OBSERVATIONS
ON THE
CONDITION
OF THE
BONES IN RICKETS,
WITH
AN ACCOUNT
OF
SOME CIRCUMSTANCES NOT BEFORE NOTICED
RELATING TO THE
PROCESSES OF RESTORATION
WHICH TAKE PLACE IN THEM;
By **EDWARD STANLEY, Esq.**
ASSISTANT SURGEON TO SAINT BARTHOLOMEW'S HOSPITAL.

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HAVING had an opportunity of examining the internal structure of the bones, from a subject affected with rickets, I became desirous to understand how the soft ricketty bone, which presents an almost uniform structure throughout, being without any distinction into solid walls and medullary cavity, becomes changed into the condition in which it will be found, when upon the res-

toration of healthy actions it has acquired strength and power of resistance. And as in the latter part of this investigation, some circumstances were noticed, which as far as I can ascertain have not been before mentioned, I therefore thought their communication might not be uninteresting to this Society.

It is well known that ricketty bones, from their generally softened condition, yield in whatever direction they may be determined, either by the weight and pressure of the body, or by muscular contraction; thus the bones of the upper extremity become occasionally bent from muscular action alone, and from the preponderance of power in the flexor muscles, they acquire a direction forwards. The femur has its concavity backwards in consequence of the weight of the body tending to augment the natural curvature of the bone in that direction, the flexor muscles also contributing to the same effect. The tibia and fibula frequently become curved in the same direction as the femur; occasionally however, these bones yield laterally and inwards. A curious circumstance is also to be noticed with respect to the tibia and fibula: when they become curved, they will sometimes acquire increased breadth in the direction of the curve, losing a proportionate degree of thickness in the opposite direction; hence the bones become as it were newly modelled, passing from the cylindrical into the flattened form; this would seem to be de-

signed for the purpose of enabling them to support more efficiently the weight of the body, since by this alteration, they acquire increased breadth and power of resistance in that direction where the greatest strength is required. I have never noticed any expansion in the articular ends of rickety bones, as is mentioned by some authors. I should therefore feel inclined to believe that there has existed only the appearance of such a phenomenon, the ends of the bones having appeared swollen in consequence of the emaciation of the surrounding soft parts.

Very few observations have been made respecting rickety bones, during the continuance of their soft state, or state of disease, and none at all (as far as I am informed) respecting the process by which they resume their solid and healthy condition. Lèveillé has given an account of the structure of a soft rickety bone with a representation of its curved figure. It is described as having been exceedingly light, yielding with facility to the scalpel, and presenting throughout a cellular and spongy texture *. Bichat thus remarks concerning the condition of the bones in rickets. "In this disease the solid structure forming the walls of a long bone entirely disappears, the whole interior of the bone presents a homogeneous appearance, and cellular texture throughout; the periosteum is also

* Mémoires de Physiologie et de Chirurgie pratique par Scarpa et Lèveillé.

thickened *.” The several bones which I have examined, exhibited nearly the same structure as that here described by Lveill and Bichat, excepting that the periosteum was not thickened as is mentioned by the latter. The consistence of the bones was nearly that of common cartilage, they presented throughout an areolated texture, and the cells were in some parts large, and contained a brownish gelatinous substance.

Such is the state of the soft rickety bone, that is to say, of the bone, during the continuance of the diseased action which constitutes rickets ; but to this there must necessarily succeed some process of restoration, some new-modelling of its internal structure, in order to produce that distinction between the external walls and internal cavity, which it is afterwards found to acquire. From the examination of a series of rickety bones, which have undergone different degrees of curvature, and where the process of restoration has been completed, it will be seen that in the accomplishment of this end, there invariably obtains an exact relation to the circumstances of each case, with respect to the situation, extent and direction in which the earthy matter is deposited ; thus it is obvious that in the curved bone, the part where there is the greatest need of strength, to prevent its further yielding, is in the middle of its concavity, or in

* Anatomie Gnrale, Tom. III.

other words, in the line of its interior curve; and it is just in this situation that strength and compactness will be first imparted to the bone by the deposition of phosphate of lime. It will be further found that the greatest resistance being wanted at this part, the walls are accordingly rendered thicker here than elsewhere, and the degree to which this excess in thickness is carried, bears an exact ratio to the degree of curvature which the bone has undergone. An example drawn from a principle in mechanics may be here introduced: if a weight is placed upon the top of a hollow elastic cylinder curved to the degree of one, and the same weight is placed upon the top of another cylinder curved to the degree of three, in the latter case, the superincumbent weight will tend to increase the bending of the pillar with a greater force than in the former; if therefore it becomes necessary to apply in both cases a power of resistance, this ought to be so much greater in that instance where the disposition to bend is greater. It is obvious what will be the application of this principle to the strengthening of a curved rickety bone, as may be readily exemplified by examining bones that have suffered different degrees of curvature; thus according to the extent in which a bone has yielded, and the weight it has to support, the thickness and solidity of the walls in the line of the interior curve will be found greater than in any other situation; it will also be noticed that the bony fibres are arranged obliquely across the axis of the

bone, in a direction evidently calculated to augment its strength and power of resistance. Lastly, if such a bone as the tibia has become bent, perhaps into an angle, or so as to form the greater part of a circle, and at the same time it has to support a great superincumbent weight, the deposition of the bony matter may not be confined to the thickening of the walls in the concave side, but may extend across the medullary cavity, rendering the bone here perfectly solid, and thereby greatly augmenting its strength and power of resistance.

After the discovery of these circumstances with respect to ricketty bones, I next, at the suggestion of my friend Mr. Lawrence, became desirous to ascertain whether the same principle is observed in the original construction of the body of the femur, since there here exists the same necessity for greater strength and resistance in the concave side to prevent the increase of that curvature which the bone naturally possesses, as when it becomes subsequently curved from rickets: accordingly I made sections of several bones, and uniformly found the walls thicken at that part, corresponding to the situation of the *linea aspera*. Whatever other purpose may be answered by this line, its existence would therefore seem calculated to augment the strength and power of resistance in the whole bone, since, according to the developement of the external projecting ridge, the walls acquire an additional thickness. The same principle may also be noticed

in the neck of the femur, where there exists uniformly a distinction between the thickness of the walls in the upper and lower side.

Of the three drawings which I have the honour to present to the Society, the first represents the internal structure of a rickety bone in its softened and diseased state. The two others represent sections of bones differently curved, but which have now, by the restoration of healthy actions, acquired compactness of structure. In one, the deposition of bony matter is confined to the thickening of the walls on the concave side; in the other bone, a tibia which has become bent into an angle, the medullary cavity is filled by osseous matter at the part which has yielded, and the bone consequently made solid in this situation.

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