posture during sleep is not so material, because no matter the side that is slept on, it is clear

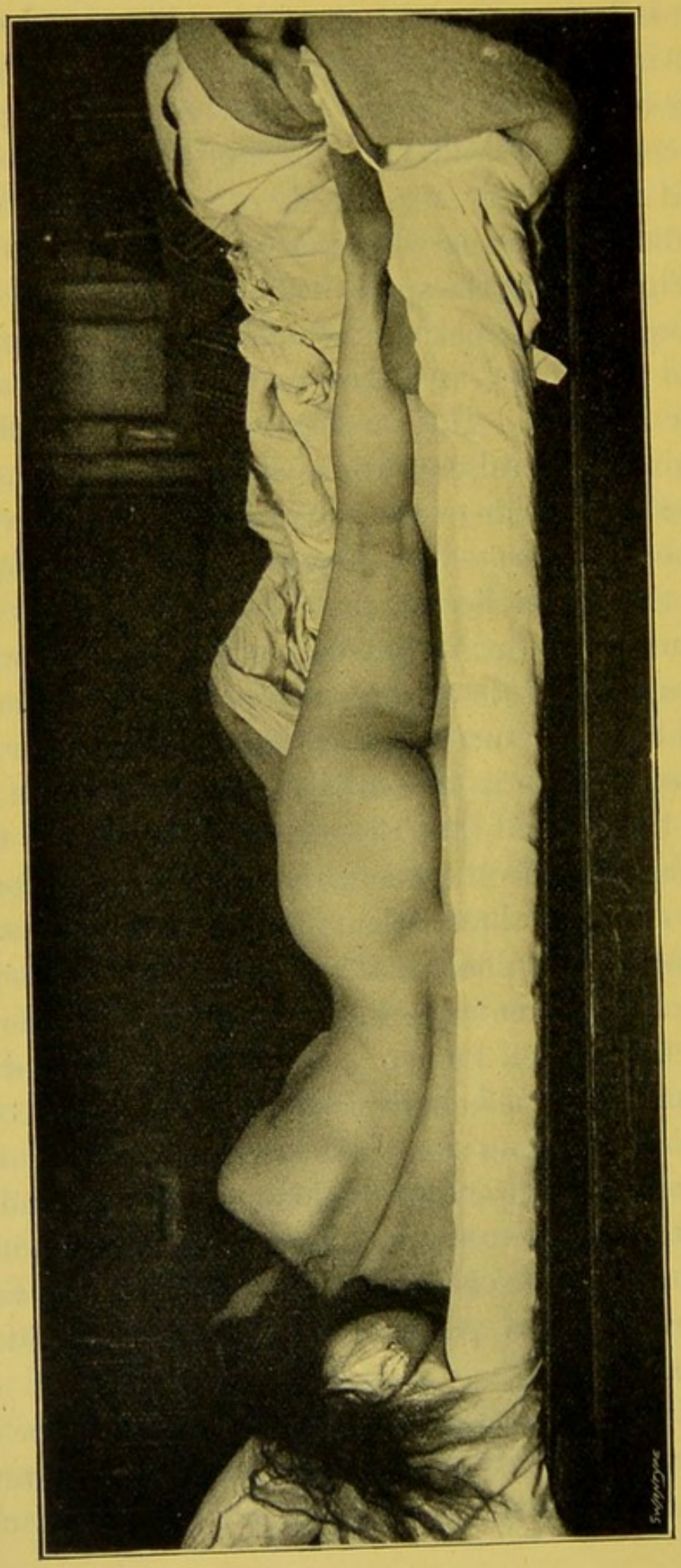

Fig. 22.—The accommodative curve induced in a normal spine by sleeping on the side with the usual mattress and pillow.

that if one curvature is thereby unfolded, the other is likewise accentuated. Practically sleeping on the back is best, as being quite negative in postural results. But if an election of sides has to be made, it is my experience that the side of the prominent hip is still the one to be elected. But as the ensuing results cannot from the nature of things be very marked, I generally altogether disregard posture at night in double lateral curvatures.

Nor, indeed, must it be assumed that too much stress should be laid on night-posture even in single lateral cases, for the beneficial results are rather matters of speculation than of certainty, and for these reasons: If the girl shown in the figure (Fig. 22), who has a perfectly straight and normal spine, is in the habit of constantly sleeping on the left side, it is clear that for eight hours out of the twenty-four her spine is in a state of curve. But it does not follow that she, or any other person who is practically passing the third of a lifetime in a position of curve, should thereby acquire a condition of curvature; indeed, the very contrary is the case. Hence it is a little difficult to understand, if no appreciable effect is produced by this lifelong posture on a healthy and normal spine, why any ameliorative effect should be attained by a similar procedure in the case of a perverted spine. And it is not unusual to find that a patient suffering from a single lateral curvature has, nevertheless, been sleeping all her life on the side which is antagonistic to the establishment of such a curvature. Still, as some common-sense advantages would seem to be derived from unfolding a curvature during sleep, I am accustomed, as I have said, to adopt the counter-vailing posture as an adjunctive safeguard in slighter

cases. In graver ones I pursue by night a more definite treatment, which I shall presently describe.

Now, an ordinary bed would scarcely appear to any casual observer to be an apparatus capable of exercising an orthopædic effect on the shape of the body. Yet it actually consists of a level surface (the mattress) having one particular prominence (the pillow) upon it, and it can, therefore, as I have shown, dictate a definite posture to the recumbent body. And from the outset of the last century this dictation of posture by varied surfaces and prominences constituted during many years a very distinct procedure for treatment. It must be remembered that at that time the appliances now worn for the cure of curvatures were uninvented, always excepting that of Le Vacher, which simply made extension on the spine by means of a jury-mast, and did not do this particularly well. And it must be remembered also that for relieving the spine of the weight of the trunk, recumbency both by day as well as by night was then the only plan known, elevating crutch pieces under the armpits not having then been generally introduced into usage.

Hence treatment by couch was a very widely recognised practice, the patients being kept recumbent during the twenty-four hours for many months, or even for years. And hence, also, very considerable ingenuity was expended in advancing step by step from the most primitive form of couch to that which was most perfected. Indeed, a process of evolution took place very similar to what I have already described in the history of spinal appliances. The simplest couch was based on the same principle as Le Vacher's appliance—that is to say, on extension of the spine by the head. It consisted of a polished blackboard or

table, the one end of which would be considerably raised by mechanism. At this top end was a hold, in which the head rested and was fastened. The patient was placed supine upon the so-called couch, the head was duly attached, and the top of the couch was elevated to such an extent that the body tended to slip downwards, and its weight, in consequence, brought suspensory extension to act on the spine. This couch is usually associated with the name of Dr. Harrison (Fig. 23).

The next improvement was to superadd the principle of traction to that of suspension. The couch invented

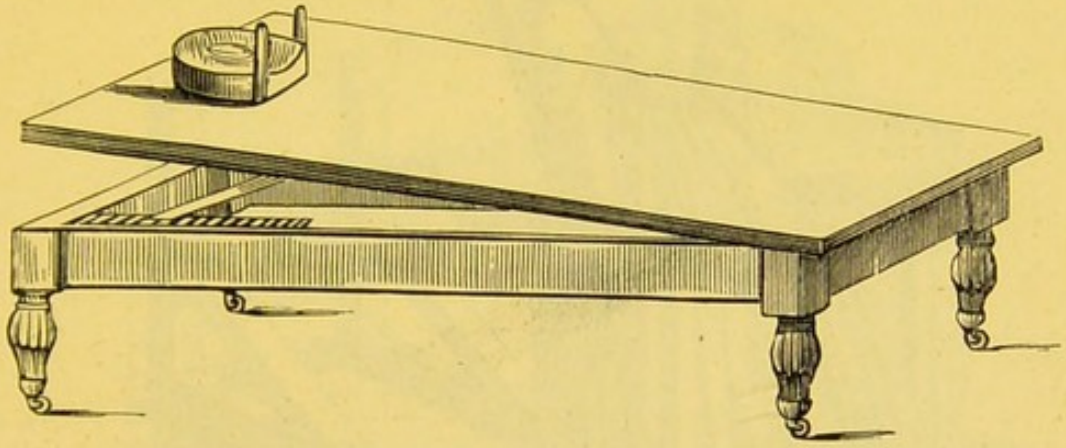

Fig. 23.—Harrison's spinal couch (from 'Orthopraxy').

by my predecessor, Sheldrake, provided for both these methods, permitting the patient to be either suspended by the head in a nearly vertical position, or, if the hips or lower limbs were fixed, to be submitted to traction by the screw head-gear, which is shown in the illustration (Fig. 24) so clearly that it needs no further description.

And, just as in the case of the spinal appliance, so the next step was to introduce plans for direct pressure on the deviating parts of the trunk. This was effected either by slings, as in Lonsdale's couch (Fig. 25), or by padded pillows, as in Burhing's. And many other

clever inventions were made which had similar aims, and which the curious inquirer may find described and illustrated in 'Orthopraxy' (Heather Bigg, third edition, 1877). But it is quite unnecessary to review them here, and for two reasons. First, the couch treatment of curvatures during the day has been entirely superseded by the use of spinal appliances. And next, the

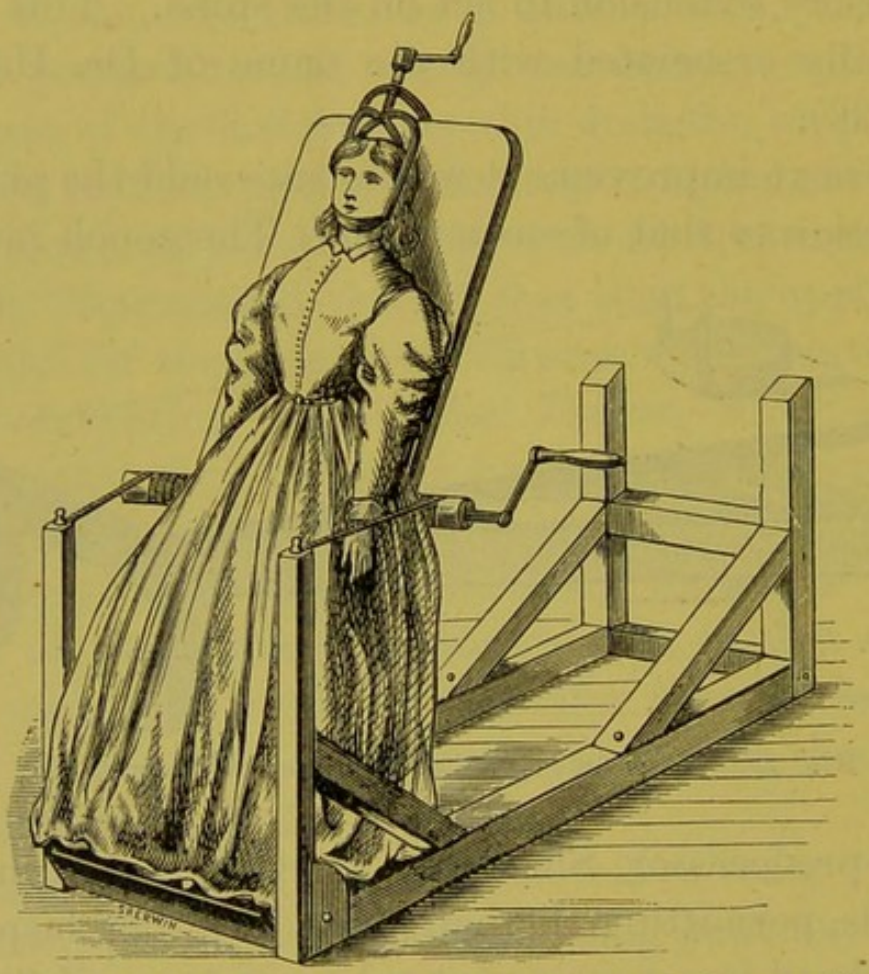

Fig. 24.—Sheldrake's spinal couch (from 'Orthopraxy').

couch method invented by my father entirely surpassed all previous designs in efficiency. And what is more, being easily adapted to an ordinary bed, it is still very largely used even at the present time as a treatment by night, although more, perhaps, in Scotland than in England. Holding, as it thus does, a permanent position of service when other methods of couch-treatment have become obsolete for more than half a

century, it may very rightly be here carefully described and figured.

It consisted in its original form of the usual couch on four legs, the two at the head end being very much longer than those at the foot end, thereby giving the couch such a marked inclination that the head of a patient lying supine upon it was at a very much higher level than his feet. To a crossbar fixed at the head end of the couch the patient was attached, either

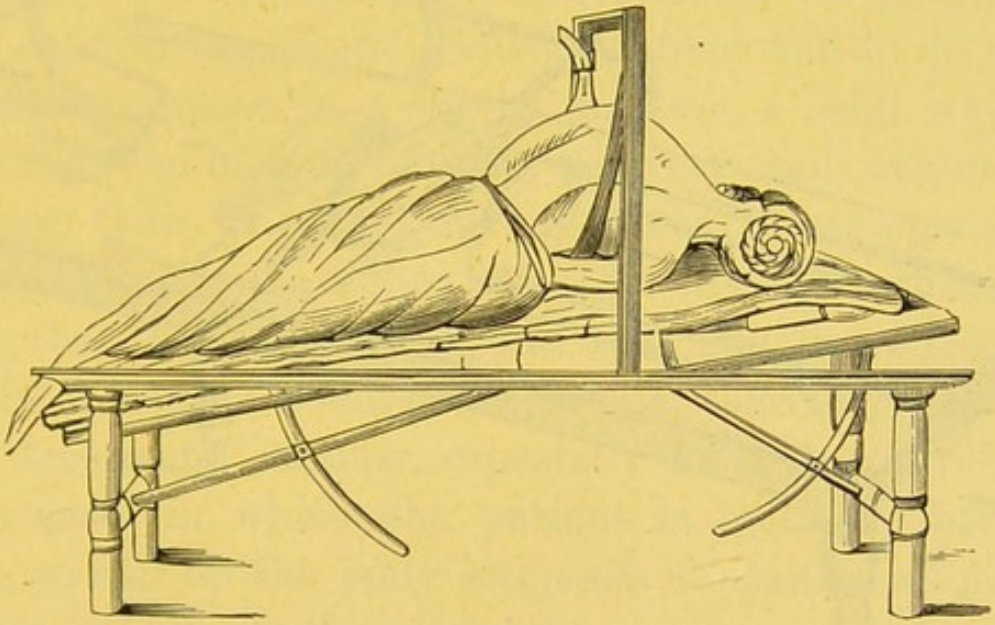

FIG. 25.—Lonsdale's spinal couch (from 'Orthopraxy').

by head-slings or by axillary slings, according to the position of the curvature. Around the small of the hips a belt made of textile material was accurately fitted, and to each side of this belt straps were attached, which reached downwards to be connected to a cross-bar fixed at the foot end of the couch. Round the body of the patient two wide slings, also of textile material, were passed in opposite directions, each ending in straps that were connected to crossbars fixed to the sides of the couch.

The capabilities of such a couch, diagrammatically represented in the illustration (Fig. 26), are very

obvious. If it was used with either the head-slings or the axillary slings alone, and if the head end of the couch was elevated, the weight of the body, in its tendency to slide downwards, caused extension of the spine by **suspension.** If the straps of the hip-belt were tightened, then the pelvis was drawn upon and extension of the spine by **traction** was attained. And if, further, in lateral cases of curvature, the respective body-slings were placed over the deviating prominences

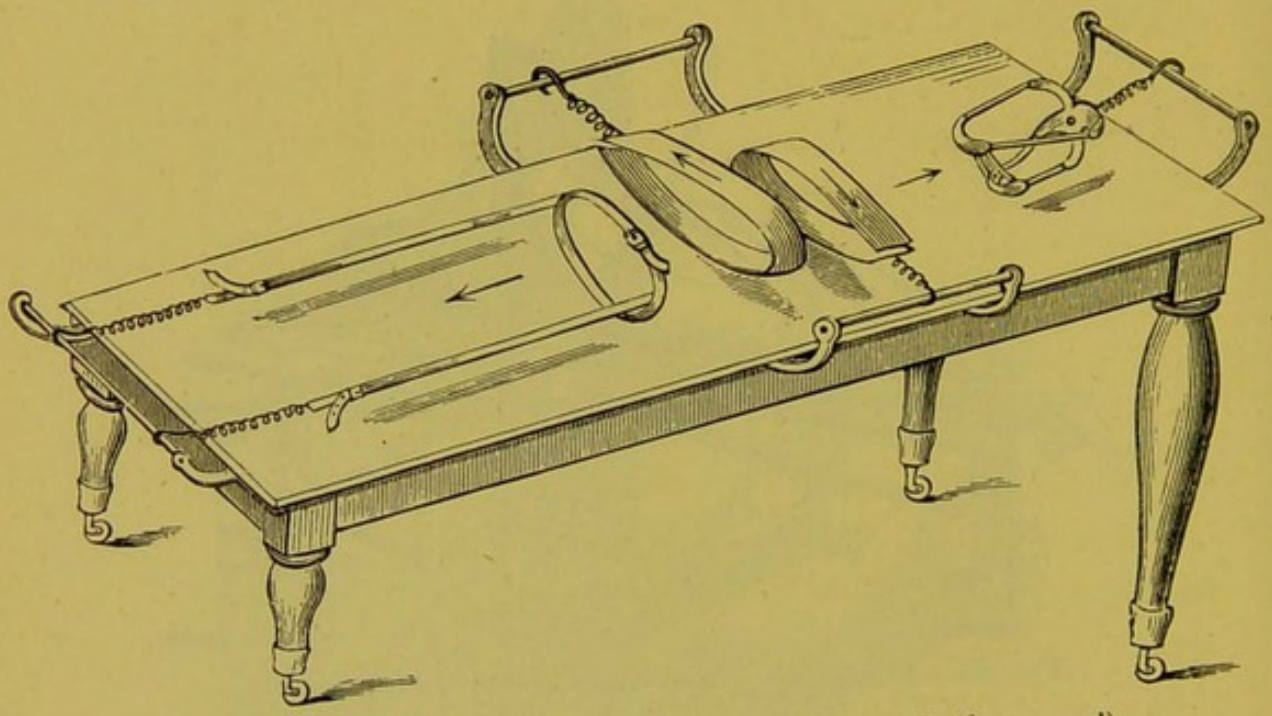

Fig. 26.—H. Heather Bigg's spinal couch (from 'Orthopraxy').

of the ribs and pelvis, and the straps attached to them were tightened, then straightening by **direct force** was available.

This entire apparatus was, when originally invented, employed for recumbency treatment by day as well as by night. But when the day treatment by couch was superseded by the use of appliances, the whole gear was conveniently adapted so as to be of service with any ordinary bed and was used as an adjunctive treatment by night only. And another great improvement in its detail was also made. For in **1854** my father

had introduced and registered at the Patent Office (No. 2062) his invention for applying elastic bands or straps for the relief of deformities of the body, and he adapted this power to the couch in question (as well as to many other well-known appliances for the deformities and debilities of the trunk and limbs). As a result, elastic cords were introduced into all the straps that brought the head, hip, and body gears into tension. And as a result, also, these straps could be graduated in tension at will and could be tolerated with ease during sleep. All the patient had to do was to learn to repose in a supine position, a habit which, after the trial of a night or so, was very easily acquired.

Here, then, is an adjunctive night treatment that has survived unquestioned since its invention through more than half a century, and that can be relied on for its accessory results. It is one, therefore, that I very frequently employ, especially for the control of those cases in which the patient is inclined, during sleep, to coil up the body into such a position as must tend to accentuate the curvature.

Seat treatment.—I now pass to another adjunctive method of treatment which also depends on the posture dictated to the body by the surface on which it rests. When a normal person is sitting erect on an ordinary level seat or chair, the pelvis is truly horizontal and the spine is quite straight and true above its base (Fig. 27). But if by any simple mechanism the seat or chair is tilted laterally so that one side is higher than the other, then the pelvis is tilted to a similar inclination, and the spine has to assume a curved position so as to accommodate the centre of gravity of the body to the altered base on which it rests (Fig. 28).

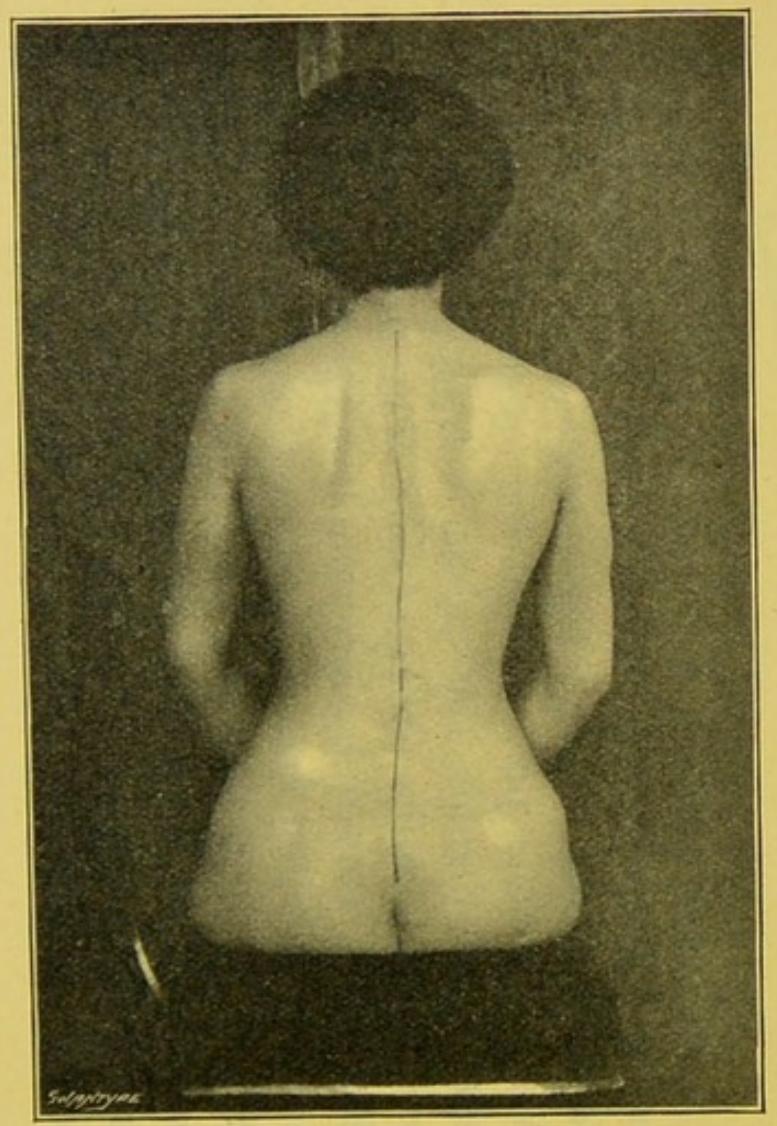

Fig. 27.

Fig. 27 represents a normal girl seated on a level base above which the spine therefore is erect and straight.

Fig. 28 represents the same normal girl seated on a tilted base, above which the spine therefore disposes itself in accommodative curves.

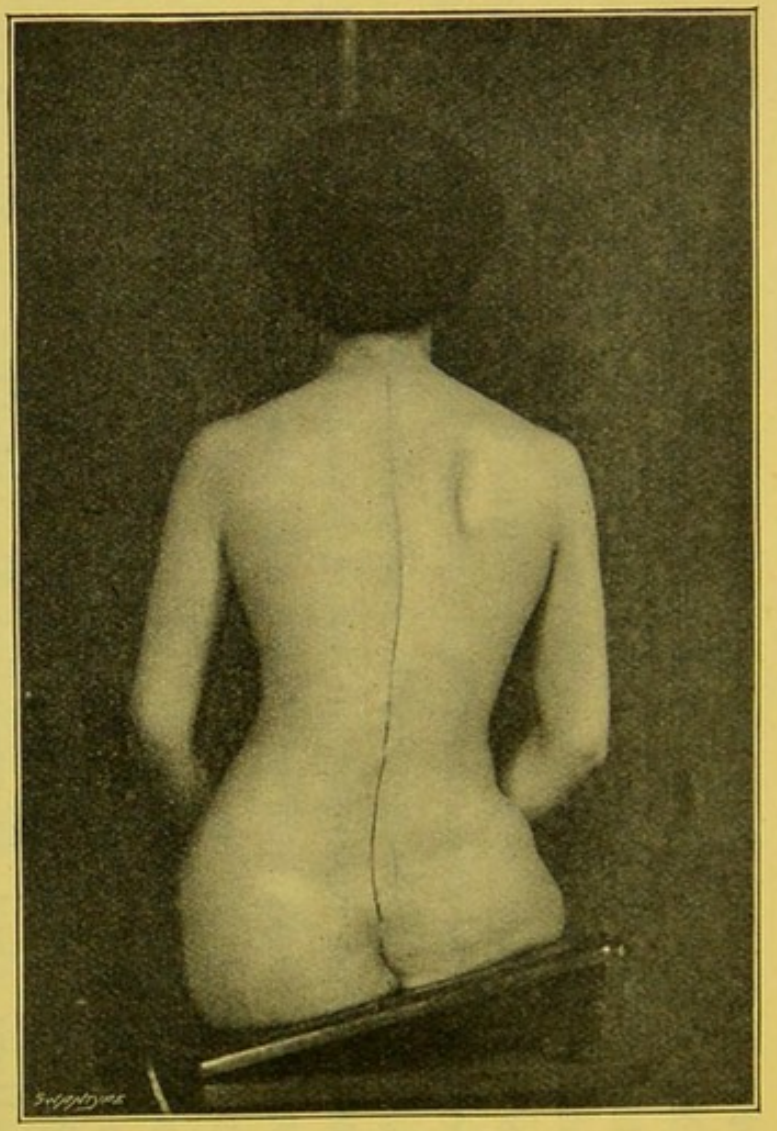

Fig. 28.

The curve thus artificially formed in a normal spine is a double one; there is a sharp loin curve, with its convexity to the side of the lower hip, and a long dorsal curve, with its convexity to the side of the raised hip. Now, it would seem obvious, and it is indeed a fact, that a patient who suffers from a fairly supple double lateral curvature can be so seated on an inclined base that the accommodative curve thereby induced will temporarily unfold and straighten out the previously existent curvature. And it is equally a fact that with a supple patient suffering from a single lateral curvature this curvature can by similar seating be temporarily eliminated. And on these facts was founded a method of treatment by which the patient should be seated for the greater part of the day on a seat that was so beneficially tilted.

But the question that naturally arises is similar to that already discussed under Couch Treatment, and it is this. What permanent curative influence could such a provoked accommodative curve exercise over a pre-existent curvature of the spine, even if the treatment could be conveniently kept up for a good number of hours out of the twenty-four? And the answer would seem to be that the evidence of benefit is not particularly strong. For, as I have already shown, a great proportion of healthy persons sleep on one side only, and consequently pass one third of their entire lives with the spine in a position of curve induced by the pillow and the mattress, and yet they do not in consequence suffer from curvature. And I pointed out that if so continuous a condition of curve was without effect on the healthy spine, there was little reason to believe that it would be of much effect on a spine affected by curvature. And I am inclined to think the

same deductions must be drawn with seat treatment, although there are certain differences of conditions. For in the recumbency of sleep the spinal muscles are in a state of rest, and the vertebræ simply lie adapted to each other by the play of their facets; there is no weight passing through them, and consequently there is no persistent pressure on any particular parts of their surfaces by which absorption and ensuing deformity can be induced. On the other hand, when the spine is erect over its base (the pelvis), either in sitting or in standing, the conditions are very different. Every fibre of muscle is brought into play to help the balancing of the trunk over its base, every ligament is in use, and every vertebra is bearing its share of the bodily weight. If, then, by means of an inclined seat a curvature can be unfolded and the pressure borne too persistently by one particular part of any vertebra can be transferred to the opposite part, it would theoretically seem that the result should be beneficial.

In any event this treatment enjoyed a vogue during the last century, but was superseded by the use of the perfected spinal appliance. Now, as it is one of the fundamental principles of the mechanical treatment that the pelvis should always be kept level during daytime, the obliquity imposed by an inclined seat does not accord with the rectitude required by an appliance for its base. The two methods were therefore incompatible. And as a consequence the treatment by seats fell into a disuetude, which, considering also its very doubtful value, was perhaps natural.

Fig. 29 represents a girl standing on level ground. The legs are of even length, although slightly knock-kneed, as is common with women. The pelvis therefore is level and the spine is consequently true above it.

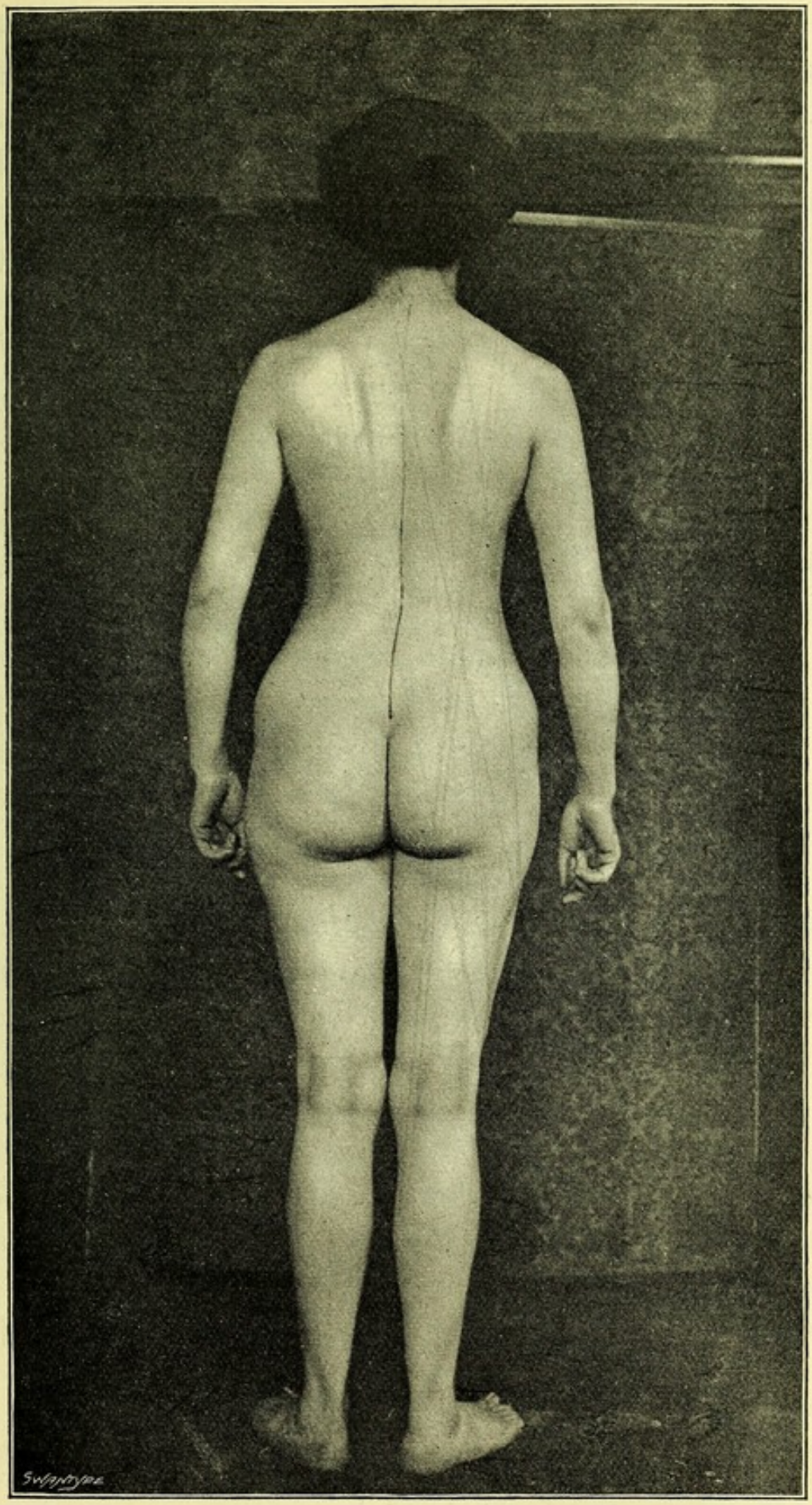

FIG. 29.

Boot treatment.—I have just stated that one of the fundamental principles in the treatment of spinal curvature is that the hips—the base on which the spine itself is reared—should by day be kept level. The adjunctive treatment that I now have to consider may be said to have for its one end and aim the restoration of an unlevel pelvis into level truth, and it is on this account of paramount importance. For if from any temporary cause the two legs are mechanically of unequal length, the pelvis becomes tilted, and a lateral accommodative curving of the spine results. And if from any cause this disparity of limb becomes permanent, then a lateral curvature of the spine must ultimately ensue.

When a normal person, whose legs are true and of even length, stands on level ground without boots or stockings, the pelvis is also level, and the spine rears itself in truth and straightness over such level base (Fig. 29).

But if from any cause a variation is made in the relative length of the legs, then and thereon the pelvis is tilted downwards to the side of the shortened limb, and immediately an accommodative curve is formed in the spine for the proper replacement of the centre of gravity of the body. This curve, to be precise, has its convexity towards the side of the shorter limb, or, what is the same thing, towards the side of the lower hip. The illustration (Fig. 30) represents the same girl as is shown in the previous figure, but a block of one inch in thickness has been introduced under the

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Fig. 30 represents the same girl as in the previous figure, standing on an unlevel surface, there being a block of one inch in thickness beneath the left foot. The pelvis is therefore tilted and the spine curves with a concavity towards the lengthened leg.

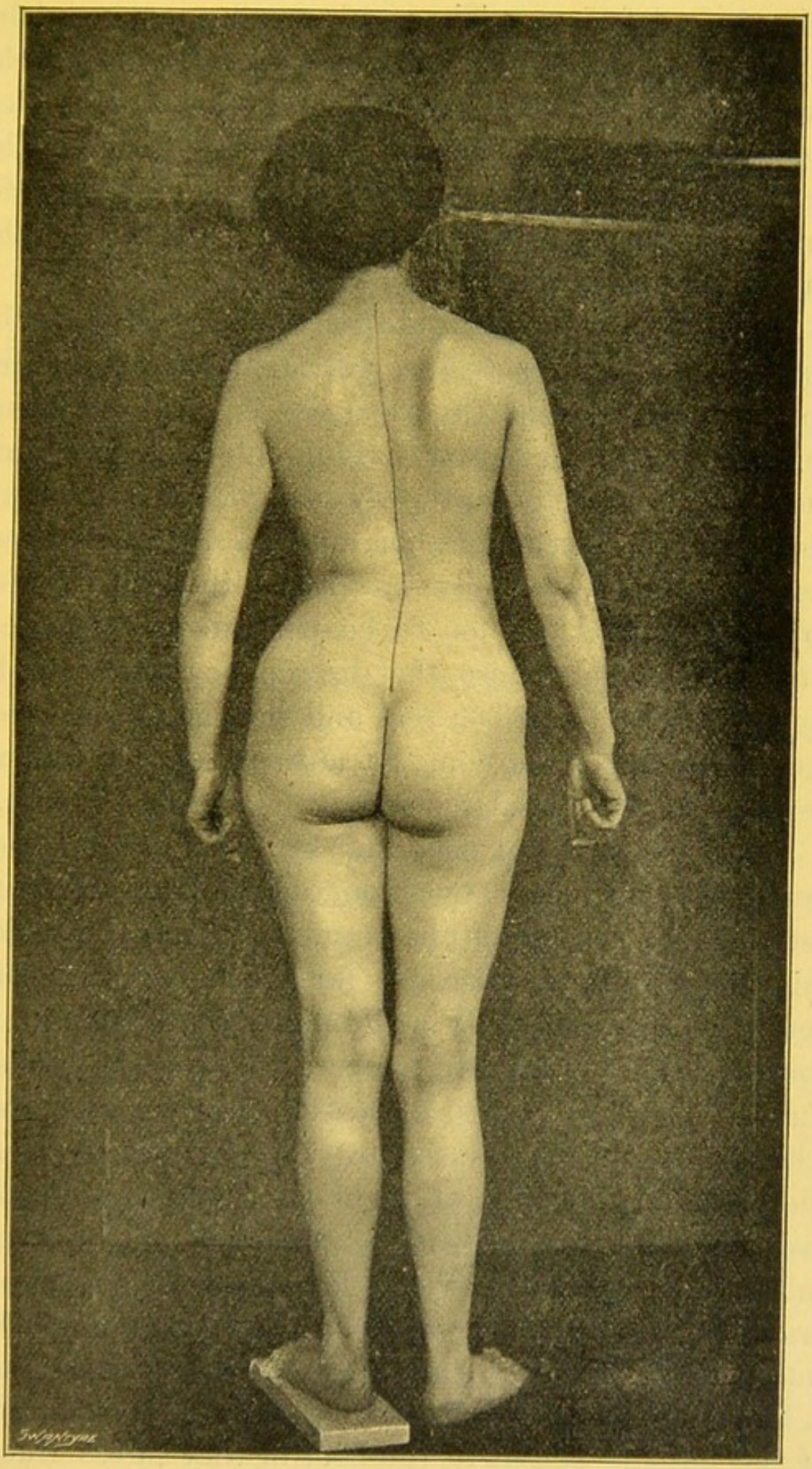

Fig. 30.

sole of the left foot. The result can be expressed by saying that the left leg has been lengthened to the extent of an inch, or alternatively that the right leg has been relatively shortened to the same degree. The pelvis is therefore tilted and the accommodation of the centre of gravity over this uneven base causes the curve that is exhibited.

Now, the curve induced by this disparity in the length of the limbs is here only temporary, and disappears the moment the cause is removed. We are constantly walking or standing on unlevel ground and the pelvis is thereby constantly being tilted first in one direction and then in another, and the spine with equal constancy is perpetually curving, although only for so short a time as not to be permanently affected. But if from any cause the discrepancy between the length of the limbs is a real and persistent one, then the curve, which is no longer transient, tends to become permanent as a fixed curvature.

It may be stated at once that by far the commonest cause of **extrinsic** lateral curvature is a disparity between the length of the legs. The ways in which this disparity may arise are far too numerous to be detailed here, especially as I shall have occasion to consider them elsewhere under the head of Extrinsic Curvatures. But this, at least, may be said, that whilst some of the causes are very obvious, and can therefore be remedied at their outset, some are quite insidious, and are not usually discerned until the resultant curvature has arisen. For example, if a patient breaks his thigh, or if he suffers from a congenital dislocation of the hip, the shortening of the affected limb is looked for, and is dealt with at once by the addition of the missing height to the boot of that side. But if

the shortening is slow and insidious, then it may be entirely overlooked. As an example, I may quote a condition to which I believe I was the first to draw attention in the 'British Medical Journal' (April 6th, 1895), and again in an article in the 'Lancet' (December 21st, 1901), and for which I suggested the name "infantile trophic paresis." This ailment appeared to me to be akin to ordinary infantile paralysis, only that the trophic centres rather than the motor ones were affected. Hence, as there was no loss of power at the time of its inception no notice could be taken of the condition, although, from the outset onwards a trophic retardation took place in the growth of one of the lower limbs, which very gradually became shorter than the other. The pelvis, therefore, was slowly tilted down to one side, and an accommodative curvature was initiated, which little by little increased until its detection became the first indication of this peculiar trophic defect in the limb. I have found this trophic paresis to be so extremely common that I have little hesitation in saying that it is by far the most usual cause of extrinsic lateral curvatures.

It is always, of course, the duty of everyone who is examining a deformed spine to ascertain first of all whether the pelvis in standing is actually level or not. The common way of doing this is to lay the patient supine on a couch and to test with a tape measure the length of each leg, either from the anterior superior iliac spine to the inner malleolus or from the great trochanter to the outer malleolus. Such a method is inaccurate and fallacious. The proper plan is to remove the boots and to disrobe the patient to the pelvis, and place her with her back to the light whilst the examiner kneels behind her with his eyes on a

level with the top of the pelvis. The patient's ankles are then put together (or her knees, if she is knock-kneed, which is not uncommon with women), and the knee-joints are fully extended so as to completely straighten the legs. When all this has been done the examiner slips the fingers of his hands horizontally in over the iliac crests and he can instantly ascertain if they are level, taking if necessary the horizontal lines on the wall of the room in which he is as a guide. If the hips are not level, then blocks of wood, graduated in thickness from an eighth of an inch upwards, are slipped beneath the foot of the lowest side until the pelvis is perfectly true. The thickness of the blocks can then be read off, and this gives the amount that has to be added to the boot to render the pelvis mechanically level.

Now, with a disparity that has been immediately caught and made up, the spine of course is not affected at all. A surgeon ordinarily after fracture of one of the bones of the leg takes care that the shortening, if any, shall immediately be measured and rectified, and therefore as the patient resumes walking, he does so with his pelvis already excluded from tilting. Consequently no treatment of the spine itself is ever necessitated.

But in those cases in which the curvature itself is the first indication of inequality in the limbs, the detection of disparity has probably never been possible, because no occasion may have arisen until then for the limbs to be surgically examined. In such cases, therefore, two things become absolutely necessary. The first is that the length of the shorter limb should be properly restored by a heightened boot, and the next is that the spine itself should be brought into rectitude

by an appropriate appliance. It might at first seem that, as the curvature has been induced by the shortness of one leg, it would be quite sufficient to restore the latter to its proper length, and that the spine would thereon straighten out, and that, therefore, the use of any appliance to guide it into truth would be entirely unnecessary. But precisely the opposite is the case. For if the mere heightener be added to the shortened leg so as to bring the pelvis into truth, and if the spine be allowed thereupon to follow its own unguided way, it will be found that in its attempt to replace the centre of gravity of the body duly over the legs, it does not do so by unfolding and straightening out the original curvatures, but that, on the contrary, it does so by initiating new curves that are counter to the former in direction. Hence if there is a single curvature it is simply converted into a double one, and if there is a double curvature this is forthwith further intensified. And hence also it is obvious that it is absolutely requisite to guide the spine into straightness over its restored base by the use of an appropriate appliance. Or, in other words, one must not only deal with the leg but one must also treat the spine itself as well. Now, there are several points that are accessory to these general principles on which I may make observations. One is that where the discrepancy between the legs is considerable and the induced curvature is consequently very marked, it is not always wise to add the whole of the heightening at once. If, for example, the shortage of the leg was a good inch, I should only add half an inch at first, and at the end of three months or so another quarter of an inch, and the final quarter-inch probably after an interval of another three or four months. The reason of this has been previously indi-

cated, and it is because the spine, if its base is too suddenly rectified, tends to take its own course of accommodation by intensifying or re-duplicating the original curvatures. If, therefore, the base is gradually restored while the spine is being guided into straightness by the appropriate appliance, this chance of what I may term self-willed action is obviated. And another point is that a leg may be functionally shortened, although its component bones are of correct length, by some such deformity as contraction of the knee or one-sided flat-foot. In such instances, of course, the cure of this deformity of the limb would be effected in lieu of adding a heightener—the curvature of the spine all the while being straightened out by an appropriate appliance.

One other point also arises. It is known that if the hips are level, a curve can be initiated by lengthening one of the legs. Now, supposing that a patient is affected by a single curvature of the intrinsic type (that is to say, originated within the spine itself and not due to extrinsic provocation from without) is it justifiable to counteract this curvature by tilting the hips and provoking a curve in the opposite direction? My answer is that this is an entirely faulty method of practice. The spine should be straightened by the proper appliance and not by endeavouring to substitute a new untruth in the attempt to remedy an untruth that is already existent. In the matter of the spine two such negatives will not make a satisfactory positive. Indeed, I end as I have started, by asserting that the whole end and aim of treatment by an elevated boot is to bring the pelvis into level truth, and any deviation from this course will only end in faulty results.

Weight treatment.—In all cases of dorsal lateral curvature the ribs on the convex side of the curve tend to fan out, and in consequence to carry the clavicle and the scapula upwards. On the concave side precisely the reverse is the case. The popular mode of expressing these results is to say that the one shoulder has grown higher than the other. And it is a fact that, in order to remedy this defect and to concomitantly straighten the spine, some surgeons in old days were wont to advise that such a patient should walk about for some portion of the day carrying a heavy weight in the hand on that side on which the shoulder was elevated. Even in recent days so great a surgeon as the late Sir Prescott Hewett (who was kind enough to send me his cases) could not divest his mind of this view, and employed the carriage of a weight as an adjunctive treatment. For it appeared to him that if a contracted limb could be straightened by the tension of a pulleyed weight, so also an elevated shoulder should be capable of being depressed by the same similar method.

But as a matter of fact such a treatment tends to an effect that is precisely the reverse of that which is aimed at. For if a perfectly straight person stands erect, holding any such heavy weight as a pitcher full of water in one hand, then the spine, in adjusting the conjoined centre of gravity of the body as well as that of the pitcher, is provoked into a curve that has its convexity to the side on which this weight is borne (Fig. 31). And the heavier the weight the greater will be the curve that is thus induced. Hence it is evident that if a weight by its carriage is to be of any effect whatever in unfolding a spinal curvature, it should be borne on the side of the depressed shoulder,

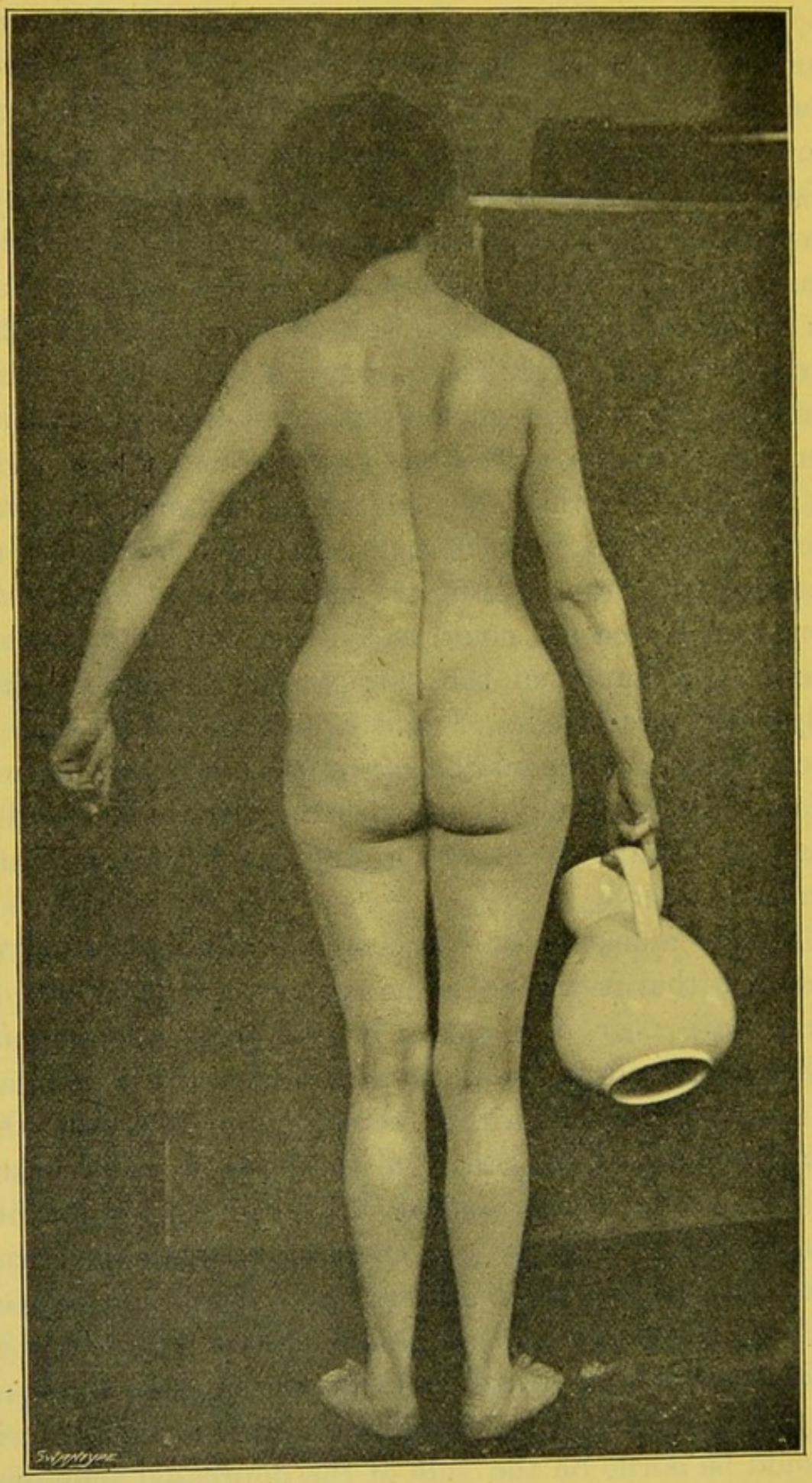

FIG. 31.

and not on the side of the elevated one. But even if so correctly used, there is not the slightest evidence that such a method would be of any service. Indeed, if treatment by weight were to be of any value at all, the weight itself should be borne on the head and nowhere else. It has been asserted that in Eastern countries amongst the women who carry pitchers of water from the wells upon their heads spinal curvature is unknown. That there is no truth in this statement I have had opportunities of ascertaining; still, theoretically it had some appearance of consistency. But in any event an adjunctive treatment by the carriage of weights is now entirely obsolete, and for the simple reason that all the necessary cure is readily effected by such appliances as have merely to be worn as garments by day and without the tedious necessity for troubling about any other accessory obligations.

Recapitulation.—Such, then, were the adjunctive treatments that had been tried and tested before the year **1870**. As will have been seen, they most of them aimed at producing accommodative or provoked curves that should be antagonistic in direction to already existing curvatures, and this was generally attempted by some irregularities either of the base on which the body rested or of the burden which the spine had to bear. In winnowing out what was ephemeral and useless from what may be accepted as of persistent and of proven value, it may at once be said that the treatment by seats and by weights may be relegated to the limbo of unrealised speculations. On the other

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Fig. 31 represents the same girl as in the two previous figures, standing on level ground but carrying a heavy object in the right hand. The spine therefore curves with a concavity towards the left side.

hand, the restoration of the pelvis to its true level by means of a properly heightened boot must always remain a fundamental principle of rightly dealing with curvatures. As to couch treatment, all the varied recumbent methods of coping with curvatures by day-time have been entirely superseded by the use of perfect and appropriate appliances. By night it may not be disadvantageous, in cases of single lateral curvature, to endeavour to make the patient lie during sleep on the side that unfolds the deformity—that is to say, on the side of the prominent hip. But of all adjunctive night treatments there is only one that completely fulfils the conditions necessary to attain the cure of curvature, and that is a method embodied in the "Heather Bigg" couch invented by my father. As has been noted, it acts on the spine both by extension and by the gentle application of direct force over the errant parts, and, as it continues by night the process pursued with the proper appliance by day, it therefore very materially expedites cure. It is somewhat curious that in England its use has of late years been rather neglected, but in Scotland and other countries it is to my knowledge very widely employed.

Conclusion.—Before closing this section I may perhaps briefly refer to certain subsidiary treatments which are sometimes held to be accessory to the principal method. Of such a sort are the application of cold or salt water douches to the spine, the employment of electricity or massage to the spinal muscles, and the exercise of these latter muscles by gymnastic movements. But none of these treatments are applicable except in the minor run of cases, and cannot, therefore, be viewed as broadly and generally adjunctive.

The use of tonic baths is a constitutional rather than a particular remedy. Electricity, whilst it may prove of distinct service in those rarer cases of curvature that are of paralytic origin, may be regarded rather as falling within the therapeutics of the nervous system. And massage, or, as it was originally designated, shampooing, before this word had become restricted to the province of hairdressing, may also be rightly regarded in a similar and separate light. All of these remedies may be of distinct service in special cases, which must accordingly be discriminated, and under these special heads I shall elsewhere refer to them. But they cannot claim to hold the broad position of generally adjunctive methods. And the same also may be said of treatment by gymnastic exercises. This was very carefully tried in the "forties" and "fifties," and failed entirely in its prospective results. Recently, however, it has been resuscitated by arguments and advertisements that have appeared to me to be rather diplomatic than scientific; and it has obtained in consequence a very distinct hold on the public mind, a hold which is not in any way justified. However, later on, when I come to review the modern methods of treatment, I shall very fully give my reasons for this adverse opinion.

SECTION V

Author's own Methods of Treatment
1870 to 1905

Preliminary remarks.—In the previous pages I have traced the history of spinal curvatures down to the year **1870.** I have shown the manner in which the mechanical principles of treatment were evolved through centuries from the time of Hippocrates onwards. I have paused at some length over the work of Percivall Pott because he was the first to differentiate between spinal caries and spinal curvatures proper—between the disease and the malady. I have indicated the fact that whereas spinal caries must in its acute stages, of necessity, be treated by a purely passive splint for the purpose of attaining absolute and static quiescence, lateral and other curvatures require to be dealt with, on the contrary, by such dynamic appliances as shall exercise active forces for the restoration of the bodily shape. And then, leaving caries entirely on one side as a separate disease, whose treatment has long since been put beyond modern dispute, I have described the steps by which my own immediate predecessors advanced the treatment of curvatures by curative appliances, basing my assertions on the records I have in my possession. I have given an account of the appliances invented by my father, who had by **1870** brought the long evolution of the mechanical treatment

into practical perfection. And I have finally detailed certain adjunctive treatments which had been introduced at various times, some of which were of little value, some of distinct service, and one of which at all events—the levelling of an uneven pelvis—was of paramount and primary importance.

Having thus followed the treatment of curvatures from the earliest times down to its existent state in **1870**, I have now to continue the narrative, and in so doing to cover the period of my own personal experiments and experiences during the last thirty-five years. And for the sake of clearness I propose to immediately divide the subject into two distinct partitions, which although concurrent in time, are quite diverse in scope. I shall in the first place give an account of those methods which after careful trial I have personally found to constitute the most efficient plans of treatment. And I shall then devote some subsequent sections to the consideration of certain alien methods which have at various times been introduced as substitutes for the established ones, and which, from the fact that they have invariably waxed with a few years into notoriety only to wane away into disuse with the same comparative rapidity, may be designated as ephemeral. Hence, although the years to be covered are the same in both instances, still, I believe these two different aspects of view, taken separately, will prevent any needless confusion.

Author's original experiments with various forces.—The additions that I have been enabled to make to the details of mechanical treatment may not seem so very numerous nor so very startling, seeing that I was in the position of one who succeeded to a full heritage of

ideas that had already accumulated round this special subject. Still, although of all sciences the mechanical is the oldest and its principles have been the longest understood, yet new ways of application are constantly arising with the increasing ingenuity of each succeeding generation. I shall therefore proceed, not only to recount the inventions that I may have personally added to them, but shall also give the steps by which they were gradually arrived at.

During the earlier years of the "seventies" I was simply a student at the hospital, seeking to observe everything that might bear on deformities in general and on the spine in particular. It was during this period that the plaster-of-Paris treatment was introduced into England by Sayre, of New York, and I had ample opportunities of immediately acquiring the method of its application. Now, my father was one of those broad-minded men who thought that everything that was newly advanced should be fairly and honestly tried, and that any subsequent condemnation should depend rather on practical test than on theoretical arguments. Hence, when I came home in **1876** and the plaster splint was becoming "the rage," a room was set aside in our house, and it was my duty to put on these splints in cases selected for the plaster treatment. And as the method grew to its acme shortly afterwards, and as, also, most of the principal consulting surgeons sent their cases to us for the application of the splint—for they also were equally anxious to test its efficacy—it is, perhaps, no exaggeration to affirm that certainly up to **1882,** and probably even to the present date, I had put on more plaster-of-Paris splints to the spine than anyone else in England. In the meantime, whilst I was daily rolling these splints

in my own room, my father was in his rooms still pursuing the old-established treatment by mechanical appliances. Hence, for the purposes of comparison, the two things were going on side by side. And as we both kept careful notes and case-sheets of the results, and as likewise it was my duty at the end of each day to write up these notes in our conjoint case-books, I had naturally very ample opportunities of carefully weighing the respective merits of these two different methods, and, moreover, I expressed my conclusions, in a couple of published books, as being entirely adverse to the plaster treatment—conclusions that were ultimately expressed in almost the same language by the International Medical Congress of **1881.**

It will therefore be seen, and it is evidence of an open mind, that neither my father nor myself maintained any bigoted or unreasonable adherence to one single routine of treatment, and that my own work at that time was not the pursuit of the mechanical method (with which our name was generally associated) but that, on the contrary, I was relegated to the duty of testing a fresh and altogether different plan of treatment, which happened to be then on its trial. Had it proved better than the mechanical method, we certainly should have adopted it. But in the meantime we pursued the safer course of continuing the old and efficient mechanical treatment with the mass of cases and of testing the new treatment in cases that were specially set aside for the purpose. And the ultimate failure of the plaster plan proved the wisdom of this tentative and alternative method of procedure.

And as it was with the plaster treatment, so was it with the gymnastic treatment. It had a vogue in the "forties" and the "fifties," when my father tested it

most carefully, and with adverse results. It was again in recent years resuscitated, and again for several years I tested it carefully in selected cases, and also again with adverse results. But, as I shall have to refer to this particular method in complete fulness later on, I need not dwell upon it here; indeed, I only refer to it to accentuate a principle. It would be quite immaterial to me by what plan I dealt with spinal curvatures provided that plan produced the best results. And it is precisely because I have carefully tested all other new treatments with unsatisfactory results that I have adhered to the mechanical method as still proving, as indeed it has done in the past, the only successful treatment.

But I will revert to narrative. During the six or seven years that represented the rise and fall of the plaster-of-Paris method my duties left me considerable leisure, and this I devoted to carefully investigating such active forces as could be adequately employed in restoring the misplaced parts of the body into their proper positions, or, in other words, the forces that were available for the remedy of deformities.

In the first place, I began by studying the bones and ligaments of the body afresh with the aid of rule and compass, examining them rather as a cabinet-maker or a watchmaker would do than in the way a surgeon is accustomed to regard them. For operative purposes, of course, an intimate acquaintance with lines and processes and tuberosities, and with such named parts is naturally essential; but for the exercise of mechanical force upon joints, whether such force be gentle or abrupt, it is the knowledge of the machinery of the bones and ligaments, and not of their configurative landmarks, that is principally required. And it was

this mechanical knowledge that only thirty odd years ago enabled the thoughtful but unqualified bonesetter to reduce a dislocation of the hip-joint in five seconds by manipulation, whilst the experienced surgeon was still wasting his time over ropes and pulleys. Force of any kind to be properly employed must be exerted in the right direction, and, as in the instance quoted, a minimum correctly applied may easily and rapidly effect what a maximum, wrongly used, could only accomplish with lengthy risk and prolonged difficulty. Therefore, with all jointed parts—and the spine is the most jointed part of the whole body—a knowledge of right direction must necessarily underlie all successful exercise of any employed power.

And in the next place I made careful experiments with the various practicable forces. I was not at the outset enabled fully to do so with respect to the spine, because, as I have said, my father reserved to himself the mass of those cases that were to be dealt with mechanically, and only allotted to me those that were relegated to the plaster-of-Paris treatment; hence it was only during his autumnal holiday that I at first had occasional opportunities in the former respect. But he handed over to me many of his cases of club-foot, and these, not only on account of the simplicity of the bones and joints involved, but also because the direct results of any applied force could be more readily discernible, perhaps afforded the better field for preliminary investigation.

The contemporary methods of straightening out club-foot included rack-force and spring-force. Both of these had been introduced by Tisphiane and Scarpa, and had been adapted and applied by means of the shoe that bears the name of the latter. To these forces

my father had subsequently added the elastic power obtained from the use of indiarubber cords. And, of course, Stromeyer had concurrently devised the release of resistance by means of subcutaneous operation, although that is a point which I shall here disregard as being outside the matter under consideration. The forces therefore in usage were of two kinds. In the first place, there was rack-force, which, provided always that the mechanism of its application was sufficiently strong, was practically and rigidly irresistible; indeed, it could be pushed into actual fracture of the bones themselves, supposing such was requisite. And next, there was resilient force, exerted either by metallic springs or indiarubber cords, which could be graduated by appropriate tension to any desired grade of strength, and which, moreover, was gentle, though pertinaciously persistent in action.

Now, when I first turned my attention to the cure of club-foot it had long been a conventional custom (and I know not for what reason), to employ rack-force by night and elastic force by day. In bed the patient wore some improved modification of the original Scarpa's shoe. This was first of all turned by the key into the shape of the deformed foot, which latter was then laced or strapped within it. The key was then again employed to straighten out the shoe as well as the contained foot into the best position that the patient could tolerate during sleep; or, if one may put it in other words, the production only of pain represented the check-point to straightening. In walking by day, a boot was worn attached to such surgical mechanism as best allowed elastic cords to exercise their tension in the desired direction, a thing that was certainly not uncomfortable.

After pursuing these two methods according to customary routine for a year or so, it occurred to me that there was no valid reason why elastic force should not at night be quite as efficient as the rack-force usually employed, and, further, that if this were so, all the cramping pain that was generally caused by the use of rack-force would be obviated. And when at last, after testing this new procedure, I found that the beneficial results more than outreached anticipation, I discarded rack-force from the treatment of club-foot once and for all.

Having reached this discrimination of forces in the treatment of club-foot, it seemed to me that similar principles should also be applicable to cases of curved spines, and that resilient force rather than rack-force would always be most appropriately employed in dealing with curvatures. Now, I have already shown (Section III) that in **1870** two very distinct appliances were in vogue for such treatment. In both of them steel plates were employed to bear on the errant parts of the body. But in the one the active power was obtained by means of rack-levers, whilst in the other it was exerted by spring-carriers. The position seemed, therefore, precisely analogous to that which had been existent with club-foot, and I came to the conclusion that, notwithstanding its proven efficiency in the past, the use of rack-force could be entirely discarded, and that all attempts at inventions in the direction of improved appliances should be made with resilient force as the active agent.

In **1881** the plaster-of-Paris system, which had been somewhat pompously introduced by Sayre "to the exclusion of all other treatments," and which had been raised by him into a great but transient notoriety,

received its decree of extinction at the hands of the International Medical Congress; whilst the mechanical system, which it was intended to supersede, and which it had not even in the least degree affected, continued to maintain its established and paramount position as the best and most certain method of treatment. In the same year also, owing to the death of my father, I was left with a perfectly free hand to put to the test the result of my recent experiments with spring-force, and I published within a short time an account of the appliance here shown (Fig. 32). It consisted of the usual and essential pelvic band and lateral uprights, but the active power brought into play on the body was exercised by a strong steel spiral spring which, starting from the front of the pelvic band on the side opposite the convexity of the lateral curve, wound round the back of the body and terminated in a steel plate that rested on the rotated ribs. The circular force and direction of this spring were designed to reverse the rotation of the ribs and to bring pressure to bear on the convexity of the curve. Theoretically nothing could be seen more perfect in device nor more likely to attain practical success. And in testing the efficacy of this new invention I pursued precisely the same plan as that which had been adopted in testing the plaster-of-Paris method. I did not apply it indiscriminately to the exclusion of the older appliances, but simply selected a few very suitable cases, with such near residence that they could be under careful and constant supervision.

The results—and it took a few years to reach them—did not come up to the anticipations that I had formed from the somewhat analogous results in club-foot. On the contrary, they were distinctly less beneficial than

those attained with the older form of spinal appliances. It appeared, indeed, almost as if this circular exercise

FIG. 32 represents an appliance exercising spiral spring-force on the body—a method that proved unsuccessful.

of spring-force upon the body rather provoked it to rebel into an undesired direction than to be persuaded into a right one. When, however, I came to investi-

gate this somewhat paradoxical result I found out, I believe, the reason why the resilient force that answered so well in the deformity of a foot failed to do so with equally marked success in a deformity of the spine. The spine itself was many jointed, and was constantly engaged in balancing the centre of gravity of the body in its poise over the lower limbs. The foot, on the contrary, was simply attached to the leg by a simple hinge-joint and had no such balancing functions. Hence, from this difference, what was applicable to the deformed foot was by no means necessarily applicable to the deformed spine. Indeed, I have already illustrated this difference under the head of Weight Treatment, where I have shown that whilst a sufficient weight attached to the foot will by traction extend a contracted knee, yet that a weight carried on the side of a shoulder elevated by a spinal curve will, instead of depressing such shoulder, only increase its elevation and increase the spinal curve. Consequently it will be seen that I was in error in thinking that the principles that may apply to one part of the body are applicable to another part, where the mechanical conditions are different.

But it may at once be asked why I should apparently waste words in describing an invention that ultimately failed to prove successful. I have, however, done so intentionally, and for two reasons. In the first place, I was anxious to show that conclusions drawn by analogy from the treatment of one part of the body may not necessarily prove sound when applied to some other part of the body that is of diverse mechanical construction. And next, I was desirous of indicating the very careful way in which I have conducted all my experiments so as to eliminate every-

thing that had not been found wholly efficacious after the test of a lengthy trial. Hence, I am in the position to assert that the methods and the appliances which I at present use, and which I shall now proceed to describe, have been carefully tested by me for over a quarter of a century, and can be relied on to give the excellent results that are claimed for them.

Author's methods and appliances.—If the reader now turns back to the end of Section III he will find described and figured the two main types of appliances that were employed for curvatures in **1870.** One of them was specially schemed to control deviations of the spine in an antero-posterior direction—that is to say, in the mesial plane; and the other was designed to control the deviations in the lateral direction. For the sake of brevity I denominated these as the "mesial" and the "lateral" appliances respectively. But just as the universal joint in machinery is composed of two hinges allowing motion in planes at right angles to each other, and just as the conjunction of these two motions allows movement in all and every direction whatever, so it seemed evident that as the two appliances controlled curvatures in complementary planes, so a conjunction of their mechanism could control curvatures in all and every plane whatever. Hence, an attempt was made to render the mesial appliance, which was primarily intended for antero-posterior curvatures only, serviceable also in slight cases of lateral curvature by adding to its construction costal plates and lateral uprights. As a matter of fact such a proceeding was really in the nature of a compromise, based on the consideration that the resulting appliance, being made of thin sheet steel, could be completely concealed

beneath ordinary corsets; whereas the lateral appliance (as then constructed) was incapable of such unobtrusiveness.

When, however, after **1881,** I was freely able to continuously observe the effects of the various appliances, I came to conclusions so distinct that they may practically be enunciated as principles; and they are these. The simple mesial appliance should be restricted in its use to cases of purely antero-posterior curvature only. And in all cases in which there was the slightest lateral deviation, then an appliance of the lateral type should be immediately employed. For I had observed that the mesial appliance as modified by the addition of plates and uprights was by no means reliable in its effects, whereas the lateral appliance, on the contrary, was perfectly effectual. And, with lighter construction, it had been brought to the same capacity for concealment as had only been previously attainable with an appliance of the mesial type. Having made clear these distinctions in the use of the two types of appliance, I may now proceed to describe them in detail.

The appliance for mesial curvature.—It may at once be said that this appliance varies very little in construction at the present date from the form to which it had attained by **1870**, and the reason for this is quite clear. As I have shown in Section III, it had by them been developed to perfection through at least a century, and there was very little more to be added to it. Le Vacher's appliance of **1768** was its progenitor. A model of its evolution up to date was in the **1852** Exhibition (Fig. 10), and its further development by the reduplication of its back piece and by

improvements in its pelvic hold have already been described. Originally it was rigid, but with the introduction of spring-force it came to be made of any spring-strength exercised in any antero-posterior direction.

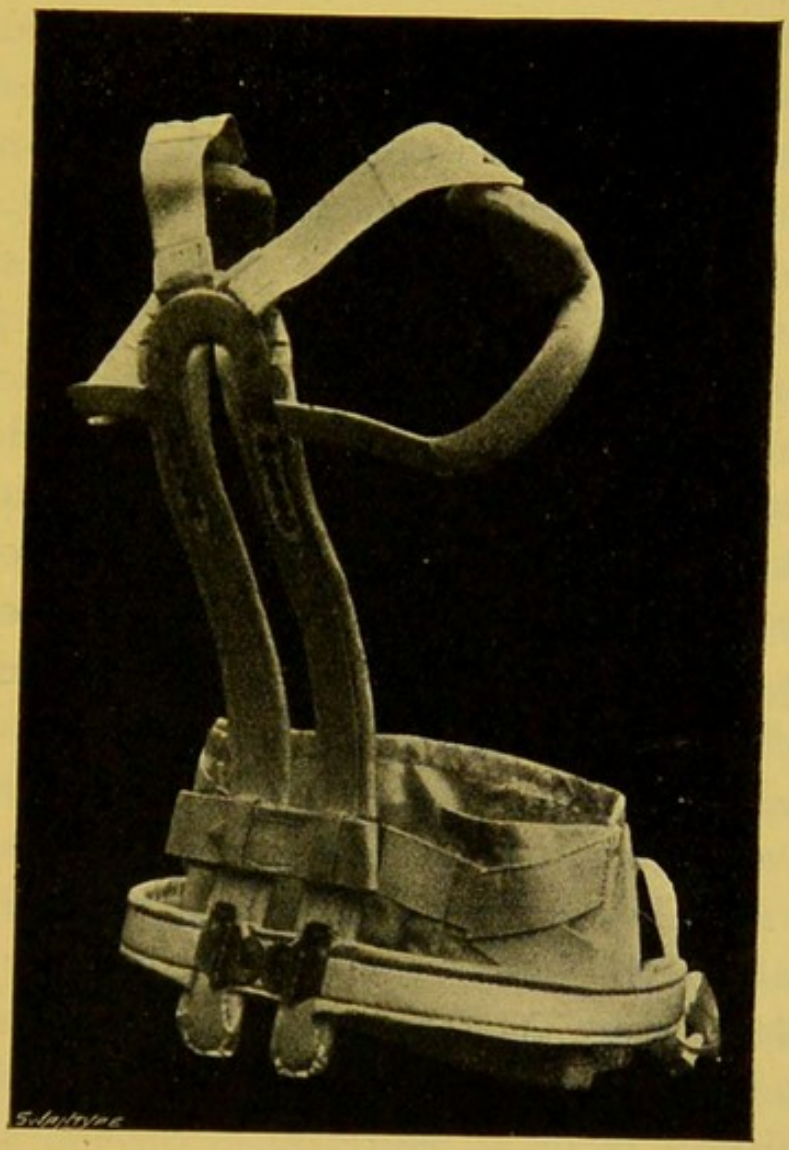

Fig. 33.—Author's mesial appliance.

In its present form (Fig. 33) it consists of a spring band encircling the pelvis in precisely the same line of hold as that taken by an ordinary double truss. From this base-hold are extended upwards, on each side of the spinous processes and over the transverse processes, two steel bands, terminating at the level of the

axillæ in arm-crutches, which pass beneath the armpits and reach upwards in front to within an inch of the centre of the clavicle. The whole appliance is usually held to the body by means of an abdominal belt, but in cases where no very great force has to be exercised (as, for example, in atonic stoop) the belt can be dispensed with, and ordinary corsets can be relied on to keep the appliance in place when these are worn over it. It will be seen that in this appliance there is nothing metallic to impinge either on the thorax or on the abdomen, or on the sides of the body, and that all these parts are left free from any restraint. As a matter of fact I shall show in the next section that the encasement of the body, even by such rigid splints as are requisite in cases of acute caries, produces no permanent ill results. Still, for the benefit of those who, contrary to all proof and reason, hold the opposite view, here, at all events, is an appliance which compresses nothing.

Its base-hold is round the bony hips and therefore below the abdomen; its counter-holds are around the bony arms and therefore above the thorax; and its back-bands lie along the bony spine, to which they dictate the necessary restoration of shape, whether forwards or backwards. The rest of the trunk has the most licensed liberty from all restraint.

In accordance with the strength and "set" given to the back-bands, so are definite results attainable. If the back-bands are fairly rigid and without spring set at all in any direction, then the appliance can act as a purely passive splint to the spine, giving it repose after strains or ricks. In a similar way it can be used for those weaknesses of the loins that are not uncommon in certain obstetric cases. If rendered

active by the exercise of spring set, it is capable of controlling and remedying all deformities of the spine that are purely forwards or backwards in direction. It can cope with lordosis or cyphosis alike, according to the direction of its spring power. If set forwards, it can be made to gradually diminish the hump after angular dorsal curvature; if set backwards, it can be made the stay towards which excessive hollow of the loins (as after double congenital dislocation of the hips) can be drawn. It remedies alike the senile stoop of age, the atonic stoop of anæmic girls, and the "alar formation" of weakly children. And it opens the chest and draws the shoulder-blades together into their correct position. In short, there is no deviation of the spine which is purely antero-posterior, whether this be due to an exaggeration of the natural curves or to the formation of unnatural ones, with which this particular appliance is not capable of coping. This is a statement of general principle. When elsewhere I come to describe and discuss each particular kind of curvature, then I shall enter into such fuller details of specific effect and action as may be required.

The appliance for lateral curvature.—So much, then, for the particular appliance adapted to antero-posterior curvatures. I now come to those appliances that are necessary for the cure of lateral curvatures. And if on account of simplicity I have dismissed the former with permissible brevity, I shall have to discuss the latter at much greater length, for the subject is more complex. In the first place, with antero-posterior curvatures, there is no need to very materially up-buoy the weight of the trunk, because the vertebræ still maintain their true mesial positions

one above the other, still work truly on their articular facets, and are still, therefore, competent to transmit any superincumbent weight symmetrically through their bodies. All that is necessary, therefore, is to obtain such sufficient hold on the body as will enable the spring-force of the mesial appliance to recall the vertebræ from their antero-posterior lapse; and it is to be observed that although the required force may be slight, yet it is capable of being exerted directly on the spine itself over the transverse processes.

With lateral curvatures all these conditions are reversed. The bodies of the vertebræ have ceased to be symmetrically superimposed one above the other, they no longer work truly on their articular facets, and they are, therefore, incompetent to transmit any superincumbent weight symmetrically through their bodies. And, moreover, whatever may be the lateral force employed to restore the spine into straightness, this force cannot be applied directly to the spine itself, because it is impossible to get at the sides of the vertebræ; and, consequently, the necessary force has to be exerted indirectly over the errant parts of the trunk.

The principles of the lateral appliance.—From these considerations, therefore, it is obvious that two distinct principles are involved in the construction of the lateral appliance, principles which it is most important to grasp, and which are as follows:

(1) The first principle is that the weight of the trunk must be up-buoyed; for thereby the whole spine is relieved of its burden, the separate vertebræ eased from the weight that tends to push them from place, and the entire trunk so upslung that it becomes more easily amenable to the dictation of curative forces.

(2) The other principle is that active force of some kind shall be brought to bear against the errant parts of the trunk, so that these latter may directly, and the spine itself indirectly, be restored to shape and place.

These two principles being quite distinct, it follows that, although the appliance for lateral curvature must conjoin the fulfilment of both of them, they must still be separately considered as factors in the conditions of cure.

The up-buoying of the trunk.—The spine, which is completely capable in health of carrying the weight of the trunk, rises from the sacrum, which is the key-stone of an arch of which the pelvic bones are the crown and the legs are the piers. As the spine courses upwards the various parts of the body are slung or attached to it. The intestines are slung to it by the mesenteries, the arms are slung to it by the scapular muscles, the thorax is attached to it by the ribs, and the head is superimposed above it. The spine, therefore, acts as a scaffolding by which all parts of the body above the hips are carried, and it is competent ordinarily to bear these parts with ease. But if from any cause the spine gives way, and it is desired to relieve it from the burden it is no longer capable of carrying, then some other system of scaffolding becomes needed, not only to prevent but also to remedy the lapse.

The way in which this is afforded is well known and is as old as the history of man himself. If any part of the bodily structure that is devoted to the carriage of the bodily weight becomes injured or incompetent, then the invalid has recourse to a common pair of crutches, by which the whole weight of the

body is borne directly from the armpits to the ground, without having to be transmitted through the spine or the pelvis or the legs at all. And similarly if the spine alone gives way, the legs remaining sound and stable, then the weight of the trunk can readily be up-borne by crutches extending from the armpits to the pelvis only, and taking their purchase on this latter part. This up-carriage of the weight of the whole or of part of the body by crutches is a very old method, and is, moreover, a matter of common experience and of common sense. And yet when anyone wishes to foist a new treatment forwards, and to discredit the established one, probably the first thing that he does is to attack this method of crutch support, simply and solely because he cannot make headway unless he does so. One instance will suffice. Sayre, who was nothing if not clever, when he wished to bring into vogue his plaster-of-Paris treatment, which from its very nature dispensed with crutches, felt bound to cover this omission by the assertion that crutches were useless. Hence, at the very outset of his book on the subject, he made the ridiculously false statement that the idea that crutches can carry the weight of the body "is simply absurd, because the mobility of the scapulæ is so great that they can be elevated as far as the endurance of the patient will allow without relieving the weight of the body on the spine." I need scarcely waste words in refutation. As a matter of fact the scapulæ have nothing whatever to do with it, because when a man is walking with crutches his body is slung on the tonic muscles that constitute the folds of the axillæ. Probably, therefore, Sayre when he wrote this sentence was quite aware of its unsoundness, but trusted that the mere appearance of pseudo-scientific reasons might

make his words skim into acceptance by the casual reader. But the ordinary "man in the street," who sees invalid after invalid walking about with a common pair of crutches to take the weight of his body off the spine and limbs, cannot be so deluded. The point is evident to him that crutches are and always have been used for such a purpose, and the thing stands staring him clearly in the face as an actual fact—a fact which all the sophistry of a Sayre cannot upset.

The manner in which the weight of the trunk is removed from the spine and is vicariously transmitted to the pelvis is simple, and can be understood by reference to the adjoining figure (Fig. 34) of the appliance I principally use for the treatment of lateral curvature. A sheet-steel band ("pelvic band") is accurately fitted to the hips at the level of the anterior superior iliac spines. Attached to this pelvic band is a gored webbing ("pelvic webbing"), which is closely modelled to the hips and which, rising into the waist, obtains over the iliac crests so perfect a hold that the steel pelvic band itself is absolutely precluded from slipping in the least from its place. From the sides of the steel pelvic band, and above the great trochanters, and therefore on a line with the legs, two vertical struts of adequate length ("lateral uprights") arise, and these, being made of flat, finely tempered steel, are quite unbulky. At the top of the lateral uprights are the crutches ("armpieces"), which are half-hoops of metal so pivoted as to allow free movements of the arms in all directions. The lateral uprights themselves are made in two pieces, which slide one on the other in such a way that the crutches can be raised to any desired extent.

The parts just described are essential to all appliances for the remedy of lateral curvature, and their

action is readily intelligible. The pelvic band, held immovably on the hips by means of the pelvic webbing, grips the pelvis and acts as a basehold from which the uplifting power of the crutches can act. The crutches themselves sling the body by the axillary folds as the arms rest in them, and as they can be

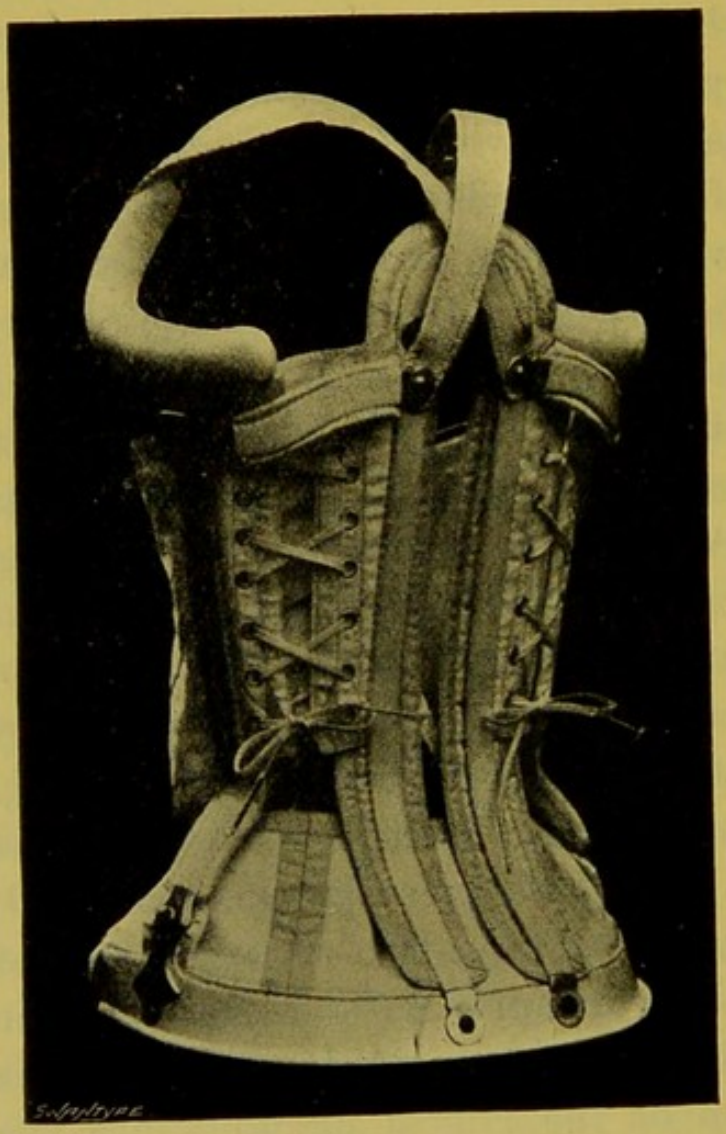

Fig. 34.—Author's lateral appliance.

raised by means of the slides to any desired extent, so can the weight of the trunk to any desired extent be taken off the spine.

Now, several most important results ensue from this uplifting of the trunk by means of the crutches. First,

the weight of the trunk is taken off the spine. Next, the trunk is so slung and buoyed that it readily responds to the action of whatever direct force may be employed towards bringing both it and the spine back into shape. The facility with which any buoyed bulk can be moved is well known. A stone, for example, that cannot be lifted by a man on dry land may easily be lifted if lying under water—that is to say, if buoyed by the water. Or, again, a huge piece of granite which it might take several horses to draw on a trolly can, if buoyed and suspended by the chain of a mason's crane, be easily slid by a single man into its place. Hence both the distorted trunk and the curved spine are infinitely more amenable to replacement when buoyed and slung in the crutches. But there is a further result that also ensues from this same use of the crutches. The arms are separated or extended from the pelvis, and the spine itself (apart from any direct power) is perceptibly straightened along all that portion of its course which lies below the third dorsal vertebræ—that is to say, along that portion usually affected by lateral curvatures. This straightening is in part due to actual extension just in the same way as a curled piece of string may be straightened by pulling on its two ends; and it is in part perhaps due also to some suspension of the trunk on the crutches. And, moreover, such straightening is readily capable of proof. For if a patient's height be carefully taken by a measuring standard before the appliance is first put on, and if the height is again taken immediately after the appliance has been put on and after extension has thereby been effected, a notable increase in bodily height will be at once discernible, an increase which in an old-standing and rigid case may only be half an inch, but

which in a severe and recent case of rapid lapse may extend to one or two or even more inches. I give a remarkable instance of this fact in a case which I am fully describing in the final section (Section VI), and reference to which I commend.

To sum up, then, the results attained by the use of the crutches and of their elevation on the sliding uprights are: (1) the relief of the spine from the weight of the trunk; (2) the upbuoying of the trunk so that it becomes more amenable to the action of direct restorative force; and (3) the actual straightening effect on the spine by extension.

The application of direct force.—Having thus considered in adequate fulness that upbuoying of the weight of the trunk which constitutes the first of the two principles governing the mechanical treatment of curvatures, I will now review the second principle—that is to say, the application of direct force to the errant parts of the body, so that these directly, and the spine itself indirectly, may be restored into their rightful places. And it will be found that in so doing I shall have to place on record certain observations which have not only been hitherto unpublished, but which so simplify the treatment of curvatures that they may almost be said to constitute the bases of an entirely new method.

Now, if the illustrations given at the end of Section III be referred to, and if the descriptions of them be re-perused, it will be seen that in **1870** the application of direct force to the trunk was effected by steel plates broadly fitted to the errant parts, and that these plates were pointedly pressed home against the body either by the rigid action of racked bars, or by the resilient

power of steel springs. I have pointed out that for at least forty years previously rack-force had been satisfactorily though clumsily used to effect restoration of shape. And I have subsequently shown how rack-force began to be very reasonably superseded by spring-force, and with such obvious advantages that the former gradually tended to become obsolete. Still, whichever of these forces was selected, the method of its application was through the medium of plates, and these, if I may so put it, carried out a pointed attack on the most advanced outposts of the deformity and so sought to drive them back into the main body. And although, as was indeed natural, spring-force has now entirely displaced rack-force from usage, still, the exercise of power through the medium of plates has been continued and is employed by most practitioners at the present day.

I may state at once that, in consequence of the results of continued experiment, I have long since discarded the general use of metal plates as the medium through which curative force could be best brought into bearing upon the body, and I have substituted for them the broader and more adaptable employment of textile slings or lacing pieces; and further, that, although I use spring-force as the most perfect power for bodily correction, I do so by disposing its action generally through the whole appliance rather than by directing it pointedly and separately upon any particular parts of the trunk. Having made this preliminary enunciation of method clear, I will substantiate it by theoretical reasoning, as well as by practical evidence, and will then describe the particular mechanism by which it can be carried into effect.

As to the potency of the distribution of spring-forces

by textile bands, this can perhaps be best appreciated by considering their action in a very common bodily deformity. With an ordinary bowed tibia the usual and efficient treatment is carried out by an ordinary wooden splint and a bandage. If the splint is rightly made, it is fashioned out of some such wood as ash and of such a thickness only that it will have a spring somewhat similar to that exerted by an archer's bow. When the splint is laid along the concave side of the bone, and the convexity of the latter is firmly bandaged to the former, such a sufficient power is exerted through the diffused medium of the bandage as will gradually bring the bone into straightness. This is a fact within the cognisance of every hospital surgeon. Now, the tibia is a single and unjointed part, and therefore more difficult to straighten than a jointed part. Still, wherever possible the procedure is the same. Thus, in cases of knocked knees similar splints and similar bandages are effectually employed. And further, it is obvious that the same method of the exercise of spring-force by textile bands or bandages would be even more efficient with the many-jointed spine, provided, of course, that it could be applied. One cannot deal with the trunk precisely in the same easy way as one can deal with a limb—that is to say, one cannot simply bandage the body to a wooden splint in the same way as one can bandage a leg. But supposing any method existed by which spring-force could be exerted through a textile band on the perverted trunk, and indirectly, therefore, on the perverted spine, the same beneficial straightening would naturally ensue as in the previous instances. It is this method that I claim to have invented, and which I shall presently describe. For the moment, however, I am only enunciating the

principle that textile bands afford a better medium for the application of corrective spring-force than do the steel plates which have been mostly used in curative appliances.

Author's experiments with plants.—Now, Andry, the father of Orthopædy, was well aware of this fact, and affirmed it. Only to make it more palpably patent he substantiated it by an equivalent analogy. Hence, when he wished to enunciate the principle that a bent bone could be straightened by a splint and a bandage, he gave the drawing (Fig. 6) of a crooked tree, together with the stake and the rope that could be used to correct it. For the fact that such a tree could readily be brought into truth was a matter of common knowledge to everyone who had a garden, and capable of proof also by anyone who cared to make the experiment. Indeed, the action of various forces on living tissues is much more readily observed by experiments on plants than in any other way; for not only can they be made with comparative rapidity, but the plant itself can be afterwards cut to pieces, and its internal changes of structure can be thereby readily noted. Hence, I have myself been in the habit of conducting experiments on plants in my own garden in order to ascertain results that could by analogy be expected also upon the tissues of the human body. I tested the effects of elastic force, of rack force, of weights, of bindings, and of bandages in the training of espalier fruit-trees. I purchased crooked saplings, and when they were established in the soil tried the various means of straightening them. I perverted straight "Telegraph" cucumbers into crookedness, and I brought into perfect straightness those of the curly kind.

I need only, however, here describe in detail two of my experiments, giving these because each of them illustrates and substantiates a particular principle which is as much applicable to the alteration of shape in animals as it is to that in plants. My first experiment was a verification of the one already suggested by Andry. For this purpose I bought several crooked sapling fruit-trees, transplanted them into my garden in the autumn, and, when they were established and the sap had begun to flow in the following spring, I "subjected them to treatment," only with a little more care than is usually given by the gardener. I placed a very stout straight stake on the concave side of the trunk of the tree, just as is shown in Andry's diagram, but I inserted a hay-band pad at the top of the stake so that it could bear against the trunk of the sapling above the curvature; and I bound the whole of the curvature to and towards the stake with coarse canvas bandages, tightening these up periodically as they became loose, which was generally with the advent of dry weather after rain. Indeed, the wet caused the bandages to shrink and to thereby exercise a strong, active force towards the straightening of the sapling. A tolerably crooked sapling could readily be straightened during one season—that is to say, between the spring and the fall; but a very distorted one required a couple of seasons, the bandage pressure being intermitted during the winter when the sap was stagnant in the tree.

The experiment which I shall next give was of quite a different nature as regards the force employed,

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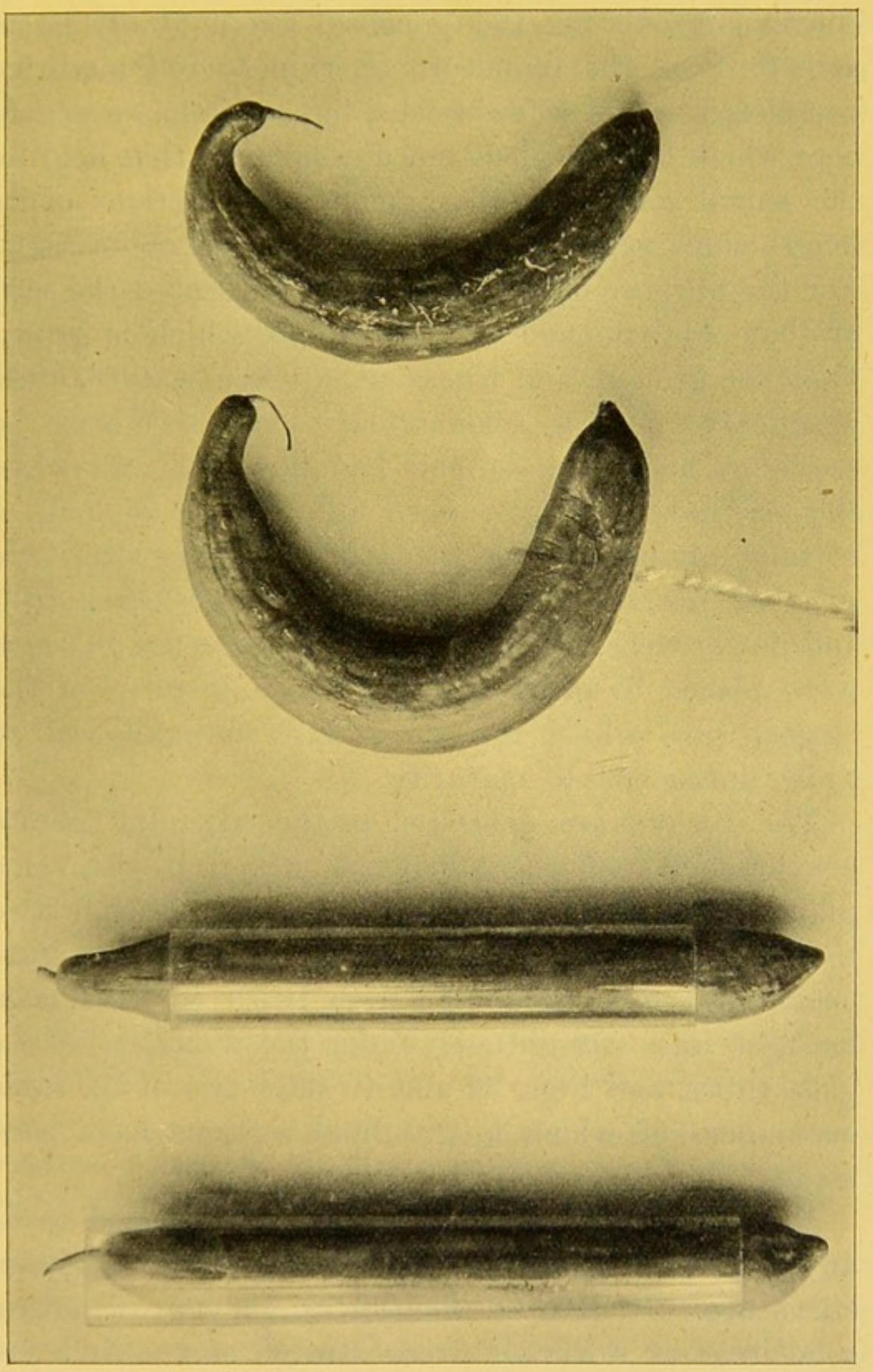
Figs. 35 and 36 represent two cucumbers of the curly kind grown into unrestrained curvature. Figs. 37 and 38 represent two cucumbers on the same plant persuaded into straightness by growth in glass tubes.



FIGS. 35, 36, 37, 38.

and it was made with cucumbers. This fruit is a very convenient one for the purpose; for not only is its growth from the miniature gherkin to full maturity completed within a few weeks, but, as it has a centre core which holds a place not dissimilar to that held by the spinal column in the human body, sections of its length show very clearly the arrangement of its parts. For the purpose of the experiment I selected the seed of that old-fashioned curly cucumber which is grown upon the ground, and whose fruit, when mature, curls practically into a semicircular shape. When the seedlings had been set and had flowered, and when the resultant gherkins were an inch or so long, a certain number of the latter of the same size were selected for the experiments, whilst all other fruit and flower were nipped off. Half the selected gherkins were placed to grow within glass lamp-tubes of the largest size, whilst the other half were allowed to grow untouched to maturity.

The results are exhibited in the adjoining photogravures of four cucumbers, all cut from the same plant and on the same day. Figs. 35 and 36 show two that have been permitted to grow untouched into their usual curl; Figs. 37 and 38 show two that have been brought into straightness under the dictation of the glass tubes, and Figs. 39 and 40 show two of the same cucumbers of which longitudinal sections have been made.

Now, these curly cucumbers may be affirmed to be affected by a persistent and inherited tendency to curvature. If left to themselves, they grow into a semicircle of deviation from straightness. And yet it is clear that, notwithstanding their strenuous proclivity towards deformity, they can quite easily be

brought into rectitude by simple mechanical persuasion. It might at first sight seem that the power of the glass tube was rigidly irresistible. But this is not so, as the force and strength of the cucumber are

FIGS. 39 and 40.

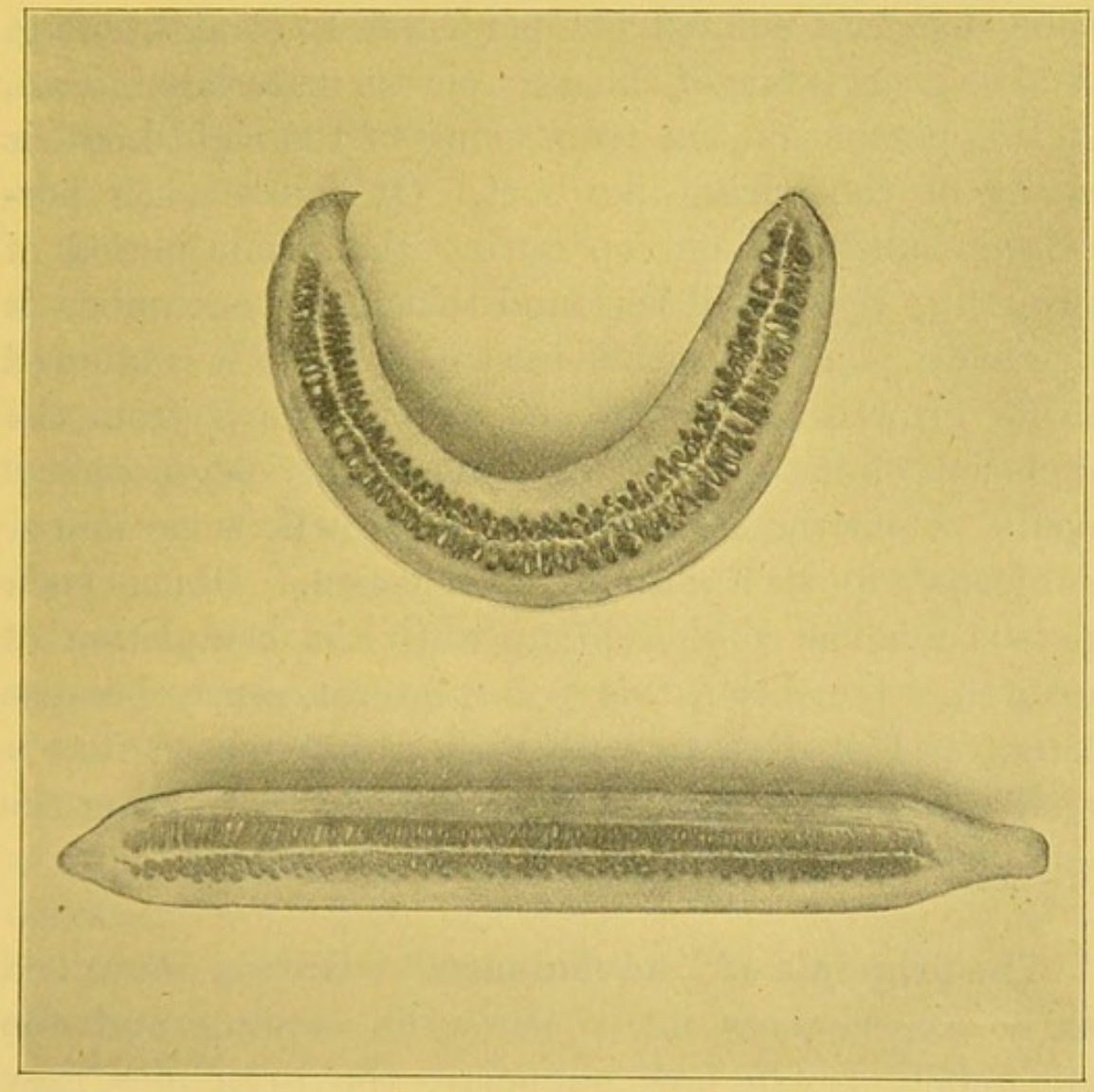


Fig. 39 represents the mesial section of a curly cucumber grown into unrestrained curvature. Fig. 40 represents the mesial section of a cucumber on the same plant persuaded into straightness by growth in a glass tube.

really infinitely greater than that of the tube. If, for example, the original gherkin is placed within a tube of a lesser size than that which will contain it at full growth, then it will be found that the cucumber, although it has readily acquiesced in the straightening

influence of the tube, when it is precluded by constriction from further enlargement, will in its expansion simply shatter the glass to pieces. Hence it is quite obvious that the cucumber has a greater strength than the tube, and that although it will yield to persuasion it will rebel against obstruction. Hence also the tube does not compel but persuades to straightening. And as glass is one of the most elastic materials known, so this persuasion, far from being of the rigid kind, is really of the spring-like sort. Of course such persuasion must be kept up during the whole period of growth. For it will be found that if the cucumber is originally placed in a tube too small, and if it is allowed in its growth to shatter and to free itself from the dictation of the tube, it will immediately begin to curl again, when the direction of its growth is no longer subjected to straightening persuasion. Hence such persuasion has to be kept up until the completion of growth. I mention this point intercurrently because later on I shall show with very strong reason that a similar safeguard has to be exercised in treating the common lateral curvature of growing girls.

The principle of "advenience."—Having described these experiments made with the sapling and the cucumber, I can now enunciate the principles they illustrate—principles which are as applicable to the curvatures of the human body as they are to the curvatures of plants. The first I have already defined, and it is this—that the exercise of active forces by textile bands over a full area of the body is better than the old-fashioned pointed pressure by plates over a circumscribed area only. And the other is this—that if an appliance of completely comprehensive hold is

made straighter than the body, it will, when worn, induce the contained body to come by persuasion towards its shape. And it will do this, not only with a growing body that is increasing in stature and in bulk, but also, although in a slower degree, with an adult body, seeing that the latter is by no means fixed in tissue, but is constantly changing its elements, or is, as Huxley has put it, a mere "eddy of atoms" which will shift under dictation just in the same way as an eddy of water will do.

Now, this principle—that the human body, when unsymmetrical, will gradually come to the shape of an appliance of diffused hold which has a greater nearness to symmetry than the body on which it is worn—I may designate for brevity's sake by the term **advenience.** It is a principle of supreme importance, for it is the fundamental basis of all the mechanical treatment of spinal curvatures. The body is as the cucumber, the appliance is as the glass tube, and the former has to come to the latter. That the human body readily responds to such persuasion, in precisely the same way as the vegetable body will do, I shall have to show elsewhere when I am dealing with the various types of curvature under their own particular headings. For the moment I elect to follow the example of Andry, and to make the principle clear by its cognate analogy in plants. The ordinary lay person cannot get several thousand human bodies in succession under personal observation as I have done. But anyone with a garden or even a few flower-pots can verify the general proposition. And in this respect a common geranium can preach more wisdom than all the books that have been written on spinal curvature throughout the past century.

The appliance for lateral curvature (continued).—Having thus carefully expounded the principles which govern the application of active force to the errant body, and having previously also detailed those principles which govern the up-buoying of the weight of the trunk, I can now complete the description of the appliance that I use by day for the treatment of cases of lateral curvature (Fig. 34).

It has already been in part described in so far as those portions of its framework are concerned which relieve the spine of its weight (p. 111). These, it may be remembered, consisted of the pelvic band, the pelvic webbing, the lateral sliding uprights, and the crutched armpieces. The additions that are needed to make the appliance perfect are few and simple. From the back of the pelvic band two steel bands arise, and extend upwards along each side of the spine over the transverse processes. These are technically known as the "back-piece," and hold a similar position to that of the back-spring of the mesial appliance. In some cases, especially those of old-standing and severe lateral curvature, the back-piece is constructed of a single band only which extends upwards along the mesial line of the body. At the level of the armpieces two "cross-bands" connect the back-piece to the lateral uprights, and whether the back-piece be double or single is immaterial. These parts complete the metal framework, which is then filled in by lacing-pieces both behind and in front, and the whole thing when so finished has much the shape and appearance of an ordinary pair of corsets. But it is in reality a tubular frame analogous in its usage to the glass tube of the cucumber experiment.

The method of its application and the modes of its

action are as follows. The pelvic band and the pelvic webbing, fitting closely and firmly to the swell of the hips, establish a fixed basis from which the rest of the appliance can act. By means of the slides in the lateral uprights the crutched arm-pieces are raised until the weight of the trunk is just borne on the tonic axillary folds. The shoulders are slightly uplifted but not to any exaggerated extent ; as a rule they do not require to be raised more than three eighths of an inch above the normal. Indeed, the very slight uplifting that occurs even when the whole weight of the body is slung on the axillary folds can be observed in any ordinary patient walking with crutches in the street. And when only part of the weight of the body—that is to say, only the weight of the trunk—is to be so upborne, the elevation of the shoulders is, of course, less. When the trunk has been so upbuoyed the lacing-pieces are tightened over the prominent and errant parts of the trunk, whilst they are left slack over those parts that are recessed from the normal shape.

The whole appliance when thus arranged acts precisely in the same way as the glass tube does on the cucumber. For if the latter is watched after it has first been placed in the tube as a tiny gherkin, it will be found that, as it grows into curl, its two ends begin to bear on the tube on the concave side, whilst its middle, which is prominent in the other direction, begins to bear against the tube on the convex side. At this time there are spaces where the cucumber does not touch the tube at all; but gradually, as the tube exercises its dictating power, all these vacant spaces become filled, until finally the cucumber lies straightly in the tube and fills it in all its parts. It is the same with the appliance and the body. The

former presses the latter over its prominent parts and compels it to fill up the vacancies left over the recessed parts. But it might be argued that the cucumber is a growing body which tends to fill up the glass tube by increment and by expansion, and that, therefore, although the analogy was quite applicable to a growing person, it was not so to an adult. But, as I shall presently show, there are reasons why the appliance will compel "advenience" even with an adult, and this by mere dictation of the steel frame to its bodily contents. But even presuming for the moment that this were not so, another principle is likewise embodied in this appliance, namely that of the sapling straightened towards its stake by means of bandages. With the sapling there is no growing (as in the cucumber) into a dictated space and yet the same result—straightness—is attained. It will be observed that the frame of the appliance being the stake, the lacing pieces act in precisely the same way on the body as the bandages do on the sapling. Hence it will be seen that this particular appliance fulfils concordantly two completely separate principles, the one, that which induces the straightening of the cucumber, and the other, that which induces the straightening of the sapling.

The principles of "set."—So much, then, for the general principles embodied in the scheme of the appliance. I now come to certain particular principles in its construction which are of paramount importance because they explain the vitality and persistency of action by which the desired results are attained.

The whole appliance is originally fitted exactly to the shape of the deformed body, the steel being at that time soft and untempered. After it has been

removed from the body this fit or "set" is altered so as to bring the appliance straighter than the body and, therefore, nearer the ideal shape of rectitude into which it is intended that the body shall come. The metal is then tempered to sword temper, and the appliance, when finally put on, is not only straighter than the body on which it is to be worn, but it is persistently exercising spring-power so as to persuade the body to come by "advenience" to its shape. And the point is this, that when the appliance is so arranged all the prominences of error over the body are being pressed back and back into place, whilst there is the precise proportion of vacant space left over the recessions of bodily error, so that these parts have ample room left into which they may pass as the body straightens. When the body has become quite straight, it precisely fills the appliance, having merged to the dictated shape by advenience.

Now, in cases of slight curvature and where the tissues of the body are quite lissome, the appliance may be at once shaped to the complete and ideal form of straightness. For, be it said, every deformed body which has lapsed from its true shape has an ideal shape into which it has to be reverted. If, then, the deformity is slight and only a little vagrant from its true ideal, the appliance may forthwith be "set" into complete truth and the body will without much difficulty respond to it. Such cases constitute those that are simple and are early caught, and they are rapidly curable, although, as I have said, relapses may have to be watched for in the years before growth is completed.

But in cases of pronounced curvature the method is different. It does not answer to put the appliance

forthwith into its perfect ideal of straightness, seeing that this would lead to a detrimental looseness of hold. The restoration, therefore, from deformity to truth is made by gradations, and in the following way. The appliance is in the first instance "set" only some few degrees straighter than the body itself. Then the necessary weeks are allowed to elapse for the body to come by advenience to the dictated shape. When this has been accomplished the appliance is again "re-set" into greater straightness, and this course is periodically pursued until at last complete truth and cure have been attained.

The question at once arises as to what interval should be allowed to elapse between these gradations of straightening. This materially depends on the intrinsic yield of the tissues, for in young people of the same age and growth there is often a very material difference between the stubbornness or looseness of their bodily tissues. Roughly speaking, however, the period of gradation varies from two to three months, according to these distinctions. Ambroise Paré fixed it at three months (p. 20), the process being repeated till straightening was effected.

Of course, in old-standing, neglected, and rigid adult cases complete straightening may not be possible; nevertheless considerable amelioration of the condition is invariably attainable. In all cases the pain concomitant on an exaggerated curvature is removable within a few weeks—indeed, often within a few hours—after the use of the appliance, which relieves the intercostal nerves from strain and from pressure. And this also, without hesitation, can be asserted, that even if the much misshapen and rotated ribs of old-standing cases cannot be restored to shape and place, yet there

is no case that is so bad that the shoulders and hips cannot be restored into level truth. This is a very broad statement, but it is a very true one.

It will at once be seen that the whole method of treatment really depends upon these graded alterations in the shape of the appliance, so that, as the body changes for the better, the spring-force of the appliance may follow it up by persistent steps until the successively enforced improvements culminate in complete straightness. This, indeed, constitutes the mechanical secret of the plan by which my father and myself have for nearly fifty years successfully dealt with cases of lateral curvature, although it has not hitherto been published.

The period of treatment.—There is another matter that is also relevant to this straightening of the spine by the graded straightening of the appliance that controls it, and it is this: that the period of treatment cannot for obvious reasons be a brief one; indeed, its duration will depend on the stage at which the curvature is caught and dealt with, as well as upon the age of the patient and the nature of the perverting influence under which the spine is brought into distortion. One may illustrate these points by considering the common lateral curvature of girls which comes on at puberty, and the tendency towards which may persist till the termination of growth. If it is caught early in a girl of thirteen or fourteen, a very few months may suffice to bring the spine straight. But if it is first dealt with after it has been going on for a couple of years, then it would naturally take a couple of years to get complete restoration of shape. The fact is, that the process of restoration is a reversal of the process of lapse, and

roughly, therefore, takes the same time to complete. But even after straightening has been accomplished there may still be the tendency to combat. Hence, with such growing girls, the case has to be closely watched till the commencement of epiphyseal ossification (at about seventeen), and less closely until its completion (at about twenty-two). Again, with curvatures due to such lesions of the nervous centres as produce paralytic or spastic results, it is not sufficient to obtain straightening, but it is also necessary afterwards to safeguard the body from relapse. And if the nervous lesion is incurable, then the appliance will have persistently to be worn even through a lifetime. Or again, one meets with severe old-standing adult cases which have been carelessly allowed to lapse without proper treatment until extreme intercostal pain or derangement of the abdominal organs have rendered treatment positively imperative. Supposing such a case had been lapsing for fifteen years, it would theoretically take fifteen years to restore the body to straightness. As a matter of fact, this is rarely attempted; but the symptoms are relieved within a few weeks by the appliance. And, moreover, the shoulders and hips are always finally brought level, a thing which may, however, take several years to accomplish; and when this has at last been done, even then a safeguarding appliance has generally to be worn continually afterwards to avoid relapse.

Now, I have dwelt on this point, that the duration of treatment must bear some direct proportion to the duration of lapse, because the gymnastic practitioner preaches precisely the reverse. His text is that cases with no osseous deformity are curable within a month, and that cases in which there is osseous

deformity are incurable, but can be brought into the best possible position by three months of his daily treatment. The whole of this proposition is nonsense. Where there is no osseous deformity there is no actual curvature to cure; therefore in such cases he treats nothing in the way of curvature. And where there is osseous deformity he pronounces his own inability to cure, yet none the less advocates three months of his treatment, and asserts that nothing further is required. As a matter of positive fact, the osseous deformity of curvature is mechanically curable in those growing persons who constitute the mass of cases of curvature, and this is readily proved by photographic and skiagraphic records. It is quite easy to get from the front beautifully clear skiagrams of the bodies of the vertebræ as well as of the ribs. Where there is lateral curvature the bodies of the vertebræ lose their rectilinear outline, becoming somewhat wedge-shaped towards the concavity of the curve. With mechanical treatment, as the weight is taken off the vertebræ on the concave side and transmitted to the other, the rectilinear outline is restored. To say, then, that osseous deformity is incurable is contrary to easily-recorded facts. And it is, moreover, contrary to common experience in other parts of the body. Every surgeon, as I have said, knows that a laterally-curved tibia is readily straightened mechanically by a splint and bandage of some kind or other. This is every-day surgical knowledge, and in respect of a single solid bone without joint. How much more readily, therefore, will a jointed part be amenable to mechanical straightening, and indeed it is so. But I need not pursue the delusive propositions of the gymnastic practitioner further, seeing that I shall very fully review them

later on, and I can, therefore, now pass to another matter.

Certain adjuncts to the appliances for curvature.—To the appliances, both for lateral as well as for antero-posterior curvatures, the jury-mast and head-slings can always be superadded, but they are very rarely needed. I have already shown, in my book on 'Caries,' that whenever the spot affected by angular curvature lies above the sixth dorsal vertebra the weight of the head has to be supported. But with lateral curvatures such procedure is unneeded. And the reason is that it is sufficient to treat the lower half of a curvature only, for, if this be restored to place, the parts above right themselves spontaneously. Thus, supposing there is a long, single, lateral curvature affecting all the dorsal vertebræ and one or two of the cervical ones, and supposing that the acme of the convexity of this curvature be at the fifth dorsal vertebra, it suffices to control and replace the curved spine below that spot, and as this lower segment of the curve is restored to place and straightness, so will the upper segment concomitantly travel into its right position. Hence the appliance for lateral curvature competently deals with curvatures whose range extends even above the apparent control of the appliance itself. But it might be argued that there must be cervical curves that required the control of the jury-mast for their treatment. This may occasionally be the case where a high dorsal curvature is associated with a cervical one. Still, it is rare that general curvatures of the spine affect the neck to any great degree. On the other hand, of course, the neck is subject to curvatures which are due to paralysis, spasm, or reflex action of

its own intrinsic muscles. Such curvatures, however, have always been separately considered under the heading of Wry-Neck, and although they come truly within the category of spinal curvatures proper, still, as their causes are somewhat distinct from those of ordinary curvatures, it has always been considered convenient to keep them in a class by themselves under a separate title.

Another very valuable adjunct to the lateral appliance is one that is of service when the body tends to tilt sideways at the hip-joints, and, therefore, at a point below the control of the appliance. This tendency, which is an accommodative one, is somewhat common in cases of caries, and is not altogether uncommon in cases of lateral curvature. In the old days it used to be met by encircling each thigh with a steel thigh-band, which was attached to the spinal appliance by a steel rod jointed opposite the axis of the hip. This plan answered its purpose well, but it meant so much extra inconvenience to the patient. Some years ago, however, whilst dealing with a girl who was recovering from caries, and who, after the necessary period of recumbency, was beginning to be allowed to walk, I noted that she tilted on one side at the hips, and I also noticed that she was wearing a waistband to which her stockings were suspended by elastic webbing. It struck me that if the stockings were suspended from the splint she was wearing, and that if the suspensory webbing was duplicated or triplicated on the side from which the body leant, then possibly rectification might be induced by the tension of elastic force. I made the experiment and it answered rapidly and admirably. Since then, therefore, and with both sexes, I have employed strong elastic tension, exercised in the same way as a stocking

suspender, to rectify the lateral tilt in question, and the results are excellent. This, indeed, is only another example of the benefits to be attained by "the application of the elastic force of india-rubber to the cure of deformities," patented by my father in **1854**.

The night-treatment of lateral curvature.—Under this heading I shall have to describe an entirely new method of treatment, from which I have obtained in severe cases some very remarkable adjunctive results. But before doing so I will first of all refer to some of those older methods of night-treatment which have previously been detailed under the head of Couch-Treatment, and which are of service in cases of minor severity.

As a rough and general rule slight cases of lateral curvature do not require to be treated by night at all, because when the body is recumbent the tendency towards lapse is practically eliminated, and, moreover, the day appliance is quite adequate alone to eliminate the curvature. Still, if any necessary precaution is to be observed, it is that the patient should, if possible, sleep on the side of the prominent hip. The reasons for this I have already given (page 67).

In cases of medium severity, treatment by night very materially expedites the process of straightening, and of all methods in vogue the use of the Heather Bigg bed-gear, already figured and described (page 74), gives far and away the best results. There are a great many girls and others who, suffering from lateral curvature, habitually sleep coiled up in such a way as to intensify their spinal deformity. The bed-gear in question not only prevents this, but it exerts an elastic tension on the body in all required and curative direc-

tions, and this, too, without any discomfort. For the first night or so it may seem a little irksome for anyone who is accustomed to sleep on the side to have to sleep on the back. But this is a mere matter of a habit which is readily acquired within a week's time.

Now, this method of treatment by bed-gear, which is largely employed in Scotland, and which has stood the test of half a century's usage, owes its efficacy to the action on the body of direct sling force, and it is based, therefore, on the principle of Andry's tree, with its stake and its rope (Fig. 6). But the entirely new method that I have next to describe is based on quite a different principle, for it depends on the fact that the body, when broadly embraced within a firm casing that is straighter and yet roomier than itself, will by "advenience" take the better shape thereby dictated to it. As may therefore be anticipated, such an appliance must necessarily be in the form of a comprehensive splint, and further its underlying principle must be that of the cucumber and the glass tube (Figs. 35–40).

The idea of such a curative splint was originally deduced by me from some observations that I had previously made in cases of caries. I have found that, entirely apart from the angularity that might occur at the diseased spot, there was very often a certain amount of accommodative lateral curvature which had arisen from the effort of the patient to assume the most convenient and accommodative position in walking, and this before the appropriate treatment by splint and by recumbency had been commenced. Now the usual strict rule in the treatment of active caries is that the splint should be purely passive and should be fitted to exactly what shape the body may have when splint treatment commences. But I ventured in many

instances to discriminate between the purely angular mischief and the purely accommodative lateral curvature, and I rectified the splint in such a way as to eliminate the latter, whilst the carious vertebræ were still held and kept in passive quiescence. The manner in which I did this has been already described and figured in my published book on 'Caries' (1902), and it is by a further expansion of the same method that the splint treatment by night is rendered so remarkably efficient in severe cases of lateral curvature, not only in those of ordinary, old-standing, adult, and neglected curvatures, but also in those of non-adult, rachitic curvatures, in which the bones are all quite soft and the ribs tend to crinkle away from their rightful shape.

The plan of procedure, taken for the sake of clearness in separate steps, is as follows:

(1) The patient, clad in a woven vest, is balanced in the usual tripod by slings under the arms, and is extended into the most erect position. Wet plaster-of-Paris bandages are then wound round the body so as to form a "shell-mould," and this latter when "set" is cut down the front middle line and removed from the body. It may be noted in passing that this mould is precisely the same as that Sayre recommended for continuous wearing as a splint, and the reasons of his failure to attain any satisfactory results by such procedure are practically made clear by the subsequent processes of my method.

(2) When the shell mould has been so obtained, the line of section is stitched up, and the mould itself is

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Fig. 41 represents the solid plaster cast obtained by "running" the plaster bandage mould taken on the body of the patient. Fig. 42 represents the same plaster cast rectified into symmetry. Fig. 43 represents a splint made on the rectified cast.

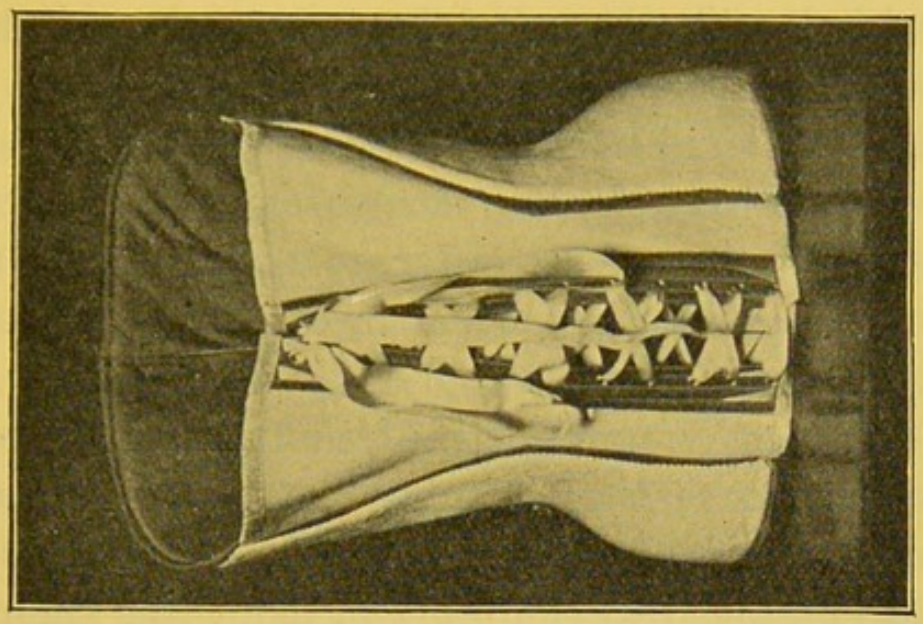

FIG. 43.

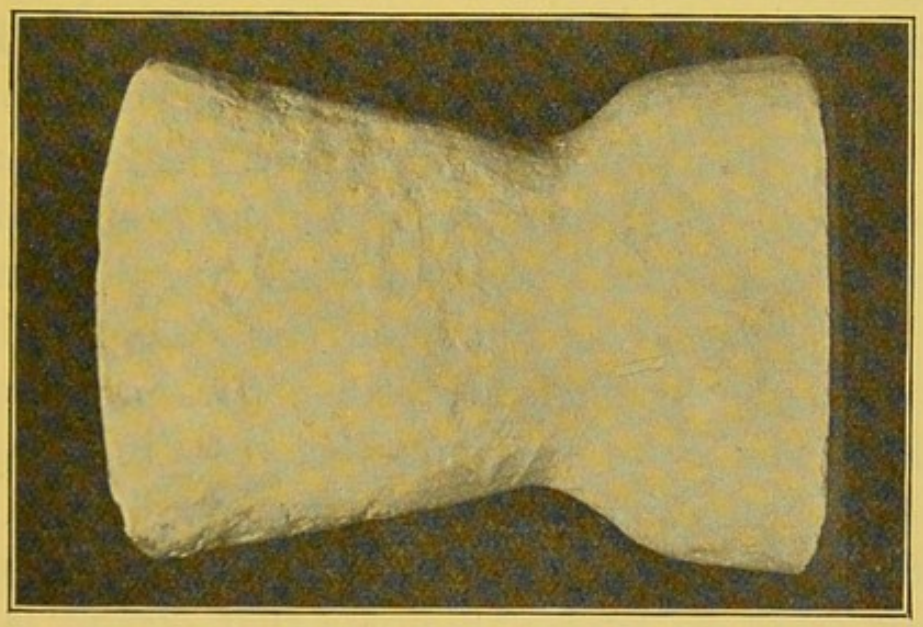

FIG. 42.

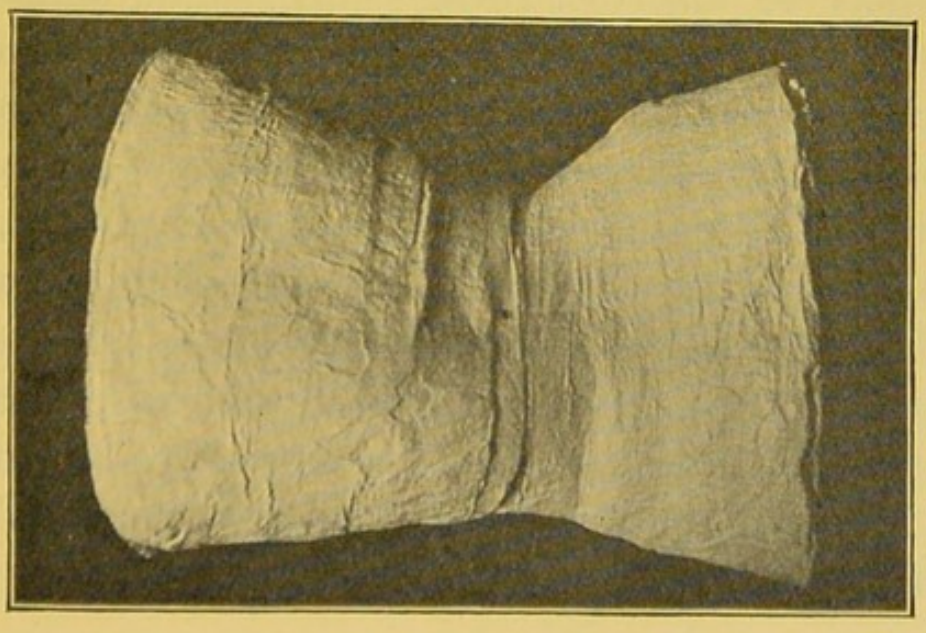

FIG. 41.

filled with liquid plaster of Paris. When this latter has "set," the outer shell mould is peeled off, and there is left a solid "cast," which represents the shape of the body drawn by the suspensory tripod into its most erect position. In order to make things quite clear an actual case has been selected for illustration, and Fig. 41 represents the solid cast so obtained.

(3) This cast is now rectified, and it is this process of rectification that constitutes the key to the whole method. It is done in precisely the same way as that which is employed by sculptors in modelling their clay figures. The distorted cast is first carefully looked at, and the symmetrical form that the body of the patient would hold if unaffected by deformity is projected in the mind of the manipulator. All the errant protrusions of the deformity are cut away and all the errant recessions of the body are filled up with plaster. When the process is complete, a rectified solid plaster block is obtained, which represents the figure of the patient as it ought to be if undeformed (Fig. 42).

(4) On this rectified block the actual splint of some very stiff material is made. This splint is then cut away in front in such a manner that elastic lacing-pieces may be inserted, these being ample across the thorax so as to admit of full respiration, and of lesser amplitude across the abdomen so as to hold the splint firmly in apposition to the lower portions of the trunk. A splint of this description is shown at Fig. 43.

The material of which such a splint should be made must be firm and also incapable of being affected by either the warmth or the moisture of the body. Leather is an excellent substance, but it is expensive on account of the labour that has to be expended in its modelling. Plaster bandages worked carefully on to the solid

plaster block yield a capital splint; but the various felts that are stiffened with gum resins are quite unreliable, as they will frequently soften and buckle up in a single night under the softening influence of the bodily warmth. In my experience, therefore, I should condemn them as things to be avoided. If a felt at all is used, that which is most ideal is a felt which hardens when it is damped. Such a felt is impregnated with a powdered cement and sets when saturated with moisture. Before being so treated it is accurately stretched and fitted to the plaster block; it is then wetted and sets firmly within a few minutes, after which it is as hard as a rock and entirely unaffected by either heat or humidity. It makes a smoother splint than do plaster bandages, but the latter are by no means to be despised, being both cheap and efficient.

Of whatever material the splint is constructed, it is to be observed that it is a "secondary" splint. The original shell taken of the body in plaster bandages is the "primary" splint or mould. The cast that is obtained by running this mould is, to begin with, the precise shape of the primary splint; but this cast is rectified and symmetrised to become the block on which the final or "secondary" splint is made. This final splint is therefore much straighter than is the body, even when brought to its most erect position by suspension on the tripod. And as the body reposes at night in this splint, it tends to come by "advenience" to its shape in very much the same way as the cucumber does to the glass tube. Or the thing may be put in a different way. The splint from its very method of shaping is bound to bring pressure to bear all over the errant prominences of the deformed body, whilst it leaves very ample room and easement over all the

errant recessions. Whilst, therefore, the body is being pressed from error into straightness, there is also ample room into which the recessions of the body can pass and dispose themselves. In the Sayre's splint there was nothing of the kind. It might press on the prominences a little, but it also pressed with the same force into the recessions, which were therefore precluded by sheer lack of room from any rectification; they could not pass into straightness because the walls of the splint itself acted as a barrier. But with my novel splint provision is made, not only for greater pressure over the prominent parts of the body, but also for ample space over the recessed portions. The difference in benefit is very clear, therefore, and distinct.

In cases of medium severity, as in the example given in Figs. 41, 42, and 43, the cast or "block" may be immediately modelled into symmetry—that is to say, into the ideal form the body would have if undeformed. But in very severe cases the same method is adopted as that which is habitual with the day appliance—that is to say, the process of rectification into symmetry has to be made by gradations. My meaning will be made clear by reference to the adjoining figures (Figs. 44, 45, 46 and 47), which represent the cast, blocks, and the splint which pertained to the "exemplary case" described in Section VI. Here the splint was first of all brought some halfway towards ideal truth, and afterwards, when the body had come by advenience to this amelioration, the block was further amended and a renewed stage towards rectification was made. But

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Fig. 44 represents the solid plaster cast obtained by "running" the plaster bandage mould taken on the body of the patient. Fig. 45 represents the same plaster cast rectified. Fig. 46 represents the same cast still further rectified. Fig. 47 represents a splint made on the rectified cast.

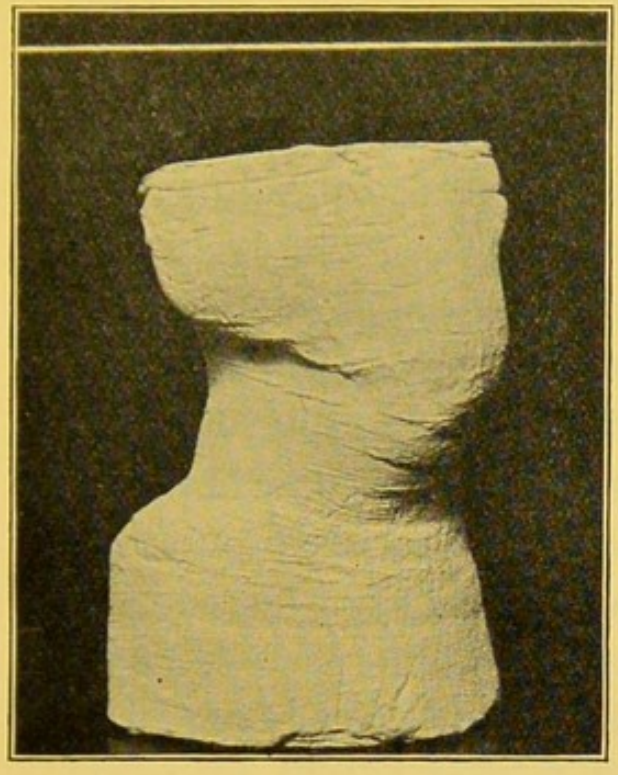

FIG. 44.

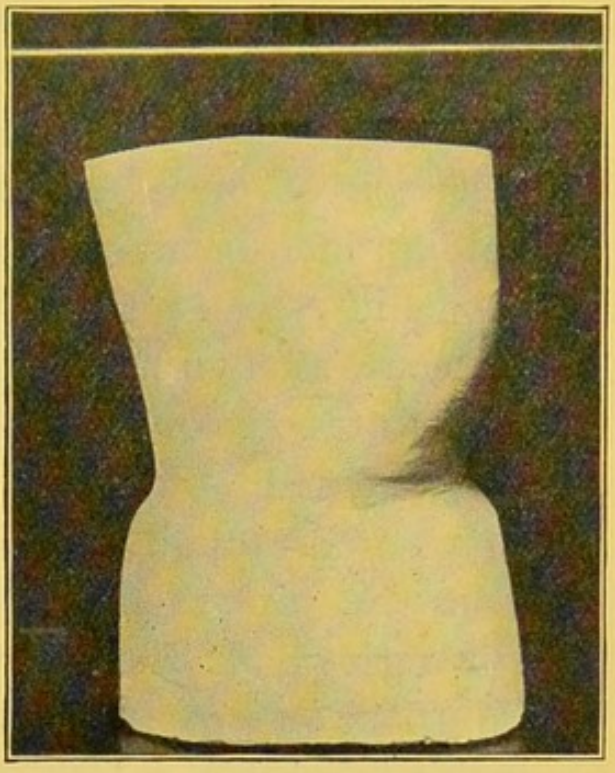

FIG. 45.

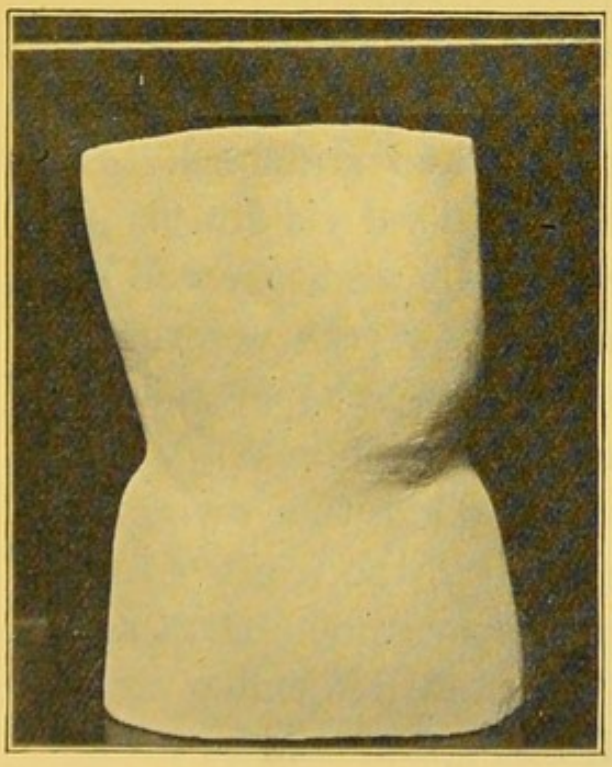

FIG. 46.

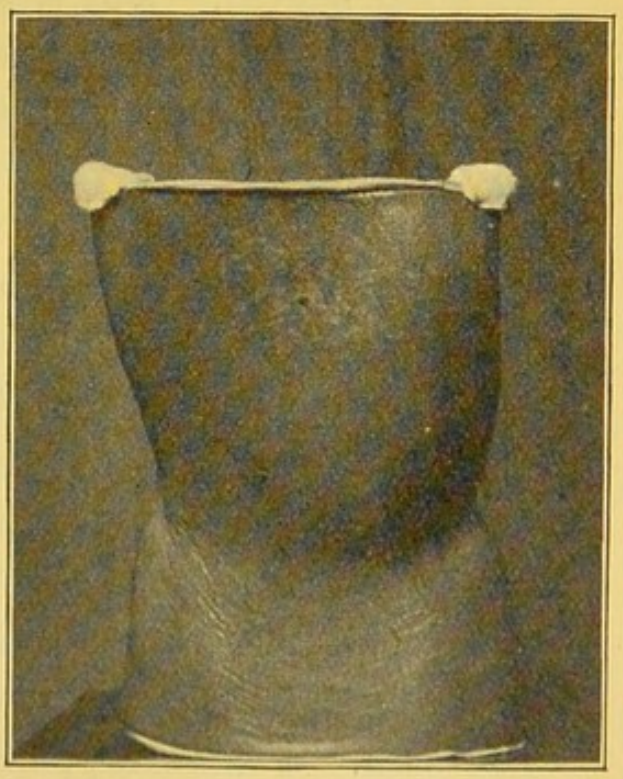

FIG. 47.

this rectification of the splint need not be so very frequently performed, as there is an accessory method by which renewed pressure over the prominences of the deformity may be attained. This is effected by the insertion of pieces of saddle-felt of the thickness of half an inch between the prominences of the body and the splint, these pieces of felt being pasted to the latter to secure their fixity. As long, therefore, as the room over the recessions of the deformity is ample enough, pieces of saddle-felt may be successively superimposed so as to gradually increase the accentuated pressure over the prominences of the deformity. Of course, when the body has duly passed over so as to occupy the room left over the recessions then a newly rectified splint is needed.

As to the cases in which the splint I have described are needed, I have already indicated that its use is not requisite in the ordinary slighter cases of growing girls in good health. But it is especially applicable to certain cases that lie at opposite extremes, either to those in which the bone tissues are very lax and loose or to those in which they are very firm and stubborn. In the former the tendency towards general yielding is so great that it is wise to cope with it by night as well as by day; and in the latter the fixity of the deformity is so stubborn that the efforts towards recuperation of shape should be as continuous as possible.

And finally, there is this to be added, that owing to the elastic lacings which firmly fill in the front of the splint, all respiratory movements are unembarrassed and the thorax is safeguarded from all deforming compression. Practically, indeed, this splint makes every provision for restoring the general shape of the trunk, whilst leaving its vital cavities—the thorax and the

abdomen—exempt from unnatural pressure or interference.

A hospital splint for lateral curvature.—The splint I have just described is the best that can possibly be produced for the night treatment of lateral curvatures, because, from its very plan of construction, it allows the most precise and regulated dictation to be made on the deformed body. At the same time, its various and necessary processes—the taking of a mould, the running of a cast, the modelled modification of the latter, and the production of the final splint—all these represent a considerable expenditure of time and a consequent outlay of money. By those who have sufficient means such a consideration would naturally not be taken into any account. But whilst it is the duty of every specialist to seek to discover, in despite of cost, those remedies that may prove most perfect for the well-to-do, it is none the less his duty to aim likewise at finding methods of treatment which with the least expense may still be valuable for the poor. When, therefore, I was working out the constructive details of the previous splint, I was also endeavouring to discover some simpler method by which the same principles of treatment could be approximately fulfilled, but with less labour and less expense.

Now, the principles themselves have already been completely enunciated and are quite clear. There must be a full and continued maintenance of pressure over the errant prominences of the deformed body, and there must also be left over the errant recessions of the body the sufficient and ample room into which the body itself, as it re-forms, can pass. And it is precisely because this latter point was missed by Sayre that

his splint entirely failed in lateral curvatures. If he had thought for a little longer, he might possibly have hit on the plan I shall presently describe. But, like most excitable enthusiasts, he was too anxious to immediately propound his ideas before he had fairly reconsidered and tested them. He put his first plaster splint on in America in **1874**, and within less than a year he was trying to teach Europe and the world, instead of taking a year or so to substantiate theory by experiment. And he, therefore, by over-haste missed the success which, if he could have seen it, was almost within his grasp.

The hospital splint that I have now to describe is made, like that of Sayre, from plaster-of-Paris bandages; and as its process of construction falls into several separate steps, I will illustrate these by diagrams drawn from a selected case. Further, as lateral curvature is commonest amongst women, I will use the feminine person in my description.

(1) The patient is clad in the ordinary tight-fitting woven vest (Fig. 48). She could for the application of the splint stand unassisted and erect, but, to save both fatigue and to prevent movement, it is often better to balance her in the usual slings under the arm-pits and to uplift her thereby into the most erect position. Actual suspension is quite unneeded. When she is so prepared the existent deformity is clearly seen owing to the closeness of the vest, and the body is now inspected in order to carry out the next proceeding.

Fig. 48 represents a patient prepared with a vest for the application of the hospital splint. Fig. 49 represents the patient with the preliminary pads in place between the vest and the skin. Fig. 50 represents the patient with the plaster bandage splint applied.

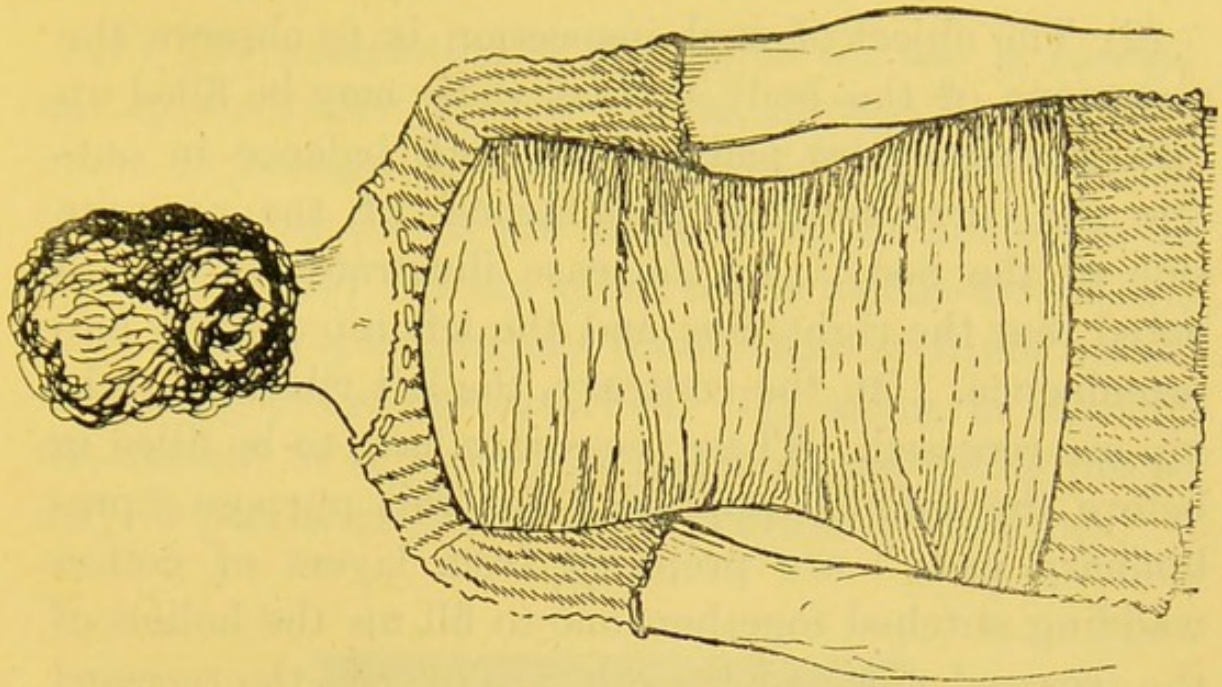

FIG 50.

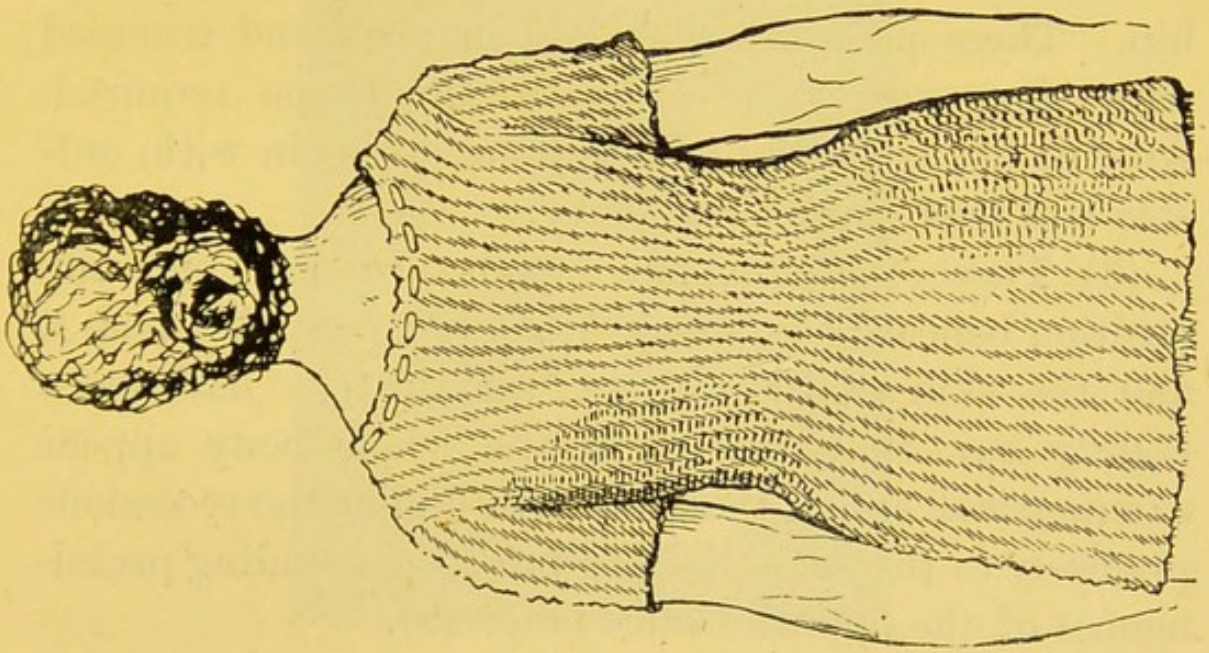

FIG. 49.

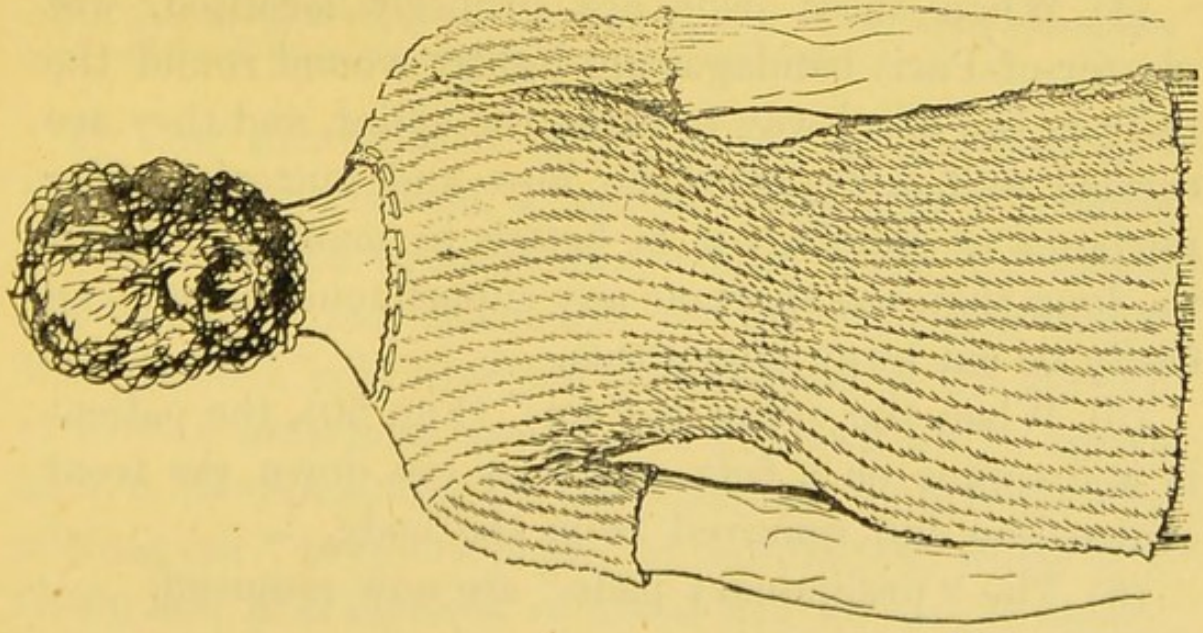

FIG. 48.

(2) The object of such inspection is to observe the recessions of the body so that these may be filled up into symmetry by pads which shall balance in outline the corresponding prominences of the opposite side of the body. In the case illustrated it will be noted that the right ribs and the left hip project into prominence. On the contrary, the left ribs and right hip are recessed. These recessions have to be filled in before the splint is applied. For this purpose "preliminary pads" are prepared from layers of cotton wadding stitched together, one to fill up the hollow of the recessed ribs and the other to overlie the recessed hip. These pads are then laid in place and trimmed with shear-scissors precisely to the shape required. All this fitting of the pads is done, to begin with, outside and over the woven jersey.

(3) These "preliminary" pads are now put into position beneath the jersey—that is to say, between it and the skin of the patient; and if they have been rightly cut, they will make the whole body appear symmetrical, seeing that they will fill out the recessions precisely to the same bulk as the corresponding prominences of the opposite sides (Fig. 49).

(4) When these pads are properly localised, wet plaster-of-Paris bandages are lightly wound round the body in the usual way to make the splint, and they are carried well down over the hips and buttocks. For purposes of stability, it is better to make the splint too long than too short, as any superfluous portion can easily be cut away afterwards.

(5) When the splint is "set" (Fig. 50), the patient is laid supine on a sofa, and it is cut down the front centre line and removed from the body.

(6) The "preliminary pads" are now removed.

(7) The completion of the splint for use is carried out in the following way: It is allowed twenty-four hours to become thoroughly set and dry, after which leather lacing pieces are stitched to the cut edges as shown (Fig. 51). If the splint seems a little too roomy, then it is proportionately diminished in front before the lacing pieces are attached. Or, again, in cases of flat-chested or thin patients ample elastic lacing pieces may be put in similar to those previously described.

FIG. 51.

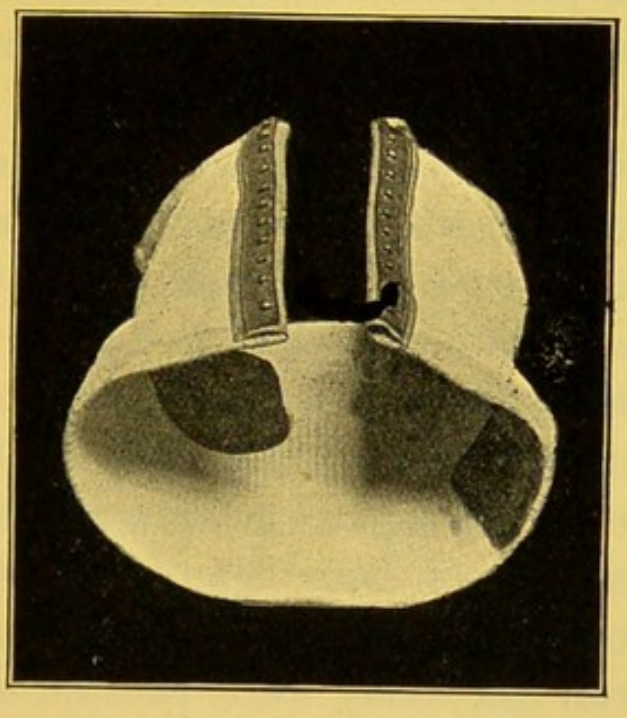

Fig. 51 represents the plaster bandage splint after the lacing pieces have been added and the pressure-pads have been inserted.

If now the finished splint is put on the patient's body and is percussed, it will be found that it touches firmly over the prominences, whilst there are ample hollows over the recessions of the deformed body. But the firm hold over the prominences is not enough to correct deformity, and, therefore, some active means have to be superadded for the purpose. This is done by cutting out "pressure-pads" of saddle-felt, which is a cheap and firm material of about half an inch in thick-

ness. At the outset single pads are pasted inside the splint over both of the prominences of the deformity. At the end of six weeks other similar pads are superimposed over the original ones, and the process is continued as necessity requires. Also, to save friction, the part of the splint that rises into the axillæ is covered with felt in order that cutting of the skin may be prevented. The photograph of the splint (Fig. 51) is taken in such a position that the "pressure-pads" can be seen inside the splint, the one localised to press over the prominent ribs, the other to press over the prominent hip, thereby tending to restore these parts into position.

Now, although such a splint is by no means as effectual as the one previously described, still it is very serviceable in hospital practice, being cheaply and simply made. In its method of formation from plaster bandages it is similar to the splint advocated by Sayre, but in principle of construction and in efficiency it is totally different. In Sayre's splint whatever firm pressure was exercised on one part of the body was also equally exerted on all other parts. If, therefore, the prominences of the body were pressed upon, so also were the recessions; hence there was absolutely no room left for the body to pass over into a truer shape. And, consequently, for lateral curvatures Sayre's splint was an utter failure. But in my splint not only is there ample room left for the passage of the recessions of the body into a straighter position, but the straightening itself is completed by the periodic insertion of the felt pads between the splint and the deviating prominences of the patient's body.

One further observation I may make. In ordinary practice I never use a splint in lateral curvature except

for the night treatment of severe cases. But this hospital splint can, with some modifications, be used in the day by patients whose means preclude the use of the proper appliances. If the bandages are carried sufficiently high under the arm-pits, and if the edge of the splint at these spots is copiously padded by layers of felt, it will be found that the weight of the trunk can be slung and upborne in a very similar way to that effected by the crutched arm-pieces of the ordinary spinal appliance; and thereby the two conditions for the straightening of the spine are attained, namely the upbuoying of the trunk, and the exercise of appropriate pressure over the prominences of the deformity. As I have already stated, such a method of splint treatment does not constitute the best of all plans; but, as I have tested its general efficacy for some years in poorer cases, I can at all events recommend it as an adequate addition to the resources of hospital practice.

Permanent records of results.—One of the most difficult problems, until quite recently, has been to establish some authentic and indisputable record of the results of the treatment of spinal curvatures, in order that periodic comparisons of its stages of progress could be incontrovertibly made. In mild cases, which took only a brief time to straighten out, such records were not perhaps so very necessary. The fact was simply evident to the doctor and to the friends of the patient that a curvature which had a short time previously existed was now entirely eliminated. Brevity therefore could dispense with records altogether. But in bad cases of curvature, where there was much osseous deformity and where the treatment was necessarily extended over some lengthened time, it has always

been a desideratum to obtain some positive records of proof by means of which progressive improvements could be noted and could be demonstrated to those who were concerned in the welfare of the patient.

Years ago many devices were attempted for these purposes of proof, and all of them were utterly fallacious. None of them were exempt from error even if most carefully used, and none were incapable of perversion if, let us say, casually employed. One of the commonest plans, and one which I used myself in my earlier days, was to adapt a strip of some pliable metal, such as lead or solder, to the outline of the deformity, and then to place this modelled strip on a sheet of paper so that the result could be traced with a pencil. This process was afterwards repeated at intervals for presumed comparative observation. Theoretically nothing could appear more convincing, practically nothing proved more delusive. And of the truth of this last statement very clear evidence is easily adducible. Sayre, for example, relied entirely on the metal-strip method. His book on the spine teemed with tracing after tracing intended to demonstrate the wonderful straightenings he had attained by his splints in the treatment of lateral curvatures. And he printed similar tracings in proof of similar successes in cases of caries. Yet when all his affirmations and professed proofs were brought before the International Medical Congress of **1881**, the President of the Surgical Section, who had to sum up the consensus of the medical world's opinion upon Sayre's allegations, expressly deplored that lateral curvatures had ever been brought into the discussion at all, and affirmed that neither in lateral nor in angular curvatures was there the slightest evidence that any straightening of the spine had ever

been produced. And all this in the face of Sayre's publication of innumerable metal-strip tracings!

One would almost have imagined that such a sweeping condemnation would once and for all have terminated the employment of so fallacious a system of record. But this was not so. The gymnastic practitioner of to-day still continues to appeal to the same method, and copies of tracings, thicker and deeper indeed than his most displayed Clarendon type, ornament his works and, purporting to be records of alleged improvements, are appealed to by him as proofs positive. But such tracings have no reliability whatever, and are as valueless as those of Sayre were very positively proved to be. All one can, therefore, perhaps opine is this, that whilst the employers of the metal-strip method may themselves conscientiously believe in the value of their own statistics, yet that the metal strip itself, in its passage from the body of the patient to the sheet of paper upon which it is traced, may most possibly undergo some such accidental alteration as may perhaps be due to unconscious cerebral volition on the part of the manipulator. A metal strip is a very pliant and delicate thing to handle.

Another plan of record, which may be designated the "caliper" method, was invented by my father and is described at the end of the third edition of his work 'Orthopraxy.' The apparatus employed consisted of a stool on which the patient sat, whilst all around were vertical rods carrying at right angles other rods which could be slid into position against the body. As the various rods were scribed and figured, their positions could be read off and written down. The whole thing was on the principle of a well-known machine by which a hatter can take the precise shape of his

customer's head. This apparatus I very carefully tested, but having found that it also was utterly unreliable and fallacious, I finally discarded it altogether.

The method of record I now personally employ is the photographic one, used under absolutely definite and unalterable conditions. To satisfy these, the camera is placed in a permanently fixed position beneath a sky-lit window whose lower half is occluded so as to obtain a fixed top source of light. The lens is constructed so as to give at the range of eight feet images that are exactly to the scale of one inch to the foot. At precisely eight feet from the lens, and in the focal line, a brass stud is nailed into the floor, so as to obtain this fixed focussing point. A six-foot standard T-square is placed on this stud and the patient is made to accord to its line by coincidence of the mesial folds of the buttocks. When the patient is in this position the feet are turned out to an angle of 30° each, and this position is insured by means of a 60° angle gauge. If the legs are straight, or even bowed, the ankles are brought together; but if they are knock-kneed, then the knees are approximated till they touch. The patient is then told to press the knees back into full extension, and to look at a spot on the further wall which is also permanently fixed in the focal line. Finally, to prevent the assumption of any strained position, the arms are ordered to be elevated above the head and, after the eyes have been closed, to be allowed to drop loosely to the side. It is in this position of unrestraint that the photograph of a back view is taken. And, moreover, precisely the same natural mathematical precautions are observed with both front and side views. With the special instruments that are at present manufactured perfect photographs are as

readily taken in December as they are in June—that is to say, in the best chemical potency of the solar height as in the diminished power of its least elevation. Only one barrier ever militates against clearness of light and shadow, and that obtains when there is any fog in the atmosphere, as sometimes occurs in the winter months. But even then a photograph perfect in outline is readily insured by the use of a flash-light cartridge. Only, from the difference in the source and nature of the light, such pictures cannot be fairly used for comparison with previous or subsequent impressions that have been gained by the use of the fixed light of the day.

As I have stated, all the photographs obtained by my fixed camera with its fixed focus come out exactly an inch to the foot, so that, with a pair of fine compasses and a graduated scale, measurements can be obtained from them of sufficient exactitude for ordinary purposes. But I have also in my house an enlarging room in which there is the necessary apparatus for magnifying the original negatives back from an inch to a foot—that is to say, for securing a precisely life-sized representation of the patient. In the process of enlargement the same mathematical precautions are also observed. The screen and the enlarger are laid by rule and square and plumb-line. For ordinary purposes the life-size image so obtained can be traced on a strained sheet of paper. But if for any reason it may be positively necessary, then the life-size image may be exposed to sensitive paper and, by development and fixing, a printed life-size record of the patient's condition can be permanently obtained.

No possible system of record can, I submit, give more accurate results than this one, based as it is on

mathematical precision, and divested as it is from all those chances of manipulation which render the metal-strip method so liable to error. The photographic plan is wholly fair and square. The photographs of record are taken in the presence of the doctor who comes with the case and in sight of the relatives concerned, and the prints, being kept in chronological sequence in indexed albums, are always available as evidence from the beginning to the end of the case. And I may perhaps also be permitted to affirm that it argues absolute confidence in one's own methods of treatment when one keeps such indubitable records for comparative inspection. Retrogression, if there were any, could be immediately detected, whilst the actual and invariable progress towards straightening is constantly capable of verification.

Still, notwithstanding all this clearness, there may still be some who, like the gymnastic practitioner, will prefer the hazy and pervertible employment of the metal strip. Or there might be others who would incline towards the use of the caliper method. With such people it is useless to argue. Perhaps, however, one simple illustration will prove more convincing than any array of reasons. Supposing, for example, that a lady who had been left a widow wished for some similitudes of her lost husband at various periods of his life, what records would she most prize and prefer? Would some tin-strip tracings of the contour of his nose or of his forehead suffice to revive his memory? Or would the caliper dimensions of his cheek and chin be of any cherished value? Or would she prefer rather to have fair photographs of his presentment by which to recall his likeness? This is a homely comparison, but an apt one. I think the lady would prefer the photographs,

and I think also by analogy that those who are concerned in watching the treatment of a deformity would prefer the photographs also. But the gymnastic practitioner clings to his metal strip, possibly because it suits his convenience to do so.

Some remarks on "spurious" appliances.—Before closing this section, there is one final point on which I must offer some rather important observations. Most aptly, perhaps, these would have fallen under the previous heading of the "Principles of Set," but as their insertion at that place would have interrupted currency, and as also they are of such gravity that they deserve more than parenthetical attention, I have reserved them for ultimate and separate consideration.

For this purpose I must refer back to the passage to which my remarks will be relevant. I stated on page 129 that the "whole method of the treatment of lateral curvature really depends on the graded alterations in the shape of the appliance, so that, as the body changes for the better, the force of the appliance may follow it up by persistent steps." Now, these periodic and projected re-arrangements of the shape of the appliance require considerable judgment and experience, both surgical and mechanical combined.

In the old days this was amply provided for. Men such as Tamplin, Adams, and Brodhurst had their own special mechanicians, who devoted themselves entirely to the construction of orthopædic appliances and to nothing else, and who designed, constructed, and made the progressive alterations of set and shape in conjunction with and under the immediate guidance of the orthopædic surgeon. The two worked so intimately together that the surgeon, although not of

course the proprietor of the factory in which his instruments were made, had, nevertheless, almost the same control over their construction as if he actually were so. And so essential is this control to success, that one or two orthopædic surgeons, who are resident in the north, have begun again to have their instruments made under their own supervision, very much in the same way as the numerous dental surgeons supervise the construction of their own mechanical devices. Such a common-sense method, of course, materially conduces to perfection in results.

But a little over thirty years ago a new departure had begun in quite the reverse direction. The mechanical treatment of spinal and other deformities had then become brilliantly successful in the hands of various distinguished surgeons, and the extraordinary benefits derived from the treatment were universally well known. And, perhaps, too much stress had come to be laid on the part played by the mechanism and too little on the part exercised by the directing surgeon. Hence the idea began to be conceived by the public that it should be quite sufficient to purchase and to wear an imitation of any of the appliances that were figured in recognised orthopædic works in order that full benefit and cure might thereby be derived.

Now, it is a commercial rule that any demand is certain to be met by some responsive supply, and it was so in this case. In the early "seventies" certain large firms had arisen who made it their business to deal in all the various appliances and appurtenances that were requisite in every branch of medicine and of surgery. They constituted themselves traders in everything that pertained to medical science, and undertook to supply outright anything, from a field

hospital down to a piece of sticking-plaster. It is almost needless to say that they also traded in copies of those appliances that had been used by experts for the cure of spinal curvature. Nor was this venture confined to those who restricted their trade to things purely medical. Firms and companies arose of the type then known in America as "stores," who undertook to universally provide within one establishment everything for which the necessities of humanity might call. A Stilton cheese could be purchased in one department, a pair of trousers in another, and in a further department a truss or a set of instruments for knock-knees. It is needless also to say that appliances for spinal curvature could likewise be obtained on the premises of these gigantic emporia.

And it is to be further observed that these traders did not undertake in any way to explain the uses or to guarantee the beneficial effects of the appliances they sold. They simply catalogued the designs and the prices in order that the public might buy. Any invention that had emanated from the brains of expert thinkers, and any notable illustrations that had been published in special works, were unscrupulously annexed by them without the slightest regard to copyright, or indeed to any other rights at all. And catalogues were issued teeming with woodcuts, on most of which was inscribed the name of the advertising firms, as if to indicate that they themselves were the original designers, whereas, in nearly every instance, the illustrations had been pilfered from works of others —a wrong which it is possible, however, that the recent decision in Oetzmann *v.* Lefever may in future tend to prevent.

As a result of these allurements the public began to

believe that they had merely to purchase and to wear the imitations in order to obtain those benefits that were well known to have accrued from the use of originals in expert hands.

I have no hesitation, however, in saying that "spurious" appliances employed in this way are utterly useless; and, what is more, they are of distinct damage to the reputation of the very principles on which they are professed to be constructed, for the failure of the useless copy brings disparagement upon the successful original from which it is imitated.

There is an ancient story of a Chinaman who, seeing the working model of a steam-engine in his English master's rooms, took the opportunity while the latter was absent to pull the thing to pieces and to make an exact counterpart of it in ivory. He had not the slightest knowledge of the principles of the steam-engine, but he produced a copy that was perfect in every similitude. And he was utterly surprised, when he placed fire beneath the copy, to find that it refused to work. It is the same thing with these imitation appliances: they are valueless as active agents. A spinal appliance to be of rightful service must be properly designed by an expert, must be properly constructed by experts, and must be properly governed afterwards also by an expert. The same applies to any other piece of mechanism. A locomotive must be rightly designed, must be rightly built, and when all this has been done it must be rightly controlled by an expert driver. This is quite clear with a locomotive, and no one would think of starting it uncontrolled along a line of rails, unless he were like the eccentric Indian Rajah who wished to indulge in the sight of a catastrophe. But what the public can easily see with

one piece of mechanism (the locomotive) it does not appear to appreciate with another piece of mechanism (the spinal appliance). Therefore it is sometimes—nay, indeed, often—content to purchase the copies of the Chinaman, and to indulge in the catastrophes of the eccentric Rajah.

SECTION VI

A Review of other Methods of Treatment

1870 to 1905

Preliminary remarks.—At the outset of the last section I explained that, in covering the period from **1870** to the present time, I should, in order to avoid confusion, review the treatment of spinal curvature from two quite different standpoints. For I was in a position of a man who sails his yacht in a race. He can either devote his whole attention to the seamanship by which his own craft runs successfully to the finish, or he can minutely watch the handling of such other vessels as are working towards the same goal. During the race itself he will probably be equally concerned in both these matters; but if afterwards he wishes to give a just account of the results he will best do so by considering them separately. He will on the one hand describe his own successful navigation, and on the other hand he will criticise that of his beaten rivals; and by so distinguishing between these two subjects he will be enabled subsequently to bring them into final and decisive comparison. This is precisely the course that I have set myself to follow. I have given in the previous section as succinctly as possible the way in which my own treatment has developed since **1870** from the established methods

left to me by my predecessors, and in so doing I have referred as little as possible to the works of others. I shall now have to travel over the same period again, but with this reversal of procedure, that I shall devote myself entirely to the successively introduced methods of others, and shall, for the moment, disregard my own methods altogether. In this manner a fair basis will be arrived at for making some comparative review.

And in order to do this I shall refer to the established procedure of treatment in **1870**. I shall indicate the clinical leanings that paved the way for the phenomenal and immediate acceptance of Sayre's methods by plaster-of-Paris splint (**1876**), and I shall trace this method through its ephemeral career until its final condemnation by the International Medical Congress (**1881**). I shall show how thereon a revulsion towards the established mechanical method had taken place by the time of the production of 'Quain's Dictionary of Medicine' (**1883**). I shall recount the oppugnant resuscitation of the obsolete gymnastic method through the editorial inclinations of Mr. Heath, in his 'Dictionary of Surgery' (**1886**). I shall demonstrate how this gymnastic system gradually became interwoven with a series of cranks and fads which have long since become so ridiculous that they are satirised in literature and travestied upon the stage. And whilst doing all this I shall have intercurrently to enunciate the somewhat curious proposition that the "swing of the pendulum" from reverse to reverse is as much a factor in the establishment of prevalent surgical ideas as it is in the establishment of those political. And, further, I shall have to show the still more curious fact that the drift of opinion on quite special subjects may more often depend on the vaguely biassed or even polemic

personal views of some eminent clinical teacher than on the investigations of those who have made such special subjects the study of a lifetime. And, finally, in the last section it will be my duty to submit the present-day gymnastic method of treatment to the same careful examination and criticism as that to which I submitted the plaster-of-Paris method about a quarter of a century ago, and to show, from the printed works of its advocates, that neither are the theories that they advance tenable nor are the results that they assert in any way more reliable than those which were positively asserted by Sayre, and which were as positively also proved to be fallacious by the General Medical Congress.

Personal experiences.—When I first entered at University College Hospital, in **1871**, it was with the express intention of gathering all information that could bear upon the subject of deformities. My course had been planned out for me, and I started on it with the perfectly open mind of a schoolboy. It is true that I had gathered some general knowledge of the scope of the subject from some previous reading. But without any preconceived ideas whatever I took notes on everything that might bear upon the subject.

With respect to the spine I knew that the treatment by mechanical methods was then the established one. I knew that it had been developed from Hippocrates downwards through at least twenty centuries. What had been recognised in its crudity by the physicians of Greece and Rome, before the commencement of the Christian era, had been brought into acknowledged perfection by the progress of modern science, and had stood the test of modern experience. Even throughout

the nineteenth century it had received the stamp of user from the most famous surgeons of their periods, by Sir Astley Cooper through one generation and by Sir James Paget through the next. And it was scarcely to be presumed that these two great pathologists would have persistently pursued any particular method of treatment unless they had found by long experience that such treatment was reliable in results. Moreover, I knew that at my own hospital the senior men, such as Erichsen, Russell Reynolds, Henry Thompson, and John Marshall, pursued the same practice, as did also innumerable other consulting surgeons. And in the current works on general surgery mechanical appliances were figured to indicate the correct method of treatment.

I was, therefore, a little startled to find that Mr. Christopher Heath, who was one of our junior lecturers and who was, moreover, a very illustrious exponent of the principles of general and operative surgery, should often hold and express views that were entirely antagonistic to the mechanical treatment of curvature, notwithstanding the fact that there was no other alternative treatment which could claim to be equally beneficial, or even beneficial at all. It became very clear to me, therefore, that if any new treatment should by any chance arise, it would be immediately acceptable to those who might hold views similar to Mr. Heath's, and that it would be at once exploited. As a matter of fact it was not long before the new alternative was forthcoming.

The plaster-of-Paris splint treatment.—In the summer of **1874** a Dr. Joseph Bryan, of Lexington, U.S.A., drew attention to the fact that he employed

plaster-of-Paris bandages as a material for splints in cases of spinal caries. There was nothing particularly novel in the method, seeing that, in England at all events, body splints had for many years been used in dealing with caries, and that the construction of such splints from plaster bandages was so old that its description can be found even in the earliest editions of such an ordinary lay work as Chambers' 'Encyclopædia.' Dr. Bryan himself sought no further personal merit beyond recording the fact that he obtained a capital splint in this way.

In the winter of the same year Dr. Lewis Sayre, of New York, adopted the same method and for the same purpose, only that he suspended the patient for the steadier application of the splint. But he did not stop here. It occurred to his fertile imagination that he saw the way to a new procedure by which every case of curvature, whether of carious or other origin, could be treated alike. In fact, he thought he had found a perfect panacea for every deformity of the spine. And he was not a man to waste several years in the careful experiments necessary to confirm his views. On the contrary, within a few months he had issued papers and illustrations exhibiting the wonderful results he claimed to have attained. These were disseminated in England and abroad, whilst a book was prepared for publication in various European countries, so that it might serve the end known in the dramatic profession as "the advance agency business." The English edition was published in **1877** by Smith, Elder & Co. These things having all been rapidly prepared and perfected, Sayre crossed the Atlantic in order to convert the surgical schools of Europe (and of England in particular) to his splendid and novel method. He had

been to England before, in the "sixties," also with a new idea in the shape of an apparatus that was to rapidly cure cases of hip-disease, and had been so well received that he was enabled to give demonstrations also on this particular new idea at various London hospitals. But, unfortunately for him, his method frizzled away before the much more efficient results obtained from a much older British method, known to-day under the title of the Thomas's splint. Still, this was no discouragement to a man like Lewis Sayre. He arrived in England determined to revolutionise the treatment of spinal curvature, and the first of the demonstrations that he gave at various English hospitals was given at University College Hospital. This demonstration was delivered in association with Mr. Christopher Heath, who was able to lay preliminary emphasis on the advantages that the profession was about to receive from Dr. Sayre's personal genius, and to dilate on the promised fact that every surgeon would henceforth be enabled to treat all his cases of curvature himself and to be entirely independent of the mechanical specialist.

The substance of the lectures Dr. Sayre gave at the various hospitals was in all cases practically the same, and, as it was a repetition of the Preface of the book he had just published in England, it can be given in his own words, which can easily be verified.

In the first place, with a personal and dramatic presumption of supreme superiority which can scarcely be realised by those who did not see and hear him, he made a virulent and satirical attack upon all previous treatments. After vilifying these as absolutely worthless, he disclosed to his hearers the fact that he himself had of late devised and carried out a new and perfect plan of treatment which ought to be adopted univer-

sally, and to the exclusion of all others, both in cases of spinal caries and in cases of lateral curvature. By his newly-invented plan any medical man in any part of the country could treat all these cases himself with perfect success, thus saving the patient the pain and expense of travelling long journeys to some specialist or institution devoted particularly to this class of deformities, and the patient so treated would be able from the beginning to the end to remain under the sole care of him who is best fitted to apply remedial means—namely, the properly educated general practitioner, who, by following the instructions which he (the lecturer) was about to give, would be enabled to treat all these cases with perfect success. Dr. Sayre was then wont to dwell on the simplicity and economy of his method, which merely required a dozen muslin bandages, a little plaster of Paris, some rope slings, and a cheap jersey, things which (he added) can be obtained in almost any village by the expenditure of a few shillings. Having thus opened his lecture with such enticing inducements, he proceeded to give a demonstration on one or two cases of the way in which the plaster-of-Paris bandages were to be wound round the body so as to form what he had christened his "plaster-of-Paris jacket." And when this demonstration was completed he referred his hearers, as a guarantee of their own prospective attainments, to the records he had published of his personal successes, modestly averring that some of the cases recorded were so remarkable as not, perhaps, easily to be credited, and guaranteeing similar results to all who faithfully followed his exemplary procedure.

With such a brilliant and alluring prospectus it was scarcely astonishing to find that the thing "caught

on" at once in despite of obvious fallacies in theory and palpable crudities in practice. Sayre laid immense stress on the idea that every medical man should splint his own cases, and that specialists should be thereby dispensed with. The reverse, however, proved to be the case. For many practitioners, whilst ready enough to try the new method, preferred to leave its application to others. And hence it was that when my father, anxious to meet a new necessity, handed over the application of the plaster jackets to myself, I was in a very short time putting them on at an average of about half a dozen a day for other men. The truth is that the great consulting surgeons were not able to spare the time or to face the mess required in applying these jackets, and the general practitioner did not have enough cases of spinal curvature to make it worth his while even to buy the tripod for suspension. Hence specialism, contrary to Sayre's anticipations, was rather created than extinguished by the introduction of his new method.

And the reason is intelligible, for the application of the jackets was by no means the simple thing it seemed to be. Sayre himself, with all his experience, did not apply them in the best way. His plaster never "set" properly, and in consequence he was obliged to advocate the insertion of metal strips between the layers of the splint for strengthening purposes, and indeed as late as **1877** one finds him writing in the 'British Medical Journal' to advocate that the jacket should be ironed with a hot metal cylinder so as to expedite consolidation. As a matter of fact if he had used the best dental plaster the jackets would have set like rock within a few minutes, and would have required neither strips of cold iron for strengthening nor rollers

of hot iron for fixing. But it was a little curious to see the man who had just condemned metal as a material for spinal appliances twisting pieces of metal into shape so as to make his own jacket the more serviceable.

And just as there were crudities about the construction of the splint itself, so there were grave hazards in its mode of application, at all events in carious cases. Sayre insisted that suspension by the head was a principal factor in straightening the spine into its best position for splinting. But even whilst he was lecturing in England, a case arose in which the spine of a child, who was being treated for cervical caries at one of the principal London hospitals under his new system, gave way altogether and instant death ensued.

However, apart from such little preliminary drawbacks it still became quite evident that Sayre, by his colloquial ability and by dominant personality, had convinced many English surgeons that his new treatment was one which was destined to oust all other treatments from tenure and usage. The thing ran. Obvious errors in the construction of the splint were one by one eliminated, and the dangers of capital suspension were minimised by the introduction of a pulleyed apparatus which allowed a discriminating division to be made between the strain borne by the head and that borne by the arms in suspension.

The English medical periodicals of the time began to teem, almost within a few weeks, with extraordinary testimonials to the efficacy of the new method. Abroad it was a little different. The cautious German, the alert Frenchman, the analytical Italian—all these wanted more time to try the method carefully before deciding on its real merits, and they were not carried away by an enthusiasm which was perhaps in England

dependent on the fact that Sayre could address his audiences in their native language. Therefore, abroad the thing took the ordinary quiet course by which that which is new is generally and with reason tested. But in England many surgeons accepted Sayre's statements at once, and before these statements had been in the least degree put to the proof. The proposition was so extremely simple. Sayre affirmed that by suspension the spine could be straightened out, and that by splinting the body in plaster of Paris this straightening out could be maintained and perpetuated. And as Sayre put it, it seemed so exceedingly clear and so utterly incapable of contradiction. The whole thing, therefore, was by many accepted in block, and with such an increasing appreciation in England, that in a year or so it ran to what appeared to be an acme of success. Sayre himself, flushed with the apparent realisation of his ideas, came to England again. Again he made a professional tour, and again he delivered his demonstrations. And again it was in association with Mr. Christopher Heath that he lectured in the theatre of University College Hospital, and in language that was no longer measured. The spinal specialists were, he reckoned, entirely "wiped out," and he stamped on them accordingly.

But this acme of supposed success was only the acme before the wane, only the crisis before the recovery. Little by little, as experience dictated them, doubts which had started in suggestion ended in confirmation. Was suspension necessary at all? Could not the splint be applied as well if the patient were hammocked? Did the splint really maintain the straightening that was supposed to be effected? At last the crash of the delusion came. The International Medical Congress

met in London in the autumn of **1881.** Every nation was represented, and Sayre was particularly represented by himself. In one of the surgical sections "The Treatment of Spinal Curvature with reference to Sayre's Method" was set down as a subject for special discussion, and at the debate which followed the best-known orthopædic authorities of the world were present. Sayre himself personally argued his own points. But, notwithstanding such special pleading, the summing up went absolutely against him, after the experiences of surgeons of all countries had been deliberately delivered. And the decisive judgment, pronounced by Mr. Jonathan Hutchinson, ran as follows :

The suspensory-plaster method was useless altogether in cases of lateral curvature. A splint was of service in cases of caries (a thing that had been known in England for half a century), but no form of extension by suspension was a necessary part of the treatment. There was not the slightest evidence that any straightening of the spine had ever been produced by the suspensory-plaster method, notwithstanding Dr. Sayre's metal-strip records. And there was no valid reason to suppose, in such cases as caries, where a splint was really needed, that any other mouldable material would not answer equally as well, although Dr. Sayre had a preference for plaster of Paris.

Now, considering Sayre had given in his books and pamphlets endless metal-strip tracings of the straightenings he professed to have attained, the decrees of the International Medical Council placed him in a somewhat awkward position. Either the tracings themselves were not honest ones, a view that cannot be for a moment entertained, or else it was

evident that the method of record by metal-strip tracings was utterly unreliable. The latter is, of course, the proper explanation, and the truth is that these metal-strip tracings are valueless. They were authoritatively proved to be so in Sayre's case. And yet the gymnastic practitioner of to-day appeals to them as infallible. Lord Chesterfield told his son in his 'Letters' that to deceive people the first appeal should be to the eye, the next to the heart, and the last to reason. This is precisely what these metal-strip tracings are intended to do. They appeal to the eye only, and laggard reason is in delusion.

It is almost needless to say that, after the decrees of the Congress, Sayre's method snuffed out with almost the same rapidity as it had sprung into accession. I had myself ventured to predict that such would be the case in a couple of works published respectively in **1880** and in **1882**.

As I have already stated, I had from the outset the amplest opportunity of applying the plaster jackets to the number of many hundreds, and of watching the results in a continuity of cases. Hence I was able to rapidly discover the absolute inefficiency of the new method and to express beforehand the same precise conclusions as were subsequently come to by the International Medical Congress.

The reversion to the established mechanical treatment.—After the failure of Sayre there came a lull in all controversy, and the professional bent reverted once again to the established and mechanical treatment. Of this fact there were ample evidences in the medical literature of the time, but one instance alone will suffice for illustration. At the end of **1882**—that is to

say, just after the Congress had condemned the plaster-jacket method—Quain's 'Dictionary of Medicine' appeared. It comprised articles on all medical subjects, written by the very pick of the medical profession. Two separate articles, the one on "Spinal Caries" and the other on "Spinal Curvatures," were both of them embraced under the same heading and were both of them written by the same author—the late Mr. William Adams.

With respect to caries little need be noted here, not only because the subject is not now under discussion, but also because its treatment had long since ceased to be a matter either of speculation or of dispute. Suffice it to say that Mr. Adams concurred in the practice of recumbency conjoined with the use of a proper spinal splint, and that whilst he expressed a reasonable preference for the employment of guttapercha or leather as the best material for such splints in private work, he nevertheless conceded that plaster-of-Paris bandages were of economical service for a similar purpose in hospital cases. In short, his general opinions tallied entirely with those of other leading surgeons on the subject of spinal disease.

With respect to lateral curvature the views expressed by Mr. Adams were extremely clear and definite, and, what is more, they were based on a special experience that was greater and longer than that of any then living authority. In the first place he recognised that there were certain atonic conditions of the muscles which allowed the body to drop or slouch into faulty postures, so that a curvature might be simulated, although by proper examination it could be proved that no actual curvature existed at all. To this condition, which might perhaps best have been denomi-

nated "pseudo-curvature," he applied the somewhat vague term of "physiological curvature," and he admitted that it might be remedied by general tonic pursuits, fresh air, and exercises. This was reasonable enough, seeing that it is by such means that a slouching raw recruit is brought within a few months into the condition of a well set up soldier. But such a recruit, far from having any actual curvature, has already on enlistment been passed by the medical officer as perfectly straight, and has only to be corrected of a faulty and slouching carriage.

But, setting these atonic conditions entirely on one side as irrelevant, when it came to actual and positive curvature, Mr. William Adams expressed himself in very distinct terms, and most emphatically asserted that, in his experience, only one reasonable plan of treatment existed. This was by the employment of such a mechanical appliance as, both in design and intent, was best suited to the particular curvature under which the patient suffered. And he gave in his article a brief description of the design on which such appliances should be constructed, and he discriminated between the actual kinds of forces that should be used. It is almost needless to say that both the designs and the active powers to be employed are identical with those previously described in these pages. One may add also that although the article of Mr. Adams had probably gone to press before the decrees of the International Congress had been promulgated, yet he had arrived at conclusions substantially identical in condemning the plaster-of-Paris jacket when applied by the Sayre method as utterly useless.

For the next three or four years there was a pause in the discussion. True, for a little while there still

came some waning waft of correspondence in defence of the plaster jacket; but this was only like the after-rumble of a storm and finally died away altogether, whilst the mechanical treatment which was based on the experience of centuries, and was so surely grounded as to be unaffected by mere ephemeral theories, resumed once more its rightful estimation.

The resuscitation of the gymnastic treatment.—This pause, however, was only the prelude to a new delivery, and, as before, it was Mr. Christopher Heath who was again the leader of the movement. In **1886** there appeared his 'Dictionary of Practical Surgery.' The distinguished editor, instead of pursuing the plan followed by Sir Richard Quain, and of placing the two subjects of "Caries" and "Curvature" in the hands of the same single authority, elected to allot them to two separate writers.

"Spinal Caries" was given to Mr. Golding Bird, and although the subject is not here under consideration, it may still be stated that this eminent authority entirely concurred with the generally accepted views of treatment. He advocated the use of the spinal splint, recumbency, certain counter-irritations, certain tonic medicines, and a full access to light and air. Further, he recognised that, whilst the splint treatment was necessary during the period of consolidation, so also was treatment by some light governing apparatus usually needed afterwards, a thing which I believe I was the first to point out in my book on spinal curvatures in **1882.**

The selection of a writer for the article on "Spinal Curvature" must, from force of circumstances, have placed Mr. Heath in some little difficulty. Obviously

he could not allot it to one of the mechanical school as Sir Richard Quain had done, for all his teachings had been strenuously adverse to this method. Obviously, also, he could not allot it to Sayre himself, as, indeed, he might have done five years previously, and before the condemnation of the Medical Congress. The point, however, that stared him in the face was the quiet reversion to the old-established mechanical method, a method to which he was personally opposed. By what means, then, could such a reversion be met? Mr. Heath made his decision and revived the gymnastic treatment. The truth is, if I may use the language of the churches, Mr. Heath was in an awkward dilemma. He had only one of two alternatives to adopt. He was either bound to revert to the established religion which he disliked, or to propound some other heresy as a substitute for the one he had previously preached, and which had just been extinguished by ecumenical condemnation.

The article on "Curvatures" was given to Mr. Roth, who subdivided his subject into the antero-posterior and lateral sorts, giving, however, the same proposed methods of treatment for both. For the moment one may simply say that Mr. Roth apparently added nothing that was new or original to the previous general knowledge of curvatures, either in respect of their causes, their symptoms, or their pathology. All he actually did do was to re-introduce a method of practice that had already been tried in the "fifties," and had then faded away into disuse. He asserted that all curvatures could be successfully and indiscriminately treated by "medical gymnastic exercises, with attention to good postures." And he further asserted that "lateral curvature without any osseous deformity" could "be

practically cured by one month's daily treatment," and, moreover, that "although it is an important fact that when once there is actual osseous deformity of the ribs and vertebræ lateral curvature is incurable," yet none the less that in such cases "the patient can be sufficiently strengthened and the muscular sense thoroughly re-educated so that the best possible position becomes an habitual one, by three months' daily treatment." And having made these promises of benefit, Mr. Roth proceeded to give "a prescription of exercises" as the means by which such promises could be fulfilled.

Now, if the foregoing assertions are pieced together, it will be seen that they simply resolve themselves into the following statements: that all cases of curvature could be quite satisfactorily treated by any medical man who employed Mr. Roth's "prescription of exercises," and this within a time of which one month was the minimum and three months the maximum limit.

Such, then, was the gymnastic method of treatment which was revived to take the place of Sayre's plaster method of treatment, and it will be interesting to make some brief comparison between the two. As might be expected, the one was the very reverse of the other. For when one thing fails, the tendency, in surgery as in politics, is to swing to the very opposite range of the pendulum. Sayre had recognised that a lapsing spine required mechanical support, but he had endeavoured to give this by a method that was inadequate. Mr. Roth, on the contrary, proclaimed that the body when lapsing into curvature required no support whatever. Sayre admitted that treatment to be effective must be continued through months or even years till straightening was effected. Mr. Roth asserted that three months

was the outside limit of requisite time and that in mild cases a mere month sufficed. Sayre only required one visit from the patient about every four months for the renewal of the splint. Mr. Roth demanded a daily visit during the whole of the three months of treatment.

On one point, however, Dr. Sayre and Mr. Roth were in common agreement, and this was on the promise that every practitioner in all parts of the kingdom should be able to successfully treat his own cases. By the Sayre treatment all that the practitioner needed to do was to learn in the course of half an hour's demonstration the proper application of the plaster bandages, and he became forthwith possessed of a remedy by which he could himself treat all his cases, both of caries and curvatures alike, "with perfect success." And similarly Mr. Roth, although compelled from the perturbing nature of his treatment to exclude caries altogether from the category, still promised that by the use of his published "prescription of exercises," which could presumably be mastered in half an hour's reading, every practitioner could also personally and successfully deal with all his own cases of curvature. It will be seen, therefore, that both these progenitors of such diversely opposite methods professed to be teachers merely of others, and claimed that when they had given their doctrines to their fellow-practitioners their duties were entirely ended. They did not apparently so much seek practice for themselves, as aim at putting their simple methods of treatment into the hands of others who could thenceforth perform all the necessary operations.

Now, with the mechanical practitioner it is, from the very nature of things, quite otherwise. He is

compelled to assert that his treatment can only be effectually carried out by means of a specially designed and constructed piece of mechanism, which must be fitted and applied under his own supervision and must be modified from time to time by himself, so as to follow up the improvements attained in the shape of the body. And, moreover, he has to draw a very clear distinction between mechanical treatment and the mere wearing of a purchased piece of mechanism. It is the expert fitting and the expert usage that constitute the essentials of the mechanical treatment. The mere purchase of a spinal appliance of some particular pattern is not of service. A man might buy the best laryngoscope in the world, but this would not make him an expert laryngeal surgeon; or he might purchase the best gun that Purdey ever projected, but this would not make him an expert shot. It is the experience of constant usage that makes an expert. And in the mechanical treatment of curvatures it is the same. Men like Tamplin or Adams or Brodhurst became successful experts only by years of practice, and not within a single day. And, therefore, the mechanical practitioner is obliged to assert that his method of treatment is not available to every practitioner at less than a day's notice, and that it cannot be acquired with the rapidity of an hour's demonstration of the best method of applying a plaster splint or half an hour's study of a couple of pages of "prescriptions of exercises."

But the mechanical methods have already been fully discussed, and their mention here is merely intercurrent. I will revert, therefore, to the time (**1886**) when the gymnastic treatment was revived. It was introduced with considerable quietude. It was no new

thing, for it had been tried in the "fifties," and had then faded away into disuse. It could not, therefore, be proclaimed as a splendid novelty by dramatic demonstrations in the theatres of all the London hospitals, nor with the delivery of such oratory as that with which Sayre had heralded his new and much vaunted method. It had to be allowed to leak into usage, and without any doubt it gradually stole into a large acceptance.

There were several reasons for this. First, there was the void left vacant by the failure of Sayre. Then there was the natural swing of the pendulum towards anything that was the very opposite of such antecedent failure. Then, again, there was the promise that every medical man could, by employing the promulgated "prescription of exercises," successfully treat all his own cases without recourse to a specialist. And, lastly, there was the somewhat curious fact that the principles of the gymnastic treatment became diplomatically interwoven with certain popular fads which were quite irrespective of matters surgical, as indeed, I shall take the trouble presently to show. It remains a fact, however, that the gymnastic method attained a very considerable usage within the first few years of its re-introduction. Still, from the quietude of its drift, it is somewhat difficult to state at what period it reached its acme, and when precisely it had lost its hold upon surgical consideration. One thing, however, is quite certain, that its wane was within less than a decade from its original re-introduction, and the evidence of this fact is easily adduced.

In the 'British Medical Journal' of May 18th, **1895**, can be found a clinical lecture by Mr. Christopher Heath on the subject of spinal curvature (as also my

own reply in the same journal of April 6th). As Mr. Heath has now retired into the ease to which his years and his distinguished career have so justly entitled him, I may take it that this lecture represents his final views on the subject. It contains some adverse comments on the obsolete mechanical treatment by rack-force, some curious misconceptions of rather rudimentary principles in mechanics, and some unfortunate allegations against the honesty of a whole class of orthopædic specialists, a class which included men of such recognised standing as Adams and Brodhurst. As regards treatment, the indications are principally confined to climbing ropes, riding ponies, and paying proper attention to respiration. There is not the slightest allusion to Sayre, although in the very theatre in which the lecture was delivered Mr. Heath had some twenty years previously declared Sayre's treatment to be infallible. And there is not the slightest allusion to Mr. Roth or to his gymnastic methods, although only nine years previously Mr. Heath had published Mr. Roth's articles in his 'Dictionary of Surgery.' I take it, therefore, that in Mr. Heath's mind "prescriptions of exercises" were to him as much things of the past as were Sayre's plaster jackets. And I take it also that one is justified therefore in concluding that even as early as 1896 such prescriptions of exercises were waning from clinical recognition.

One admission, however, is fully made, and it is this: that when cases of curvature have lapsed into severity, then mechanical supports are imperative. But Mr. Heath qualifies this necessary assertion by adding the caution that the parents are to be assured that such mechanical support is then not calculated to cure the deformity, but is merely intended to pre-

vent the curvature from becoming worse. Now, is there not something superbly contradictory about a teaching that admits that a mechanical appliance can prevent any further lapse into deformity when such deformity has reached (under other treatments) its severer stage, and which yet pretends to deny that an appliance can be of service in the earlier stages—when, in fact, by its use deformity could be altogether averted? The truth is that Mr. Christopher Heath has always been ready to admit, as indeed he does in this lecture, that the mechanical treatment is available as a final resource when everything else has failed. But, on the other hand, he has always been equally zealous in exploiting the efficacy of any novel method that might possibly seem of easier application. He has done so in two notable instances, and I think I have shown with what results.

I have stated that even by **1896** the gymnastic treatment appeared to have fallen into clinical disregard. But disregard alone will not necessarily annihilate treatments. They may be immediately and completely snuffed out, as Sayre's was, when they are bravely brought before the judgment of such a final body as the International Medical Congress. But if, on the other hand, they are quietly and modestly run on such humbler lines as may evade the challenge of authoritative decision, they may linger on for some few years. The gymnastic treatment appears to have so lingered on; and this result has been attained, not only because it has evaded decisive dispute, but much more largely because it has been intentionally interwoven with certain cranks and fads that have been gradually grafted on to the popular mind. This being so, before I submit the gymnastic treatment of curvature to its rightful

critical analysis, I shall pass in review certain matters of bodily clothing and bodily exercises which have spuriously been made relevant to the subject.

Bodily exercises.—There are some words, such as "gymnastics," "athletics," and "calisthenics," that are so frequently used in connection with bodily exercises, that it will be wise at the outset to define their specific meanings.

The two words "gymnastics" and "athletics" are as old as the Greek language itself, and were current even in the time of Homer. Although both of them refer to the training of the human body in particular ways and for specific purposes, still, their meanings and objects are quite different and distinct. The practice of gymnastics was used for enduing the body with the greatest possible agility, and, as the exercises pursued for this purpose were undertaken in a state of practical nudity, the Greek word for nakedness gave origin to the word "gymnastic." On the other hand, the pursuit of athletics was intended to cultivate the body into its highest capacity for endurance, and it was from the Greek word for this latter quality that the word "athletic" was derived.

Gymnastics and athletics, as means whereby bodily agility and bodily endurance could be insured, were both employed for one single purpose—that of making men most perfect for the enterprises of warfare. As such they were pursued by the Greeks, as such by the Romans, and as such by the pages and squires of the medieval ages. From the beginning of history until about three hundred years ago they constituted some of the principal factors in the training of a soldier. The management of his horse and the skilled use of

his weapons were his other attainments in those days of hand-to-hand combat.

By the beginning of the seventeenth century the universal introduction of firearms, the disuse of armour, and the advent of the rapier or pointed sword had caused an entire alteration in the methods of military training, and both gymnastics and athletics ceased to be considered of general service. Officers and gentlemen learned to fence, whilst the rank and file learned to aim and to shoot. And although the effective range of firearms was then limited to a hundred yards or less, still it was rather by the stolid quietude of the firing line than by any personal activity that battles were won.

After a couple of hundred years and as the range of the musket began to increase, and greater mobility became requisite with masses of men, gymnastics were again restored as factors in military training. At the beginning of the nineteenth century the Prussians re-introduced them, the Swedes followed suit, and later the French did the same. Still, it was not till long past the middle of the century that the English military authorities thought them worthy of approbation. The fact is that the inhabitants of different countries vary in their innate and natural activity of habit. Where the people of a nation are ordinarily sluggish in everyday life, they may require gymnastic training to render them active, whilst nations that are by habit active in themselves require no such bodily stimulus or training. Thus the English soldiers who conquered those of Napoleon in the Peninsula and at Waterloo had had no preliminary gymnastic training at all. And yet in the very same wars the Prussians ascribed their own successes over the same Imperial troops to an

endurance in marching and an activity in assault which they believed to be dependent on the previous gymnastic training of their troops. The truth seems to be that whilst the mere life led in one country may be of such a nature as to train its race to complete activity and hardiness, the people of another country may from their inherent inactivity require special training to give them the endurance and activity needed for practical warfare. The sports to which the boys of England are accustomed—cricket, football, and running—breed such physical qualities that Wellington expressed the results in his aphorism that the battle of Waterloo was won in the playing-fields of Eton. Or, again, to go further afield, the Ghoorka troops drawn from the mountainous districts of Nepaul are second to none in activity and endurance, and this simply because of the hardiness of the life they have to lead in their own country. The country breeds the men.

Now, gymnastic exercises were, as I have said, re-introduced by the Prussians about a century ago, but for military purposes only. As, however, the gymnasia gradually became meeting-places or clubs for the manhood of the nation, so gymnastics themselves began to assume a more general use as a healthy occupation for young men leading sedentary lives. In a continental nation that lacked such outdoor games and sports as were practised in England it was quite natural that the practice of gymnastic exercises should attain a very prevalent hold. And their pursuit, which had been introduced as a military object, now became also a civil one. It might be a gymnastic distinction that one youth should surpass all his fellows in expert feats upon the ladder or on the parallel

bars; but he did not any longer cultivate these abilities to climb the ramparts or escalade the walls of his enemy. Or it might also be an athletic distinction that a young man could run his ten miles in less than an hour, or do his twenty feet in the long jump; but he had no longer to clear a hostile moat or to carry messages on whose swiftness of delivery the security of an army might depend.

It became evident, therefore, at all events abroad, that regulated exercises were bound to become serviceable for boys and youths on account of their beneficial effects, not only in cultivating agility and endurance, but also because of their general effects on the health of those who, living in cities, had no other opportunities of bodily exertion. And the matter did not stop at this point, for the cognate idea arose that girls also would be benefited if they could, in some such milder degree as should be suited to their sex, also be physically tutored.

The practical result of this conception was that a system of gentle exercises was devised which could be pursued by girls without any risk of bodily strain. This new system was denominated "calisthenic." This term is not, of course, to be found in the Greek lexicon, and much less in Johnson's dictionary; it is merely a modern conjunction of a couple of Greek words denoting strength and grace, these being the two objects which the system was presumed by its practice to attain. A very short time elapsed before "calisthenic" exercises were universally adopted in England in "seminaries for young ladies," where they were practised in conjunction with the teaching of dancing and of deportment. The truth is that these exercises were a great boon to girls in the middle of

the last century, because, beyond the prim and daily march out in twos and twos, they had very little other bodily exertion. Such a thing as hockey or lawn tennis would at that time have been execrated.

And just as "calisthenics" became part and parcel of the scholastic routine with girls, so drilling and the military "extension exercises" were adopted in the schools for boys, hence by the middle of the century both boys and girls had the incipient advantages of what is now known as "physical education."

But it is to be observed that it was only the children of the well-to-do who enjoyed such beneficial privileges, and it took some time before the children of the masses of the people could attain to similar advantages. At last in **1870** the Education Act was passed, and amongst the many extraneous subjects that were included in the State curriculum (beyond the learning of the necessary and conventional three "R's") physical exercises were wisely included. It is possible that with village children, who could run wild at their own games in the fresh air and sunlight of the countryside, such exercises were not absolutely needed; but with the children of the large towns (and these children constitute the mass of the up-growing generation) some sort of physical training was not only a boon, but a necessity. It took, roughly, about ten years for the provisions of the Education Acts to be brought into working order. But it may be said that after the year **1880** the children of the masses were enjoying to a greater or less degree the benefits of physical education; and, moreover, if statistics are looked at—and they can be gathered easily from the consecutive editions of even so general a work as 'Whitaker's Almanack'—it will be found by this present time (**1905**) the greater

part of the up-growing population of Britain have had the benefits of physical education. As a matter of fact, it stares one in the face. A piano-organ need only strum out an Irish jig or a Scotch reel and at once the children of the neighbourhood throng to dance with a grace that hitherto had only been observed on the Terpsichorean stage. The general walk and bearing of the children of the masses have improved, and this without doubt because of the physical, or rather calisthenic, training to which they have been submitted. The facts, indeed, as they stand, would show that, whereas in the old days most schools opened with devotions, in the present day these have been superseded by physical exercises. Calisthenics, in short, have taken the place of morning prayers.

The gymnastic treatment of curvature confused with physical exercises.—I must now advert to an entirely different matter. Before the middle of the last century, and when gymnastic and calisthenic exercises were coming into prevalent use, one or two medical men conceived the idea that the exercises which appeared of such benefit in the physical development of the straight and normal body could also be utilised to remedy its deformities, and more particularly to correct curvature of the spine. The number of such medical men, whom I believe to have been misled by delusion, was extremely few. Even as late as **1885** Dr. Matthias Roth, himself an exponent of these curative theories, asserted that only three manuals on the subject had then been published—one in England by himself, one in Sweden by Dr. Hartelius, and one in Germany by Dr. Newmann. Hence, although the professed cure had been for some length of time in

experimental usage, it evidently had made very little headway. It was tried in England in the "fifties," and lapsed from lack of success into complete disuse. But, as I have shown, it was again revived by Mr. Christopher Heath in **1886,** when he inserted Mr. Bernard Roth's articles in his 'Dictionary of Surgery.' Now, I do not propose at this point to examine in detail the fallacies of such gymnastic treatment, for I shall do this later on. But I wish, first of all, to show that the gymnastic treatment of spinal curvature has been interwoven with many matters that are quite alien to it.

I admit that athletic and gymnastic exercises have been of service from the beginning of history downwards for the purpose of training soldiery to agility and endurance. I admit that in the present day they wisely form part of the training of military men, but, it must be remembered, of men already passed by the surgeon as physically sound and absolutely undeformed. I admit that calisthenics may impart an alert carriage to those who practise them in health. I admit that universal physical education is of distinct benefit to the children of the masses, and especially to those who live in large towns. But I deny entirely that gymnastic exercises will cure actual curvatures, and I deny that there is any relevance in adducing the benefits to be derived by sound and undeformed persons from athletics, gymnastics, calisthenics, and general physical education, as arguments for asserting that gymnastic exercises will cure curvatures of the spine.

But the gymnastic practitioner wishes to associate his treatment with universal physical exercises. Well, let this position for the moment be accepted simply for

the purpose of arriving at certain facts. He asserts that by exercises all cases of curvature without osseous deformity can be cured in a month. It follows as a corollary from this assertion that if exercises could be universally practised, spinal curvature could not arise at all. That is to say, if the cure was constantly being employed the malady could not by any chance originate. Hence, on this presumption, if exercises could by any means be universally and continuously practised in youth, spinal curvature would become so utterly obsolete that in future time its sole record would be found only perhaps by reference to ancient and musty surgical volumes. Very good. But I have stated that it is a fact that since **1880** gymnastic exercises have been universally adopted at the Primary Schools. And it is a fact that out of the forty odd millions of people who inhabit the British Isles some six million children are at the present time at the Primary Schools. And it is a further fact that these children perform physical exercises roughly from the age of seven to the age of fifteen. And it is also a final fact that, at the very lowest estimate, over half the present population of the British Isles have passed through the Primary Schools, and have enjoyed the presumed paramount advantages of physical exercises. That being so, of course, one would look for the results promised by the gymnastic practitioners. And one would expect an enormous diminution in the cases of spinal curvature. But is this so? Most certainly not. Indeed, the statistics alone show that spinal curvature has rather increased than diminished of recent years. And if corroborative evidence were even wanted, it is to be found in the consideration of the common law of supply and demand—the number of surgeons who

have studied and written on spinal curvature is probably greater now than at any previous time. Hence, although by an educational chance the gymnastic practitioner has seen his dream realised and physical exercises have universally been adopted, yet the results that he promised to accrue have not been attained. On the contrary, a Commission has been appointed to report on the present physical deterioration of the race. Hence I think I may be permitted to very forcibly assert that exercises will not even prevent the accidence of spinal curvature, and much less can they pretend to be factors in its cure. They will neither stop nor will they remedy actual curvature.

The attack of the gymnastic practitioner on the mechanical treatment.—Of course he attacks mechanical appliances. Their mere weight alone is a sufficient reason against their use. As a matter of fact the average weight of a modern mechanical appliance is less than thirty ounces. Still, according to him the thing does weigh something, and he professes to cure by methods that have no weight at all. Let us follow this argument onwards. A lady's winter skirt weighs about twice as much as a spinal appliance, therefore no lady in winter should wear a skirt. Her winter cloak may weigh four times as much as an appliance; she should certainly not wear a cloak in winter. A man's shooting boots weigh three pounds and his gun weighs seven; with these, apart from all else, he will trudge all day long, day after day, to put up his birds. He is utterly wrong. His boots and his gun weigh together five times as much as a spinal appliance. He should not use them and he certainly therefore should not shoot. One is almost led to suspect that the gymnastic prac-

titioner is a little foreign in his views, and that he forgets that when the English race was, at the time of Elizabeth, in virile perfection, gentlemen thought nothing of walking about with sixty pounds of light armour on their bodies, and ladies promenaded in costumes to which the modern dresses are feather weights. Still, as I say, he longs for things that have no weight.

Then, again, he asserts that a spinal appliance deprives the muscles of the body of all activity and thereby causes them to waste, and that on this account such an appliance should never be worn. As a matter of fact this is not so, but even if it were the argument would be a little ridiculous. The muscles of the body are deprived of all activity when a man goes to bed and to sleep; consequently, according to the contention of the gymnastic practitioner, it is unwise for a man to venture to sleep in bed. But a spinal appliance does not compress the body. On the contrary, it upbuoys it by means of the crutched uprights and presses only over the prominent parts of the deformity, whilst there is the amplest room left over the recessions of the body so that the latter may pass into straightness. All this I have previously explained. Still, I can give the clearest and most direct evidence, both by instance and by illustration, that the gymnastic practitioner is wrong in his assertions, which are really only made to discredit a system that is rival to his own.

The two subsequent figures are taken from my photographic albums and represent a child that has been treated for caries. During the acute stage of the disease this child was compulsorily, and according to the proper method, kept recumbent in a splint. The first photograph (Fig. 52) shows the child after the use

Fig. 52.

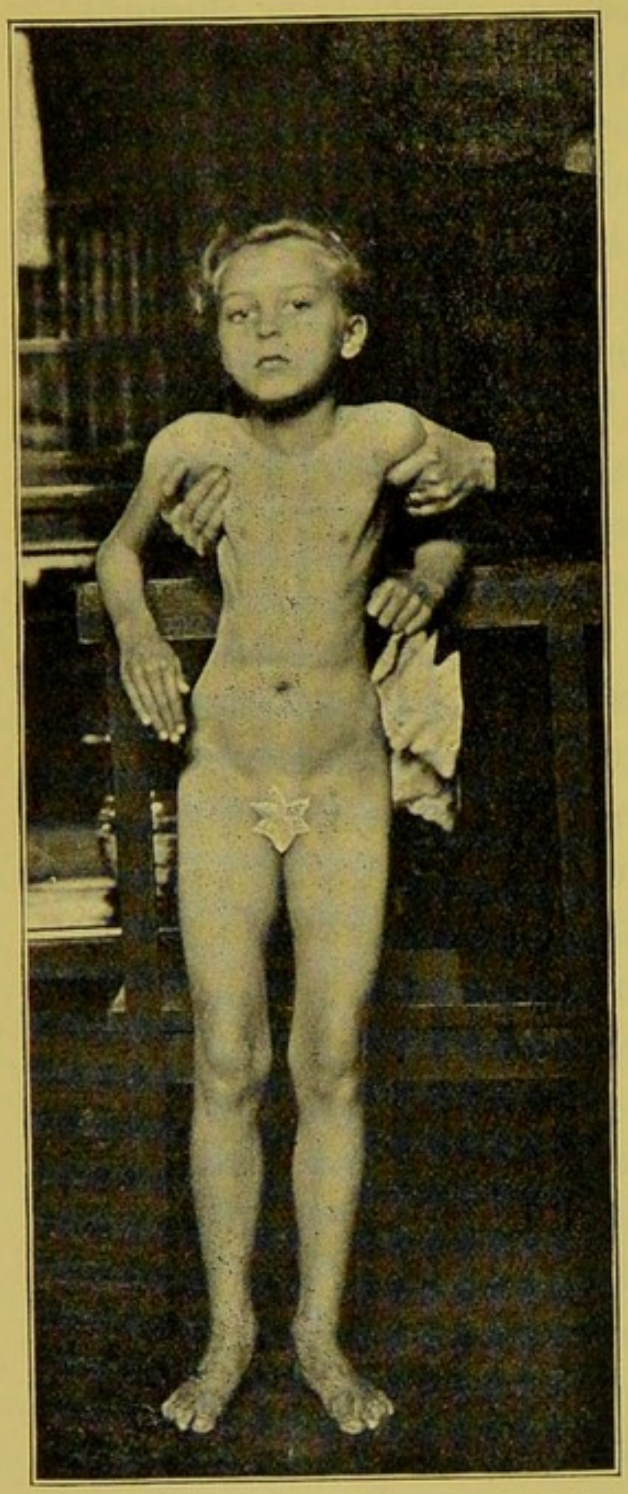

Fig. 53.

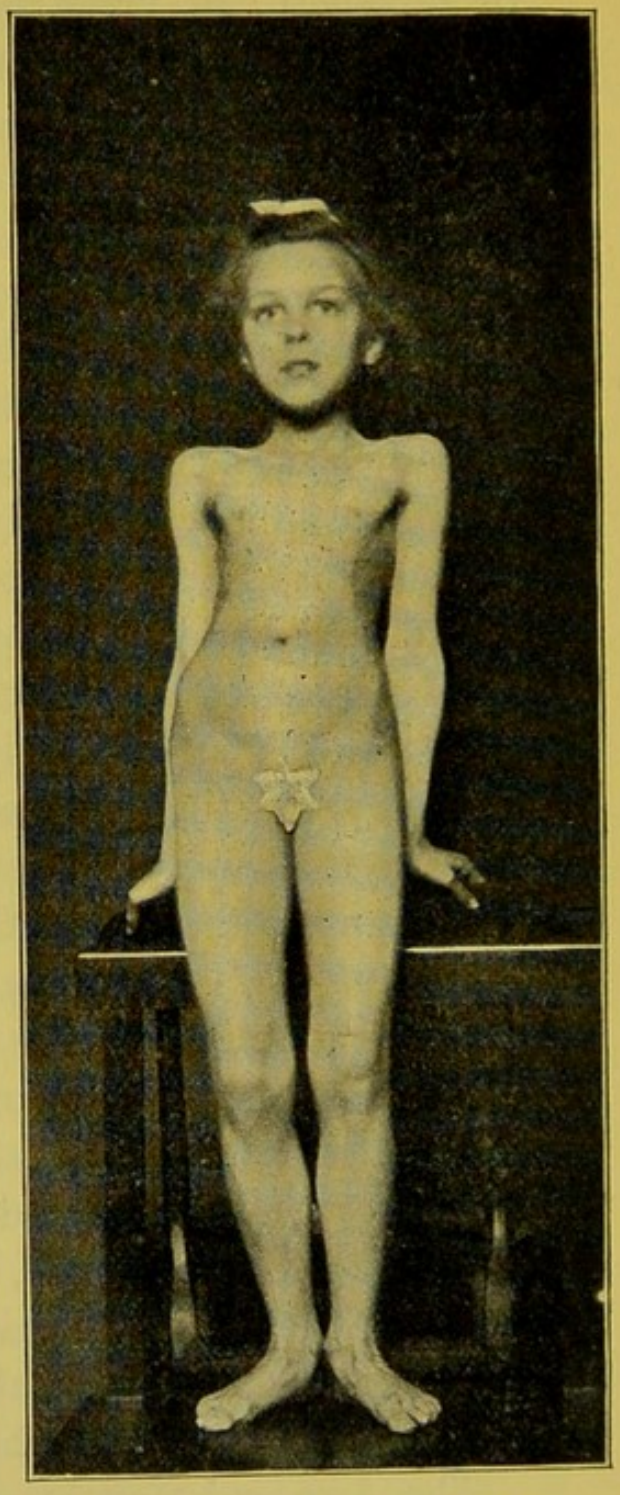

Fig. 52 represents a child who has suffered from spinal caries and who has been compelled to wear a splint in recumbency for five years. The resultant emaciation is well shown.

Fig. 53 represents the same child after discontinuing the splint and wearing for eighteen months an appliance similar to that worn for lateral curvature. The recovery from emaciation is also well shown.

of the splint for nearly five years—that is to say, from January, 1898, to November, 1902. I have specially picked a case in which from the gravity of the disease the splint treatment was obliged to be pursued for a much longer time than is usually the case. Now, a splint such as is necessary for caries does keep the trunk motionless, and it does put the muscles out of play, and it does compress the body in a way that might appear undesirable were it not an imperative necessity for what is often the actual saving of a life. The body therefore does become attenuated, and this condition is well shown in the photograph, taken in November, **1902.** At that date, the diseased spot having been presumed to be healed and consolidated, the child was put by day into a steel appliance of exactly the same kind as I use for lateral curvature, and which was arranged to exercise a straightening influence on the angular spine. In the meantime she continued the use of the splint, loosely laced, by night. Now, the photograph (Fig. 53) taken in May, **1904,** shows the child's condition after eighteen months' use of the steel appliance. It will be seen at once that all emaciation of the trunk is gone, and that she has the right proportions of a girl of eleven, that being her age.

Now, such an illustration—and I could from my albums give many, were one not quite sufficient—disproves completely the contentions of the gymnastic practitioner. For it shows, first of all, that even if a child is kept recumbent and splinted for five years, the body readily recovers its substance and tone as the cogency of the splint is relaxed. And it shows, what in the matter under consideration is of far greater importance, that this recovery of bodily substance and tone takes place perfectly well when a child is daily

wearing the very appliance that the gymnastic practitioner affirms will cause atrophy and permanent bodily damage. Can any proof be more convincing? I might, perhaps, as a mere rebutment have given photographic illustrations of any of my lateral curvature cases at the commencement and termination of treatment, and have pointed to the fact that none of the atrophy and atony, declared by the gymnastic practitioner to be inevitable, ever arises. But I have put the contradiction even more strongly, and have selected a case already atrophied in body by the necessary treatment for caries, and have shown that such a case will, whilst wearing the very appliance that the gymnastic practitioner condemns, resume its substance and its tone. Hence it follows that the appliance for lateral curvature, far from inhibiting the development of the body, does precisely the reverse. And hence, also, it follows that the contentions of the gymnastic practitioner are, at all events, erroneous in this respect.

The disrobing views of the gymnastic practitioner.—But, as I have said, the gymnastic practitioner does not only confine himself to attacking methods of treatment. He goes much further, and in order to popularise his own practice he endeavours to intertwine it with revolutions that shall extend even to the simplest garments of the human body. He tries to cultivate a series of fads, and to form an exoteric following of disciples of whom he shall be the high priest.

On corsets.—He attacks corsets and pronounces them detrimental to health. Now, as I myself largely

employ special corsets, both as precautionary means of support where curvatures may threaten to be incipient, as well also as safeguards against relapse after the mechanical treatment of curvature has been consummated, I may perhaps be allowed to offer some remarks on such a subject.

The women of all dominant and civilised races always will wear, and with advantage always have worn, some form of binder or corset. In those primitive and aboriginal races in which the women do not wear them, or, indeed, anything else beyond a few beads, they may as girls be perfect in form at puberty, but they are, as a rule, hideous objects of disfigurement after their first child. And, as they generally marry immediately after puberty, their lapse into unsightliness is pretty early.

As one comes towards civilisation the beneficial advantages of "girding the loins" in both sexes is well known. The native Indian has learnt to gird his loins for labour. The native Arabian of to-day does the same, and so fully is this reckoned indicative of energy that the term "loose-girted" is applied as one of contempt to men who are feeble and effeminate. And if one looks back through history one sees the same thing. Elijah girt his loins when he ran before the chariot of Ahab from Carmel to Jezreel, a pretty long run even to the athletes of Northern climes. The men of Rome and of Greece were wont to gird their loins for war or for exercise, and their customary expression to denote an active, well-set-up man was that he was well girt. With men, of course, it was only the loins that were girt, and one can still see this done by men of to-day—by navvies at heavy work or by soldiers at stable duty.

With women, from their frailer build, the development of their breasts, and their pectoral mode of respiration, corsets naturally took an ampler form than the mere loin-band worn by men. The original corsets used by the women of Egypt, of Greece, and of Rome, were of three pieces, and these were worn either together or separately, as required. They consisted of supporting bands worn round the body in a way very similar to the "putties" worn for support round the legs by the present-day soldiery. The main and most useful portion of the corset was the zone, or loin band. Then there was the thoracic band, or strophion, intended to uphold the breasts and conserve the figure. And, lastly, there was the waistband, which filled up the space between the other two. It is from the conjunction of these triple bands that the modern corset has been evolved, as it is worn by women of every class throughout civilised Europe to-day. What was made before in three pieces is now simply manufactured in one.

A good corset should take a very firm hold around the hips and loins, it should support or stay the back, it should leave the body free from any undue pressure across the abdomen and the chest, and the top of the "busk" should never be allowed to press upon the lower end of the breast-bone. Corsets are intended in their right and proper use simply to stay and support the body in its natural shape, and not to mould it into funny forms according to the vagaries of fashion. The women of classic times did not use them for this purpose. On the contrary, they had no reason to do so, as their flowing garments did not permit them to display the outlines of their figures; they, therefore, simply wore corsets because it had been found

by centuries of experience that they were conducive to health and serviceable in exertion.

But it may be asked at once, Why should the whole history of the world show that such extraneous support is beneficial? just as indeed it might be asked, Why should any clothing whatever be found requisite by civilised mankind? The answer is, I think, extremely simple, even if Darwinian. Man, according to his obvious mechanism and morphology, is a creature built on the quadrupled pattern, with the intent that his body should be horizontal instead of vertical. Out of all the vertebrates he is the only one (with the exception of a few cousinly anthropoid apes) who has managed to permanently rear himself into the erect position. All his internal organs are arranged for progress on four legs instead of on two. But as he has chosen the upright position so he has had to experience some of the penalties attached to it, and so also he has had to find out for himself some of the methods of evading those penalties. By morphological rights he should be a hairy quadruped. But as he has (with the roll of centuries) lost his hairiness, so he has found by experience that clothing is necessary for healthful warmth. And as he has also reared himself from four legs on to two, so he has found by similar experience that some sort of bandaged support is required in order to assist an abdominal mechanism that is inadequate for biped progression.

The truth is, man must seek by experience what is of service both as regards his health and his pursuits, and he must do so without taking heed of the cranks of faddists or the lucrative deceptions of pseudo-scientists. A paragraph or so back I mentioned "putties." Every argument that the gymnastic prac-

titioner advances against the use of corsets can also be advanced against the use of putties. They must cramp the muscles of the leg, they must atrophy those muscles by pressure, they must stop the circulation, they must hamper vitality. But it happens that a quarter of a million of men, engaged during nearly three years in physical efforts that were almost superhuman, found by experience in South Africa that the use of putties was of benefit in protracted exertion, and they found further that no ill effects accrued through their usage. They scarcely therefore required to be told, with countless and trivial reasons, that putties are either unnecessary or detrimental. Similarly women do not require to be told that corsets are unnecessary when they have the accumulated experience of centuries to prove the reverse.

But the gymnastic practitioner not only affirms that corsets are quite unnecessary—a thing which I have, I think, controverted—but he goes to the great length of asserting that on medical grounds they are positively and scientifically injurious to health. On this latter point I will also join issue with him, and will show that, after the most careful and independent investigations, they have been scientifically proved to be very distinctly beneficial.

In **1888**, at the meeting of the British Association at Bath, a conjoint address was delivered by Professor Roy, F.R.S., and Professor Adami, of Cambridge, on "The Physiological Bearing of Waist-Belts and Stays." Neither of these gentlemen were in special medical practice, and neither of them held briefs from interested persons to promulgate opinions that should be substantive in any particular direction. On the contrary, they both belonged to that distinguished class of dis-

interested investigators to whose scientific experiments the medical profession owe most of the facts upon which actual medical practice is based.

These two scientists first of all devised an instrument, which they termed a "cardiometer," and by which the force and volume of the blood propelled by the heart under various conditions could be accurately gauged and recorded. This done, they proceeded to investigate the effects of stays, not only upon actual humanity, but also upon animals of different kinds. They found that when the abdomen was gently constricted by belts or bandages there was an immediate increase in the volume of blood put into circulation through other parts of the body, and a consequent increase in the vital activity of those parts to which the additional amount of blood was supplied. As might have been mechanically expected, the effect was most marked in four-footed animals, whose bodies were horizontal. In dogs the increased blood-supply amounted to between 30 and 40 per cent. In mankind, owing of course to the fact that the body is vertical, only about half this increase was registered. They found, further, that a gentle compression of the abdomen by any means would, without disturbing arterial supply, drive from the abdominal veins and capillaries a large amount of diverted and stagnant blood, and that the blood so driven out would, so long as compression was continued, be of service to the other regions of the body, to the brain and to the muscles. And they found likewise that such compression of the abdomen was most potent in beneficial effects when a belt or stays were used, not only by those who were delicate but also, and most frequently, by those who were in perfect apparent health. Abdominal com-

pression, they proved, brought more blood into the service of the brain and the muscles, and conduced in consequence to an increase of mental and muscular activity. Finally they concluded by showing that the facts they had elucidated correctly explained "the beneficial and extensive use of some form or other of waist-belt by all nations who had passed beyond the stage of absolute barbarity."

What I have given is a brief, but accurate, summary of the address delivered by these two careful investigators before the British Association. Those who wish to consult the lecture at full length will find it printed in the volume of 'Proceedings' for **1888**, and they will see that it refutes entirely the ridiculous contention that proper corsets are in any way harmful.

On boots and stockings.—But the gymnastic practitioner is not content with trying to dispose of the unseen undergarments with which women have from time immemorial clothed themselves. When once he has started on his idea of disrobement the wildness of his theories carry him on and on to any extremes. He attacks boots and stockings. He declares that they cramp the feet, deform the toes, and destroy the muscular activity of the arches and ankles. He avers that certainly all growing children, and most advantageously most adults, should go about bare-footed. And the public, which seems periodically to enjoy a brief indulgence in cranks and crazes, thoughtlessly follows his teachings.

But what evidence is there that, in this respect, the gymnastic practitioner is right? I not only assert that there is none, but, on the contrary, I submit that there is overwhelming evidence in the opposite direction.

Take shape first. It so happens that there are two classes of people in the British Isles who do habitually discard boots and stockings. One is the fisher-folk who are to be found all round our coasts, and the other is the factory girls who work in some of the larger Scottish cities. I scarcely like to be ungallant about the latter, but I commend the adult feet of both these classes to the inspection of those who draft their children into the "bare-footed brigade." The truth is that the feet of those who have been unbooted till they have reached adult life are splayed and spread, large-jointed, and very generally deformed from all approach to the ideal foot as it is depicted by the greatest painters, or modelled by the greatest sculptors. But I need not carry this point further, for the actual object-lesson lies in everybody's way.

Next, as to activity. Is there not positive evidence that the greatest power of the feet is attained by those who wear boots? Are not the greatest athletes booted men? Let me even show this from amongst my old schoolfellows at Rugby: Brooks beat every record for the high jump at the Inter-University sports, and Bulpett was a record long-runner; both were booted men. Now, probably nothing requires greater activity of foot than running and jumping, and yet has anyone ever made a record in either of these who has not been a booted man? Deerfoot, the celebrated North American Indian, who was brought up, I believe, in mocassins, came over to England in the "sixties" to prove, if possible, that he was the finest long-runner of the world, but his records were easily broken by booted Europeans. The fact is indubitable that the booted races have always been the most active and have always dominated all others. A handful of

booted men conquered the bare-footed Empire of India.

So much for the activity of the booted races. But the gymnastic practitioner makes another entirely false assertion, and affirms that all boots deform the feet. Well, just as with corsets so with boots, I will advance careful scientific evidence to the contrary. The Infant Orphan Asylum at Wanstead is a superb institution which takes charge of some six hundred of the better class of children who have had the misfortune to lose one or both their parents. The children enter in infancy and leave on their fifteenth birthday. They are always under the medical supervision of a permanent physician, and the greatest care is exercised in respect to their clothing, which is of an uniform character. They wear boots and stockings, the stockings roomy and the boots square-toed and somewhat on the Army pattern. With six hundred children, all wearing boots and stockings, there was an obvious opportunity of obtaining very correct statistics. I therefore asked Dr. Ernest Cross, with whom I was acquainted, and who was physician to the institution, if he would kindly allow me to have the benefit of his own investigations into the question of the damage asserted to be done by boots to growing feet. He very courteously answered that he would parade the hundred eldest girls and the hundred eldest boys, and that, after carefully examining their bare feet, he would let me know the result. The obvious object of selecting the oldest children was that they had been in residence for some years, and had therefore worn for some time the boots supplied by the institution.

A few days later I had Dr. Ernest Cross's statement. The two hundred children he had examined ranged between the ages of ten and fifteen. Out of the

hundred girls ninety-seven had perfect feet, and out of the hundred boys ninety-five were similarly perfect. Out of the two hundred children, therefore, one hundred and ninety-two had absolutely nothing wrong with their feet. Of the eight abnormalities from perfect shape there were two girls and three boys with contractions of the upper tendons of the toes, and there were two boys and one girl with contraction of the lower tendons. These contractions were, of course, idiosyncratic and entirely independent of the boots. I commend these statistics to the opponents of the use of boots and stockings.

On waistcoats.—But the vagrant theories of the gymnastic practitioner are not yet finished with. He denounces waistcoats. For weeks (as I am now writing) discussions have been going on in the lay papers as to whether waistcoats should not be totally discarded. Conscientious schoolmasters, guided by what they think scientific light, write to state that henceforth at their particular schools boys shall reap special advantages, inasmuch as waistcoats will no longer be permitted. And at a recent conference of schools at Birmingham it was seriously proposed that not only waistcoats but that coats also should be permanently eschewed. The man in the street who has worn a coat and waistcoat for thirty or forty years without detriment, and who knows that his forebears have for centuries done the same, is inclined to exclaim "Rubbish!" And rubbish it is. If there is a garment that allows absolute freedom of movement it is a waistcoat. Its large armholes permit the upper limbs to travel in all directions, and without the least restraint. It cannot cramp the limbs, and it cannot cramp the chest unless,

indeed, its buttons are too tight, and if by chance this is so they can be easily altered. I might, as I have done with boots, obtain determinate statistics, but the thing is not worth the trouble. With boots it was different, because the feet cannot be actually seen or judged of in their leather investments, but everyone can clearly see the carriage of a boy through his clothing. Personally I consider the upright carriage of an average Eton boy, with his coat and waistcoat, infinitely preferable to the slouching shoulders and ungainly walk that one can so readily observe in the boys of many seaside schools where the permitted garments are only "shorts" and jerseys. But the gymnastic practitioner thinks differently.

On other articles of clothing.—It may be presumed that under the influence of the gymnastic practitioner this system of disrobing will be continued until its ridiculousness becomes self-evident. Hats have come under the ban, and there is a "hatless brigade" of enthusiasts who dispense with them altogether, even in church. Then again, and still for liberty of limb, girls and women are advised to clothe their upper bodies in blouses of the loosest and most open tissue which positively mock the modesty of an ordinary evening dress. And what was at first a crank has almost become a fashion. At well-known seaside resorts one sees girls and women, without hats, without stays, without shoes, and without stockings—in short, with very little else upon them beyond a skirt that is none too long, and a "pneumonia blouse" that is so beautifully open in its pattern that its image is printed by the sun on their chests and arms, and is displayed thereon in bathing.

If by chance these crazes have not reached their climax, as indeed seems probable from the satire that has recently been showered upon them, one may expect in a year or so to see men taking their lounge in the park clad in the flimsiest of pyjamas and ladies reverting once again to the alluring simplicity of the Coan vestment. A year or two more and the business of the tailor and of the modiste will have become entirely extinct—unless, indeed, they turn their attention to horticultural pursuits, and pass their time in rearing the largest-leaved specimens of the *Ficus religiosa*. But even this occupation will fail when mankind finally reaches its highest gymnastic ideal and adopts the sweet "altogether" of Trilby.

Now, if I have rather ridiculously followed this dispersion of clothing down to its ultimate absurdity, it is because it has been cultivated into a popular movement and then used as a counter-argument against the mechanical treatment of deformities. The gymnastic practitioner asserts that nearly everything that is worn is an encumbrance to the body and should be eschewed. Half of the ordinary garments have already been condemned by him. Stays, boots, stockings, hats, waistcoats, and coats have already been stigmatised as physically injurious. And, when once the public have accepted and acted on what they believe to be beneficial criticism, he is able to turn round and say that if so slight a thing as a pair of stockings is prejudicial to the liberty of the body, how much more prejudicial must an appliance be that is worn for the cure of spinal curvature; and he proposes as an alternative treatment a course of his own gymnastic exercises. Nay, he goes further, and asserts that if gymnastic exercises, or as they are now termed

"physical education," were universal, then spinal curvature would cease to exist. When he first preached this doctrine there were no statistics to use as proofs of the falsity of his assertions. But the Education Acts have produced them. The conditions he demanded have been fulfilled, but the promises that he based on these conditions have remained entirely unrealised. Gymnastics will no more prevent or cure actual spinal curvature than they will prevent or cure scarlet fever.

An exemplary case.—Now I have already given the theoretical grounds on which I have based the assertion that actual spinal curvature can be cured or, in very bad cases, vastly ameliorated by the mechanical treatment, whilst the gymnastic treatment utterly fails in producing the like beneficial result. But as it is always desirable to substantiate theoretical propositions by convincing practical proofs, I will for this purpose recount at once a selected and typical case which will clearly illustrate the efficacy of the mechanical method of treatment in direct comparison with the complete failure of the gymnastic one. And, moreover, this particular case has very distinct advantages for the purpose. It was originally for a few weeks in my hands; it was then placed by the advice

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Fig. 54 represents the young lady alluded to in the text. She was first brought to the author on December 10, 1901, for mechanical treatment, but her parents were shortly afterwards persuaded to submit her to the gymnastic treatment instead.

Fig. 55 represents the same patient (July 15, 1903), showing the terrible lapse after fourteen months of the gymnastic treatment. At this point the mechanical treatment was recommenced.

Fig. 56 represents the same patient (March 1, 1904) eight months after the recommencement of the mechanical treatment, and shows the immense improvement.

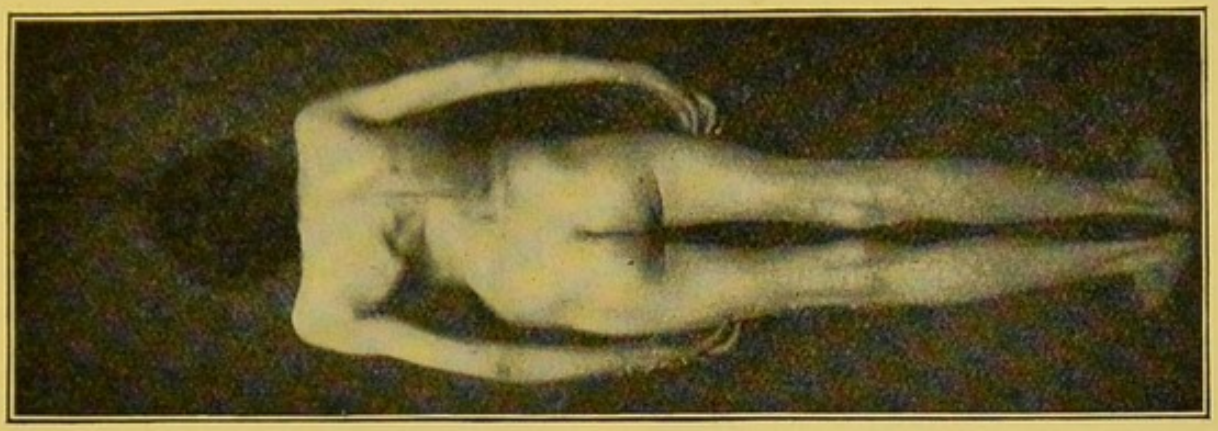


FIG. 56.

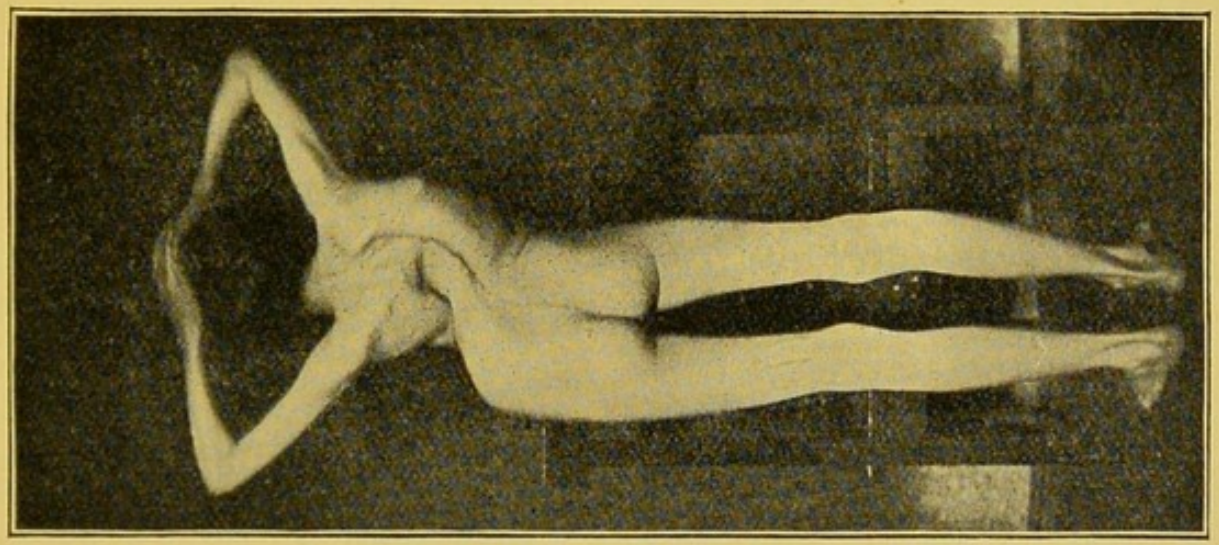


FIG. 55.

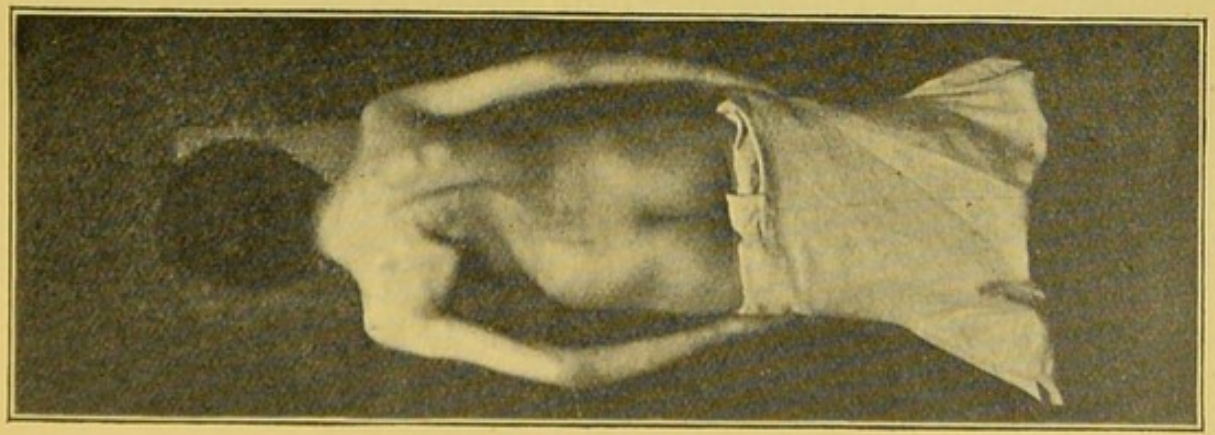


FIG. 54.

of the friends of the patient in the hands of a gymnastic practitioner, and it subsequently reverted again into mine. Moreover, it had the benefit of photographic records during the whole of these stages. It will therefore, I think, be found to afford paramount opportunities for the comparison of two distinct methods of treatment, and, without further preamble, I will proceed to give its history.

A young lady, who was eleven and a half years of age, was sent to me by Dr. Albert Hingston, of Plymouth. Her previous history was that at the age of six she was noted to be walking badly, and that her shoulder was growing out. By the advice of her local doctor a poroplastic splint was applied on the Sayre principle. As this method proved inadequate to check the progress of the curvature she was sent to London to consult a well-known specialist, and was under his care for two years and a half, coming to town for the purpose at intervals of every three months. As she still, unfortunately, became worse, Dr. Hingston was consulted, and by him she was sent to me. It should be added that all the rest of her family were fine, well-built people, and that they resided in a healthy locality on the sea-coast.

I first saw her on **December 10th, 1901**. Two days later I applied an instrument of the kind which I have previously described as adequate in lateral curvature (Fig. 34). At the same time, also, I took a photograph of her condition for record, and it is shown at Fig. 54. I did not take her height, as at that time I saw no reason to anticipate the need of specially careful records, in addition to which my photographs, which are taken to scale, actually record all dimensions as far as they are usually required.

FIG. 57.

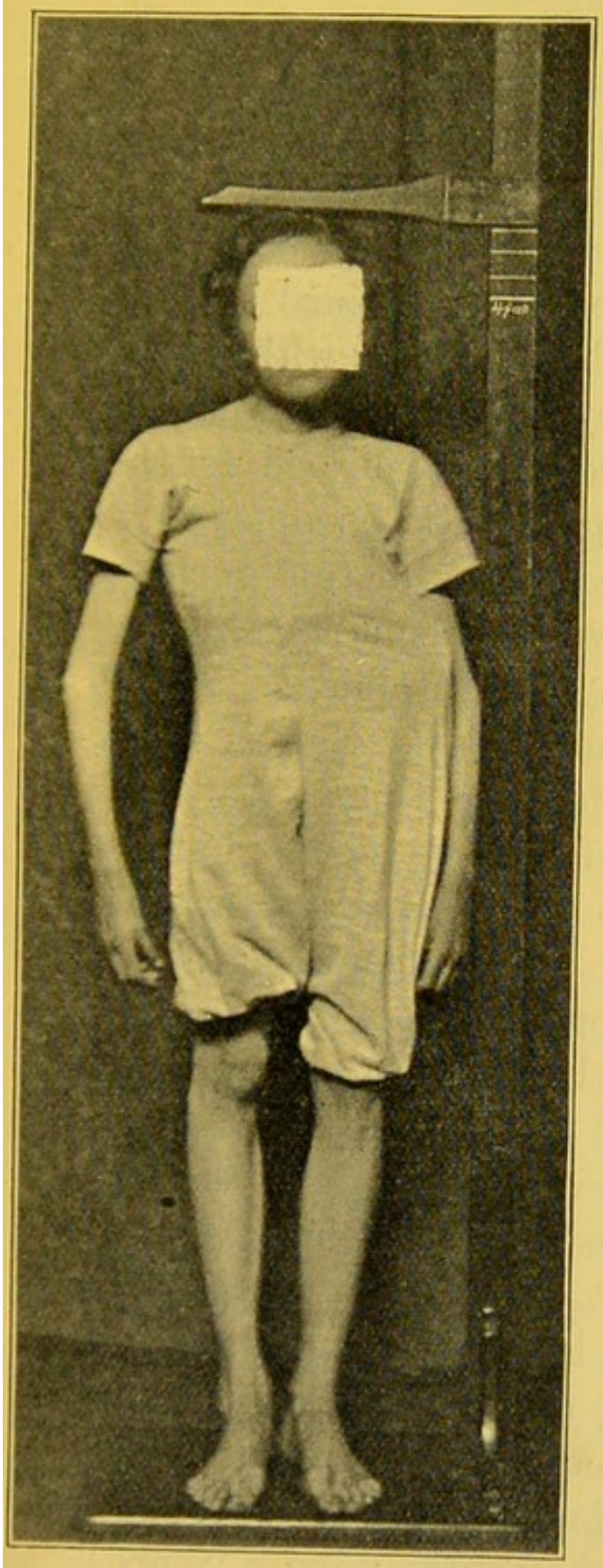


FIG. 58.

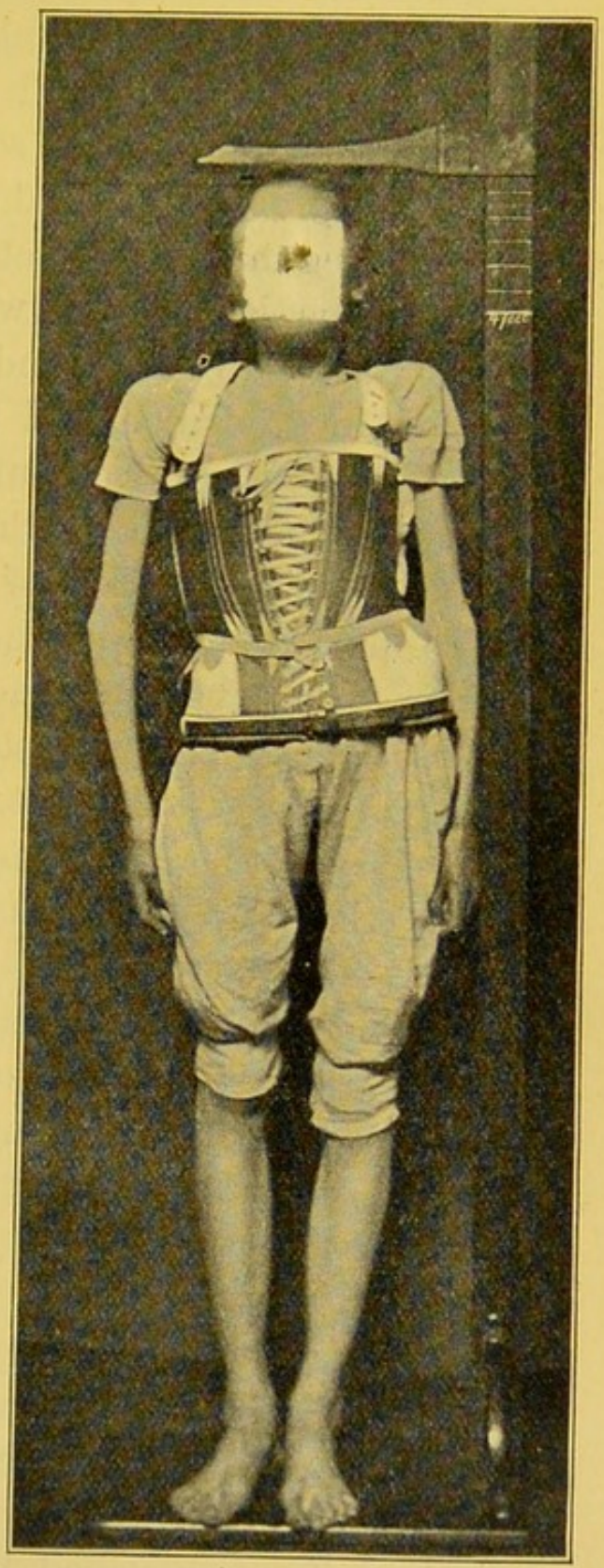


Fig. 57 represents the same patient at the recommencement of the mechanical treatment (July 18, 1903) standing in a state of lapse after the gymnastic treatment, and without an appliance.

Fig. 58 represents the same patient on the same day (July 18, 1903), and shows the immediate extension of the spine and the increase of bodily height attained the moment the appliance was put on.

I did not see the young lady again until the **July** of **1903.** The reasons for this void were given to me by her father. It appeared that, on her return home after first coming to me, some of her mother's friends, whilst they acknowledged the improvement that had already begun, stated that they had heard that much more immediate results were to be obtained by "the muscular treatment," and this entirely without the use of an appliance, and they recommended that she should be taken to a surgeon distinguished for his strenuous advocacy of the gymnastic as opposed to the mechanical method of treatment for this purpose.

To him, accordingly, she went "about **May, 1902,**" still wearing the instrument I had applied. He, of course, removed the instrument and, what is more, he took possession of it,—for the time. And also he advised that she should be put under him, in order that she might have the alleged advantages of his daily treatment by posture and exercises. She remained under his constant care for thirteen weeks, that is to say, for the full term of time required by him as essential for his "cure." As a matter of fact her father visited her about the end of the tenth week—and was so disappointed by her material change for the worse that he ventured to remonstrate. This surgeon, however, assured him that he himself was personally quite satisfied with the results, and that, if the course was completed and home exercises were continued, after the termination of the prescribed three months, then a "cure" would be attained. And the father, on the faith of this promise, assented.

Notwithstanding all this, the patient became gradually much worse, until at last the father wrote to

me to ask if I would resume my mechanical treatment, as this had proved, even during the short time that it had previously been adopted, of greater benefit than any other.

I therefore saw the young lady again on **July 15th, 1903,** and for the first time since her original visit to myself. And I took an immediate photograph of her condition. The deformity, as can be seen, Fig. 55, was simply appalling. All the lower ribs on the left side had sunk within the hollow of the pelvis, whilst the lower angle of the left shoulder-blade was bedded behind a fold of flesh, and was resting on the very edge of the iliac crest. And all this after a year's unrestricted and personal treatment according to the surgeon's prescription of exercises. The lapse that had taken place is readily judged by a comparison between the first and second photographs taken respectively in December, 1901, and July, 1903. I think further comment is rendered entirely unnecessary.

I resumed my own mechanical treatment on **July 18th.** A fresh instrument was put on, and photographs, as well as height measurements, were taken both immediately before and immediately after its application. The first photograph is shown at Fig. 57. The height of the body as taken by the measuring standard was **4 ft. 3¼ in.** The second photograph is shown at Fig. 58. The height of the body was **4 ft. 5¾ in.** The instrument therefore produced an immediate extension of the spine to the amount of **2½ inches.** As the patient leaned somewhat towards the right side, elastic stocking-suspenders were added, that on the right side being only of a single strand of light elastic, whilst that on the left was of quadruple strong elastic, exercising such considerable tension as should

draw the body over into erectness. This plan, as I have elsewhere mentioned, is a simple and efficient way of correcting those lateral inclinations at the hips that are due to the overweighting of the one side of the upper part of the body by the fulness of the distortion.

In addition to this I later on gave the patient a splint to be worn at night, constructed on the straightening principles already described at p. 135. The photographs of the cast, plaster blocks, and of the actual splint employed in this particular case have likewise been given (Figs. 44, 45, 46, and 47), and I need not further refer to them.

The patient was then dismissed to her home with instructions to come up to London every six months in order that periodical alterations in the shape of both the appliance and the splint could be made, and the improvement in the shape of the body could be thereby followed up. As a matter of fact intervals of eight months elapsed between the next two visits, the dates and the results of which are as follows.

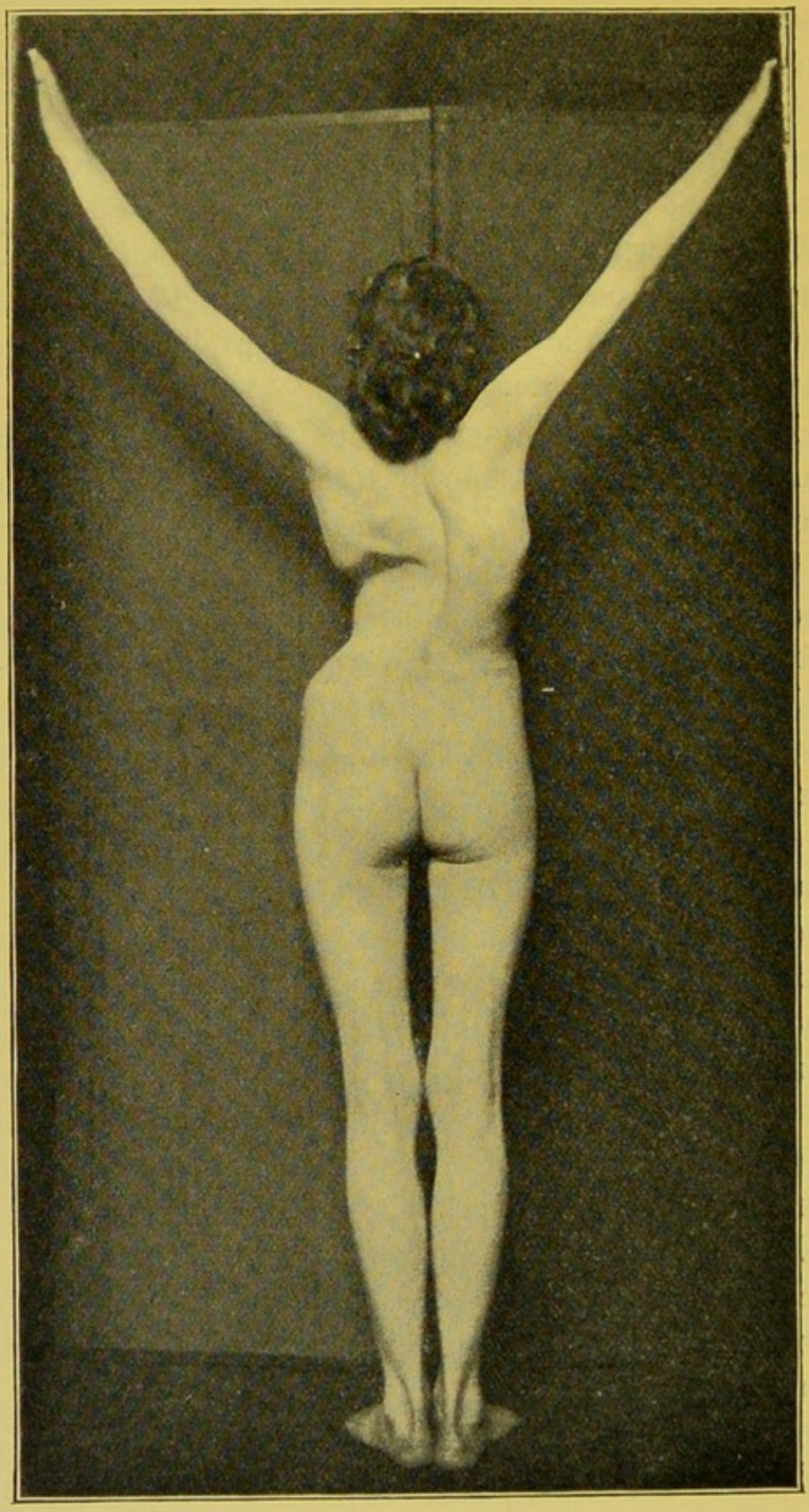
In **March, 1904,** the improvement was as is shown in the photograph, Fig. 56. The height of the body without the appliance was then **4 ft. 7¼ in.,** showing a gain of **4 inches** in eight months. When the appliance had been lengthened the height of the body in the appliance itself was **4 ft. 8½ in.**; hence, it is obvious that full provision for further mechanical extension was made. In the meantime, also, the general framework was re-shaped into greater straightness.

In **November, 1904,** the further improvement had been fully maintained, as is shown by the photograph Fig. 59. In order to more clearly indicate the general outline of the body this photograph was taken with

the finger tips lightly resting on the top of the Japanese screen that I used as a background for my photographs. The height of the patient, however, taken with the arms pendant and without the appliance, was **4 ft. 8¾ in.**, showing a further improvement of **1½ inches.** And when the patient again left town with the altered and extended appliance worn on the body the height was **4 ft. 10½ in.** Here, again, an ample provision for further mechanical extension was made.

I have given the measurements, with the appliance on, after each visit merely to indicate the powers of immediate extension. But, of course, the actual figures of improvement are those recorded when the appliance had been removed from the body. These, it will be seen, are pronounced. The patient started with a height of **4 ft. 3¼ in.** In eight months' time her height had increased to **4 ft. 7¼ in.** And in another eight months her height reached **4 ft. 8¾ in.** She had gained in the sixteen months **5½ inches** in height, **4 inches** of which were due to the first eight months' treatment, and **1½ inches** of which were due to the next eight months' treatment. As a matter of fact it is well known that in most deformities affecting lapsed and jointed parts the amount of improvement is greatest at the outset. This is well seen in knock-knees where, as a rule, half the deformity is eliminable in the first six months, half of what is left in the next six months, half of the remnant in the next term, and so on. Hence the ratio of improvement is in a diminishing progression until practical straightness is reached. And in this particular case of spinal curvature the same ratio would, of course, be observable. But the point that I particularly wish here to enunciate is this,

Fig. 59.



that here is a case in which, as the photographs prove, there had been rapid lapse whilst the patient was under a year's treatment by the gymnastic prescription of exercises, and that the moment the mechanical method of treatment was adopted a rapid restoration towards straightness was at once attainable. In other words, the gymnastic treatment was an utter failure, whilst the mechanical treatment was a pronounced success. Now, as the gymnastic surgeon himself practically took this case out of my hands as a test one, I think the deductions therefrom as to which of the two treatments is correct are extremely obvious.*

* As these pages go to press, and in consequence too late to insert a further photograph, the patient has again been seen, and a further extension of over an inch has been attained (October 12, 1905).

Fig. 59 represents the same patient (November 3, 1904) sixteen months after the recommencement of the mechanical treatment.

SECTION VII.

A Particular Analysis of the Gymnastic Treatment.

Preliminary remarks.—I have now to pass from things general to things particular. In the last section I recounted, and in broad terms only, the wax and wane of two modern methods of treating Lateral Curvature which were expressly put forward to supersede the established mechanical method. And this, although the latter had already endured in the past for over two thousand years, and was bound to be further substantiated in the future by every stride that was made in the persistent progress of mechanical science—a science which, as Macaulay observes, can never go backwards or even remain stationary, but must always progress.

Still, two modern attempts have been made to displace this mechanical method, the one by the plaster-of-Paris jacket, and the other by the use of gymnastic exercises. Whoever the followers of these diversely opposite and oppugnant plans may at any time have been, and whatever others may have written upon such widely separate subjects, it remains none the less a fact that the former method must be associated with the bygone writings of Lewis Sayre, and the latter with the less ancient writings of Mr. Bernard Roth.

With respect to the writings of Sayre upon his

"suspensory-plaster" system, it is sufficient to say that they are now so completely out of date that it is unnecessary for me to again seriously discuss them. I particularly analysed them in my previous works, both before and after the condemnation of the "jacket" by the International Medical Congress, and that was a quarter of a century ago. The use of the plaster jacket for lateral curvature, applied as Sayre proposed to apply it, has long since been shown to be valueless; the system is obsolete, and the whole thing is a matter of stale history. The subject, therefore, requires no re-opening.

But with Mr. Roth's writings it has been different. His method was no novelty, but a mere revival. His expositions could not therefore, like Sayre's, be propounded broadcast in the theatres of all the greatest London hospitals under the auspices of all the greatest London surgeons. They could not be blazed abroad by personal demonstrations. But for this very reason they could and they have escaped the same amount of discussion as was devoted to the plaster-of-Paris method. His propositions are quite as broad and quite as sweeping as those of Sayre, but they are embodied in writings more modest in size and fewer in number. As far as I have observed these writings, which are persistently pregnant with strictures on the mechanical method, have never yet been submitted to critical analysis.

Mr. Roth's propositions.—It is these writings I propose presently to review. They consist roughly of Mr. Roth's original articles in Mr. Heath's Dictionary, a book on lateral curvature, some pamphlets on the same subject, and a particular advertisement that has,

for some years, enjoyed the privilege of a front-page space in the 'Lancet.'

Now the original gist of Mr. Roth's writings is, I think, to be fairly summed up in the following propositions which are in Mr. Roth's own words. He asserts that by following his "prescription of exercises" lateral curvature without any osseous deformity can be practically cured by one month's daily treatment. He asserts also that although "when once there is actual osseous deformity of the ribs and vertebræ, to that extent lateral curvature is incurable," yet "the patient can be sufficiently straightened and the muscular sense thoroughly re-educated, so that the best possible position becomes an habitual one." These extracts are quoted, without the least attempt at perversion from their context, out of Mr. Roth's articles of 1886. Personally, I should say that where there is no osseous deformity there is no actual curvature at all, and personally, also, I should say that Mr. Roth's admission that a case of osseous curvature is incurable by his methods is a very distinct admission also of the incompetency of his system to cure actual curvature. But I will abstain from even enlarging on these commonsense points because I prefer that Mr. Roth's methods should stand or fall out of his own actual writings and statistics.

By **1896** Mr. Roth had condensed his propositions into a much simpler brevity. In a pamphlet of that date, intended for American consumption, he makes the opening sentence, and it is the text to all that follows, stand thus: "Any ordinary case of lateral curvature, where the patient is fairly intelligent and co-operates in the treatment, can be practically cured by a course of three months' daily treatment by posture

and exercise." This statement I maintain to be wrong, and yet Mr. Roth attempts to prove it to be right by the exhibition of a number of those metal-strip tracings to whose entire unreliability I have already referred (p. 150).

Whilst expatiating, however, on such methods of cure, Mr. Roth takes the trouble to attack the mechanical treatment as being not only useless but as being utterly harmful. And yet with the same breath, or to be more accurate with the same strokes of the pen, he is bound to admit that many surgeons who have tried his treatment have found it entirely unsuccessful. He is bitterly regretful for these unfortunate men because (still to quote Mr. Roth's own words) "their results have been less successful than mine, and these surgeons have more often than not relapsed into the old-fashioned treatment by mechanical appliances." "Relapsed" is a delightfully selected word, but the whole thing is a little vague. Clearly expressed the admission simply means this—that surgeons have found the gymnastic treatment to be a failure, and after trial have preferred to follow the mechanical method. And I may add that Mr. Roth's own statistics, as I shall later on show, indicate this to be the case.

Still, although Mr. Roth is compelled to admit that many surgeons relapse from his gymnastic method of treatment, yet he tries to find some explanation that may be advanced as a cover to such backslidings. He seeks this with the broadcast assurances that characterise the rest of his writings. These surgeons, he asserts, "supposed themselves to be carrying out my treatment," whilst, in reality, they were not doing so. In short it would appear that those surgeons who have tried most closely to follow out Mr. Roth's instructions

have proved themselves incompetent to obtain the promised results. This is rather a curious argument for Mr. Roth to advance with respect to a treatment which, like that of Sayre, is supposed to be easily mastered in the briefest time, and to be readily applicable by any and every practitioner to any patient with a certainty of success. One thing, at all events, is clear; either the system of treatment or the surgeon must be at fault. Mr. Roth expresses the opinion that it must be the surgeon; personally, I think I can show that it is the system.

Mr. Roth's writings.—As I have already stated, the published works which embody Mr. Roth's views on the treatment of lateral curvature consist of a book, sundry pamphlets, and a certain advertisement. As the contents of the pamphlets seem practically to be contained in the book, it will be unnecessary to take these apart. The advertisement also is included in the book, being in fact a quotation from its title page; but as it enjoys, as an advertisement, quite a different circulation, and is probably much more read, it seems only reasonable to consider it first and separately.

This advertisement is most ingeniously worded. After recording the title of the book advertised it continues with the following sentence:—"With appendix giving an analysis of 1000 consecutive cases treated by posture and exercise exclusively (without mechanical supports)." Now this sentence must be viewed as a statement of three separate facts, which, if taken by themselves, may be perfectly true, and yet when placed in correlative juxtaposition may none the less convey impressions that are entirely erroneous. It may be true that between certain dates, which roughly com-

prise seven years and a half, Mr. Roth may have had under his care a thousand cases, just as indeed any other specialist on spinal curvature would very easily have had. And it may be true that Mr. Roth will have treated all these cases by gymnastic methods he advocates. And it may be also true that he would treat none of them by the mechanical method he eschews. These three statements taken separately, and accepted as true may have nothing so peculiar or startling about them as to render them very seductive in advertisement. But strung together as the words are with the antithesis between "posture and exercise" as contrasted with "mechanical supports," and taking also the conventional usage of the word "treated" as implying that treatment was successful and final, the advertisement may be, and indeed is, a little elusive.

And this is perhaps best shown by giving some simple analogies. Supposing, for example, that there were advertised "a thousand consecutive cases of appendicitis treated by lotions to the top of the head exclusively (without surgical interference)," or again, "a thousand consecutive cases of cataract treated by faith-healing exclusively (without operation)." Both these analogous advertisements might possibly contain statements actually true in fact; and yet they would none the less be very poor guidance to those who were suffering either from appendicitis or from cataract.

It is obvious that they would not in any way disprove the efficacy of surgical operation in these particular affections, and still less would they prove the curative value of either lotions or faith. Yet this is what the lotion-monger and faith-healer would, by the wording of their advertisements, intend to impute. Similarly, and by analogy, it is obvious that Mr. Roth's

advertisement by no means disproves the efficacy of "mechanical supports," nor does it in the least way establish the value of "posture and exercise." Still this is what Mr. Roth, by the wording of his advertisement, apparently also intends to impute.

The truth is that the whole impression created turns on the use of the word "treated." When this word is thus simply and solely put, it is intended to imply that the cases were successfully and finally dealt with, or in other words "cured." And when put in antithesis to any other method of treatment there is the further imputation that such other method is either vastly inferior, or indeed positively useless. This conclusion I have shown by analogy to be in argument unsound. If Mr. Roth had been so sure of his own system he ought to have straightforwardly used the word "cured" at once, instead of the word "treated." But as a statement so definite might have been capable of contradiction by anyone into whose hands his treated cases might have subsequently passed, it was hazardous apparently for him to make it.

The advertisement therefore, in the manner in which it is worded, evades such controversion. And the same method is apparent also in Mr. Roth's other works—in his pamphlets and in his book. They all start with the same promise, that cases of lateral curvature can be practically "cured" by his method in three months at the outside. They all appeal to the records he professes to give of the results in cases with which he has himself personally dealt. His analysis of a thousand consecutive cases is put forward to substantiate his assertions. And yet when this analysis is looked at what is to be found? Not one single case of cure is recorded. After allowing for

fifty-eight admitted failures, the remaining 942 cases are simply registered as "improved" or "much improved." This is not as it should be. If Mr. Roth cannot in all his recorded cases give one single instance of cure, then surely he should have made no claim to promise this result, as he indeed does. But here again it is evident that if the word "cured" had been used by him there would always have been the possibility of subsequent contradiction, whereas if improvement only is recorded there is less likelihood of this possibility. And so the use of the word "improved" in the analysis is like the use of the word "treated" in the advertisement.

But I will now take in greater detail the contentions advanced in Mr. Roth's book, which practically, as I have said, contains the summation of all his previous writings. The book itself consists of about eighty pages of type, so largely "leaded" that the actual bulk of the volume could be conveniently comprised within less than a couple of pages of the 'Times,' or of the 'Morning Post.' In front of the letterpress are inserted some photographs purporting to be convincingly illustrative of the correctness of Mr. Roth's ideas; interspersed through the letterpress are numerous tracings which are alleged to support his assertions; and at the close of the work is the much advertised analysis of the thousand cases. The work contains such usual paragraphs on such usual subjects as definition, causes, examination, attention to general health, and like matters, but nothing is revealed in these respects that is new or that was not previously known to every medical man.

Mr. Roth's classification on the other hand is quite his own, and is ingeniously suited to his peculiar

method of treatment. He divides curvatures, and without the slightest regard to their origin, into two classes only. The one that includes all cases in which there is no osseous deformity at all (or, as I prefer to put it, in which there is no actual deformity at all) he christens as the "postural" class; and the other, which includes all cases in which there is actual osseous deformity, he denominates the "osseous" class. Mr. Roth's treatment is divided in a similar and correlative way into the one month's course and the three months' course. The non-osseous cases, he affirms, can be "practically cured" by one month's treatment, the osseous cases by three months' treatment. There is some little discrepancy between his statements made at different times. In 'Heath's Dictionary' he admits that osseous cases are incurable by his method, but asserts that they can be brought into the best possible position; on the other hand, in his American pamphlet he asserts that any ordinary case of lateral curvature can be practically cured in three months. It is difficult, even if it was worth the while, to in any way attempt to reconcile these two entirely contradictory statements, but as the latter one is of more recent date it may perhaps be taken as final.

In order to obtain the realisation of this promise of cure, certain prescribed treatment has to be followed. This is described by Mr. Roth as being pursued by "a first prescription of exercises," "a second prescription of exercises," and "a home prescription of exercises." The exercises laid down in the two former are fully given by Mr. Roth. As to the "home prescription of exercises," it is sufficiently well known to those who may have subsequently had the care of Mr. Roth's cases, and consists of an auto-lithographed form which

appears to act as a common "prescription," and into which some slight manuscript alterations are inserted according to the nature of the case. All these "prescriptions" are stated to be applicable by any surgeon to his own cases, but it is a curious fact that Mr. Roth gives no particular data as to the results of his methods when pursued by others. He tells us that he has found surgeons (other than himself) lapsing again into the mechanical method of treatment; but he allows loopholes for this deplorable result. Either the patient has not been sufficiently intelligent to co-operate in the treatment, or the surgeon has been incompetent to fully grasp the method of treatment, notwithstanding that it is clearly and succinctly laid down in Mr. Roth's own book. These are rather sorry grounds on which to excuse the failure of a treatment whose simplicity has been so much vaunted. In the absence, therefore, of full tabulative testimony of the results attained by other surgeons, one is compelled to fall back on Mr. Roth's solitary statistics, which naturally should be submitted to very careful examination.

Mr. Roth's alleged records of proof.—The soundness of all treatment can only be measured by results; and with deformities these results must of necessity be gauged by some very definite system of record. A man may be dying of pneumonia at the beginning of a month, and walking about quite well at the end of it. The result here carries its own conviction. But in order to know whether a case of spinal curvature, which was in a certain condition at the commencement of any year, is the better or the worse for treatment at the end of that year, some form of record beyond mere memory is positively needed. Mr. Roth is of course

aware of this fact and endeavours to meet it. In his original article of **1886** he states that, to obtain an accurate record he employs a malleable strip of lead. As all lead is malleable, and as the strip of lead in question has not to be hammered or malleted in this particular instance, the use of the epithet seems unnecessary, unless it was intended to convey the wrong impression of a new idea. As a matter of fact, this plan of roughly taking the shape of the body by means of a pliant metallic strip (usually of solder, as being most suitable) has been employed for over a hundred years.

But as a record of deformities it is absolutely valueless, and has already been authoritatively proved to be so. For example, the method was employed persistently by Sayre, whose book on the spine (**1877**) simply teems (just as, indeed, Mr. Roth's book does) with diagrams of metallic strip tracings purporting to be reliable records of the straightening attained both in cases of caries and in cases of lateral curvature. And yet it is well known that the International Medical Congress (**1881**) decided that there was not the slightest evidence that any such straightening had ever been attained. It is therefore perfectly obvious that metal strip tracings are not veracious as records, no matter how prettily and persuasively they may be displayed in books.

Notwithstanding this fact, however, Mr. Roth still elects to allege them as his own records of proof, only he invests a very old and common thing with the novelty of a fresh scientific verbiage. He now prefers, he states, "pure tin, 50 centimetres long, 1·5 centimetres wide, and 1 millimetre thick," and he christens this ordinary strip of metal, as though it were a

great invention, by the high-sounding name of "scoliosiometer." It is scarcely conceivable that a more appropriate name could have been selected. The Greek word σκολιος has two distinct meanings. As applied to ordinary objects it means "crooked," as applied to methods it means "unreliable, unfair." The conjunction therefore with the word μετρον would seem to mean "an unreliable method of measurement." Such construction of the term so completely embodies the actual facts, that this classical attempt at new nomenclature seems to me to be precisely, though unintentionally, apt.

The truth is that the only reliable and available methods of record are the photographic ones, and it is these that I myself always now employ. I have given the conditions under which they can be made with invariable fairness and accuracy, and I have also hinted at the manner in which, failing these conditions, they can be faulty. But taken always at the same precise focus, in the same constant plane, and on the same spot beneath the same source of light, they yield positive results that are quite exempt from all those sources of error which imperceptibly creep into those manipulative methods in which the hands of the operator play the principal part.

Mr. Roth himself ornaments his book with certain photographs, which assuredly are not in any way indicative of the course of a particular case like those are which I have previously given at Fig. 54, *et seq.* Still, for the moment Mr. Roth's photographs may be worthy of consideration. They are in three groups of six, two, and ten respectively.

The first group of six gives the front, back, and side views of a girl, first in what Mr. Roth terms the

"habitual" postures, and next in what, with Bisleyan phraseology, he calls the "best possible" postures. Personally I should term the first postures assumed ones, and for two reasons. To begin with, looking at them with the experience of some thousands of inspections, I decline to accept the so-called habitual postures as otherwise than assumed. And next I have in my own book on the spine, **1882**, given precisely similar figures in side and back view. Now these two figures of mine were drawn from photographs I took of a perfectly shaped girl who sat as a model at the Academy School. There was therefore no question about her being deformed; but for diagrammatic purposes I placed her first in the deformed position and then in the straight position. Mr. Roth's photographs exhibit precisely similar characteristics; but they claim not to be deformity represented in diagram, but deformity as it exists in reality. If I understand rightly the perverted positions represent what Mr. Roth calls a deformed woman in her "habitual position," but who nevertheless, as "placed by the surgeon," can be immediately made straight. But, adds Mr. Roth, this was only possible "for the second or two required for taking the photographs." Now can a person be considered as actually deformed who not only can immediately be made straight by the hands of the surgeon, but who can forthwith and without support stand quite symmetrically erect, even if only for a "second or two," in order to have her photograph taken? But to the casual observer this group of photographs would convey the idea of a deformed person who has been brought into the straight position by means of treatment, although this actually is not the case.

The second group represents two figures of a girl. The one is taken close to the camera, a position which enlarges all the prominences; whilst the other is taken at a much further distance away, a position which, of course, diminishes the prominences. These two photographs, therefore, are not taken according to the rules of accuracy that I have shown to be necessary as regards light and distance, and are consequently valueless for comparative purposes.

The remaining group of ten is still more illusive on ordinary inspection. It is to be noted that whereas the previous photographs all have their descriptions attached to them, these ten have only numbers of reference. If, with the description lacking, one looks through the whole ten figures one finds nine representing a girl in various stages of deformity, and the remaining one representing apparently the same girl very nearly straight. The natural conclusion, therefore, seems to be that the one straight figure represents the splendid results of treatment on the deformity represented in the other nine figures. The casual reader, who invariably looks at illustrations first, can scarcely escape this inference. But it is only when one comes to carefully investigate the letterpress of the book by means of the reference numbers, that one finds out that there are two sisters involved. The nine photographs of deformity are those of the elder sister, who, at one time, however, "was not more deformed than her younger sister whose photograph is given." So the nine deformed figures really represent the patient with whom the tenth and tolerably straight figure has nothing whatever to do except that she is a sister, and, being a sister, is so similar in general build to the elder girl that she is, of course, readily confused

with her. For what other conceivable purpose, therefore, are the figures of these two girls put into unexplained juxtaposition?

I may say at once that photographs of this sort are of the diplomatic type. They do not illustrate for the purposes of demonstration the course of a case, and still less are they evidences of the benefits to be derived from a specific treatment. I need not reiterate again the precision with which photographs of evidence should be taken, nor need I again accentuate their value as records of proof, when properly done. But I think I have clearly shown that the photographs in Mr. Roth's book are not of this kind, and are therefore of no scientific value.

Mr. Roth's analysis.—Everything on which I have previously commented, the substance of Mr. Roth's writings, and the unreliability of his evidences, all these things are perhaps minor in comparison with the tabulated statement of the results that Mr. Roth alleges he has obtained. The much advertised analysis is represented to be, in itself, a proof positive of the contention that the gymnastic treatment should be exclusively employed in curvatures, and that the mechanical treatment should be completely relegated into disuse.

I have already given very potent evidences to the contrary (pp. 209, *et seq.*). Still, as Mr. Roth's analysis constitutes his own document of appeal, it ought on this account to be very carefully examined. It appears to be a studiously compiled piece of work, and there may be no reason, at all events for the sake of argument, why all its statistics should not be accepted as entirely veracious. But in its bare form it

affords very little condensed information. And it is scarcely to be supposed that the ordinary reader would do much more than casually glance it through, and would, perhaps, accept it without deeper consideration as containing all the weight of evidence that Mr. Roth assigns to it. But, personally, I am not disposed to pass it by so lightly; on the contrary I incline to the belief that its actual value or the reverse will be best estimated by some sort of 'Coke upon Littleton' procedure, and that, to put things quite fairly, even whilst accepting Mr. Roth's own statistics as true, an analysis of the analysis ought to be made. And this is precisely what I now propose to do.

The analysis purports to give a condensed record of 1000 consecutive cases treated by Mr. Roth on the gymnastic system between the dates of **June 27th, 1885**, and **November 24th, 1892**, a period roughly of seven years and a third. The facts that I am about to state will be found to be readily summarised from its tabulations by the simple process of mathematical extraction.

Out of the 1000 cases, 444 have the names of medical men attached to them, whilst the remaining 556 are not claimed to have been sent by medical men at all. The first fact that is established, therefore, is that considerably over half the number of cases owed their recommendation to lay sources. This minority of medical support is rather an unfortunate argument at the outset against the vaunted acceptance of the gymnastic treatment. But that such treatment should depend much more largely on lay than on medical support is scarcely to be wondered at.

Still, out of the thousand cases, 444 have doctors' names attached to them. The actual number of

doctors who sent these cases is 219. Out of these 219 doctors, 152 never sent more than one single case during the whole of the seven years and a third. This is another rather unfortunate fact for Mr. Roth to put forward in a statistical table that purports to corroborate the benefits received from the gymnastic treatment. For, had these 152 doctors been satisfied with the results attained in their first case, they would surely have sent a second, or even more cases, during so long a stretch of time as seven years and a third. But it is evident, from Mr. Roth's own testimony, that they did not do so.

However, after these 152 doctors have been deducted, there still remain 67 doctors who have sent more than one case to Mr. Roth. But, of these, 30 doctors only sent two cases each in the seven years and a third, a result that can scarcely be held as any strong confirmation of confidence.

And after these thirty have been again deducted, there remains the obvious fact that, according to Mr. Roth's own published figures, only about forty doctors out of the whole rough 30,000 practising in the British Isles ever ventured to send him more than a couple of cases during the whole seven years and a third.

Can it, by any stretch of imagination, be asserted that these figures indicate in the least degree any medical acceptance of the gymnastic treatment. On the contrary, they point to exactly the opposite conclusion. They show that those who ventured to try the treatment ceased after an experience or two from pursuing it further. These, then, are the actual facts recorded by Mr. Roth himself in the columns of his analysis, only in so disseminated a way that they are not at all obvious until they have been reduced to

mathematical nakedness and are divested of the voluminous clothing of a very curiously arranged tabulation.

Still, Mr. Roth has his consolations recorded in another of his columns, that which comprises "visits." He appears to have recorded from each of his thousand patients an average of sixty-two visits, or, to be accurate, about 62,280 visits in all. This, on the average, represents over 8000 visits in each year. Such a number, translated into the usual professional equivalent in fees, represents something rather splendid as income. Now, I should certainly not have touched upon this financial matter at all had it not been that Mr. Christopher Heath, in the clinical lecture to the publication of which I have previously referred ('Brit. Med. Journ.,' May 18th, 1895) felt himself compelled, and probably from the weakness of his other arguments, to impute financial greed against those who practised the mechanical method of treatment. He asserted, and I think with very dubitable taste, that they were "monstrous" in their sedulous attention to the pockets, rather than to the welfare of their patients. As one so high in the profession as Mr. Heath has thought it necessary to have recourse to financial arguments, it would seem that this is the proper place to rebut them. I assert that, on the whole, far greater expenditure is made on the gymnastic than on the mechanical treatment, a thing that is perhaps best shown by comparing the two methods together.

Under the gymnastic tenets it is postulated that seventy-two daily visits should be paid right off. The results promised are "practical cure," and this is to be attained in three months. If the patient is not "practically cured," or relapses, still the treatment

has been completed, and the costs presumably have been defrayed, once and for all.

The mechanical theory is quite different. After the appropriate instrument has been applied, it only postulates that visits should be paid once in three months by growing persons, and once or twice a year by adults. It asserts that, in growing persons, real curvature needs persistent attention from the time of its origin until the termination of bodily growth. It affirms that cases of osseous curvature of comparatively recent origin can be cured, and means by this affirmation that the spine can be straightened out, the vertebræ rectified, and the misplaced bones be restored to their places. It admits that, after the termination of growth and the due consolidation of the bones, persons suffering from even marked osseous curvatures may be able to go about without mechanical support, although a yearly watch should be kept against lapse, but it maintains that such persons are liable to lapse, especially during ill health, and that they then require treatment by support, and it avers that with such lapsing adults, after the instrument has been applied, a visit once a year is all that is requisite. Finally, it very strongly insists that, even in the worst and most neglected cases, it is invariably possible by mechanical methods to bring the general outline of the body into truth, to make the hips and the shoulders level, to perceptibly increase the height of the stature and the capacity of the thorax and of the abdomen, and thereby to improve the general figure and the general health of the patient, even although it may not be possible to completely straighten the spine. In short, in these latter cases it claims to cure the distressing and consecutive symptoms of curvature, even where it is not

actually feasible to straighten out the spine. Further, it claims most emphatically that, if such severe cases had been caught at the outset and had been dealt with by mechanical support, curvature could have been entirely averted.

From this contrast between the two distinct methods of treatment a calculation of visits and of financial expenditure can be gathered. The gymnastic practitioner says practically, "Pay me for seventy-two visits straight away and I will cure you in twelve weeks." The mechanical practitioner denies the possibility of such rapid cure where there is actual curvature, and he says, "The treatment will take some length of time, but pay by results as you go along. Four visits only a year are requisite during growth, and one visit or so yearly in adult life. You will have photographic records of your improvement periodically taken during treatment, and if by any chance you should be dissatisfied, it is in your power to discontinue it." Such is the antithesis between the two methods, and I think it disposes once and for all of the monetary mis-statement Mr. Christopher Heath has thought fit to make.

From the somewhat infelicitous subject of Mr. Heath's financial aspersions, I will revert once again to Mr. Roth's analysis, and may briefly touch on the statistics he gives in the columns devoted to "flat-foot." It appears that out of his 1000 cases of lateral curvature he only found about 174 exempt from this debility. Now, although flat-foot in its rarer instances may arise from a variety of causes which need not here be enumerated, still the vast majority of cases, probably 90 to 95 per cent., are purely dependent on such general muscular atony as renders the tibiales muscles incompetent to sustain the arches of the feet when

these latter are supporting the weight of the body. That Mr. Roth therefore should have found 826 cases of flat-foot requiring treatment amongst his 1000 cases of curvature must, I think, show one of two things. Either, the cases of curvature that were entrusted to him were of the simple atonic type; or else, if this was not the case, he must have a peculiarly sensitive appreciation of the condition commonly known as flat-foot. Mr. Roth's statistical point is that over 80 per cent. of cases of lateral curvature also suffer from concomitant flat-foot. I simply note this because it constitutes a discrepancy against the general experience of those who see quite an equal number of cases of curvature, and who are rightly careful to examine them from the supporting base upwards, that is to say, from the soles of the feet to the nape of the neck.

But the work of further analysing Mr. Roth's analysis must draw to its close. There are columns that would be most interesting for comment did space allow it—columns headed sex, age, duration, pain, previous treatment, and the like. The column on the "causes of scoliosis" is very enticing. Premature birth, birth in India, being one of twins, faulty eye-sight, and a variety of various weaknesses, illnesses, and occupations, all of these, according to Mr. Roth, play their parts in the causation of curvature. All of these, however, I will pass by because they are quite subordinate to the contrast between the gymnastic and mechanical methods of treatment, which is at present the issue under review, and I will come forthwith to what, after all, is the end and aim of every treatment, that is to say, results.

Mr. Roth's results.—A record of results in science is invariably given to show the fulfilment either of speculative experiment, of theoretical anticipation, or of definite promises. The scientist who seeks information purely and solely from experiment, starts simply on a course of inquiry, without any certainty as to the results he may attain. Again, the scientist who seeks the practical corroboration of some preconceived theory, anticipates with hope that the results may turn out to be confirmatory of his views, although he has no positive assurance, at the outset, that such will be the case. In both these instances not the slightest reflection of blame can attach to the experimentalist if his net results come to nothing; they were only sought in speculation, and no distinct affirmation was made that they would be forthcoming. But, in contradistinction, the man who positively promises certain distinct results as corroborative proof of the truth of his previous statements, and as evidence of the soundness of his assertions is in quite a different position. His promises and his results are correlative one to another. And if his results prove failures, then and immediately one can affirm that not only must his promises be unreliable, but also that the theories and principles on which they were based are unreliable also.

Now this, I take it, is precisely Mr. Roth's position as shown by the final column of his analysis. The whole of his previous works, whether articles, or pamphlets, or books, reiterate the promises of cure. Let me for the last time repeat, although this repetition is getting a little stale, the very expressions of promise that Mr. Roth uses. "All ordinary cases of lateral curvature of the spine, where the patient is fairly intelligent and co-operates in the treatment, can be

practically cured by a course of three months' daily treatment." This sentence is not an early effusion of Mr. Roth's, which might have been due to the enthusiasm of youthful anticipation, but it is the opening sentence of his article in the 'Transactions' of the American Orthopædic Association, **1896,** and it was therefore written in the maturity of middle age. And again he continues in the same opening paragraph, "I am preparing a paper giving the analysis of 1000 consecutive cases of lateral curvature—upwards of 900 of which were practically cured." Very well, these two statements of promise are clear enough. There is the assertion that a certain method of treatment will ensure cure, and there is the promise to bring forward results which shall show that cure has been attained.

In Mr. Roth's book, second edition, **1899,** we at last have the promised analysis, and we have in the final column the record of the results in the 1000 cases. But in what way does this record fulfil the promises of cure? Nine of the cases were admittedly failures, still one need offer no further comment on this fact beyond the statement that it is impossible always to compel success, and that in every treatment a few failures may occur. Again, forty-nine cases are admitted to have "relapsed," even after Mr. Roth had been quite satisfied with the results of his treatment. Still, here again no adverse comment need be offered, seeing that relapses are not unusual in many maladies, and are to be met by the resumption of the original and beneficial treatment. Curiously enough it does not clearly appear from Mr. Roth's records that these relapsed cases ever again resumed his treatment, but even this is not of particular consequence.

Having thus accounted for fifty-eight cases which,

from circumstances, have to be eliminated, one has, at all events, 942 cases left, and in the column of "results" one would naturally expect to find Mr. Roth's promises amply fulfilled by the reiteration after each case of the word "cured." But it is simply astonishing to find nothing of the kind. In not one single instance is the word "cured" set down, or is even the vague phrase "practically cured" employed. All that one finds is that the whole of these 942 cases are merely recorded by Mr. Roth as "improved" or "much improved."

Now there are some scientists who are so inherently modest that even whilst producing the best of work they almost depreciate themselves by failing to lay proper stress on their own excellent productions. But this reason certainly cannot be assigned for Mr. Roth's failure to indicate any case that he can claim as cured, for there is not the slightest evidence of such shrinking modesty in any other part of his writings. On the contrary he not only persists in a laudation of his own methods, but he goes out of his way on every possible occasion and by every possible insinuation to depreciate the methods of others. How then is it that, after all these promises of cure, no single instance of cure is recorded by him in the very document—the analysis of the thousand cases—to which all along he has referred as being intended to convey evidence of convincing proof? There is, I conceive, only one possible answer.

Conclusion.—So much for Mr. Roth's analysis. I think I am justified in saying that it appears to be, in common with the rest of his writings, of the vague and diplomatic rather than of the precise kind. If a man

has perfectly good and sound grounds on which to base his method of treatment, he has no need to use language that is dubitable, and much less has he the necessity for attempting to maintain his own methods by the persistent disparagement of those of others. The ambiguity conveyed by the specific use of the word "treated" in Mr. Roth's advertisement, the entire absence of the word "cured" from Mr. Roth's analysis, the various innuendoes cast by him against the mechanical method of treatment—all these things tend to prove the weakness rather than the strength of the practice Mr. Roth sets himself to uphold, and which I believe, on the grounds I have already given, to be an entirely incorrect one.

As to the mechanical principles of treatment I do not believe that they can ever suffer more than a temporary detraction from current criticism. They are too well and too stably founded to be upset, seeing that they are independent of the mere ephemeral fashion of a decade or so. The Sayre methods and the gymnastic methods have both been successful in attaining adoption for a few years each, just indeed as in future years other treatments similarly fallacious may possibly attain a brief notoriety. But the mechanical treatment is based on the established experience of centuries that extend back to before the Christian era. Far be it from me to deny that with new revelations of science new mechanical procedures may not be discovered which will be complementary to those already existent. But, like the mathematical, the mechanical science is a fixed one, and although it may be added to by new discernments, yet its previously proven principles can in no way be disturbed. Once established they have become incontrovertible.

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