AN ANATOMIC EXPLANATION OF MANY OF THE CASES OF WEAK OR PAINFUL BACKS, AS WELL AS OF MANY OF THE LEG PARALYSES.

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In the two articles which have been published by the writer upon the sacro iliac joints,¹ and in the article upon the lumbo sacral joint,² as well as the articles upon hypertrophic arthritis of the spine³ and the rheumatoid diseases, mention has been made of conditions which frequently lead to pain or weakness referred to the back, as well as at times to much pain, numbness, or complete paralysis of the legs and buttocks.

The justification for the present communication lies in the fact that with a larger experience and a greater understanding of the anatomic formation of the body, not only is it evident that these conditions exist, but that some of the peculiarities which have been described in these articles are much more common than was originally supposed, and that the combination of some of these conditions explains symptoms which had formerly not been understood and consequently made relief difficult or uncertain. It is the hope that this communication may serve to explain some of the features not before understood, and also to correlate the knowledge contained in these previously mentioned papers, so that the confusion which may result from the treatment of a single feature without its commonly associated other features, may be removed.

PELVIC JOINT OR SACRO ILIAC LESIONS.

That disease, strain, or weakness of the joints of the pelvic girdle, with at times displacement of the bones, especially at the sacro iliac juncture, takes place, there can be no question. (Figs. 1 and 2.) That such conditions are common, the knowledge of the anatomic formation of the part should make understandable. The flat surfaces of the articulation with their vertical or oblique axes show that there can be but little support from the bones themselves, and that their stability must depend upon the soft structures, the muscles and ligaments. Of these, the muscles are, of course, of chief importance, since without their aid the ligaments cannot for long retain their tone.

That patients can usually be relieved by supports, such as belts, straps, braces, and exercises, in case the bones are not misplaced, there is also no question. That this same class, in case the bones are misplaced, find relief after the bones have been replaced by belts, straps, braces, and exercises, is equally certain. There are a certain number of these cases, however, which have not

been relieved by such methods of treatment, and the reason for this has not been understood until recently. In the study of the proper relationship of the parts as affected by good and bad poise,⁴ a better understanding of the function of the pelvic joints, together with the appreciation that their stability is almost wholly dependent upon the tone of the muscles (which can only be maintained by proper poise), has made it possible many times to correct postures of strain and to restore muscle balance so that normal instead of harmful function could result. Even with this knowledge, however, certain cases of backache in which undoubted sacro iliac strain existed were formerly not satisfactorily relieved. With an understanding of the lumbo sacral joint with its many peculiarities and the frequent resulting unnatural strain to the sacro iliac joints, many of the cases of sacro iliac disturbance not controlled by the usual treatment become understandable, and since the lumbo sacral joint is so much concerned with the sacro iliac joint function, its special peculiarities must be considered at this time.

LUMBO SACRAL ARTICULATION.

Transverse Processes.—In the article entitled, "The Lumbo-Sacral Articulation. An Explanation of Many Cases of Lumbago, Sciatica, and Paraplegia,"⁵ attention was called to the fact that at times the transverse processes upon the last lumbar vertebra are broader than normal, and that occasionally they are articulated with the top of the sacrum. It was appreciated at that time that this peculiarity might lead to strain or undue leverage upon the lumbo sacral joint, but it was not appreciated at that time the extent to which this leverage might strain or injure the sacro iliac joint, nor was it appreciated that many times the transverse processes of the last lumbar vertebra are so long and broad that they not only articulate with or press against the top of the sacrum, but that they also press against or articulate with the wing of the ilium, with resulting weakness of the sacro iliac point. It is by appreciating this that the confused symptoms of lumbo sacral and sacro iliac joint lesions can be understood.

In that article the fact that these peculiarities in the form of the last lumbar transverse process exist was mentioned, but the great frequency of such formation was not at that time appreciated. In the further study of a considerable number of patients and a large number of spines the variation in the shape and size of these parts is shown to be so great as to be a matter of much surprise.

The variation from the normal (Fig. 3) is not only very common, but the special peculiarity of shape of the processes also varies. It may simply be somewhat larger in all its dimensions (Fig. 4) and be of little importance except

¹ BOSTON MED. AND SURG. JOUR., May 25 and June 1, 1905. Journal A. M. A., August 31, 1907. Goldthwait and Osgood.

² BOSTON MED. AND SURG. JOUR., March 16, 1911.

³ BOSTON MED. AND SURG. JOUR., Dec. 26, 1895; Aug. 10, 1899; March 20, 1902.

⁴ BOSTON MED. AND SURG. JOUR., Dec. 9, 1909.

⁵ BOSTON MED. AND SURG. JOUR., March 16, 1911.

Fig. 1—Note the twist in the whole pelvis, the separation of the ilium from the sacrum on the right side, with the marked elevation of the ilium on that side. Marked inclination of the spine as the result of tip of the sacrum.

Fig. 2—The marked distortion in the shape of the pelvis, the separation between the sacrum and ilium upon the right side, with the elevation of the ilium upon that side; the spine of the ischium on the right side showing inside the pelvic line much more conspicuously than on the left.

Fig. 3—Practically normal spine with slender transverse processes. A female pelvis.

Fig. 4—Short, thick transverse processes on the last lumbar vertebra, the sacrum set well between the wings of the ilia. A crescentic-shaped articular process on the left side (a.) between the fourth and fifth vertebrae, and a flat articular process on the right side (b.) at the same level.

Fig. 5

Fig. 8—A lumbo sacral transverse articulation on the left side with a short thick transverse process on the right, with undoubtedly a bursa between the sacrum and process upon that side. The articular processes at the lumbo sacral and between the fourth and fifth lumbar of the flat type, the crescentic type showing in the articulations above.

Fig. 6

Fig. 7—Showing the articular surface upon the top of the sacrum at the sides with which the transverse process of the vertebra above articulated.

Fig. 9—The lumbo-sacral transverse articulation upon the right side; also an articulation of the tip of the transverse process with the wing of the ilium. Note the hypertrophic arthritic deposit just below the angle of the transverse process as the result of continued strain.

Fig. 10—Another view of same pelvis as Fig. 9, showing the articulation of the transverse process with the ilium more perfectly.

Fig. 12—The complete fusion of the last lumbar vertebra with the sacrum. The articular processes are of the crescentic type, except, possibly, the one on the right at the junction of the sacrum with the spine.

Fig. 11—Fusion of the transverse process of the last lumbar vertebra with the sacrum on the left side, with the forked and broad transverse process on the left in the vertebra above, with a short, broad, non-fused transverse process on the last lumbar vertebra on the right side, with a long, slender transverse process on the right side of the vertebra above. The ilium on the left side is larger than on the right. The articular processes are of the flat type in all the joints shown.

Fig. 13—The broad, fin-shaped transverse process on the last lumbar vertebra, with a similar type, less marked, in the vertebra above. The flat articular processes at both the lumbo sacral and the articulation between the fourth and fifth vertebrae, with the crescentic articulations above.

Fig. 14—Partial fusion of the last lumbar vertebra with the sacrum. Complete fusion of the sacrum with the ilium, with fusion of the transverse process of the last lumbar vertebra with the crest of the ilium.

Fig. 17—Showing the crescentic type of articular process upon the right side, the flat type upon the left.

Fig. 15—Showing the crescentic type of articular process.

Fig. 16—Showing the flat type of articular process.

Fig. 18—The short thick transverse processes on the last lumbar vertebra, with the flat articular processes on the right side (a.) of the lumbosacral joint, the joint between the fourth and fifth vertebrae, and between the third and fourth vertebrae, the crescentic articulation showing in all the articulations on the left side.

as the body is bent to the side, at which times the process impinges against the top of the sacrum much more easily than normal, and if carried far enough serves as the fulcrum for straining the lumbo sacral joint. It may be still larger, but evenly and bilaterally enlarged, so that not only does the process impinge against the top of the sacrum in side bending, but in drooping the body (Fig. 5) the increased lordosis results in the crowding of the processes against the top of the sacrum. In such posture, since the transverse and articular processes are behind the body of the vertebra, the weight of the individual must, to a greater or less extent, be taken off the body of the vertebra and thrown upon the transverse processes and the tip of the articular processes. With the transverse process, if this is long continued, a bursa forms between the tip of the process and the sacrum, and when once developed is capable of all of the phenomena of inflammation with resulting symptoms, as exists in bursae in any other part of the body. In Fig. 6 when freshly dissected a complete bursa existed at this point on both sides. This was exhibited as a wet specimen at the meeting of our association held in Cincinnati last year.

LUMBO SACRAL TRANSVERSE ARTICULATION.

Not only are these types common, but it is also a common thing to have the peculiar formation carried further and a true articulation exist between the tip of the transverse process and the top of the sacrum. This articulation is so frequent and is so distinct that it must be reckoned with in the treatment of joint conditions, and the name "*lumbo sacral transverse articulation*" was given to it by the late Professor Thomas Dwight, this representing one of the last things of an anatomic nature performed by him before his death.

The lumbo sacral transverse articulation may exist upon both sides (Fig. 7) or upon only one (Fig. 8), but if it exists upon both sides the two sides are rarely the same, one side being usually larger than the other. In Fig. 8 the articulation exists upon one side, while a bursa was present between the tip of the transverse process and the top of the sacrum upon the other side.

In Figs. 9 and 10 not only is the articulation between the transverse process and the sacrum evident, but the articulation of the tip of the process with the ilium is shown, and the evidence of the resulting continued strain upon the sacro iliac joint which such a mechanical formation would represent is shown by the hypertrophic arthritic process which has formed in the anterior ligament of the sacro iliac joint upon that side. Even where the true lumbo sacral transverse articulation does not exist, but where simply the bursa is present the increased strain of the sacro iliac joints which, with the necessary

limitation of the low spinal motions, must result, is at least suggested by a similar hypertrophic arthritic change in the anterior ligament of the sacro iliac joint in Fig. 6.

The next stage of anatomic peculiarity of the transverse process at the lumbo sacral junction apparently represents the fusion of the transverse process with the sacrum. This may exist only upon one side (Fig. 11), or may represent a complete fusion of the bones (Fig. 12), and the part which represents the upper part of this fusion may be the upper sacral vertebra, which has been partially lumbarized, or the last lumbar vertebra, which has become sacralized. This special feature has been admirably described by Böhm. (Stuttgart, 1907. F. Enke.)

In the broadening of the transverse process the development seems to follow definitely the direction of the lumbo sacral ligament or the ilio lumbar ligament or both. The result of this is shown in the common formation of these peculiar processes resembling in outline the tail fin of the fish (Figs. 13 and 8 and 3). In the hypertrophic arthritis which frequently leads to the fusion of these bones, as well as of the sacro iliac joints (Fig. 14), the osseous deposit takes place first along these ligaments.

In the consideration of the relations of the transverse process of the last lumbar vertebra it should be remembered that at times the wings of the ilia are so high or the sacrum is placed so low that the transverse process next above the last may also press against the ilium in lateral motion, with resulting symptoms, and not only this but the formation may be such that the processes of the two vertebrae may be involved upon one side, while only one may be involved upon the other (Fig. 11).

ARTICULAR PROCESSES.

That which has thus far been said in regard to the lumbo sacral articulations has had to do chiefly with the transverse processes, but in any consideration of this region the formation of and effect of motion or posture upon the articular processes is of much importance. If, for instance, the body is drooped so that there is an increase of the lumbar curve, the weight is received in part upon the tip of the articular processes, with the effect that if long continued a new articular facet at the top of the articular process of the lower bone is formed, while at the base of this process, in the curve where the articular process joins the lamina, a new articular surface forms as the result of the articular process of the vertebra above being crowded downward on to this point. Such a facet may naturally form, not simply at the lumbo sacral joint, but in any of the lumbar articulations, since in the lordosis which is peculiar to such posture the pressure is relieved from the anterior part of the spine, the vertebral bodies, and is thrown upon the posterior parts. Such a new

articular facet is shown in the specimens which are passed about.

With the understanding of such conditions, the variation in the shape of the articular processes, as was mentioned in the previous article upon "The Lumbo Sacral Articulation," must be remembered. With the later study not only have these variations been confirmed, but the crescentic type (Fig. 15) and the flat type (Fig. 16) with the blending of the two, one side showing the crescentic form, while the other side shows the flat type (Fig. 17), are not only shown to exist at the lumbo sacral junction, but also at the vertebral articulations higher up (Figs. 18, 4, 8, and 13). The effect which such peculiarity of formation must have upon the stability or the motions of the spine must be readily apparent. With the one sided crescentic articulation, naturally, in bending to that side the stability of the opposite joint being less, is naturally easily strained. Also with such differences in the formation of the articular processes it is readily apparent that, if at the same time the transverse processes are broad, in side bending the lumbo sacral joint must be less stable, so that strain of this joint, especially in bending to the side of the crescentic articulation, is much more easily produced than normal. The localized painful points along the sides of the lumbar spine with the irregular limitation of motion is often to be explained by this.

The significance which such anatomic features must have in the production of symptoms and in connection with treatment and prognosis must be apparent.

PAIN, NUMBNESS, OR PARALYSIS IN THE LEG.

Of the local symptoms little need be said in such a gathering as this except to call attention to the anatomic features which easily explain many of the points of local tenderness as well as the irregular or peculiar limitations in the spinal motions. The referred symptoms, however, may not be so obvious, and are briefly considered. That complete paraplegia involving not only the legs but the bladder and bowel may occur as the result of strain or displacement of the last vertebra upon the sacrum or as the result of the dislocation backward of the intervertebral disc, there is no question, as this has been fully demonstrated in the study of several cases. This was so fully described in the previous article upon the lumbo sacral articulation that further statement at this time is not necessary. Less extreme conditions of paralysis or disturbance of sensation in the leg are, of course, much more common and find their explanation in the anatomic formation described above. With the increased width of the transverse processes or with the crowding of the articular processes together, the space in which the nerve root leaves the spine or the space, in which the lumbo sacral cord lies as it passes under the transverse process and over the sacrum to join the sacral

plexus, must be narrowed. This at times is enough to simply irritate the nerve, causing pain referred to the leg at the distribution of the nerve, while at other times the constriction is enough to cause paralysis or numbness through this same distribution. Naturally the muscles supplied by other nerves are not involved in such cases. That this condition of paralysis is not rare shown by the fact that since this condition has been understood, several cases of localized paralysis of the thigh and buttock have been seen, with relief brought about by changing the poise so that the compression of the nerve could not take place. With such general and anatomic knowledge it is usually possible to determine, especially if the x-ray is used, the anatomic diagnosis.

TREATMENT.

It is not the purpose of this paper to enter extensively into all that is concerned in treatment, since that was not the intent of the paper, and since once the anatomic conditions are appreciated the principles of treatment would be apparent to men trained as are the members of this Association. Nothing more is attempted here than to emphasize a few special points which might not at first be thought to be apparent.

With the simple sacro iliac strains or displacements there is no need of repeating what has already been written, but if the sacro iliac joint is involved as part of a lumbo sacral malformation it is obvious that treatment directed to the sacro iliac joint alone will not bring relief. In such a case not only must the sacro iliac joint be supported, but at the same time the body must be so poised that there is the least possible irritation at the lumbo sacral joint, as well as the least possible pressure of the transverse process against the sacrum and ilium. To relieve this pressure of the transverse process, since it is increased by drooping the body and increasing the normal lordosis, it will be lessened by anything that holds the body fully erect or which flattens the back. For this reason pain in the lumbo sacral or lumbo sacral transverse articulation is usually relieved by simple recumbency upon the back, although a sacro iliac joint pain may be increased by this same position.

If the condition is purely a lumbo sacral lesion, naturally the most important element in the treatment consists in so changing the poise of the body that there will be the least unnatural pressure at the joint. Usually the anatomic peculiarity, if present, has existed since birth, and the symptoms have come on late in life simply because of undesirable postures, which have been acquired. Recognizing this, it is usually possible to relieve the symptoms, although the potential of trouble remains, to become active again in case of accident or careless habits of carriage. With the sacro iliac joint lesions naturally the elements of poise are equally import-

ant, but unless other elements are present the permanence of the improvement is more certain.

In such a paper the pathologic conditions which many times are responsible for backache are not considered, since there is little new for the writer to add to that which has already been written upon these features. The anatomic elements had not, however, to his knowledge, been fully described before and hence their mention here seemed justified.

My indebtedness is here expressed to Dr. Percy Brown for his skill in securing the radiographs here presented.

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THIRTY-EIGHTH ANNUAL MEETING, HELD AT BOSTON, MASS., MAY 30 TO JUNE 1, 1912.

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TABES DORSALIS: THE EXHAUSTION THEORY OF ITS PATHOGENESIS WITH EXPERIMENTAL EVIDENCE.

DR. COLIN K. RUSSEL, Montreal, Canada: The pathogenesis of tabes dorsalis is admittedly unsatisfactory. In tabes there is probably a slowly acting toxine which influences cell metabolism in a deleterious manner so that the building-up process is relatively insufficient and the cell becomes exhausted. The cells which are most constantly active, and which we would expect to be affected first, are those cells which maintain the tone and position of the muscles, especially those muscles which are most frequently called into activity. The distal parts of the neurone wither or atrophy and thus the peculiar anatomical-pathological condition of the fibres in the posterior columns may be accounted for. The practical absence of any lesion in the posterior ganglia is also explicable. The reaction of the pupils to light, being far more frequent and active than that to accommodation, produces an exhaustion of the neurones subserving that function giving rise to the well-known Argyll-Robertson pupil. Clinically this theory explains also the fact that men are more frequently affected than women and why the natives of tropical countries are practically immune to the disease. The lightning and girdle pains are probably due to a definite syphilitic process in the spinal meninges as is shown among other things by their alleviation after salvarsan treatment. Following up this theory the writer has been able to produce the Argyll-Robertson pupil in rabbits which had first been inoculated with the spirochaeta pallida, by subjecting them to alternating light and darkness, by means of a miniature revolving light house. Control rabbits which had not been inoculated did not develop any abnormality of the pupil although placed under the same conditions, and rabbits which had been inoculated but had not been subjected to the light stimulation also remained normal.

DISCUSSION.

DR. B. SACHS, New York: I have tried ever since Edinger first formulated his theory to reconcile the facts with the theories or the theories with the facts,

but cannot say that I have adopted the theory as anything more than an interesting theory. It has not proved particularly helpful in the explanation of the morbid processes. It seems easy enough to explain a number of the morbid symptoms on the basis of the theory, but, on the other hand, there are a number of cases that we all see in which just the opposite course occurs to what one would expect if the theory were true.

DR. JOSEPH COLLINS, New York: I am in a position today to say that a case has come under my observation in which the Argyll-Robertson pupil existed according to the opinion of three competent trained neurologists and that it disappeared after active salvarsan therapy. If Dr. Russel's very ingenious explanation, or rather his explanation of the Argyll-Robertson pupil based on this ingenious experiment which he has carried out, is true, and I see no reason why it should not be considered to be so, then it is likely that and the other cardinal symptoms of the disease may be relieved if attacked sufficiently early by appropriate therapy. These observations support the contention that tabes is in reality a meningitis which is an expression of a syphilosis.

DR. HUGH T. PATRICK, Chicago, Ill.: I have not been able to find facts in my practice to support Edinger's theory. On the contrary, I have been inclined to think that such patients as pursue an occupation making a particularly strong call upon one set of extremities are apt to suffer in that side less. I have in mind a painter of pictures, who was and always has been, very sluggish in regard to general exercise, who became exceedingly ataxic in his legs, but painted his pictures exceedingly well.

DR. F. W. LANGDON, Cincinnati, O.: Dr. Russel has given an extremely valuable contribution to what we might term rational pathology of tabes. Some 15 years ago in a paper upon this subject I alluded quite emphatically to the biological reason for the preponderance of tabes in the lower extremities in man. Man has for a comparatively few generations been walking on his hind legs, so to speak, and these are the neurones, as Dr. Russel has pointed out, that have no rest. The muscle sense is continually acting even in the sitting position and more so in standing. Some years later, when Edinger's exhaustion theory was promulgated, I called attention to not only the upright position as putting this constant strain, but also the enormous demand on sensory light reflex of the pupil.

DR. RUSSEL, in closing: I have found a great many patients who have not done well on the Fraenkel treatment. In these cases it has practically always turned out that in their enthusiasm to get well they have overstepped the limit and done too much and they have exhausted themselves rather than reeducated themselves. The only way to prevent this is to take the pulse as an indication as to when the patient is becoming exhausted. In every case that I have had experience with where this has been done the patients have become re-educated.

SOME ATYPICAL FORMS OF TABES AND PARESIS CONSIDERED IN THE LIGHT OF SERODIAGNOSIS.

DR. C. EUGENE RIGGS, St. Paul, Minn.: I report four irregular cases of tabes and one of general paralysis. In none of these were the classical, clinical symptoms of tabes or paresis present. Kneejerks and Argyll-Robertson phenomenon were wanting in all the tabetics. Lightning pains present in two; lymphocytosis in only two cases. The blood