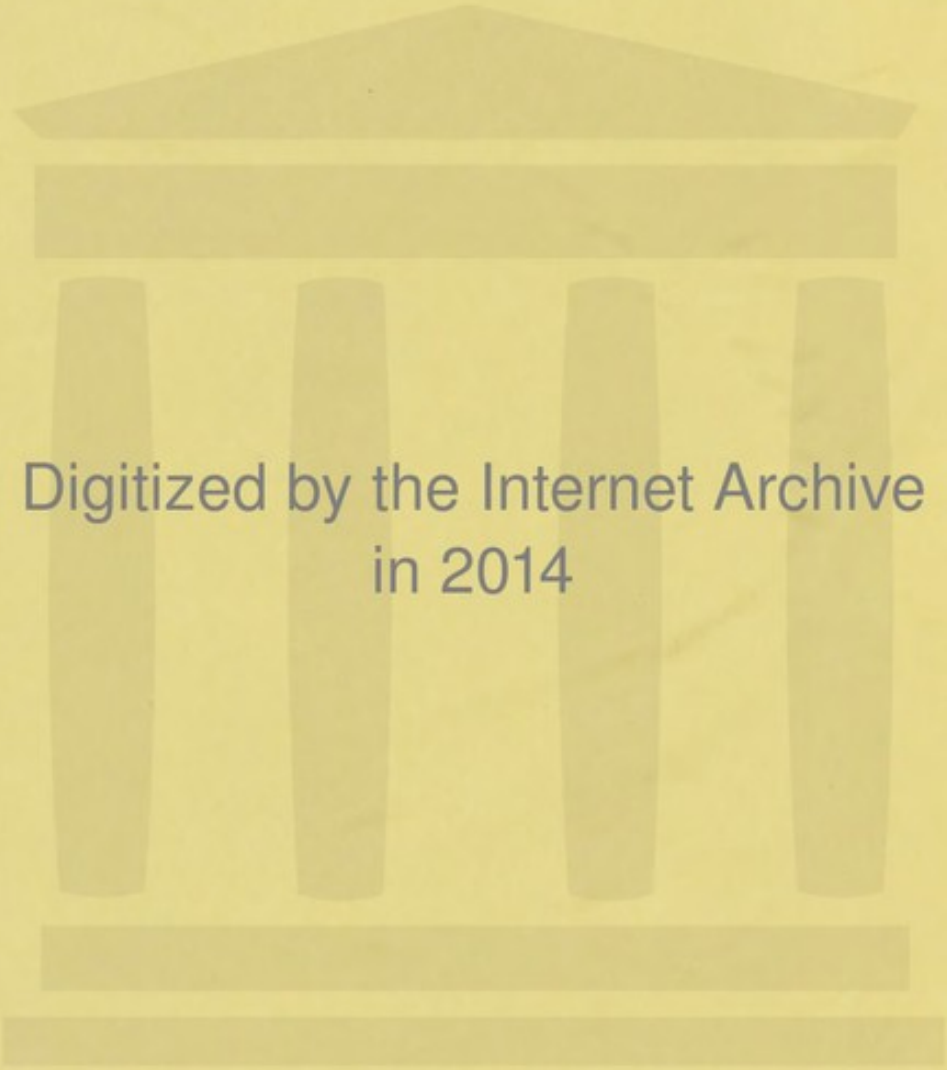
Localized movements, or, Muscular exercises, combined with mechanical appliances, for the treatment of spinal curvature and other deformities / by Henry Heather Bigg.



Edgar D. Cyriat

LOCALIZED MOVEMENTS.

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OR,

MUSCULAR EXERCISES,

COMBINED WITH

MECHANICAL APPLIANCES,

FOR THE TREATMENT OF

SPINAL CURVATURE

AND OTHER DEFORMITIES.

BY

HENRY HEATHER BIGG,

ANATOMICAL MECHANICIAN TO THE QUEEN; THE ROYAL HOSPITALS OF CHELSEA AND GREENWICH; THE BOARD OF ORDNANCE; THE ADMIRALTY; THE EAST INDIA DEPARTMENT; ST. GEORGE'S; ST. THOMAS'S; GUY'S; MIDDLESEX; KING'S COLLEGE; UNIVERSITY COLLEGE; ROYAL FREE HOSPITAL.

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PREFACE.

EVERY medical man in large practice must occasionally have felt himself at a loss to know what plan of treatment he should advise in cases of *incipient* deformity. His embarrassment might not probably arise from any doubt as to the best measures he ought to recommend, but from the difficulty of finding some one to whom he could safely entrust the execution of his scientific suggestions, which he knows would be productive of much good, if competently carried out.

The practice of muscular exercise is one of those plans which would most probably be the first to suggest itself as a remedy, and his mind would next be engaged in devising how this exercise could be satisfactorily performed.

It is to supply this particular requirement that I have of late especially directed my attention to the construction of a Medical Gymnasium, which will be essentially an establishment where medical men of eminence and experience can send or bring their

patients. The Profession will thus be enabled to recommend any special exercise to be followed, and they will be certain of having their ideas, with regard to the measure and duration of such exercise, scrupulously adhered to.

As a surgeon would find it impossible to execute, personally, the required manipulations, he would be naturally anxious that the person deputed to superintend them should be fully capable of comprehending his wishes, and responsible for the perfect performance of the muscular motions required. He would also feel more certain that his plan of treatment would be attended with success, when he found that the exercises were superintended by some one who practically understood the nature and mechanical treatment of deformities.

In order to qualify myself for the task of undertaking this duty, I recently visited the Orthopædic and Gymnastic Institutions of Vienna, Berlin, Stuttgard, Dresden, &c., with a view of personally ascertaining the method by which mechanical appliances and gymnastic exercises were combined; and, guided by the experience thus obtained, I have made such arrangements as will enable me to administer the different exercises as perfectly as on the Continent.

I found that the Continental practitioners had their scientific hobbies as much as we have in this country, but the plan pursued in the treatment of

deformities was, in general, infinitely more systematic than our own. Thus, in some cases of a slight character, frictions and manipulations were alone considered sufficient; in others of greater severity, mechanical appliances were adopted; in a third class of cases, surgical section of tendons was employed; but in all, a thorough series of well-regulated muscular exercises was instituted, in order to complete the restoration of health and strength in the deformed part under treatment. I earnestly trust that my endeavours to create in London a Gymnasium capable of fulfilling the wishes of the members of the Medical Profession will meet with general encouragement and approval.

29, Leicester Square, London,
January 1*st*, 1859.

INTRODUCTION.

LOCALIZED MOVEMENTS, ETC.

GYMNASTIC movements are of two kinds; viz.:— those which are practised for the maintenance of health and physical vigour in a body perfect in its symmetric arrangements, and those which are adopted for the restoration of a disturbed equilibrium, the result of certain particular muscles having become debilitated, and others abnormally strengthened.

With regard to the first division, I am not prepared to extend my observations beyond remarking that deformity may be always prevented by the employment of a judicious course of muscular exercises; and this fact cannot be too deeply impressed upon the attention of those who superintend and direct the education of our youth, both male and female. If, concurrently with the attempts made to improve and expand the intellectual faculties, similar efforts were devoted to the development of the physical organization, a far superior race of

people would be eventually produced;—a race calculated by vigour of person to sustain the wear and tear incident to excessive employment of the mental faculties.

When the human race is advancing in the scale of civilization in the rapid manner peculiarly characteristic of the present times, more physical strength than ever is needed to encounter the severe strain induced upon the body by over-study. Let any one who doubts the probability of a future degeneracy of race under present arrangements visit a fashionable English boarding-school, and, in the delicate features of the majority of the pupils, he will readily see how little chance there is for the cultivation of that "mens sana in corpore sano" which is so highly necessary for the propagation of a powerful people.

Latterly, the habit of restraining all exhibition of playful gaiety, under the impression that it betrays vulgarity of manner, has been attended with the most serious consequences to the physical development of the rising generation; and, I firmly believe, that the enormous increase in spinal curvature which has taken place during the last twenty years may be traced much more to the imprudence of forbidding "romps," and other occupations of "childhood taking holiday," than to any supposed diminution in the constitutional power of mankind. All, therefore, that is necessary for the purpose of

counteracting this serious and growing evil is to insist upon the adoption of gymnastic movements during a certain period of the day, and to accompany them, as far as possible, with the liberty of taking free and unrestrained bodily exercise. This especially refers to those persons who are *healthy;* but where debility of constitution, or any other cause, rendering one young girl weaker than another, is supposed to exist, a systematic course of "movements" should be adopted without loss of time. In order to accomplish this object in a manner certain to produce the desired result, it is necessary that all the muscles of the body should be gradually brought into gentle exercise. Many persons might consider that walking, riding, or the ordinary actions of daily life would be sufficient for the purpose; but such is not the case, and for the simplest of all reasons, viz., that owing to lassitude of frame, all the general exercises dependent upon bodily activity are imperfectly performed, and it needs the superintendence of the *gymnasiarch* to produce such an amount of well-regulated motion in each set or system of muscles, that the body may be *gradually* improved in strength.

The "movements" necessary for this purpose are fortunately very simple, but although they are so, more than ordinary care is demanded on the part of those who administer them, to see that they are judiciously applied.

I have especially arranged a course of movements calculated to effect the object just alluded to. While endeavouring to impress my opinions upon the reader as to the good derivable, in cases of malformation, from the employment of movements, I am strongly of opinion, that the subject of rendering muscular exercises a necessary accompaniment of education should not be lightly viewed.

It is with a desire of conforming to the most trite of all medical axioms, "prevention is better than cure," that I am led to make the preceding observations in reference to that branch of gymnastics which is calculated to be beneficial in *preventing* distortions, and which, as such, is legitimately within the scope and province of the present work.

The next branch of the subject is that which relates to the removal of deformity after it has arisen; and, in order to give this matter a full and fair field for consideration, it must be primarily admitted that loss of muscular equilibrium is one of the principal causes which oppose the restoration of a distorted system to its normal condition.

It is well known to almost every one, that the vertebral column consists of a certain number of bones resting in a perpendicular manner upon each other, being separated merely by a thin layer of intervertebral cartilage, which possesses sufficient elasticity to be readily compressed and expanded under the

various changes induced by bodily action upon the individual bones composing the spine.

The vertebræ are held in their position principally by ligaments passing from various surfaces of each bone, and attaching it to the bones adjacent; these ligaments possess no elasticity (or very little), being merely intended to hold the vertebræ firmly together. In addition to the cartilages and ligaments, there are various muscles attached to the vertebral bones, and inserted into other parts of the osseous framework of the body, by which muscles motion is imparted to the spine. These muscles have a peculiar and, in a mechanical point of view, most important office assigned to them, namely, that, under the control of the brain, they possess the power of retracting their extremities upon their centre (belly of the muscle); and it is upon this singular feature of contractility that I base the views I am now promulgating relative to the power of muscular traction to induce (if properly called into action) rectification of the spinal column when it has become deflected. As each muscle has the power of retracting upon its centre, it must necessarily be inferred, that the muscular action always induces an approximation of the surfaces upon which each muscle is inserted, and those from which it originates; that is to say, that the point of "origin" and the point of "insertion" *

* For the definition of "origin" and "insertion," the reader is referred to Mr. Erasmus Wilson's "Vade Mecum," where it is

must approach towards the centre of the muscle in even ratio; but it is not so. Owing to a purely mechanical law, it occurs that when one of the extremities is held by a force superior to that exercised by the muscle to which it belongs, the resulting effect is that the muscle receives this resistance as a fixed point (fulcrum), and draws or contracts the opposite extremity to it without inducing any displacement of itself.

It is *upon this principle* that I venture to recommend a new system of treating spinal curvature, which consists in rendering one extremity of a given muscle a fixed point by artificial mechanism, and then by physical movements creating such an amount of muscular action as will bring the opposite extremity into approximation. To accomplish this is a task of no ordinary difficulty: *but it can be done;* and its rationale admits of no dispute.

In nature the will produces a fixed point, and the adjacent muscles act towards it; but, in art, external mechanism must do the same thing, and then movements, or, in other words, scientific gymnastic exercises, complete the required objects.

The muscles have been truly called the moving

stated :—"In the description of a muscle, we express its attachment by the words 'origin' and 'insertion.' The term origin is generally applied to the more fixed or central attachment, or the point towards which the motion is directed; while insertion is assigned to the more moveable point, or that most distant from the centre."

organs of the animal frame, and it is upon a knowledge of their construction and action that I particularly base my ideas as to the possibility of so combining external mechanism, as to render the actions of certain muscles subservient to the direction of the manipulator.

It is to the muscles that we owe the symmetry of form which is so highly prized. They likewise defend the joints and clothe the bones; whilst in the body they constitute a substance capable of yielding to any internal pressure, and of then returning to its original form.

When it is known that muscles are composed of an immense number of parallel fibres held together by areolar tissue, their aggregate action in given directions becomes immediately intelligible. Their mode of influencing the various bones to which they are attached is by their contractility,—a quality which is capable of being excited at discretion. Hence it is most important to know the precise direction taken by a muscle, when changed in its position by deformity, as well as to make ourselves conversant with its customary action during symmetric movements. When I first began to examine the various muscles of the spine, with a view to ascertain the influence which they severally exerted, I soon perceived that some system must be devised for finding their aggregate action; because unless this action could be determined with accuracy, very little good would result from the employment of exercises.

After thinking of several plans by which the force of a certain set of muscles might be arithmetically ascertained, I hit upon the following, as most easy of adoption. I fixed to an ordinary skeleton, pieces of tape, representing the position held by the different muscles of the back. In order to distinguish their various anatomical layers, I used six distinct colours; and having commenced by arranging those of the "sixth layer," I proceeded until all were secured in the position established by nature. I then carefully examined the mechanical action of all the muscles, and observed the direction of those which concurred in effecting similar purposes. By these means, the action of the muscles in a vigorous condition of equilibrium could be readily demonstrated.

I afterwards took away one or more of the tapes representing muscles, and calculated how the remainder would exercise their forces; thus experimentally determining the production of various spinal curves.

I then placed my skeleton in a contorted form, and carefully measured the result of the change produced upon particular muscles, thus arriving analytically at a satisfactory calculation. Feeling the importance of any experiments of the kind, I prepared three tabulated forms; one referring to the muscles as they exist in their ordinary condition; the second exhibiting the mechanical result which must be occasioned by the suspension of equilibrial action in certain specified muscles; and the third showing the

muscles which are particularly displaced when spinal curvature existed to any extent. These forms, although roughly prepared, I now append, in the hope that some one better acquainted with physiology and anatomy than myself will be enabled to complete and improve them. As it is, my mechanical aim has been gained; it has enabled me at once to see that, could it be rendered certain that particular muscles should act from special points, the result must be the employment of muscular exercises in a *scientific* and satisfactory manner.

While stating that mechanical appliances are the means employed to secure the artificial fixed point, it is also necessary to explain that, during the movements, the only external mechanical appliances used are a rope and pulley, governed by a very slight weight. When the exercises have ceased, I suggest the application of a properly constructed spinal apparatus, worn so that its presence is entirely concealed, and so constructed that it permits the exercise of those muscles which require strength, and the repose of those which are already too strong.

To return to the subject I began to illustrate. The first effect produced in a weakened spine is the undue compression of its intervertebral substance: next, the ligaments become shortened on the side of the concavity: and thirdly, the muscles which are concerned lose their contractility, owing to an arrest

of their natural action in consequence of the vertebral curve.

To overcome this condition, the process is reversed. First, the muscles, the action of which has become suspended, are exercised and strengthened; next, the ligaments are elongated, by the mechanical appliances worn by the patient during the intervals which elapse after the exercises are concluded and before they are renewed; and, thirdly, the intervertebral cartilage is allowed to re-expand and the spine to become erect and perfect.

It is a judicious employment of exercises and mechanism which really constitutes the only proper plan for overcoming curvature, and establishing the strength of the patient.

This principle of employing certain muscles in given directions, and arresting the action of others, is equally applicable to every possible variety of deformity.

CHAPTER I.

ON THE NECESSITY AND ADVANTAGE OF MUSCULAR EXERCISES.

In almost all large Continental cities, the treatment of spinal and other deformities of the human body by a combination of well-directed muscular exercises, with the use of skilfully adapted orthopædic mechanism, has so long been pursued, as to be now a matter of customary arrangement.

In Vienna, Berlin, Stuttgard, Dresden, Munich, etc., special institutions are established, for the purpose of carrying out in their most perfect form the principles and practice of this method.

It hardly needs any advocacy of mine, to prove the lamentable neglect which, until the last few years, has attended every attempt in England to introduce physical exercises as a means of preventing the occurrence of distortion.

Feeling, as we do, a national pride, in the stalwart proportions and the manly symmetry exhibited in the persons of our "Household Troops," and knowing that they are but the trained and well-cultivated

representatives of the physical stamina abundantly to be found in all our rural districts, it appears surprising that we have done so little systematically to improve the muscular development of our youth, and to cherish and strengthen those thews and sinews which in due time will be called upon to bear the heat and turmoil of our modern go-a-head life.

In former ages, the tilting-ground and the wrestling-ring furnished abundant exercise for the muscular prowess both of the noble and the serf; but in our modern and, in this sense, degenerate times, the head usurps the place of the arm, and an enfeebled condition of body is too often the penalty attached to an unemployed or ill-directed physical organization.

If the evil influence of slothful habits simply led to the creation of an indolent frame, it might be extenuated on the ground of the mental cultivation promoted by abstinence from physical exertion; but a far graver result ensues than an inactive body, and it is to this result that I particularly wish to direct the attention of my readers.

Nature, in her wise and beneficent laws of human organization, has most evidently decreed that, unless the various parts of her handywork which are intended for special aims and uses are made to fulfil their destined purposes, an entire perversion of her original plans is entailed; and thus, that which ought to be a strong and vigorous frame becomes a

weak and emaciated machine, wasting its remaining energies in feeble and ineffectual efforts, and in useless exhibitions of muscular exercise. Man not only improves and perpetuates the ethnological and physiological advantages which are gained by the mingling of races, but he also increases and perpetuates any organic and physical defects which are established by non-adherence to the conditions implied in the evident adaptability of certain parts of the human frame for their several uses. How readily do we discover the inevitable results which ensue from the possession of a Sybaritic form, when viewed as exhibiting the type of a people!

The ancient Greeks and Romans, when the habits of the bath and attendance at the theatre superseded the exercises of the chariot-ring and the cestus, rapidly became the inferiors of neighbouring populations, to whom the luxuries of corrupt and enervating pastimes were as much matters of abhorrence, as the nations which found pleasure in them were the objects of their disgust and hatred.

If it were only to avert the degeneracy of form and character, such as is well known to have reduced the once masculine energy of the Roman people to the state of indolence and inactivity exhibited by their descendants of our own times, it would be urgently required that a judicious course of calisthenics should be recommended to our youth, by which exercise a vast and important principle would be

gained; but a far deeper and much more heart-stirring impression is awakened, when we reflect that the absence of bodily activity, when carried to its lowest condition, establishes a diminution of the equilibrium which is so highly necessary for the proper fulfilment of the automatic functions of the body, and leads to the creation of deformity and osseous debility.

I do not think that any reasonable doubt can be entertained that a great number of those cases of malformation which are so painful to our eyes, and mortifying to our pride, owe a large share of their origin to an absence of physical culture on the part of the race or people by whom those deformities are exhibited.

It is, therefore, to guard against and prevent the origin and perpetuation of such evils, that well-regulated bodily exercises should be cultivated and pursued.

However desirable it may be to impress upon our trainers of youth the importance attached to athletic sports for the males, and suitable exercises for the females, who are brought under their superintendence, still I must remember that the object of the present treatise is to suggest the most rational plan for the treatment of deformities, when, from whatever primary cause they may have originated, they still exist, and require removal. I therefore hasten to consider some details which are calculated to explain the system by

which muscular power and bodily energy may be restored to that portion of the frame which has been subjected to loss of symmetric form. But previously to doing so, it may be interesting to my readers to peruse a slight sketch of the progress which has been made in the treatment of distortions, from the time when only crude and imperfect instrumental aid was resorted to, up to the present day, when we have surgeons of high repute and great intellectual powers devoting themselves to the removal of distortions, and making tenotomy, together with its ally, mechanical treatment, the elements of a new branch of surgical science.

In England, the treatment of deformities has hitherto been comprised under three distinct heads. The first is purely mechanical; the second, surgical, combined with mechanical; and the third, muscular, or the adoption of exercises.

It cannot be surprising, when the peculiar character assumed by deformity is borne in mind, that the earlier efforts towards restoration should have been of a purely mechanical nature. Take, for instance, the simplest form of all distortions, namely a contracted finger; and what would be the first effort towards rendering it straight? Evidently, the exercise of mechanical power upon the affected finger, by the other hand; and in the employment of the almost intuitive principles of orthopædy (cure of deformities), some means representing the action of the

hand would undoubtedly be adopted. It would then be found, that whatever force was applied must not only attempt a temporary extension, but also secure the affected joint against future retraction; and thus an instrument must be devised to accomplish this object.

Again, in a case of greater complication, such as lateral yielding of the spine, the first effort would undoubtedly be to hold up the falling side, and to prevent an increase of deformity, by offering an opposing and obstructive power to the evident direction of the inclination.

A stiffened stay, as presenting the readiest support, would, in all probability, be the force which would first suggest itself; and thus mechanical treatment would be adopted.

In straightening the finger, and supporting the spine, no other mode of treatment might possibly be adopted than that deducible from the *external* form of such distortion. It was this recognition of the external effect only, without seeking for its internal cause, that led for so many years to the exclusive employment of mechanical treatment for remedying or counteracting the ordinary forms of distortion; and as one man's ingenuity in the construction of apparatus for carrying out particular ends became greater than that of another, a branch of business exclusively directed to the manufacture and application of such aids became gradually formed.

Probably some one more enlightened than his contemporaries found that a particular form of apparatus more readily fulfilled its purpose than another, and hence he adopted it in almost all cases which bore the same external type, but which, as is now known, may have had the most varied internal conditions. This method of constructive reasoning resulted in the general application of such apparatuses as the backboard and collar for spinal curvature, and the leg-instrument and boot for club-foot; and those who manufactured and applied them became the founders of mechanical orthopædy.

Advancing a step further, we find that another class of persons sought to treat cases of deformity on mechanical principles; and, finding those of the spine more amenable to their particular views than any others, they adopted recumbency as a means of opposing successfully the inclination shown by nature to increase a distortion, when once it has been established.

The notion among these "spinal doctors" (for they embraced among them several surgeons) was, that as the gravitating force of the superior parts of the body (head and shoulders) exercised an improper influence upon the debilitated muscles of the spine, a removal of such weight, by the adoption of continual reclination, would at once obviate the principal mechanical cause of the distortion, and admit of pressure and extension being employed to effect a

satisfactory cure! A certain amount of success attended these efforts, and the "Harrison system," and many others, held for a length of time an undisputed sway, as being the best and the most really scientific mode of treating spinal curvature.

Every imaginable amount of variety was imparted to the mechanism of the various couches; but the one great principle, of *strengthening the part under treatment*, was entirely lost sight of. Hence, when the patient, after many years of reclination, and frequently of bodily suffering, arose from her couch, it was only to find that symmetry had been obtained at the expense of health; and, in most cases, the patient relapsed into a malformed condition in less than a few months after relinquishing the habit of reclination.

This plan of treatment enjoyed, however, a long period of favour, until the conviction became apparent to every one, that the restoration to natural form was too often gained at the expense of a loss of physical power.

Then there arose a new class of "anatomical mechanists," who were well informed, by the experience of others, as to the necessity of restoring form, without, at the same time, destroying health; and who devoted their time and talents to the construction of appliances adapted to fulfil the desired end, and which should yet admit of the patient taking ordinary exercise in the meantime.

Various beautifully formed and simple appliances were devised, of which the most worthy of remark is "Sir A. Cooper's Invisible Spinal Support." In this apparatus all necessity for reclination was dispensed with, and the patient gained symmetry and strength at the same time.*

It was not for the spine alone that ingenious and well-constructed mechanism became employed. In cases of club-foot, an apparatus, invented by my predecessor, Mr. Sheldrake, fulfilled all the scientific requisites of the best instruments of the present day; and yet it presented the simplest form, and admitted of the readiest adaptation. By its use, the most severe cases of infantile club-foot (*talipes equino-varus*) were readily restored to normal form, although the cure took a few months longer to accomplish than it does by the means now employed, viz., surgical division of tendons. Still, the muscular power of

* This was the first step towards combining exercise with mechanical treatment, as the plan enabled the patient to extend and bring into use those muscles the action of which was hitherto almost entirely suspended, and was perfectly so when the recumbent system was adopted. So great was the success attendant upon this plan of overcoming spinal curvature, that, in six weeks, Sir A. Cooper sent no less than seventy-two patients to my father for such appliances, many of whom recovered their lost symmetry, and in all of them the tendency towards further increase of malformation was arrested. I mention this fact to show that, wherever exercise and mechanical support were combined, success followed the arrangement; and that the treatment received the cordial sanction of the highest surgical authority then existing, viz., Sir A. Cooper.

the limb was unimpaired by the lengthened treatment, and the foot possessed all its required action when released from the use of the apparatus.

From this time, orthopædic mechanism rapidly attained such a degree of excellence as to enable all the ordinary forms of distortion to be readily overcome. It has, however, been reserved for our own times to advance the art of constructing anatomical appliances up to the perfection and dignity of a science.

Hitherto, even during the period of excellence to which I have just referred, the mechanician contented himself with carefully ascertaining the relative positions occupied by a deformed and normal limb, and, comparing the *direction* taken by the latter in its progress to the former condition, adapted such mechanism as should enable the distortion gradually to assume the form presented by the apparatus employed; the instrument being primarily constructed on the relative dimensions corresponding with a restored and symmetric shape. This mechanism required much time in its construction, and much patient labour, the necessity of which would have been almost entirely obviated, had the knowledge of the anatomical and pathological changes belonging to each malformation been as well known to the mechanist then as they now are. Instead of compelling the deformed surfaces of the part under treatment to adapt themselves to the shape of

the instrument, it is now the practice to make the apparatus coincide in shape with the malformation, and then gradually to reduce the limb to a natural form, by producing such changes in the mechanical bearings, as well as the external form of the instrument, as will bring the part into a correct position.* This view may really be accepted as the *text* for all the improvements which have so largely extended the province of modern mechanical orthopædy, and hence led to a demand for well-educated men to exercise the duties of inventors and adapters of the required mechanism.

In order to adduce proof of what I have already advanced, it is only necessary to direct the reader's attention to the changes of osseous position incident to the several bones of the tarsus, during the production of ordinary "club-foot," as also to the important part performed by the muscles of the foot and leg in producing such movements as eventually lead to the establishment of deformity.

Taking the muscles as primary agents in the production of deformity of the foot, we find first that the contraction of the *tendo Achillis* lifts up the heel, and produces a permanent thrusting forward of the principal bones composing the anterior surface of the foot; next the *tibiales* tendons, both anterior and posterior, being shortened, direct the foot inwardly,

* "Mechanical Appliances necessary for the Treatment of Deformities," H. Heather Bigg, page 2.

and rotate, in an upward direction, its inner lateral margin, thus completing a club-foot, and displacing the bone, called the scaphoid, from the position it originally held with the astragalus. In these actions, which are due entirely to muscular traction, the foot performs a revolution round a general centre, the exact position of which I have already mathematically determined.*

Now, unless the mechanist knows well the anatomical conditions of the limb, much time must necessarily be wasted in compelling the foot to return to its normal state and to its right position. It is true that nature is so willing to aid every effort made to overcome any deviation from her established laws of form, that the muscles themselves are largely concerned in acting in the same way as the artificial mechanism does; but it is far better to assist the muscular efforts than to create an opposition to them, although we may be certain of their eventual power to conquer this opposition. It is here that I

* Bigg on "Deformities," page 84. If I required further argument to prove that only within the last few years has the construction of orthopædic mechanism been perfected and understood, I might refer my readers to an apparatus for adult varus (club-foot), described at page 105 of my work on "Mechanism for Deformities," &c. In the instrument I allude to, every centre is mathematically coincident with those observed on dissecting the club-foot; and I do not scruple to state that it exhibits the highest mechanical effort ever made to construct an apparatus so variously applicable in its different movements as to be capable of overcoming all and every variety of distortion of the foot.

must beg to be allowed to remark particularly upon the well-known power possessed by muscular traction in inducing deformity. In almost every instance with which I am acquainted, the restoration of the limb to normal form has been accomplished only after the muscles have become increased in length. Thus is clearly demonstrated the importance which ought to be attached to well-directed calisthenics or gymnastics in connexion with mechanical treatment. By careful friction and gentle exercises, a limb, however much it may be deformed, gradually becomes more supple, and hence is placed in a condition highly favourable for the extension of the muscles, and the replacement of the bones; both which objects are effected by *mechanical* apparatus.

I have selected club-foot as an instance of the good to be derived from the mechanist having a competent knowledge of the changes occurring in the limb; and his success will be greater if, at the same time, he possesses the power of taking advantage mechanically of exercise and apparatus combined. I urge this not because club-foot offers the best example of the benefit that may be obtained from exercises, but simply in order to show that every kind of distortion is within the power of care and skill to remove and cure.

Multitudes of other instances might be adduced, leading to the conviction, that had the different mechanical instruments used before the introduction of

tenotomy been assisted by muscular movements and gymnastic exercises, accompanied by friction and manipulation of the contracted articulations, those deformities of the knee, thigh, ankle, elbow, or wrist, which gave so much trouble in the earlier history of surgery, would have readily yielded to treatment.

All these methods, however, were deficient in the speed and certainty which have resulted from the introduction of tenotomy; and this remark leads me to the treatment of deformities, by the second method, viz., surgery and mechanism combined.

The greatest advance ever made towards lessening the mechanical difficulties which are always present in severe cases of distortion took place when Thilenius, Delpech, and Stromeyer suggested the propriety of dividing surgically the terminating extremities (tendons) of contracted muscles.

The opinion they entertained was, that by first separating the tendon, and then allowing it to adhere by the deposition of a new substance (capable of elongation), between the hitherto divided ends, such an amount of increase in length would be mechanically gained as should permit a limb contracted by muscular shortening to resume its original form.

This discovery laid the foundation for the modern school of Orthopædy,* which simply implies surgical

* Ορθος, "straight;" and παις, παιδος, "a child." The art of rectifying the deformities of children.

treatment, combined with mechanical aid; and as division of tendons could alone with propriety be performed by a surgeon, this treatment of club-foot and other cases arising from muscular contraction was soon adopted by every leading member of the Profession.

The almost immediate result attendant upon diminished muscular traction, and the consequent restoration of the limb to its normal form, in a comparatively short space of time, offered such advantages, that all who laboured under forms of distortion which were amenable to this particular plan of treatment gladly went through the trifling operation of having one or two tendons divided, when so promising a result as restoration to symmetric shape could be secured.

It should, however, in fairness, be borne in mind, that the mere division of tendons, unless followed by the use of properly devised mechanical appliances, proves entirely unavailing; hence the surgical separation of the contracted structure forms really only an adjunct to the action of the various instruments devised for the removal of distortions; and thus the patient, unless supplied with carefully prepared apparatus, gains very little advantage from the operation. Owing to the rapid progress and ready acceptance of tenotomy, as a simple method of lessening the difficulties attendant upon the reduction of malformations, it soon became customary to consider that hardly any distortion could be effectually cured without

having first been submitted to tendinous division; and hence some of the most trivial contractions, which are easily removed by the simplest mechanism, became instances of the cures capable of being wrought by the use of the knife.

I do not mean to state that the high-minded and intelligent men of whom the principal members of the Profession are composed deliberately preferred dividing tendons for the mere purpose of proving that the cases so subjected to surgical treatment were incapable of being otherwise cured; but, under the impression that much time was saved by the proceeding, they readily concurred in any proposition calculated to lessen the trouble and pain given to the patient by an increased period of treatment.

Neither do I mean to disparage the opinions held by others who have devoted their special attention to such operations; but as it has been advanced* that surgical division of tendons reduces the contractile power of those muscles to which the tendons belong, it is surely a subject open to observation whether the removal of various slight contractions by muscular exercises and carefully arranged mechanism would not as fully secure the strength and activity of the limb as any proceeding which allows a suspicion of diminishing its muscular contractility. This is a matter, however, which future experience and observation can alone determine; in the meantime, it is a fact beyond

* Malgaigne.

all dispute, that in the severe forms of muscular contraction, tenotomy is the operation which, accompanied by good instrumental aid, will always succeed in the removal of deformity, and enable the limb to resume its original form. If assisted by proper exercises, the limb will also be restored to its normal and destined amount of energy, in effecting which object the third method of treatment, viz. muscular exercises, either alone, assisted by mechanism, or combined with tenotomy, are employed.

CHAPTER II.

THE SPECIAL ADAPTATION OF MUSCULAR EXERCISES FOR THE TREATMENT OF DEFORMITIES.

It is easy enough to restore symmetric form in a distorted limb by the employment of tenotomy and mechanism, but it is extremely difficult to add moreover muscular vigour and power. This object can be satisfactorily achieved only by calling specially into play those muscles, the power of which is lessened. Thus the gymnasium becomes a necessary ally to our safe and certain progress in curing deformities.

Whilst readily admitting the great good capable of being accomplished by tenotomy in cases of club-foot, contracted articulations, &c., the operation has unfortunately failed to accomplish any result proportioned to the expectations entertained of its efficiency in spinal curvature. In this kind of deformity, muscular tension is so self-evident, that at first sight it would appear to be by far the most rational procedure to remove, by the use of the knife, this important

opposition to mechanical restoration; nevertheless, in the few cases which have fallen beneath my own notice, I have invariably found that division of the vertebral muscles, so far from improving the condition of the spine, diminished the chances which were previously favourable to the restoration of the bodies of the vertebræ to their original position by mechanical agency, and for the following reasons:—

The muscles selected for division are usually the longissimus dorsi and sacro-lumbalis, and, in the cases I have seen, the point of section has been in the lumbar region: now, as all lateral curvature of the spine must of necessity involve the creation of, at least, two distinct arcs of deflection, and consequently offer two areas of concavity, separation of the muscles concerned in the lumbar deformity could only admit of those muscles which had previously maintained the approximation of the extremities of the dorsal arc being still less opposed in their contractile efforts; in other words, the liberation of the muscular resistance exercised at the lumbar arc would only serve to increase the disposition evinced in the muscles of the dorsal concavity to continue their contracting power. Nothing but well-arranged exercises can produce an elongation of the muscles forming the "chords of tension" on the concavity of the vertebral curves, and even then, all attempt at extension would prove futile, unless assisted by such mechanism as should prevent the spine from again lapsing into its maxi-

mum of distortion, after the muscular system has, by friction, manipulation, and exercise, been rendered sufficiently supple to admit of the spine yielding under the pressure of well-directed mechanical forces, and assuming a more symmetric and perfect mathematical condition.

The object I have in view in making these observations is to draw attention to the fact, of how slight a knowledge the scientific world possesses of the peculiar *mechanical* conditions belonging to that form of distortion familiarly known as a curved spine. Every one conversant with such subjects is aware of the compression exercised by the various individual bodies of the vertebræ upon the inter-vertebral cartilages; nor need I do more than advert to the shortening observable in the ligamentous substance connecting laterally the bodies of the vertebræ in old-standing cases. It is also generally admitted that a disturbance of muscular equilibrium is the proximate cause of the changes from the normal condition which I have just mentioned; but the subject upon which the greatest want of knowledge exists is how to employ and direct mechanical power so as to meet every separate obstacle to the restoration of the spine, without interfering with either health, muscular development, or bodily growth.

In the earliest system, viz., that of recumbency, the idea entertained by its advocates was that of relieving the vertebræ from the superincumbent weight

of the head and shoulders, and thus presenting the spine in its most favourable condition for the employment of extensile force. This latter object was generally accomplished by placing the patient on an inclined plane or couch, and either trusting to the weight of the lower extremities for the production of vertebral elongation, or adding weights to the legs and pelvis in order to facilitate such a result.

The evil consequences attendant upon such unscientific treatment are at once apparent in the certainty of impaired health from want of physical exercise; and, indeed, we know that bitter disappointment almost constantly attended such cases, when it was discovered that many years of reclination, with its attendant discomforts and personal abnegations, had been patiently borne, and yet it was found at last that the spine was left in such a weak condition that it rapidly hastened to assume its old and malformed position, when the patient stood erect or walked. A second plan, all but universally adopted for the treatment of spinal deformity, consists in the attempt to diminish curvature by an exercise of great mechanical power upon the arcs of deflection. The false principle on which this plan is based can be at once seen when it is borne in mind that the surfaces against which external power is always exercised in such appliances are the convexities of the ribs. These, from their nature, offer less resistance than the vertebræ themselves; and thus it frequently happens that the artifi-

·cial surfaces impress their form upon the ribs without in the least effecting the rectification of the spinal column.*

If spinal instruments are well constructed,—if they have their various centres of movement really and mathematically coincident with the point around which the bones and muscles have grouped themselves in the production of a curvature,—and if they possess the

* I have a plaster of Paris cast in my possession, taken under my own inspection, which exhibits, in an indisputable manner, upon the surface of the ribs, the form of the metal plate employed to diminish the arc of dorsal curvature. The case is that of a young lady, who was submitted to the care of ———, when, instead of employing gentle extension or other means much more available, he sought to diminish the curvature by screwing almost daily two metal plates together, arranged in a vice-like form, on the patient's body, one being placed on the dorsal, the other on the lumbar arc; the result, as any person of ordinary anatomical and mechanical capacity would have predicted, was, that by constantly diminishing the space between the two hard and unyielding plates, the ribs, under such violent treatment, became compressed upon themselves, while the curvature was rather worse than when it was first placed under such treatment. Fortunately for the patient, her friends were early apprised of the mischief arising from such over-powerful employment of mechanism; and she was placed under the charge of another surgeon, who, while still using mechanical power, did so in a way not calculated to be injurious. This mode of tampering with the use of mechanical appliances only tends to bring them into undeserved disrepute; for nothing can be more judicious, and indeed strictly necessary, than the support afforded to a weakened spine by properly constructed apparatus. This may be proved by the successful results which, in a large number of instances falling under the experience of the leading members of the profession, follow the skilful use of spinal mechanism. The form of instrument originally employed in this case has been so strongly advocated by ————, that I feel it an imperative duty to awaken attention to its fearful results.

facility of being gradually and gently made to take advantage of any change beneficially produced by their action,—then nothing can be more valuable than the use of mechanism. It, however, unfortunately often happens that the patient falls into hands incapable of comprehending the most common mechanical principles, and thus much time is lost, a large sum of money is expended, and the blame is eventually laid upon the instrument, or upon the impossibility of overcoming certain severe forms of curvature; whereas it is in almost all cases, as I have just mentioned, only attributable to imperfect mechanism being adopted, and unskilful hands employed in carrying out the principles involved. On the other hand, however, there are a large number of medical men, including many orthopædic practitioners, who succeed perfectly in the management of the necessary mechanical appliances, and thereby greatly relieve the deformities brought under their care.

From the success which follows really scientific efforts, we are led to the important consideration of what might be done to facilitate mechanical action, when properly employed in the treatment of spinal curvature.

I know of nothing so eminently calculated to fulfil this desideratum as calisthenic exercises, as I have a firm conviction that, in nine cases out of ten, spinal curvature originates from muscular debility and consequent loss of vertebral equilibrium. Any plan that tends to increase and develope form and power in

those muscles which can be proved to possess less energy than nature originally intended they should have, must be a sure method of attacking the malady at its origin.

Of course, the best and most desirable cases are those where spinal curvature is as yet incipient in its character; and when it admits of the vertebræ being readily restored to perpendicularity by a slight degree of pressure used by the hands against the convexity of the dorsal and lumbar curves.

Fortunately these cases are the most numerous of any variety of spinal deformity, and only require a slight time for their rectification, if proper means are promptly resorted to; these measures consist in such muscular exercises as will encourage and develope the enlargement of those muscles whose power, being diminished, admits of the spine becoming deflected from its natural and upright condition. The exercises are to be followed by the adaptation of an extremely light mechanical support, worn beneath the clothing in such a manner as to be effectually concealed, although it constantly opposes every attempt made by the spine to return to its unnatural condition.

In young children a frequent remark is made by their tutors, governesses, nurses, &c., that they have a habit of stooping, standing on one leg, drooping either the right or left shoulder, and altogether failing to exhibit that ease of carriage which particularly distinguishes a well-formed and healthy child.

In no condition of physical development, in its relation to human form, is there greater elasticity and grace than in the movements of a young child. Every attitude is marked by a wonderful adaptation of mechanical laws to the particular requirement of the position assumed for the moment. Whether this observation be illustrated by the ordinary acts of walking, sitting, or standing, there is always a beautiful equilibrium maintained between the several forces brought into action. While these powers are normally active, the whole form displays lightness, activity, and vigour; but let the slightest disturbance occur in the equilibrium of muscular organization acting upon the spine, and the immediate result is found in the stooping shoulders, and the deflected form, so painfully evident in many of the younger members of the human family in our present time. To prove that the stooping form and rounded shoulder mainly depend upon deficient action in those muscles whose duty it is to support the trunk in its perpendicular position, is a task of not the slightest difficulty, as it is only necessary to require the patient to raise her body by muscular power; and any observer is immediately conscious of the great effort required by the patient to sustain herself in an erect condition even for a few minutes.

If mere inability to sit perfectly upright were the only penalty entailed by this state of things, it might be urged that time would suffice to strengthen the weak-

ened muscles, and to enable the patient gradually to recover perfect vigour. But nature is sometimes prone to assist, by the adaptation of her varied parts, in the maintenance of the weakened condition; and she moreover leads to still greater deformity by contracting those muscles of the chest which are particularly intended to maintain, when necessary, the position enforced upon the body by musculo-vertebral weakness. Hence, after a time, the power to hold the body erect ceases, and every act of *ordinary* exercise only increases the tendency to further spinal curvature. If, however, instead of trusting absolutely to nature for giving the required tone and strength to the debilitated muscles, calisthenic exercises are judiciously employed, the result is, that the chest becomes expanded and opened, and the muscles of the back gain such vigour and power that they are perfectly capable of opposing successfully all efforts to produce permanent stooping of the shoulders and contraction of the chest.

Again, where slight lateral yielding of the body exists, and is capable of being traced to positional causes, and when it tends to elongate unduly the muscles on one side of the body, at the expense of unduly employing those on the other,—in such cases, proper and well-directed gymnastic motions soon restore the hitherto weakened muscles to their proper vigour, and arrest the formation of spinal curvature.

If simple exercises were always used as a part of the daily education of growing children, then, in-

stead of weakened constitutions and deflected spines, we should find our offspring possessing robust and healthy frames, calculated to perform in a perfect manner, the functions specially assigned to each part of the human body; and these exercises would also render them ready to sustain a far greater amount of mental labour.

It would be very desirable that all cases of spinal curvature were seen by professional men at the early stage which I have just described; but, unhappily, those primary indications of vertebral deformity which manifest themselves in stooping shoulders and a bad gait are rarely viewed in a sufficiently important light, or appear to justify parents in having recourse to mechanical aid.

It is only when the contraction of the chest has become permanent, the deflection of the spine firmly established, and the appearance of the patient seriously interfered with, that the case is considered to evince symptoms of sufficient gravity to call for professional opinion.

It then becomes necessary to adopt more stringent and continuous measures for overcoming the rapidly increasing distortion; and these measures consist in what is termed localized exercises, combined with the adaptation of a mechanical support for the spine.

Localized exercises are those which especially bring certain muscles into play, and it is, therefore, a matter of moment so to govern the necessary

calisthenics, that the maximum effect is produced upon those portions of the body which need to be invigorated.

Although slight cases of spinal malformation are more readily influenced by gymnastic exercises than those of a more serious character, yet the greatest amount of distortion which can exist is incapable of producing any results which are beyond the power of scientific measures to ameliorate. Even in those cases where long-standing deformity has not only led to the contraction of the muscular substance, but has also established a diminution in the length of the inter-vertebral cartilages and ligaments, well-directed exercises, by tending to expand mechanically the concavity of the various curves, also overcome, to a very great extent, the resistance offered by those agencies which I have just described as opposed to the production of an improved form.

Where, however, the spinal curvature is very well marked, the first care of those who propose to employ calisthenic exercises must be, to discover which muscles are particularly deprived of their proper range of action, and then cautiously, but certainly, to bring them into play until they attain a higher degree of tone and development than they have hitherto assumed. In the next chapter, will be found a description of the exercises which are necessary to be employed, and how they particularly influence cases of ordinary deformity.

CHAPTER III.

THE LOCALIZATION OF MUSCULAR EXERCISES IN ACCORDANCE WITH EXISTING DEFORMITY.

By the term, "localized movements," are meant those movements which are especially applied to particular parts of the human frame, in order to bring into exercise certain muscles, which are either weakened by not being properly employed, or are inactive from physiological causes. In either case, the object contemplated is to induce such an amount of motion as shall tend to strengthen and develope those muscles which are rendered weak by disuse. In order completely to effect this purpose, a perfect understanding not only of the anatomical condition of the human body under usual circumstances, but also of the position assumed by certain parts during their departure from their customary action, must be thoroughly comprehended.

It requires more than a bare knowledge of the arrangement generally presented by the muscular system, to carry out such exercises as shall restore the mechanical power of the muscles, when, from whatever cause it may have arisen, a disturbance of

their usual alternations of contraction and relaxation has taken place.

No task, probably, can be more difficult, than that of determining the exact power exercised by muscles, after they have become changed in their direction by a destruction of their ordinary antagonism, and after a departure from the conditions attendant upon symmetric and regular arrangement has occurred.

It is under circumstances such as these that a combination of surgical and mechanical knowledge becomes so highly essential.

This can, fortunately, be obtained by consulting any surgeon of experience and eminence, as to the muscles especially at fault in the deformity presented to him, and by then following out the requisite exercises, and adopting the proper mechanical appliances for facilitating the restoration of the body to its normal shape.

For every variety of deformity there are special exercises, the principle in all being—that of facilitating the restoration of muscular equilibrium; and to show how I propose to accomplish this object, I append a slight description of the different gymnastic arrangements pursued when treating the more ordinary distortions by "movements."

CONTRACTION OF THE HEEL (*talipes equinus*).

In this deformity the heel-tendon is permanently shortened, and the weight of the body transferred to the ball of the toes (metatarso-phalangeal articulation), instead of being sustained by the entire surface of the sole.

This distortion presents itself in three distinct grades, all of which are due to contraction of the heel-tendon (*tendo Achillis*). In the first, the foot can be replaced in its rectangular relation to the leg by the slightest amount of external force. In the second, the adaptation of mechanical apparatus is required to effect this object. In the third, the contraction is so tense, that nothing but the knife of the surgeon (tenotomy), combined with mechanical apparatus, can restore the foot to its natural position.

Distinct as these several conditions appear, "localized movements" are applicable to all of them. In the first, they are valuable in re-establishing the disturbed balance between those muscles which flex and those which extend the foot upon the leg. In the second, they render the tendon supple, and disposed to yield to instrumental force; and in the third, they enable the surgeon permanently to insure muscular equilibrium after the division of tendons, and to establish perfect and uniform contractility.

The manner in which the exercises for contracted *tendo Achillis* are performed is as follows:—

In slight cases, the foot is rapidly flexed and extended during a period of ten minutes; then the ankle-joint and its adjacent parts are well shampooed by the hand of the operator, thus leading to flexibility being secured to the joint. In cases of the second degree, exercises are first employed for a period varying, according to the age of the patient, from five to fifteen minutes; and then, the foot is placed in a leathern boot, having a small perpendicular spring affixed to it, the action of which tends to maintain the extension which is gained by exercise. In the third stage of contracted heel, exercises are performed by the employment of a nicely padded slipper, affixed to a pulley. The patient is seated on a properly prepared stool, and commences by pulling a cord attached to the toe part of the slipper; the effect of which is to extend the heel-tendon. A strong India-rubber band, fixed to the heel of the slipper, opposes the traction of the pulley, and thus enables the patient to flex and extend the foot as rapidly as may be desired.

A small index is affixed to the apparatus, by which the person who superintends the gymnastics is rendered aware of the number of times the limb has been flexed.

This arrangement is highly important, and does not exist in any establishment, foreign or otherwise, which I have yet visited. Without such an index it is impossible to decide with accuracy as to the

number of movements; and yet, upon the regularity with which they are performed depends the ultimate success of the case.

There are several complications associated with contraction of the heel-tendon; but, by moderate care, they are readily provided for in the exercises which are adopted.

The next kind of distortion which very frequently occurs, and to which exercises are applicable, is that of—

CONTRACTION OF THE KNEE-JOINT;

Which also exhibits itself in three separate forms. The first is due to slightly disturbed equilibrium between the muscles which flex and those which extend the leg. The second shows such an amount of permanent angularity that nothing but a mechanical apparatus will in the slightest degree diminish it; and the third is of such severity as to demand the performance of tenotomy in order to liberate the contracted tendons. The localized exercises adopted in either of these conditions should be those which will particularly extend the tendons of the semi-tendinosus and semi-membranosus muscles, those muscles being the principal impediments towards establishing a perfect flexion and extension of the knee-joint at the will of the patient.

This exercise is performed by means of an apparatus, upon which the patient seats himself; and the

leg and thigh are perfectly secured by means of straps adapted for the purpose. The appliance is furnished with a slipper, in which the foot rests, and at its anterior extremity is a cord communicating with a pulley, the effect of which, when pulled by the patient, is to extend the leg. An India-rubber band establishes action in the contrary direction; and thus gentle but continuous and well-regulated exercises are employed for about half to three-quarters of an hour daily, until permanent extension of the contracted tendons and strengthening of the limb result.

In cases where the contraction of the knee-joint is slight, simple manipulations, accompanied by active and vigorous shampooing, are employed; but even in these cases, the use of the apparatus just alluded to is better than any other plan, owing to its possessing an index denoting the number of times the knee has undergone flexion and extension, and thus the amount of motion is arithmetically ascertained. An exercise of this kind soon succeeds in extending the muscles belonging to the posterior part of the leg, when the case is slight; and also, where tenotomy has been previously resorted to, an increase of power and flexibility is undoubtedly obtained. In fact, the exercises should be the invariable sequence to surgical treatment, as affording the most certain method for permanently establishing the good effects commenced by orthopædic surgery.

Another variety of knee-contraction occurs when the limb is inverted, or, in ordinary terms, when the patient becomes knock-kneed (*genu valgum*). Then an exercise of a different kind must be recommended, in order not only to overcome the resistance offered by the muscles of the outer side, which are shortened; but, also, to diminish and eventually overcome the ligamentous opposition which invariably attends cases of knock-knee, when of long standing. The plan pursued is, first, to place the heel of the patient against a slight padded rest fixed to a stool, and then, by pressure, exercised by the operator's hand applied to the inside of the knee, gradually to induce the limb to assume a straight position. Added to this, shampooing, friction, and manipulation should be freely employed to the outer side of the knee-joint, while pressure is steadily maintained against the inner surface (inner condyle of femur). After pursuing this plan vigorously, according to the age of the patient and the condition of the case, for a certain period, a padded splint should be affixed to the leg, in order to secure the advantage gained by motion.

It must be distinctly understood that in all severe cases of deformity, involving the inferior extremity (legs), exercises and movements are merely adjuncts to mechanical treatment, in the restoration of the body to its normal state; and the reason why these exercises hold this secondary position is manifest, when it is recollected, that the weight of the body rapidly

counterbalances whatever gain may have been obtained in the legs during "exercise." In such instances, very light mechanical appliances, calculated to maintain the rectification secured by movements, and yet to allow every natural bodily motion, are applied, after the exercises have ceased; and thus the patient possesses the advantage of a correct and scientific method of treatment, exactly counteracting that which Nature originally pursued, in her production of deformity.

The first effort of Nature is to diminish the muscular and cartilaginous resistance exercised by the structures around the joint; and the yielding of articular surfaces, from a want of mechanical support, soon follows.

The first effect of Art is to strengthen and restore the power of the muscles, ligaments, and cartilages, and then to support the articulation in such a manner, that it cannot yield in an objectionable and abnormal direction.

In simple cases of ligamentous weakness of the knee-joint, such as is constantly found in young children who grow too rapidly, a silk elastic knee-bandage should be applied, after the exercises have ceased. This measure secures articular integrity.

Another malady which is of very frequent occurrence, and very troublesome in its results, is—

CONTRACTION OF THE HIP-JOINT.

This deformity is so varied in its forms, that it requires a great amount of attention and care so perfectly to "localize" the "movements," that, whilst increasing the relaxation of the contracted muscles, no undue strain may be exerted against the joint itself. It is therefore necessary to employ friction and shampooing, concurrently with the extending mechanical forces. It is also requisite to be acquainted with the amount of tension which the patient can bear at one time; and to ascertain this, I employ an apparatus consisting of a seat upon which the patient rests. His pelvis or hips are gently secured to this seat; a padded band surrounds the thigh, and three little pulleys, acting against as many elastic bands, bring the limb into motion. By the patient pulling one cord the thigh is extended; by pulling another, it is abducted; and by pulling a third, it is rotated.

All these several motions are required, in order effectually to overcome contraction at the hip-joint. This exercising apparatus, like all others, is furnished with a "tell-tale," indicating the exact number of movements performed in each direction; and enabling me to judge accurately when the exercises should terminate.

There is a large number of complications arising from these several dispositions to deformity, all of

which, by proper exercises, may be eventually overcome. It is therefore a matter of considerable importance to know that properly devised and special exercises exist, and are arranged for every possible variety of distortion.

But not only are movements valuable in cases of actual deformity; they are also useful where only a slight tendency exists towards such a condition, as it enables the muscles to recover such an amount of strength as will prevent the articulations from yielding. If this fact were more generally understood, exercises would be resorted to as soon as any disposition towards displacement exhibited itself; and thus not only simple distortions, but lateral curvature of the spine, with all its attendant evils, would be assuredly averted. The most important deformity which is amenable to localized movements is—

SPINAL CURVATURE.

This subject offers so extensive a range, and the exercises are so numerous, that I cannot possibly do the subject the justice it deserves, nor describe a tenth part of the "movements" employed, both here and on the Continent, for its relief and treatment. Still, sufficient remarks may be made to enable any one, who is labouring under a deformity more rare than any of those mentioned in the following pages, to judge of the good which may be derived from the

combination of movements with mechanical appliances, in the treatment of these serious maladies.

Probably, the simplest form of spinal curvature is that which arises from a lax and debilitated muscular tissue, without any actual, or rather permanent, disturbance in the equilibrium naturally maintained by each set of muscles in their relation to the spinal column, as a perpendicular axis. From the difficulty experienced by the patient in holding the body perfectly erect for any ordinary length of time, it frequently happens, that the tendency to curvature is exhibited by a declination of the spine, first to one side, and then to the other; so that, however carefully an examination may be conducted, it by no means unfrequently happens, that the remarks at first made on the nature of the bodily inclination are found to be entirely incorrect when tested by subsequent inquiries.

In a case of this description, the whole of the muscles connected with the back must be gradually brought into exercise; and the special movements devised for this purpose consist in passing the hands and arms through a series of movements, each of which tends to influence equally the antagonistic flexors and erectors of the vertebræ.

I generally commence by requesting the patient to stand with the knees perfectly straight, but with the heels slightly apart, a position which secures a firmer and less easily disturbed base than if they were placed close together, as is sometimes recommended.

When the body is thus resting easily upon the legs and feet, the arms are very slowly raised, with the palms of the hands facing the ground, until they are perfectly rectangular with the body; they are then gently turned towards the ceiling, and deliberately raised above the head, when, by slightly flexing the elbows, the fingers are brought together. After remaining in this position for four seconds, the arms are gradually allowed to fall to the rectangular position; the palms are then turned downwards, and quietly brought again to the side. This movement must be taken with extreme slowness, and should be repeated as many times as the strength of the patient, the instructions of her medical man, or the progress of the treatment may determine. The object for which such movements are made is that of bringing into action the muscles especially involved in the support of the upper portion of the spine; and these movements also slightly influence those muscles which serve to maintain the head in an erect position.

I then proceed to direct a series of movements, in which the hands and arms are made alternately to bring into action those muscles which I find to be devoid of natural strength.

After the exercises have proceeded for such a length of time as is found to agree with the patient's strength, semi-recumbency is ordered, on a chair flexed to such an angle as is found most comfortable to the patient in affording the readiest condition of

rest; and this position is maintained for about half-an-hour, which enables the body to recover any undue fatigue it may have been subjected to, without losing the effect created by activity in strengthening the fibrillæ composing the minute muscular structure.

As in cases of spinal curvature arising from debility, the whole of the muscles of the body are generally weakened, other exercises, especially adapted for bringing into action the muscles belonging to the upper and lower extremities, as well as to the trunk, are gradually resorted to, until a renovated frame and strengthened body are the rewards of quiet but continuous perseverance.

In illustration of this class of spinal malady, it frequently happens that when a young girl, whose growth is rapidly advancing, arrives at about the age of thirteen, a habit of resting on one leg, or dropping one shoulder, is observed, sometimes accompanied by a slouching carriage and slovenly gait. All the suggestions of friends, or the corrections of governesses, avail but little towards securing an improvement in figure; and under the erroneous impression that the young lady has outgrown her strength, long periods of recumbency during the day are resorted to; which measure, unfortunately, only tends still more to the maintenance of that muscular debility which is, in truth, the proximate cause of her malady. If, instead of pursuing this course, exercises proportioned to the

diminished muscular power were adopted, a gradual but certain development of strength would ensue, and all the functions dependent upon a healthy organization would be materially promoted and improved. It is to this category of spinal curvature that "round shoulders" and "poking chins" belong. These are undoubtedly very common-place terms by which to designate a deformity, but, nevertheless, they are perfectly familiar to all who have either had a family of their own to superintend, or have witnessed the growth of children belonging to their friends and acquaintances.

The movements particularly valuable for overcoming these "mauvaises poses" are those which require the aid of such simple external apparatus as a hand-pulley and a neck-swing. The former is employed to aid the extension of the pectoral or chest muscles, at the same time strengthening those of the back, by a series of exercises peculiarly calculated to expand the chest and to increase the muscular force of the shoulders. The latter is employed gently to extend the head, in order to overcome any contractile tendency which the cervical intervertebral substances (cartilages, ligaments, etc.) may have acquired during the habit of holding the chin in an unnatural and anterior position.

By a combined use of these two simple pieces of mechanism, the head becomes readily restored to its perpendicular position, and the lungs and chest gain expansive development.

Occasionally the whole spine has an arching backwards, due to the weakness in the muscles which especially raise the body (sacro-lumbalis, longissimus dorsi, spinalis dorsi, etc.), and this deformity is frequently a sequence to the previously-described malposition. The most appropriate exercise for overcoming this condition of vertebral debility is that of raising a slight weight from the floor, by stooping the body in a forward position, until two pulleys, so conveniently placed as to be within reach of the patient's hand, are gained, when they should be gently lifted up until the figure again stands erect. Or if the contraction in the muscles of the chest, resulting from round shoulders, still exists, then the patient should hold two slightly weighted pulleys (attached to the ceiling), and stooping the body forward, should attain expansion of the chest and strengthening of the long vertebral muscles by one and the same movement. These exercises must of course be administered with judgment, but they prove highly valuable when properly performed.

LATERAL CURVATURE DUE TO MUSCULAR SHORTENING.

The next kind of lateral curvature is that where the supposed *habit* of drooping the shoulder, or standing on one leg, is found to be derived from permanent muscular traction, requiring some amount of external force even temporarily to overcome it.

In cases of this description movements will be found exceedingly useful, and for the following reasons :—On carefully examining a case of the character just stated, and accurately measuring the distance between the vertebræ and the highest point in the lateral arc formed by the ribs, it will be seen that a slight deviation from pure perpendicular form is exhibited by the spine; and if the patient be asked voluntarily to bend her body, first to one side and then to the other, great difficulty will be experienced in moving to both sides in an equal mechanical ratio; and the opposition to even motion is soon found to be attributable to a permanent shortening of the muscles belonging to one side of the spine, in contradistinction to a certain elongation observable in those of the other. To overcome this defect an elongation of the contracted muscles becomes necessary, and the peculiar combination of movements with mechanical appliances is rendered invaluable.

If, previously to the commencement of any exercise, the ribs on the drooping side are gently raised by the hand of the operator, an elongation of the contracted muscles situated within the concavity ensues, and the spine assumes its right position; but the instant such artificial support is withdrawn, the contraction of the shortened muscles is renewed, against which those counteracting muscles which are already abnormally lengthened cannot contend, and a relapse of the vertebræ to the original mal-position takes place.

This circumstance particularly proves the advantage derivable from such a system of treatment as will, first, elongate the shortened muscles; next, will strengthen and shorten those which are unduly elongated; and, thirdly, will maintain the position given to the spine in its improved condition. The first of these necessary conditions is secured by allowing the patient specially to exercise the diminished muscles existing within the concavity of the spinal curve; this being accomplished by a variety of movements calculated to bring these particular muscles into play. The next object is obtained by friction of the surface of the spinal arc; thus stimulating the elongated muscles, and leading to their ultimate resumption of the space first occupied by them; and also tending to approximate the slightly separated margins of the ribs, consequent on their uplifted position during the time the contracted muscles exert their influence on the convexity of the curve. The third object is gained by the adoption of a very light spinal apparatus, worn beneath the clothes, and so constructed as only to offer resistance to the vertebræ when they attempt to return to their mal-position.

Were it not for this mechanical arrangement, the body would, after undergoing the usual movements, relapse into its original form. It is on this particular point that much neglect has hitherto existed in England, when deformities of the spine were treated by calisthenics, gymnastics, etc., and in forgetting to

apply (or rather considering it unnecessary to do so) such light mechanical support as would firmly maintain the elongation of muscular substance gained by exercise. In the large Continental institutions for the treatment of deformities which I have recently visited, the system pursued appeared to be, first, to subject the patient to certain well-considered and appropriate exercises; next, to permit a due amount of rest on a couch properly arranged so as to sustain the body in the position attained by the exercises; and, thirdly, to adapt a light portable apparatus during the time devoted to study, walking, drawing, reading, music, or any of the multitudinous occupations always pursued by the young during their educational career.

CHAPTER IV.

LOCALIZATION OF MUSCULAR EXERCISES.

(continued.)

THE next condition of spinal curvature, in which localized exercises prove of very great value, is that which is due to muscular traction, established in opposite directions, and combined with ligamentous shortening and compression of the inter-vertebral cartilages. To this class of deformities belong those widely-spread and extremely difficult cases known as double lateral curvature.

In the distortions of the vertebral column to which I have hitherto alluded, original formation and subsequent maintenance of the arc of deformity has been entirely ascribed to muscular traction.

In the more severe forms of curvatures now about to be noticed, other elements are superadded, the strength of which opposes far greater resistance to the cure than mere muscular power can offer. These are cases of shortening of the inter-spinous ligaments, and diminution of the inter-vertebral cartilages. The

order in which a severe spinal curvature may be traced, from its earliest commencement to its fully developed condition, affords a simple clue to the rational method of ameliorative treatment. It consists in extending the lateral ligaments, elongating the contracted muscles, and increasing the power of the parts which by long disuse have been debilitated. Plainly as this procedure is indicated, the *modus operandi* is of an extremely difficult character, as it will be found that, upon making an attempt to extend the restraining inter-vertebral substances, an amount of muscular resistance is experienced which greatly interferes with the desired result. It thus becomes necessary to mollify or diminish the tense and cord-like opposition offered by muscular traction, at the same time that expansive force is brought to bear upon the restraining spinal ligaments. This treatment demands much care, from the peculiar position assumed by those muscles which particularly influence the retention of spinal curves. To explain this view, a slight description must be afforded of what takes place during the formation of a severe case of double curvature.

Probably, the primary destruction of equilibrium, and the consequent attention paid to the patient, may occur at an early age, when perhaps a slight prominence of the right shoulder and an undue enlargement of the left hip lead to observations, resulting in the discovery that the muscular antagonism existing

normally on both sides of the vertebræ has become weakened in favour of an exercise of power by one particular set of spinal muscles. In the hope that Nature may right herself if left to her unimpeded efforts, and may restore the deflected column to its natural condition, the patient is advised to take rest, and abstain from immoderate physical activity. In process of time, by the constant depression of one side of the structures composing the separate vertebræ, the disturbance in the equality of muscular traction induces a diminution of the substance (cartilage) placed between each bone, and a wedge-like shape is given to the cartilage, highly unfavourable to the restoration of rectilinear form.

When, from this circumstance, the curvatures (for there are always more than one, as will be presently described) become firmly established, those muscles which are especially employed in holding the posterior part of the trunk in an erect position, and which always exercise their traction in a line coincident with the perpendicular centre of the spine, find the space diminished (by compression of the column, owing to lateral deflection) over which they have hitherto acted; and they therefore obey the universal law impressed upon all muscular substances, and adapt their size by contracting to the lessened area or space. As, however, these muscles act in a direct line, and the curves exist laterally to them, it necessarily follows that they become cords of tension to

each separate vertebral concavity, and hence they tend to approximate the extremities of the various curves, thus rendering the case worse.

To employ calisthenic exercises to muscles already rendered abnormally tense, is an error occasionally committed by those who have not a correct knowledge of the structural changes which I have just mentioned; and the result which must necessarily follow is an increase of deformity.

It is here, therefore, that "localized exercises" are urgently required, and are calculated to effect an immense amount of practical benefit; for, instead of inducing action in the contracted muscles, every possible pains must be taken to lessen their tension, by friction, shampooing, etc., whilst the muscles whose power has been previously suspended should be gradually brought into action.

To effect this object, it is first requisite to examine carefully the condition of each arc of curvature, and to note well the muscles which are rendered specially inactive. Next, it is necessary to ascertain how much of the deformity is due to ligamentous contraction, and how much to diminished length in the erectors and other muscles of the spine. Thirdly, we must employ such movements as will assist the development of the weakened muscles, without exciting the action of those which are already too much strengthened. Fourthly, we must adjust to the figure a carefully prepared mechanical support, calculated by the delicacy

of its construction to take advantage of, and to maintain whatever improvement is effected upon the spine by the previous manipulations and exercises.

I have previously stated, that the spine rarely (if ever) exhibits a *single* curve; and the reason can be readily explained on well-known mechanical principles, viz.:—the head and upper extremities, when the vertebræ exist in a perfectly symmetric condition, are balanced by the perpendicularity given to the spine by its system of antagonistic muscles. As, however, Nature affords to the body the power of bending itself in almost every direction, an equilibrium must be established during the time when the spine loses its erect position; and this is afforded by the temporary employment of the extremities to counterbalance the disturbing effect induced upon the trunk by any deviation from the central line. Thus, if a person, placing his heels closely together, leans so far to the right side, that the line of gravity passes beyond the base afforded by the feet, he must either fall, or extend the mechanical area of support by raising the left leg or arm.

Granting, however, that instead of permitting the body to bend over so far to the side as to endanger the preservation of balance, it is only allowed to yield sufficiently in a lateral direction as to place the head out of the line it normally occupies, then another effect follows, which is, that the head, being out of the central line, seeks to restore itself by acting upon

the spine; and if any cause be present (such as muscular retention), prohibiting an expansion of the arc formed in the vertebræ by the position first assumed, a curvature of compensating extent is at once established below the first, and thus two lateral deflections are originated.

If this simple illustration be carefully considered, it will be seen that it is thoroughly impossible for only *one* spinal arc to exist in a severe case of lateral curvature.

This illustration will also afford a partial solution of the difficulty which attends upon every kind of treatment, and it will explain the necessity which exists for the correct comprehension of those mechanical laws which are involved, by any one attempting to employ muscular exercises as an adjunct in the restoration of the body to a symmetric form.

The exercises required in cases of double lateral curvature depend so greatly upon the exact magnitude and position of the various curves, that they cannot be described otherwise than imperfectly in these pages.

They are very numerous, and require such appliances as only a medical gymnasium can offer. It is, therefore, far wiser to refrain from entering into any explanation of their distinctive modes of action, than to run the chance of leading to misinterpretation, although, to any of my professional readers who are anxious to know what special movements are employed

in particular cases, I shall be glad to afford the required information.

ROTATION OF THE SPINE ON ITS OWN AXIS.

A secondary form of double lateral curvature occurs when rotation of the spine upon its transverse axis is added to the original vertebral deflection. This deformity constitutes, in long-standing cases, that amount of enlargement of the ribs which is so difficult to account for, when the purely lateral deflection is carefully measured.

The curvature of the spine is generally accompanied by a proportionate prominence of the chest, on the side opposite to the enlarged shoulder. Although I have never heard the opinion advanced, it is highly probable that torsion or rotation of the spine is largely increased, if not primarily induced, by the effort made to restore the vertebræ to their original and upright form, on the part of those muscles whose office it is to retain the spine in a perpendicular position. The malformation is also assisted by the traction of the *serratus magnus, longissimus dorsi,* and other muscles which specially govern the movement of the ribs in a latero-posterior direction.

The exercises necessary for overcoming this kind of spinal distortion consist in the following arrangements:—The patient is first seated upon a kind of padded chair, and assuming that the curvature is of

an ordinary description, viz., the prominent shoulder on the right side, with enlarged hip on the left, her right hand is employed in drawing towards her, in a horizontal direction, a pulley sufficiently weighted to need some little effort to raise it. When the arm is extended, and the weight falls to the ground, the spine and right side of the ribs follow the effort, and rotation in an anterior direction ensues. During this exercise, the left hand grasps a handle suspended just within reach of the fingers; the object of which exercise is to secure expansion in the concavity of the upper (dorsal) curve, and thus to act as a counter-resistance against the curvature, and prevent its being further increased by the rotatory movements. An attendant also administers friction upon the enlarged surfaces alternately with each exercise. After these movements have been continued for such a length of time as may be deemed necessary, the patient is allowed to rest on a properly prepared chair, the angle of which is so constructed as to preclude the possibility of the weight of the head and shoulders resting on the spine.

A very well fitting spinal support is then applied, furnished with a pad calculated to make slight but constant pressure on the rotated ribs, and thus to confirm the good effects induced by the previous exercises.

ANTERIOR CURVATURE OF THE SPINE.

Another variety of spinal curvature is that known as *lordosis,* or anterior curvature, which is characterised by the existence of a considerable increase in the natural curve of the spine, or what is generally called "the hollow of the back." The exercises employed to overcome this deformity consist in causing the patient to place both heels together, and stoop the body downwards until the hands take hold of a handle belonging to a pulley. On the body being again raised, this pulley is drawn from the floor; and thus, by alternate flexion and extension, the muscles and ligaments particularly implicated in creating lordosis are influenced. In this, as in all other cases of spinal curvature, friction during exercises, and the subsequent adaptation of a slight mechanical support, are necessary to ensure a satisfactory result.

POSTERIOR CURVATURE.

Posterior curvature of the spine is mechanically distinguished by an arching backwards of the vertebræ, and by considerable contraction of the chest. The exercises employed to overcome a distortion of this character consist in those motions which bring into action the muscles of the anterior part of the thorax, and also any that raise the vertebral column. By a judicious course of movements, whatever inter-

vertebral resistance there may be to the extension of the spine is generally overcome, and an expanded chest, with its consequent advantage of greater space for inflation of the lungs, is the result. In order to prevent the spine from lapsing into its original condition, and also to favour further extension, a spinal support is worn, taking its bearing around the pelvis, and supporting the body beneath the arms.

It must be remembered that these exercises especially refer to cases of posterior, and not *angular*, curvature of the spine; the latter malady resulting from disease in the bodies of the vertebræ, in the treatment of which, any muscular movements would be the causes of much mischief. Fortunately, posterior is readily distinguishable externally from angular curvature, the first simply consisting in an arching backwards of the vertebræ in regular proportion; the second presents the appearance of a "knuckling" of the spine, and rarely involves more than two or three separate vertebræ. Contractions affecting the head and neck are of very frequent occurrence, and, when not extremely severe, they readily yield to proper exercises, accompanied by friction, and followed by the use of a mechanical apparatus. By simple distortion of the head and neck is meant drooping the head to one side, or "craning" the chin in a forward direction. The former generally arises from shortening of the muscles of the neck, and the latter from contraction of the pectoral muscles, and those which

connect the posterior part of the head with the cervical vertebræ. In either case, the deformity rapidly yields to proper "movements."

Where, however, such an amount of distortion exists as to present the condition known as wry-neck, then nothing but tenotomy is of any avail. The use of the knife is always followed by the employment of a mechanical apparatus; and after a certain amount of extension has been gained, the muscular exercises are calculated to establish and strengthen the effect previously obtained.

CONTRACTION OF THE SHOULDER-JOINT.

Is a deformity which is but rarely met with. I have frequently found it slightly exhibited in cases of amputation above the elbow; and as the use of an artificial arm depends greatly upon the freedom of the articulation, I have for many years been accustomed to request the patient to perform rotatory movements, in order to prepare the stump for the artificial arm which I proposed to adjust. The same thing frequently occurs in the leg after amputation below the knee, and the defect is due to slight contraction in the muscles at the back of the joint. Knowing the importance of a patient possessing a straight stump, before he can satisfactorily use an artificial leg, I have always applied friction, accompanied by movement of the joint, and with the most satisfactory result.

CONTRACTION OF THE ELBOW

Presents three distinct mechanical conditions. The first is distinguished by a constant tendency to bend the elbow. The second requires some degree of force to render it straight, being permanently semi-flexed; and in the third, the muscles are so tense, that only a surgical operation can remove the angularity.

The exercises employed are, for the first, voluntary flexion and extension of the elbow; for the second, the use of a cord and pulley, to which a weight is affixed; and the third is treated by rapid flexion and extension of the elbow-joint, and afterwards the use of a cord and pulley, accompanied by friction on the inner surface of the joint. Contraction of the elbow-joint yields most readily to well-sustained movements, their number and extent being regulated by an index affixed to the rope and pulley.

CONTRACTION OF THE WRIST-JOINT

Is to be overcome by gentle friction and shampooing applied to the joint, and rapid flexion and extension performed by the hands of the operator. Contractions of the wrist and elbow are occasionally associated together; and in this case, the mechanical movements applied consist in friction and the use of two pulleys, one acting from the ceiling, which influences the wrist, the other from the wall, which extends the

elbow. Only one handle belongs to the two pulleys, so that both actions are employed at the same moment.

In contraction of the upper extremities, a large number of muscular exercises are employed, the intention of all being gradually to bring into play those muscles which, from disturbance of equilibrium or any other cause, are deficient in their necessary strength.

CONCLUDING REMARKS

The advantages which accrue from a judicious employment of muscular exercises may be very briefly summed up; viz.:—they constitute one of the measures by which a restoration to symmetric form can be secured, and they lead to the maintenance of physical energy.

The first duty of a patient who is supposed to be labouring under deformity should, therefore, be to seek for advice from the best professional sources as to the existence and nature of the distortion. Having ascertained from the medical man who is consulted, what muscles are especially weakened or otherwise at fault, and obtained his concurrence as to the expediency of employing particular exercises for their restoration to original power, then the patient should attend a course of gymnastic movements administered in obedience to those principles which especially govern the production of corporeal force.

After the requisite movements have been pursued

for a short period, it is advisable again to seek the opinion of the medical man who suggested them, in order to learn whether any practical benefit has resulted from their adoption.

By adopting this arrangement, every possible advantage is secured; first, the surgeon or physician consulted declares the muscles which are at fault; next, the exercises under proper mechanical guidance are taken to strengthen them; and, thirdly, the medical man is again referred to, in order that he may judge of the propriety of the system adopted.

There cannot be the least doubt as to the benefit secured by this procedure, as medical and mechanical aid are thereby combined. Where likewise the case is such as to necessitate the adaptation of apparatus for maintaining the effect gained by extension of muscular substance, how readily will the various conditions dependent upon the satisfactory progress of the case suggest themselves, when the patient is thus placed under constant supervision.

The error which has hitherto been committed, in the treatment of distortions, especially those of the spine, is that of imagining that when a particular kind of stay or any other piece of analogous mechanism has been adjusted, the patient must of necessity soon recover his perfect form, without any but the most ordinary attention, and a casual visit paid to his medical adviser. The rational and only perfect system of treatment exists, when the patient is often subjected to

professional examination, and the progress of his case is accurately noted. Thus every improvement or retrogression is promptly encouraged or opposed, and the patient daily gains the experience derivable from the advice which is given. It is this arrangement of subdividing the responsibility of the treatment which has led me to add a medical gymnasium to the other means already placed at the disposal of the medical Profession; and it is with an earnest hope of finding my efforts supported by the leading surgeons and physicians of England, that I bring these pages to a termination.

APPENDIX.

MECHANICAL ACTIONS PERFORMED BY THE VARIOUS MUSCLES OF THE VERTEBRÆ, AND THEIR INFLUENCE IN THE PRODUCTION AND MAINTENANCE OF SPINAL CURVES.

THE following tables are arranged for the purpose of explaining the mechanical influence exercised by the muscles of the back, in cases of spinal curvature.

In the first and second, the various muscles belonging to the spine are simply mentioned as they occur in their several layers; but as I am desirous of showing their action in connexion with those calisthenic exercises which particularly tend to give them a proper employment, the third has been so arranged, that the muscles belonging to each separate division of the vertebræ are grouped together. It will thus be readily comprehended what physical movements are really valuable in helping either to maintain the muscles in healthful strength and vigour, or to restore these elements where disease has diminished natural power, and hence led to the destruction of that equi-

librium which is the foundation of the whole muscular system.

Still further to assist the knowledge of these circumstances, another table has been appended, wherein the action of the various muscles under certain conditions of disturbed equilibrium is carefully noted, with a view of enabling the reader to ascertain whether the principles laid down as essential for the restoration of a deflected spine to its normal condition are based upon scientific grounds or otherwise. If my primary proposition is once firmly established, viz., that disturbed muscular action is one of the principal causes of deformity, then there cannot be the least doubt that all these exercises, which are specially designed for the restoration of their lost energy, must be favourably received by the Profession.

But it is not, however, sufficient only to bring into play the disused and weakened organization; other aid must be afforded in the shape of such mechanical assistance as shall enable Nature gradually to resume her original condition; and it is as much by the skill and care with which this mechanism is adapted, as by the pursuit of well-directed muscular exercises, that the desired benefit can be obtained.

When, however, the following tables are carefully examined, it will undoubtedly be admitted that the treatment of vertebral distortions must consist in a combination of many principles, rather than in an

adherence to one method of procedure. In other words, calisthenic exercises and mechanical appliances must severally assist each other, instead of being singly applied for the removal of spinal curvature. I have previously stated, that knowing no better way of determining the action resulting from particular muscles exercising their power in given directions, I placed upon a skeleton, pieces of tape of different colours, attached as nearly as possible to the points mentioned in anatomical works as those of origin and insertion. Having done so, I at once obtained a map of the different layers, with their mechanical actions; and thinking that others may feel inclined to adopt the same experiment, I have included, in Table I., the colours employed.

TABLE I.

Levatores costarum are attached to the last cervical, and to eleven dorsal vertebræ, and inserted into the whole of the ribs between their angles and tubercles. The mechanical action of these muscles is that of raising the ribs, and for this purpose they act from the spine as a fixed point. Upon any disturbance of their mutual equilibrium they tend, by unduly approximating the ribs on the strongest side, to promote dorsal curvature.*

Intertransversales are attached to the transverse processes of the entire vertebræ. Their action is that of maintaining the spine erect. When equilibrium is disturbed, they favour a lateral curvature of the entire spinal column.

Interspinales are attached to the spinous processes of the cervical and lumbar vertebræ. They hold the spine erect, but, when disturbed, admit of the vertebræ flexing anteriorly.

* By disturbance of equilibrium the author means to convey the idea that a suspension of antagonism between the two sets of muscles has taken place, *i. e.*, contraction of muscular substance, in those under consideration, is exercised *only on one side* of the vertebral column.

Multifidus spinæ passes along the whole length of the spine in the groove formed by transverse and spinous processes; it is also attached to the sacrum and ilium. Its action maintains the spine laterally erect. When disturbed, yielding ensues in a lateral direction.

These four constitute the sixth layer, and are especially calculated to give stability to the spinal column (in white).

Obliquus superior passes from the atlas to the occiput. Its action tends to hold the head erect, and aids rotation. When disturbed, reverse actions occur.

Obliquus inferior extends from transverse process of atlas to spinous process of axis, and aids oblique rotation.

Rectus lateralis joins the occiput to atlas, and aids rocking of the head. Disturbed, reverse action occurs, as in cervical curvature.

Rectus posticus minor arises from atlas, and joins occiput; it holds the head backwards. Disturbed, reverse action occurs.

Rectus posticus major arises from axis, and joins occiput; it keeps the head posteriorly perpendicular, and also draws it backwards. When disturbed, reverse action occurs.

All these five muscles move the head upon the spine.

Semispinalis colli runs from transverse processes of fifth and sixth upper dorsal to spinous processes of

two to five cervical vertebræ; it gives perpendicular motion to the cervical vertebræ, and, when disturbed, favours cervical curvature.

Semispinalis dorsi is attached to transverse processes of from six to ten dorsal vertebræ, and is inserted into transverse processes of four upper dorsal and two cervical. It exercises perpendicular action against the dorsal vertebræ, and, when disturbed, it facilitates the creation of lateral cervico-dorsal curvature. The semispinalis dorsi and colli act as erectors of the neck.

These seven constitute the fifth layer (in black).

Complexus is attached to transverse processes of three upper dorsal and one lower cervical vertebræ, and is inserted into curved line of occiput. It serves to move the head backwards, and aids rotation.

Trachelo-mastoideus is attached to three upper dorsal and last cervical vertebræ; it is inserted into the mastoid process. It thus assists the rectus lateralis in lateral movement of the head, and also the semispinalis colli and splenius capitis, in acting laterally on cervical vertebræ in the creation of cervical curvature.

Cervicis transversalis is attached to fifth and sixth upper dorsal, and inserted in second to sixth cervical vertebræ. Its action helps the intertransversales, and in curvature becomes contracted.

Cervicalis ascendens is attached to the angles of third, fourth, fifth, and sixth ribs, and is inserted into

transverse processes of third, fourth, fifth, and sixth cervical vertebræ. Its action is to draw the ribs upwards or cervical vertebræ obliquely downwards, and thus, when disturbed, it serves to maintain cervical curvature.

Spinalis dorsi arises from spinous processes of two upper lumbar and two lower dorsal vertebræ, and is inserted into spinous processes of upper dorsal from second to eighth. It is an erector spinæ, and as such assists the interspinales, sacro-lumbalis, and longissimus dorsi. When disturbed, posterior curvature ensues.

Sacro-lumbalis arises from the sacrum, ilium, and lumbar vertebræ, and is inserted into the angles of six lower ribs. Its action is to keep the lumbar vertebræ erect. When disturbed, it materially influences the formation and retention of lumbar curvature.

Longissimus dorsi arises from sacrum and lumbar vertebræ, and is inserted into angles of eleven ribs and transverse processes of dorsal and lumbar vertebræ. It conjoins with the sacro-lumbalis, and exercises a perpendicular oblique action against the lumbar and dorsal vertebræ. When disturbed, it induces lumbar curvature.

These seven constitute the fourth layer (in pink).

Splenius colli, Splenius capitis.—These two muscles have a common origin at sixth upper dorsal spinous processes and last cervical, and divide the latter going to the mastoid process of temporal bone.

They act conjointly in holding the head erect, and rotating it.

Serratus posticus inferior is attached to spinous processes of two lower dorsal and two upper lumbar vertebræ, and is inserted into the angles of the four lower ribs. Its action is that of depressing the ribs, and also slightly aiding rotation of the ribs upon the vertebræ.

Serratus posticus superior is attached to upper dorsal and one lower cervical, and is inserted into the margins of second, third, fourth, and fifth ribs. Its action is antagonistic to the preceding muscle, and tends to raise the ribs upon the spine. Disturbed, it creates dorso-lumbar curvature.

These four constitute the third layer (colour, brown).

Rhomboideus major arises from spinous processes of four upper dorsal, and is inserted into posterior border of scapula. Its action is that of drawing the scapula horizontally back upon the spine, or the spine to scapula.

Rhomboideus minor arises from the spinous processes of last cervical vertebræ, and is inserted into the edge of the triangular surface of posterior border. Draws the scapula obliquely upwards to cervical vertebræ.

These two muscles particularly influence the convexity of dorsal curves.

Levator anguli scapulæ arises from transverse pro-

cesses of four upper cervical, and is inserted into the upper angle and posterior border of the scapula. Its action is to draw the scapula upwards towards cervical vertebræ, or spine downwards to scapula.

These three form the second layer (colour, yellow).

Latissimus dorsi arises from spinous processes of the lower dorsal and all the lumbar vertebræ, also from sacrum, ilium, and four lower ribs, and is inserted into the bicipital groove of the humerus. The action of this muscle tends to draw the shoulder back upon the spine, or the spine laterally to the shoulder. It also steadies the scapula by pressing upon its inferior angle.

Trapezius arises from the inner third of occiput, and is attached to the last cervical and whole of the dorsal vertebræ, also to the scapula with clavicular attachment from occiput to clavicle. It exercises action upon the shoulder in three directions, viz., its clavicular and occipital fibres draw it upwards, its upper dorsal, cervical, and scapular fibres, backwards, its lower dorsal fibres, slightly downwards.

These two muscles form the first layer (colour, green).

*** This table admits of no other arrangement than the lengthy one adopted, as when condensed it fails to demonstrate the special action of each muscle during the period of disturbed equilibrium, and thus the value of localized exercises could not be so perfectly comprehended as the author is anxious it should be.

TABLE II.*

Mechanical action.	Upwards.	Downwards.	Laterally.	Obliquely.	Backwards.
1ST LAYER.					
Trapezius	scapula to occiput.	occiput to scapula	scapula to vertebræ vertebræ to scapula.	scapula to occiput. scapula to vertebræ.	
Latissimus dorsi			humerus to spine spine to humerus	humerus to spine. spine to humerus.	
2ND LAYER.					
Levator anguli scapulæ.	scapula to cervical vertebræ.	cervical vertebræ to scapula		scapulæ to cervical vertebræ.	
Rhomboideus minor				cervical vertebræ to scapula.	
Rhomboideus major			scapula to cervico-dorsal vertebræ cervico-dorsal vertebræ to scapula	scapula to cervical vertebræ. cervical vertebræ to scapula.	
3RD LAYER.					
Serratus posticus sup.	ribs upon spine.				
Serratus posticus inf.		ribs upon spine.			
Splenius capitis				mastoid process to vertebræ	head to vertebræ.
Splenius colli					cervical vertebræ.
4TH LAYER.					
Longissimus dorsi				lumbar and dorsal vertebræ upon pelvis	vertebræ upon pelvis.
Sacro lumbalis.		ribs upon vertebræ.		lumbar vertebræ upon pelvis	vertebræ upon pelvis.
Spinalis dorsi					vertebræ upon pelvis.
Cervicalis ascendens	ribs upon cervical vertebræ.	cervical vertebræ on ribs		cervical vertebræ to ribs.	

TABLE II. (*continued*).

Mechanical action.	Upwards.	Downwards.	Laterally.	Obliquely.	Backwards.
4TH LAYER.					
Cervicis transversalis ..	.....	.....	....	cervical upon dorsal vertebræ	cervical upon dorsal vertebræ.
Trachelo mastoideus....	.....	head to vertebræ ..	....	{ head on cervical vertebræ. { cervical vertebræ on head.	
Complexus	.....	.....	.....	.....	head upon vertebræ.
5TH LAYER.					
Semi-spinalis dorsi.....	.....	.....	.....	.....	cervical upon dorsal vertebræ.
Semi-spinalis colli	.....	....	.....	.....	cervical upon dorsal vertebræ.
Rectus posticus major ..	.....	.....	.....	.....	occiput upon cervical vertebræ.
Rectus posticus minor..	.....	....	.....	.....	occiput upon cervical vertebræ.
Rectus lateralis	.....	head upon spine ..	head upon spine.....	head upon spine.	
Obliquus inferior	.....	....	.....	head upon spine.	
Obliquus superior.....	.....	.....	.....	head upon spine.	
6TH LAYER.					
Mutifidus spinæ.....	.....	.....	the whole vertebræ.		
Interspinales	.....	.....	.....	.....	the whole vertebræ.
Intertransversales.	.....	.....	the whole vertebræ.		
Levatores costarum	the ribs upon the vertebræ.....	. .....	.....	ribs upon vertebræ.	

* This table exhibits the mechanical action of each vertebral muscle, with a view of explaining how their disturbed equilibrium produces spinal curvature, either their origin or insertion being taken for the fixed point.

TABLE III.*

Cervical Region.

Trapezius, draws the cervical vertebræ towards the shoulder, and the shoulder towards the vertebræ.

Levator anguli scapulæ, lifts the scapula towards the head, and draws the head downwards.

Rhomboideus minor, draws the scapula in an oblique direction to the spine, or spine to scapula.

Serratus posticus superior, lifts the ribs upwards upon the spine, and spine to ribs.

Splenius capitis, draws the head obliquely to the spine.

Splenius colli, draws the cervical vertebræ laterally.

Cervicalis ascendens, raises the ribs upon the cervical vertebræ, or draws the cervical vertebræ obliquely downwards.

* This table specifies, according to their anatomical layers, those muscles, and their mechanical actions, which are found grouped together in the cervical, dorsal, and lumbar regions, and thus enables the reader to ascertain the special influence they combinedly exercise in the production and retention of lateral curvature.

Cervicis transversalis, helps in sustaining the head and neck erect.

Trachelo mastoideus, moves the head laterally, and draws the cervical vertebræ towards head.

Complexus, draws the head backwards, and holds the neck erect.

Semispinalis dorsi, exercises slight perpendicular traction against cervical vertebræ.

Semispinalis colli, exercises perpendicular traction against cervical vertebræ in a larger degree.

Multifidus spinæ, holds the head and neck laterally erect.

Interspinales, hold the head and neck posteriorly erect.

Intertransversales, maintain vertebræ in erect position.

Levatores costarum, raise ribs upon cervical vertebræ.

Dorsal Region.

Trapezius, draws the scapula almost horizontally to spine, and spine to scapula.

Latissimus dorsi, draws the shoulder towards the dorsal vertebræ, and spine to shoulder.

Rhomboideus major, draws the scapula horizontally to vertebræ, and vertebræ to scapula.

Serratus posticus superior, lifts the ribs upon the spine.

Serratus posticus inferior, depresses the ribs upon the spine.

Splenius capitis, draws the head towards dorsal vertebræ, and dorsal vertebræ to head.

Longissimus dorsi, creates oblique action in the whole dorsal vertebræ.

Spinalis dorsi, holds the spine perpendicularly erect posteriorly.

Transversalis cervicis, maintains dorsal and cervical vertebræ mutually erect.

Trachelo mastoideus, obliquely flexes the cervical vertebræ.

Complexus, draws the head backwards and holds it erect.

Semispinalis dorsi, gives perpendicular attachment to the dorsal vertebræ.

Semispinalis colli, helps to keep the cervical and dorsal vertebræ erect.

Levatores costarum, lift ribs upon vertebræ.

Lumbar Region.

Latissimus dorsi, draws the shoulder toward lumbar vertebræ, and spine to shoulder.

Serratus posticus inferior, depresses the ribs upon the spine.

Sacro-lumbalis, exercises perpendicular action in whole of the lumbar vertebræ.

Longissimus dorsi, creates oblique action in the whole of the lumbar vertebræ.

Spinales dorsi, hold lumbar vertebræ posteriorly erect.

Interspinales, hold lumbar vertebræ posteriorly erect.

Multifidus spinæ, holds the spine laterally erect, and by relaxation induces slight lateral action.

Intertransversales, hold the lumbar vertebræ laterally erect.

Costal Region.

Latissimus dorsi, being affixed to the ribs, tends to draw the dorsal vertebræ into oblique lateral action.

Sacro-lumbalis, holds the spine erect, and exercises oblique lateral action against lumbar vertebræ.

Cervicalis ascendens, lifts the ribs upon the spine, and draws the cervical vertebræ obliquely downwards.

Serratus posticus superior, lifts the ribs upon the spine, or draws the spine to them.

Serratus posticus inferior, depresses the ribs upon the spine, or draws the vertebræ to them.

Longissimus dorsi, holds the lumbar vertebræ erect, or draws the ribs downwards upon them.

Levatores costarum, raise ribs upon vertebræ.

Scapular Region.

Trapezius, draws the scapula upwards, backwards, and slightly downwards.

Levator anguli scapulæ, raises the scapula towards

cervical vertebræ, or draws spine downwards to scapula.

Rhomboideus minor, draws scapula towards dorsal vertebræ, and spine to scapula.

Rhomboideus major, draws scapula horizontally to dorsal vertebræ and spine to scapula.

Pelvic Region.

Latissimus dorsi, draws the whole of the dorsal and lumbar vertebræ, together with the ribs, in an oblique direction downwards.

Sacro lumbalis, acting from the pelvis as a fixed point, induces indirect lateral movement of the lumbar vertebræ.

Longissimus dorsi, produces indirect lateral action in both lumbar and dorsal vertebræ.

Multifidus spinæ, holds the spine erect.

TABLE IV.*

Mechanical Action.

REGION.	CERVICAL.		DORSAL.		LUMBAR.	
On the side of muscular contraction, is created....	Convexity.	Concavity.	Convexity.	Concavity.	Convexity.	Concavity.
Laterally — Direct.....	Rhomboideus minor. Trapezius (middle fibres.)		Rhomboideus major. Trapezius (middle and lower fibres).		Latissimus dorsi.	
Laterally — Oblique....	Semi-spinalis colli. Cervicalis ascendens Serratus posticus superior. Trapezius (upper fibres).	Splenius capitis. Levator anguli scapulæ. Trachelo mastoideus.	Complexus. Trachelo mastoideus. Longissimus dorsi. Sacro lumbalis. Splenius capitis.	Semi spinalis dorsi. Transversalis cervicis. Serratus posticus superior.	Serratus posticus inferior. Latissimus dorsi.	
Laterally — Indirect....		Inter-transversales. Multifidus spinæ. Complexus. Transversalis cervicis. Splenius colli.	Semi-spinalis colli. Serratus posticus inferior.	Inter-transversales. Latissimus dorsi. Multifidus spinæ.		Inter-transversales. Multifidus spinæ. Longissimus dorsi. Sacro-lumbalis.
Posteriorly.....	Interspinales.		Interspinales. Spinalis dorsi.		Interspinales. Spinalis dorsi.	

* This table is intended to classify those muscles which are particularly implicated in maintaining the arcs of spinal curvature, and to explain how, by their conjoined mechanical action, they primarily induce deformity.

Also, by the same Author,

ON ARTIFICIAL LIMBS,

THEIR

CONSTRUCTION AND APPLICATION.

From Her Majesty the Queen.

BUCKINGHAM PALACE, *September* 5, 1855.

SIR,—I have the honour to acknowledge the receipt of your Letter of the 3rd inst., accompanying your work upon Artificial Limbs, which I have laid before the Queen, and which Her Majesty has been graciously pleased to accept.

I am, Sir,

Your obedient, humble servant,

C. B. PHIPPS.

To Mr. Bigg.

LANCET, *August* 4, 1855.

THIS work is one of the emanations arising out of the present unhappy war. Many of our soldiers and sailors have escaped death, but have returned with the loss of a limb, which will not only unfit them for future service, but must also render them to a certain extent incompetent to perform the necessary requirements of life. Surely time passed in studying the best artificial means of supplying a substitute for the lost part is a just tribute to those brave fellows who have fallen maimed in defence of their country's honour.

The author has done well to publish his experience at the present time. He teaches the scientific principles upon which the different parts should be manufactured, so that, in the hands of a competent mechanician, the artificial limb may not only prove pleasing to the eye, but useful to the wearer.

Some excellent remarks occur upon the form of stump best suited to the adaptation of artificial means. Mr. Bigg says, in reference to amputation of the arm, "The best shape a stump

above elbow can possibly possess is when it *gradually* tapers from the shoulder to its end, leaving a rounded surface at its inferior extremity;" also that a "stump much thickened at its end is a great trouble to the arm maker."

A chapter upon the instruments for artificial hands is particularly interesting, enabling a person to write, shoot, drive, &c., with extraordinary facility; that also upon the mechanism of artificial joints is highly instructive, and proves that the author is master of his subject. There are, however, many difficulties to overcome; for instance—

"In the form of the knee-joint the motion is not, as would at first be imagined, derivable from a point in the middle of the knee, but has its existence at least half an inch behind such supposed centre, the action resembling a hinge, with the patella, or knee-cap, covering the open or basal extremity. Thus, anatomically and osteologically, the centre is not in the place it would appear to be, when the leg is only superficially observed or considered in an artistic light."

The book is very properly addressed to the medical profession, both civil and military, and is well worthy attentive perusal.

MEDICAL TIMES AND GAZETTE, *August* 25, 1855.

MR. H. HEATHER BIGG is, we believe, the present representative of a firm that has long enjoyed considerable reputation for the excellence of their workmanship, and for the ingenuity displayed in the construction of mechanical apparatus for the relief of deformity or mutilation of the body. In the pamphlet before us, he describes the various kinds of artificial legs and arms, from the simple wooden leg of the Greenwich Pensioner, or the hook by which a one-armed labourer may lift a wheelbarrow, to the finished limbs, with their apparatus of joints and springs, which almost perfectly imitate the form and gait of the natural. Imitate, do we say? As for artificial hands, our author plainly intimates that many a man who has lost one of his two beefy fists, may derive no small consolation for his loss from the exquisite symmetry which the mechanism can impart to the artificial substitute; although as, unfortunately, no artificial means have been discovered which can compensate for the softness and warmth of nature, Mr. Bigg naïvely advises that, however pretty the artificial limb may be to the eye, yet that the patient should always "present the natural hand, whenever it is likely to be touched." This is

very judicious advice; a squeeze from a false hand would be a damper.

The surgeon who desires to procure an artificial limb for a patient may consult Mr. Bigg's pamphlet with advantage.

MEDICAL CIRCULAR, *August* 22, 1855.

WE hail this *brochure* with much satisfaction. Our surprise is that a work of this kind, explaining the various forms of mechanism employed as substitutes for lost limbs, and the principles of their application, has not long ago been offered to the profession. Every medical man must have felt at some time or other the necessity of possessing such information as this book conveys. In our view it is a part—though a subordinate one—of the surgical art, and deserves to be studied and understood by the skilful surgeon. The comfort of a patient depends upon the construction and accuracy of adaptation of his wooden leg or arm; how desirable, therefore, it is, that the surgeon should have a competent knowledge of this branch of art. Why not be as well acquainted with the mechanism of these instruments as of others for the relief of spinal curvature or bent legs?

At the present time, when so many of our fellow-countrymen are returning from the Crimea with loss of limb, this work comes before us with peculiar appositeness. The profession are indebted to Mr. Bigg for the timeliness, not less than the usefulness, of his publication, and, without wishing more misfortunes to our brave troops than the severe trials of war may necessitate, we hope that he may have that full share of public patronage which he deserves.

DUBLIN MEDICAL PRESS, *October* 2, 1855.

THIS little book, of 107 pages, consists of two parts and an appendix. The first treats of the mechanism for the formation and adjustment of artificial limbs for stumps after amputations above and below the knee. The second part is devoted to the discussion of the best form and application of artificial arms, fore-arms, and fingers. The appendix is made up of the mechanical treatment of the varieties of talipes or club-foot, deformity of the legs, curvature of the spine, hernia, varicose veins, prolapsus uteri, pendulous abdomen, prolapsus ani, &c., &c. The author has bestowed very great pains on the work, and from the numerous diagrams has made the mechanical contrivances very clear: every artificial extremity appears to be admirable in theory and ingenious in practice.

ART JOURNAL, *October*, 1855.

IT is among the peculiarities of the times—and, perhaps, one of the most promising "signs"—that the more intelligent members of several trades, occupations, and professions, are publishing the result of their experience. No doubt their principal purpose is to advance their own interests; but, in so doing, they contribute largely to public information: it is an obvious truism that those who know most can teach us most, although it is not often that we find such teachers: men are far too apt to keep their knowledge to themselves. Mr. Bigg is an eminent "surgical mechanician," who has been long employed by the several government institutions—such as Chelsea and Greenwich—and by all the great hospitals in London. His repute is, therefore, well established. His book is profusely illustrated by explanatory woodcuts, and it treats upon every branch of the art which he professes—one that, now-a-days, more especially demands attention from all classes; for, unhappily, this art is likely to be the minister of comfort to many thousands. The subject is treated with great clearness and simplicity; it does not, indeed, enable a patient to be his own "mechanician," but it instructs him how to make the best of a bad case, and to lessen, as far as possible, the grievance by which he has been afflicted. A book of this kind, therefore, at such a moment, cannot fail to be considered a public benefaction; and to refer to it such persons as need its aid is a public duty.

ERA, *September* 23, 1855.

MR. BIGG, who is well known to the faculty as an anatomical mechanician, has published a work of great value, especially at the present time. The requirements of his delicate and useful art have of course increased a thousand-fold during the present war, and we venture to say that neither the professional nor ordinary reader can peruse these pages without discovering that their author is scientific, inventive, and thoroughly master of the details of our bodily construction. In Mr. Bigg's inventions the action of the living limb is closely followed, and its loss as nearly supplied by mechanical apparatus as the closest study of the subject could enable the intelligent mechanician to effect. Extraordinary as are the means used for enabling the unfortunate person who has been deprived of one or both legs still to place a firm foot on the ground, we are nevertheless even more surprised at the

skill displayed in giving as useful a hand, after the loss of that natural member. However, our best and confident recommendation of this admirable little work will be most forcibly expressed, perhaps, by our saying that Mr. Bigg has not overstated his pretensions in these remarks, which we quote from his preface :—

"Few persons, unless made acquainted by practical experience with the difficulty of successfully imitating the mechanical action of a leg or an arm, can be at all aware of the extreme pains-taking, and care with which every movement simulated must be studied. In ordinary contrivance, it is simply requisite to consider the end to be attained, and then render the means subservient, but where the needed apparatus is of an anatomical character, and must strictly be conformed to certain symmetrical proportions, sometimes at apparent mechanical variance with the point to be accomplished, the difficulty of construction is considerably increased. To prove this, it is only necessary to examine a natural leg, and suppose its shape superficially followed in the formation of a mechanical substitute, the result of which would be that when needed for use, instead of offering support capable of sustaining the *weight* of the human body, it would yield in its joints the moment such weight was applied, the reason being that the *actual* centres of motion differ from their *apparent* external position.

"In the form of the knee-joint, for instance, the motion is not, as would at first be imagined, derivable from a point in the middle of the knee, but has its existence at least half an inch behind such supposed centre, the action resembling a hinge, with the patella, or knee-cap, covering the open or basal extremity. Thus, anatomically and osteologically, the centre is not in the place it would appear to be, when the leg is only superficially observed or considered in an artistic light."

WEEKLY TIMES, *August* 5, 1855.

THIS little treatise, from the pen of an ingenious and practical mechanist, is very suitable at this time, when the fatal conflict in the Crimea sends home limbless so many men, otherwise in the prime and vigour of their existence. The advance made in substitutions for the loss of the natural limbs is something wonderful, from the walnut-tree pin, with which the old Admiral, or General, formerly stumped into a drawing-room, to the elegant substitute, full of ingenious mechanism,

which Mr. Bigg supplies to his patients. In hands and arms, contrivances equally admirable, enable the possessor to supply the loss of the natural limbs; and by which the patient can lift weights, feed himself, and even write, and, what is scarcely indesirable, still wage battle. Amongst numerous diagrams is one of an officer in the Hudson's Bay Company, who, having lost his hand and arm, was supplied with a mechanical one, with a dagger attached to it, and with which he still pursued his dangerous avocation in the wilds of North America.

The little book is very clearly written, and cannot but be highly acceptable to all who may have been deprived of their limbs; and they will be surprised to find how greatly science and mechanism can relieve their misfortunes.

LONDON EVENING NEWS, *Sept.* 3, 1855.

THIS, although a curious book, is on a very interesting subject, and one which every one having relatives limbless, either at home or elsewhere, should immediately enlighten themselves on. The progress which has been made in later years in substitutions for natural limbs is wonderful—from the walnut-tree pin, with which the old Admiral formerly stumped into the room, to the elegant substitute which Mr. Bigg supplies to his patient. Contrivances, equally admirable, in hands and arms, enable the possessor to lift weights, feed himself, write, and even wage battle, so that many a handless Crimean hero may yet return to the help of our almost perishing army. Amongst numerous diagrams we observe that of an officer in the Hudson's Bay Company, who, having lost his hand and arm, was supplied with a mechanical one, with a dagger attached to it, and with which he still pursued his dangerous avocations in the wilds of North America. The writing is clear and forcible; and the facts revealed will astonish and please those who may have been so unfortunate as to have lost a limb.

MORNING POST, *April 3rd*, 1856.

HER MAJESTY'S BENEVOLENCE.—Amongst the many acts of kindness which her Majesty has displayed towards her wounded soldiers from the Crimea, one of the latest is, perhaps, the most considerate. The public will be gratified to learn

that, at her own private expense, the Queen has commanded artificial legs to be constructed for the following men, whose severe mutilation attracted her Majesty's notice, during the recent royal visits to the hospitals of Portsmouth and Chatham:—Corporal Burland, John Connery, Francis Ready, Samuel Huson, Corporal Marks, and Patrick Kenny. With the exception of Kenny and Huson, who still each retain one leg, all these poor fellows had lost both limbs. They are now, however, by her Majesty's bounty, enabled to walk as well as heretofore. In addition to the above-mentioned, the Queen has caused George Greenway, William Boyce, and Henry Ashforth to be supplied with artificial arms. The first man had his arm shot away just below the shoulder; the second lost both arms by the explosion of a shell, whilst he was in the act of lifting a pickaxe above his head; and the third lost his arm below the elbow. A soldier, named Edward Sharpe, has also been presented with a spinal apparatus, his vertebræ having been injured so severely by a spent ball as to prevent the poor fellow standing erect. By the aid of the instrument employed, he now walks perfectly upright with ease. All these cases were of extreme severity, and, without the exercise of her Majesty's kindly aid, the wounded men would have been unable to have procured the delicate mechanism which has now rendered them capable of fulfilling any employment suitable to their condition. The whole of these appliances have been furnished by Mr. Heather Bigg, the anatomical mechanician, of Leicester-square.

DAILY NEWS, *April* 3, 1856.

HER MAJESTY'S BENEVOLENCE.—The Queen has commanded Mr. Heather Bigg, of 29, Leicester-square, the anatomical mechanican, to construct artificial legs for the following men, whose severe mutilation attracted her Majesty's notice during her recent visits to the hospitals of Portsmouth and Chatham —viz., Corporal Burland, John Connery, Francis Ready, Samuel Huson, Corporal Marks, and Patrick Kenny. With the exception of Kenny and Huson, who still retain each one leg, all these poor fellows had lost both legs. They are now, however, by her Majesty's bounty, enabled to walk as heretofore. In addition to these, the Queen requested Mr. Bigg to supply—Greenway, William Boyce, and Henry Ashforth, with artificial arms. The first man had his arm shot away just below the shoulder, the second lost both arms by the explosion of a shell, whilst he was in the act of lifting a pickaxe above his head,

and the third lost his arm below the elbow. A man named Edward Sharpe has also been presented with a spinal apparatus, his vertebræ having been injured so severely by a spent ball as to prevent the poor fellow standing erect. By the aid of the spinal instrument employed, he now walks perfectly upright with ease. All these cases were of extreme severity; and without the exercise of her Majesty's kindly aid, the wounded men would have been unable to procure the delicate mechanism they required. They are now competent to follow a variety of light occupations, for which otherwise they would have been disqualified.

MORNING CHRONICLE, *April 3rd*, 1856.

HER MAJESTY'S BENEVOLENCE.—Amongst the numerous acts of kindness displayed by her Majesty towards the wounded soldiers from the Crimea, the public will be gratified to learn that, at her own private expense, the Queen has commanded Mr. Heather Bigg, of 29, Leicester-square, the well-known anatomical mechanician, to construct artificial legs for the following men, whose severe mutilation attracted her Majesty's notice during her recent visit to the hospitals of Portsmouth and Chatham:—Corporal Burland, John Connery, Francis Ready, Samuel Huson, Corporal Marks, and Patrick Kenny. With the exception of Kenny and Huson, who still retain each one leg, all these poor fellows had lost both legs; they are now, however, by her Majesty's bounty, enabled to walk as well as heretofore. In addition to these, the Queen requested Mr. Bigg to supply—Greenway, William Boyce, and Henry Ashforth with artificial arms The first man had his arms shot away just below the shoulder; the second lost both arms by the explosion of a shell, whilst he was in the act of lifting a pickaxe above his head; and the third lost his arm below the elbow. A man named Edward Sharpe has also been presented with a spinal apparatus, his vertebræ having been so severely injured by a spent ball as to prevent the poor fellow standing erect. By the aid of the spinal instrument employed, he now walks perfectly upright with the utmost ease. All these cases were of extreme severity; and without her Majesty's kindly aid had been exercised, the wounded men would have been unable to have procured the delicate mechanism they required. They are now capable of fulfilling any employment suitable to their condition.

THE EXPRESS, *Thursday Evening, April* 3, 1856.

HER MAJESTY'S BENEVOLENCE.—The Queen has commanded Mr. Heather Bigg, of 29, Leicester-square, the anatomical mechanician, to construct artificial legs for the following men, whose severe mutilation attracted her Majesty's notice during her recent visits to the hospitals of Portsmouth and Chatham, viz.:—Corporal Burland, John Connery, Francis Ready, Samuel Huson, Corporal Marks, and Patrick Kenny. With the exception of Kenny and Huson, who still retain each one leg, all these poor fellows had lost both legs. They are now, however, by her Majesty's bounty, enabled to walk as heretofore. In addition to these, the Queen requested Mr. Bigg to supply—Greenway, William Boyce, and Henry Ashworth with artificial arms. The first man had his arm shot away just below the shoulder; the second lost both arms by the explosion of a shell, whilst he was in the act of lifting a pickaxe above his head; and the third lost his arm below the elbow. A man named Edward Sharpe has also been presented with a spinal apparatus, his vertebræ having been injured so severely by a spent ball as to prevent the poor fellow standing erect. By the aid of the spinal instrument employed, he now walks perfectly upright, with ease. All these cases were of extreme severity; and without the exercise of her Majesty's kindly aid, the wounded men would have been unable to procure the delicate mechanism they required. They are now competent to follow a variety of light occupations, for which otherwise they would have been disqualified.

BIRMINGHAM JOURNAL, *July*, 1856.

HER MAJESTY'S KINDNESS.

(To the Editor of the *Birmingham Journal.*)

SIR,—I have just received from Mr. Heather Bigg, No. 29, Leicester-square, London, an admirably finished artificial leg, executed by her Majesty's command; and feel assured that such repeated and gracious acts of kindness by her are equally well appreciated by your readers as by the recipients of her gifts. I therefore take the liberty of writing to you to this effect, and also enclose you a copy of my case, extracted from the *Times*, in May, 1855. To the kind intercession of the Rev. W. A. Hales, late of Birmingham, but now lecturer of St. Andrew's Church, Holborn, London, am I indebted in bringing my case

again before her Majesty, and the obtaining of the artificial leg, and for whose kindness I shall ever feel grateful.

I remain, Sir, your obedient servant,

ROBERT EVANS,
Private, 13th Light Dragoons.

65, *Warstone-lane, Hockley, Birmingham, 9th July*, 1856.

(COPY.)

A BALAKLAVA DRAGOON AT FORT PITT.—Robert Evans, 13th Light Dragoons, a young man full of vigour, and with the best inclination to make use of his sabre in behalf of his country, was, in the ever-memorable charge of Balaklava, within six yards of the enemy's guns, when his horse received a shell in his chest, and from the rapidity with which he was advancing, completely turned heels over head, falling on Evans. While in this position, the shell burst in the chest of the horse, laying it open to the hind quarter. The young man laid lengthways under the horse, with his legs between those of the poor wounded animal's, at every convulsive struggle of which, Evans's legs were severely injured by the shoes of his horse, the youth's head, breast, and body being so completely under the animal as to prevent his calling for assistance. While the horse breathed, Evans took every opportunity of breathing also; but as life ebbed from the poor horse, the weight became greater, and Evans found the difficulty of fetching his breath increased. When the horse was dead, the weight was insufferable. In this position his groaning attracted the attention of two of the 17th Lancers and one of his own regiment, returning from the charge, who happily released him. The lengthened pressure rendered him quite frantic for several hours. He was taken by a doctor of the Rifles inside a battery, and had no use of his arms and legs for four days. His left ankle was injured, and with this and the lacerated state of both legs from the struggles of the horse, he was a month in the hospital at Scutari. Robert Evans entered Fort Pitt, January 20, 1855, where his youthful appearance and the severity of his case excited the sympathy of many influential persons (the Earl of Darnley, Colonel Eden, Major Boys, Rev. Mr. Whiston, and others). Upon the Queen's first visit Evans was in bed, but his case and the anticipated amputation of his leg was told her Majesty. When her Majesty was inspecting the wounded a second time, Evans was in the ranks with his crutches, holding his card. The Queen immediately asked if he was the youth whose leg was to have been amputated. She then feelingly inquired of him how he was,

whether he felt much pain, and whether he was under chloroform. This youth, who has a married brother in the 13th Light Dragoons, is very well educated; he is still in Fort Pitt on his crutches, awaiting the complete healing of a wound from amputation, performed on the morning of March 28, 1855.—*Extract from the Times, May*, 1855.

BRISTOL TIMES, *Saturday, July 12th*, 1856.

THE QUEEN'S BENEVOLENCE.—We have recently had great pleasure in inspecting two beautifully contrived artificial legs presented by her Majesty the Queen to Corporal Burland, he being one of our brave Crimean soldiers, whose case excited her Majesty's gracious interest during the Royal visit to Chatham. These admirable substitutes for the natural limb were constructed at the express command of Her Majesty by Mr. Heather Bigg, the well-known anatomical mechanician, of 29, Leicester-square, London, and they are really masterpieces of skill and ingenuity.

And, by the same Author,

DEFORMITIES,

AND THE

MECHANISM REQUIRED FOR THEIR TREATMENT.

From his Royal Highness the Prince Consort.

COLONEL PHIPPS has received the Prince Consort's commands to thank Mr. Bigg for sending his book, which has been accepted by his Royal Highness.

This answer would have been sent to Mr. Bigg sooner, but for the pressure of business.

BUCKINGHAM PALACE, 22*nd February*, 1858.

LANCET, *March* 27, 1858.

On the Mechanical Appliances necessary for the Treatment of Deformities. By HENRY HEATHER BIGG, Anatomical Mechanist to the Queen, &c. Part I. *The Lower Limbs.* London: Churchill.

THE treatment of deformities is a branch of surgical practice in which the most considerable progress has been made during the past twenty years. No small part of this advance is due to the introduction of Tenotomy, but the benefit thus derived would have been comparatively small unless a corresponding improvement had been effected in the mechanical treatment of distortions.

The art of the surgical mechanist has advanced with steps quite equal to the forward progress of the surgeon; and at the present day it is one which demands no inconsiderable attainments and no small skill for its successful practice. We wholly agree with Mr. Bigg, when he says that—

"Not only should the mechanist be familiarly acquainted

both theoretically and practically, with the sciences of 'applied mechanics' and mathematical induction, but he should likewise be tolerably well versed in the osteology and myology of the human body; he should possess an intimate knowledge of the anatomical as well as of the superficial and external characteristics of the various malformations and distortions to which the human frame is liable; he should be well read in those standard books which especially treat on these subjects; he should possess the power of readily seizing upon and scientifically eliminating and putting into shape whatever plans the surgeon may wish to see carried out in particular cases."

By the aid of tenotomy the surgeon is now enabled to reduce the number of forces which have to be opposed by the aid of the instrument, but the most delicate and careful adjustment is needed of the mechanical forces which are intended to maintain and strengthen the part in its improved position. The surgeon needs to be ably and completely seconded by the mechanist in all practical details, but it is very necessary that he should himself possess a clear and full knowledge of the best means to be employed in every case, and have the power of pointing out all the anatomical details peculiar to the case which may seem to call for special modifications of the most approved instruments.

In this work Mr. Bigg has described, illustrated, and classified all the varieties of instruments employed by our most eminent surgeons in the treatment of deformities of the lower limbs. His experience and mechanical skill especially fitted him for the task, and it is executed in such a manner as satisfactorily to fill an important void in medical literature. A very clear and useful description is given of the most approved appliances for deformities of the toes, of the foot and ankle, of the leg, knee, and hip; their varying principles of action are explained, and their relative value carefully appreciated. We would call attention to the new theory which the author enunciates of a general centre around which the osseous structures arrange themselves in the formation of club-foot proper, or equino-varus (p. 40). It is capable of valuable application to the construction of instruments intended to remedy this deformity.

There is no other book in the range of our medical literature which conveys so much practical information as to the mechanical appliances necessary in the treatment of the deformities of the lower limbs. And we would commend this little work to the attention of all surgeons, both for the fulness, the accuracy, and the intelligence, by which it is characterized.

MEDICAL TIMES AND GAZETTE, *April 3rd*, 1858.

On the Mechanical Appliances necessary for the Treatment of Deformities. By HENRY HEATHER BIGG. Pp. 225. London, 1858.

MR. HEATHER BIGG, the well-known and ingenious anatomical mechanist has here given us a work describing the artificial contrivances suitable for the deformities of the lower limbs. Some of them are applicable in cases where tenotomy cannot be performed; others are employed as adjuncts to that operation, and all are more or less available in some of the distortions to which the leg and foot are liable. The chief deformities described are those of the toes, the different varieties of club-foot, the curved tibia, genu valgum, contracted knee, and contracted hip-joint; and for all these the forms of apparatus invented from time to time, and now in use among surgeons, are described and figured. Mr. Bigg is evidently one who desires to exalt his art, and he considers that the surgical mechanist should be a scientific and well-educated person, in order to carry on his business with success.

The failure of many former efforts to relieve deformities is attributed by him to the fact that, the mechanists were too often mere "instrument-makers," and were not well acquainted with the mechanical principles on which the human body is constructed; whereas, a competent professor of the art should be tolerably well instructed in osteology and myology, both by reading, and by witnessing dissections, in order to render intelligent assistance to the surgeon in carrying out his suggestions. Mr. Bigg himself appears to be well acquainted with the anatomy of the bones and muscles connected with the deformities he describes; and his descriptions, therefore, of the construction and uses of the various apparatus employed deserve and will command attention. His book must prove of very great value to those practitioners who wish to treat cases of deformity brought under their care without consulting any of the gentlemen who have devoted special attention to orthopædic surgery; for there can be no doubt that the great difficulty medical men have to contend with in such cases is the want of the exact instrument required to carry their wishes into effect, and this want will not be felt by those who possess Mr. Bigg's very useful little work.

MEDICAL CIRCULAR, *March 10th*, 1858.

On the Mechanical Appliances necessary for the Treatment of Deformities. Part I. *Lower Limbs.* By HENRY HEATHER BIGG.

IN this work, Mr Bigg gives the result of his extensive experience in the use of artificial appliances for the correction of deformities of the lower limbs. The plan adopted is to give an illustration of each instrument, and to explain the method of adjustment, and its mode of action. Mr. Bigg justifies his views with the opinions of the ablest writers on orthopædy. In order to facilitate the taking of plaster casts of deformities, so that a suitable instrument may be designed, Mr. Bigg has given a series of directions at the close of the volume. We consider this little work indispensable to every practical surgeon.

MORNING POST, *March 11th*, 1858.

The Treatment of Deformities. By HENRY HEATHER BIGG. John Churchill.

MR. BIGG gives in this book the result of a lengthened experience in regard to the mechanical appliances which are necessary for the treatment of deformities. He says, that no work in the English language, treating exclusively upon the various mechanisms employed in curing distortions, has yet been published, and he has prepared this volume with the view of filling up that void in medical literature. It consists, as stated in the introduction, of "a detailed description of such apparatus as are peculiarly well calculated to affect the mechanical cure of the more ordinary forms of malformity at the disposal of the medical profession. Many of them are capable of being used in cases where tenotomy is unnecessary or undesirable; others are especially constructed for the purpose of elongating contracted muscles after their tendons have been divided; almost all will be found valuable and necessary adjuncts to the treatment of some one or another of the multitudinous distortions which pass beneath the eye of most surgeons." Although the treatise is eminently practical, the author has not dealt with his subject as a mere matter of manipulative skill, but he has shown an enlarged acquaintance with the science of orthopædy, which has made such rapid strides within the last few years, and to the progress of which so many of suffering humanity have had great reason to be thankful. The

book is written in a clear and simple style, and the diagrams and illustrations are very numerous. The ingenious and skilful author has good reason to hope that his little treatise will find favour with the whole body of the medical profession.

GLOBE, AND UNITED SERVICE GAZETTE, *June*, 1858.

HUMAN DEFORMITIES.—We had the pleasure of noticing in these pages a *brochure* upon "Artificial Limbs," by Mr. Heather Bigg, of 29, Leicester-square, and we would now call attention to a more compendious work by the same gentleman upon the Deformities of the Human Frame. The importance of the treatment of this class of physical evils need not be dwelt upon; and the fact that, although they may be assisted by surgical advice, their cure cannot be encompassed without mechanical aid, is no less evident. Any patient, therefore, who peruses Mr. Bigg's volume will have a perfect knowledge of the condition of his malformation; and every surgeon, however eminent his position, or special his practice, may likewise thus obtain valuable information upon the scientific construction of every description of orthopædic mechanism. Her Majesty and Prince Albert, who take a great interest in the ingenious appliances which provide cure or relief to the suffering, have acknowledged the acceptance of copies of this work.

MORNING CHRONICLE, *February 23rd*, 1858.

On the Mechanical Appliances necessary for the Treatment of Deformities. By HENRY HEATHER BIGG. London: John Churchill.

ALTHOUGH it is but just to assign due importance to the influence exerted by the discovery and practice of "tenotomy," or, in other words, the subcutaneous division of the tendons of contracted muscles, as an agent in facilitating the successful treatment of deformities, still, it should ever be borne in mind, that very little practical benefit would have been derived from this valuable addition to surgical science had not the instruments employed in effecting the mechanical changes in various distortions been constructed with a proportionate ratio of improvement. The earlier kinds of anatomical instruments used in the treatment of distortions were, for the most part, based upon a principle of "compelling the deformed superficies

of the part under treatment to adapt itself to the shape of the instrument, which was constructed upon the lines of a well-shaped body," instead of, as is the practice of the present day, "making the apparatus coincident in shape with the malformity, and then gradually reducing the limb to a natural form, by producing such changes in the mechanical bearings, as well as the external form of the instrument, as will bring the part into a correct position."

The work of Mr. Heather Bigg has been written with the view of placing a detailed description of such apparatus as are peculiarly well calculated to effect the mechanical cure of the more ordinary forms of malformity at the disposal of the medical profession. Many of them are capable of being used in cases where tenotomy is unnecessary or undesirable; others are especially constructed for the purpose of elongating contracted muscles, after their tendons have been divided; almost all will be found valuable and necessary adjuncts to the treatment of some one or another of the multitudinous distortions which pass beneath the eye of most surgeons.

Writers on "Orthopædy" usually assert, that little or no progress was effected in the treatment of deformities for many years previous to the introduction of tenotomy; and add, that this quiescent state of the science was mainly referable to the fact of such cases having been left exclusively in the hands of surgical mechanists. Here they have fallen into a grave error, since the leading surgeons of the period referred to, used always, when treating these cases, to rely for success upon the mechanical skill and knowledge of the mechanist, combined with and directed by their own opinions concerning the anatomical and surgical desiderata of each case. Sir Astley Cooper, Messrs. Liston, Aston Key, and many others of the great ones who have passed from amongst us, may be cited as having been in the habit of personally witnessing the adaptation of such scientific appliances as were constructed in their day; with, as the author can prove by many memoranda which are in his possession, highly constant and satisfactory results. The mechanical details, however, they left to the mechanist—and very properly. The failures which occasionally occurred (are the practitioners of the present day always successful?) should not be attributed to the assumed fact, "that surgeons gave no attention to deformities;" but to a far more valid one, viz., that, in the absence of tenotomy, multitudes of cases were treated by mechanical means alone, which were far too severe to be amenable to such and such only. Although it cannot be denied, that the invention of the majority of the numerous mechanical appliances mentioned in this work must be ascribed

to the fact that the introduction of tenotomy placed the treatment of distortions more immediately within the power of modern surgery, still, it must be universally conceded, that severe distortions would never be overcome, even after the performance of tenotomy, unless they were subjected to the continued mechanical action of scientific and carefully constructed instruments.

No work has, up to the present time, been published in the English language, which can be said to treat exclusively upon the mechanisms employed in curing distortions; for each orthopædic author has given a description of the particular instruments which he himself affects and recommends, but not one has attempted to arrange, classify, and illustrate any variety of the kinds employed, for one and the same malformity, by different surgeons. A moment's reflection will show that this could not be well accomplished, save by a mechanist in large practice, and daily communication with different eminent surgeons. Mr. Heather Bigg, therefore, published the present work, in the hope of filling up this void in medical literature, and in the hope that a work of this kind may be of use to surgeons practising abroad, or in distant places.

The discoveries of Delpech, Stromeyer, &c., and the consequent introduction of tenotomy, having largely contributed to the establishment of a more scientific treatment of deformities, every surgeon now has it in his power to adopt one or more of the numerous apparatus described in the course of this book. Much care, therefore, has been taken to ensure the favourable mention of none which have not been applied by himself, and of which he is enabled to express a fair opinion as regards their merits, mechanical, scientific, and practical.

THE LEADER, *March* 13*th*, 1858.

On the Mechanical Appliances necessary for the Treatment of Deformities is a treatise of real importance to the medical profession, by Mr. Henry Heather Bigg, anatomical mechanist. It is published by Mr. Churchill.

ILLUSTRATED INVENTOR, *February* 20, 1858.

BIGG ON DEFORMITIES.—It is a characteristic feature of the "Illustrated Inventor" that the description of *inventions*, especially such as bear a relation to the *necessities* of human

life, is considered of paramount importance. We, therefore, gladly devote a portion of our columns to the remarkable work which has passed into our hands from the teeming press of the great medical publisher, distinguished as it unquestionably is for perspicuity, fertility of inventive power, originality, and last, though not least in this book-making age, for the immense quantity of matter which has been compressed into a small compass. Mr. Bigg is already widely and favourably known, both to the medical profession and the general public, for his talent and experience as a constructor of scientific anatomical appliances, but the work before us proves clearly that he is possessed of scientific attainments of no common order. We are pleased with the terseness and fluency of his writings, and the modest and gentlemanly manner in which his opinions are advanced. He has successfully shown that he is worthy of occupying a high social and scientific rank; for in describing the necessary qualifications for becoming a good mechanist, he raises the educational standard of that profession; for instance, in the following passage, he says:—

"A distortion, whether congenital or not, is *now*, for the most part, easily and rapidly removed; surgeons no longer having any reason to dread the application of mechanical contrivances 'lest the patient should suffer in health!' With improved scientific resources infinitely greater successes have been obtained, and the consequent increase of practice in this department of surgery imperatively demands that the construction of the manifold contrivances required for the reduction of these malformities should be entrusted to individuals of far higher scientific attainments than the majority of the anatomical instrument makers have hitherto possessed. To devise such appliances with a due regard to the exigencies of each individual case is a matter of no ordinary importance and difficulty. Not only should the mechanist be familiarly acquainted, both theoretically and practically, with the sciences of 'Applied Mechanics' and 'Mathematical Induction,' but he should likewise be tolerably well versed in the osteology and myology of the human body; he should possess an intimate knowledge of the anatomical as well as of the superficial and external characteristics of the various malformations and distortions to which the frame of man is liable; he should be well read in those standard works which specially treat upon these subjects; he should possess the power of readily seizing upon, and scientifically eliminating and putting into shape whatever plans the surgeon may wish to see carried out in particular cases. In short, he should be well educated, and possessed of at least average ability."

"But it is very different as regards the ordinary run of 'instrument makers.' In their case orthopædic science too frequently becomes degraded into a mere matter of manipulatory skill. It is true that one workman may be better than another, but this is simply the result of practice, grafted upon a more delicate tactile sense than is possessed by the majority of his fellows. Here, science lies dormant, the whole affair is mechanical, *and mechanical only*. There is a total absence of the two great postulates of all the real science—knowledge and thought."

Mr. Bigg seems, why we confess we cannot see, somewhat fearful lest surgeons should fancy that he is trenching upon their prerogatives, but we believe that any one reading the following passage will at once acquit him on this charge:—

"When I commenced my labours I did so with a full knowledge of their importance as regards my own future career and reputation. I was well aware that my position would be greatly perilled by any misapprehension which might be excited in the medical world concerning my motives for endeavouring to place a detailed description of the most approved orthopædic appliances at their disposal; some might imagine that I wished to interfere with the position which is filled by those medical men who have especially studied this department of surgery, others that I impertinently obtruded my personal opinions upon the profession at large. Nevertheless, when I reflected on the advantages which would be derived on all sides by a more generally diffused information concerning the subject upon which the work professes to treat, I felt that none but the malevolent could affect to mistake my motives, and that I should in all probability gain the goodwill of those whose approbation I most covet."

Where so rich a pasture is spread before the critic, he is, like the ass between two thistles, perplexed as to which he shall choose: perhaps the most scientific instrument described by him is that of his own invention, which he has named the "Orthopede," intended for the cure of every kind of club-foot; we, therefore, give his description of it as our last extract:—

"It consists of a metal stem, furnished, at the point which I have just laid down as being the common centre of movement, with a rack and pinion joint, coincident in its plane with a line drawn from the great-toe joint of the deformity to the point which this articulation would occupy in the normal limb. The lower extremity of the leg-stem bears a padded metal plate, which embraces the metatarsus, and gives the mechanism control over the entire foot. Its upper extremity ends in calf and thigh bands, which secure the instrument firmly to the leg,

while at the same time they afford a *point d'appui* for the action of the lower portion of it.

"Upon moving the rack and pinion centre the foot becomes gradually unfolded, and the necessity of dividing the mechanical treatment into two heads is thus done away with.

"As the theory upon which this instrument acts is quite novel, I propose naming it the 'Orthopede,' and trust that the principles of its operation may be found worthy of attention at the hands of the scientific reader, since it certainly lessens many of the mechanical difficulties met with in the treatment of equinovarus."

The book is illustrated with numerous spirited woodcuts and a capital glossary. Indeed, in spite of the nature of the subject, the book is so well written that it may be read with positive pleasure. We part from Mr. Bigg with regret, and regarding this portion as an earnest of that which is to come, look forward to the remaining portion of his work with much interest, especially if it is to be as wonderfully cheap as that which has already appeared.

BELL'S LIFE, *March 14th*, 1858.

Bigg on Deformities and their Treatment by Mechanical Appliances. Part I. *The Lower Limb.* (John Churchill, London.)

VETERINARY surgeons may take many a valuable wrinkle from Mr. Bigg's varied and ingenious contrivances for mending a stringhalt, or kick in the gait of the *genus homo*. We are quite sure that scores of horses are pronounced useless which might be perfectly cured by a greater exhibition of "nous" on the part of the "vet." It is very lucky for suffering humanity, that men like Mr. Bigg are content to spend their days in endeavouring to alleviate the sufferings of others. The learned author condescends to enter even into the cause and treatment of bunion, among other more serious distortions of the foot, showing clearly how fair ladies get their pretty little extremities spoiled. The Regent-street "swells" we don't pity.—"It is a matter of much regret that shoemakers cannot be induced to comprehend the necessity of so constructing their boots, that a straight line may be drawn from the great toe to the heel, and also that the tread, or distance allowed for the lateral play of the joints, is not made broader than at present. The boots would not lose in elegance, whilst the natural requisitions of the foot would be better cared for than at present.

Another great evil which tends to produce bunions is the adoption of an absurdly high heel for ladies' boots; the mechanical consequence of this being, that the plane of the foot no longer maintains its normal horizontal position, but is rendered oblique; while the gravital line of the body, ceasing to pass through the centre of the foot, falls with unnatural and injurious force upon the phalangeal extremities, tending in this way to spread, and consequently weaken, their ligamentous attachments to the bone of the instep (metatarsus), and as has already been stated, disposing the articulation in such a manner as to excite the formation of a bunion in due time."

La Presse, 28*th Février*, 1858.

Nous venons de lire avec le plus grand intérêt un des plus habiles livres du jour; il est intitulé *Bigg sur les Difformités.* Cet ouvrage, qui démontre clairement la guérison de toutes les difformités de l'espèce humaine, même celles de l'enfant nouvellement né, est illustré par Mr. Bigg lui-même, et indique par des diagrammes bien dessinés tous les appareils nécessaires pour rendre aux membres recourbés leur forme naturelle; c'est surtout dans la guérison des recourbures de l'épine dorsale et du pied-bot que Mr. Bigg a montré un talent à la fois original et savant. Quand nous disons que sa Majesté la Reine Victoria a nommé Mr. Bigg son ingénieur anatomique, cela prouve que la première personne du royaume a su apprécier son talent.

LONDON: REED AND PARDON, PRINTERS, PATERNOSTER-ROW.