ANALYSIS
OF THE
BONES OF THE SPINE,
IN A CASE OF
MOLLITIES OSSIUM.

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ALTHOUGH it is generally understood, that in the disease called Mollities Ossium the bones are deficient in their proportion of earthy matter, yet I am not aware of any actual analysis of them that has been made. On this account I embraced an opportunity which presented itself of examining their composition, and I propose to submit to the Society the result of my experiments.

I received from Mr. Christian, of Liverpool, two of the dorsal vertebræ, with their accompanying ligaments and membranes, of an adult female, whose bones were discovered after death to be

unusually soft and flexible. On account of the extreme softness of the bone it could not be detached from the periosteum: the whole was therefore kept for some days in cold water, in order to separate the blood and other extraneous matters. One of the vertebræ was then digested for about an hour in warm water; the ligaments and membranes were now easily removed from it, and the bone itself, when dried by a moderate heat, was found to have lost a considerable portion of its weight, and to be converted into a substance of an extremely porous and delicate texture. The body of the vertebræ separated with a slight touch from the processes, and the central part of the body itself possessed so little coherence, as scarcely to permit it to retain its usual shape. The water in which the bones had been digested, as it cooled, exhibited on the surface a layer of fatty matter, and the fluid itself produced a considerable precipitate with the tincture of galls, thus proving that it contained a portion of jelly. After having been dried by a moderate heat, 50 grs. of the body of the vertebræ was exposed for two hours to a red heat, when only 13,5 grs. were left of a coarse white powder. The proportion of earthy matter in the processes was still smaller: the whole, which after desiccation weighed 106 grs., was reduced by calcination to 17 grs. A portion of this powder had four times its weight of muriatic acid added to it, mixed with an equal bulk of water, by which it was quickly dissolved with effervescence.

A portion of the bone in its entire state, was subjected to the action of diluted muriatic acid, and after being digested for ten days, it was removed, well washed in cold water, and then dried by a moderate heat, when it was found to be considerably more soft and flexible than before the experiment. The fluid in which it had been digested was copiously precipitated by ammonia. The bone was then boiled in water for half an hour ; by this operation it was entirely broken down into small flakes, while the periosteum was left entire, although diminished in bulk.

These experiments decidedly proved, that this diseased bone was very deficient in the usual proportion of earthy matter. A healthy bone, after having been calcined, retains its form and a considerable degree of hardness, and the digesting of bones in hot water does not materially affect their shape or their texture, unless they have been reduced to small pieces, or have been acted upon by a high temperature under an increased pressure.

The following method of calculation will enable us to form a rough estimate of the composition of the diseased bone. One quarter of the body of one of the vertebræ, with its investing membrane, was dried by exposure to the open air for fourteen days, and was found to weigh 52 grs. ; the membrane, when detached by boiling, weighed 19 grs., and the bone itself weighed 15,5 grs. What was

removed by boiling, amounting to 17,5 grs., must have been the jelly and oil, and of the 15,5 grs. of bone we may conclude from the effect of calcination, as stated above, that 4,05 grs. alone would consist of earthy matter. In order to ascertain how much of the jelly and oil was contained in the bone itself, and how much in the investing membrane, a portion of membrane was digested in weak muriatic acid, then well washed in cold water, and afterwards boiled for some time, by which it was reduced from 33 grs. to 19,5 grs. Hence it will appear that about 13 of the 17,5 grs. must be given to the membranous matter, leaving 4,5 grs. of jelly and oil for the bone itself. By a simple calculation we shall find that 100 parts of the bone, independent of its investing membrane, consist of

Jelly and oil	-	22,5
Earthy matter	-	20,25
Cartilage	- -	57,25
		100,00.

Although the analysis of bone has engaged the attention of some of the most eminent chemists, both in this country and in France, yet there is still a degree of doubt respecting the exact proportion of its ingredients. This is occasioned by some uncertainty as to the state of the bones previous to their examination, and also from the vague ideas, which, until very lately, were entertained concerning the different species of animal sub-

stances. When bones are analyzed, they are generally used in what is called a dry state, but it is evident that this term can only be employed in an indefinite manner, and that no degree of desiccation can remove from the bones the oil, and probably a portion of the water, that is diffused through the cells; this can only be accomplished by breaking the bone into small pieces and boiling it, and the process of boiling, at the same time that it removes the oil, will also dissolve the jelly, which probably ought to be considered rather as one of the proper constituents of the bone, than as a substance mechanically diffused through its parts. Without proper precautions there is also reason to apprehend, that the process of boiling would likewise remove part of the membranous matter. These observations apply to the first of the circumstances which I mentioned, and I have only to remark, that even MM. Fourcroy and Vauquelin, who have paid so much attention to the subject of animal analysis, make no mention of any animal substance, as entering into the composition of bone, except solid gelatine*. Making use, however, of the best data which we possess, we may conclude that human bones in their natural state, contain considerably more than half their weight of earthy matter, whereas the diseased bone in

* Ann. Chim. 47.258. Mr. Hatchett, in his valuable experiments on bone, only examined the nature of their ingredients, without attempting to ascertain their proportion.

question contained in one part one-fifth only, and in another one-eighth of its weight.

The analysis of the earthy matter of the bone was then attempted in the following manner. A portion of the calcined bone was dissolved in four times its weight of diluted muriatic acid. To this solution ammoniac was added in excess, which threw down a copious precipitate, which was collected and calcined at a red heat (*a*). The fluid had then carbonate of ammoniac added, by which a flocculent precipitate was thrown down in small quantity; this was also collected and dried (*b*). The residual fluid was lastly precipitated by muriate of barytes, and the precipitate was collected and calcined at a red heat (*c*). The precipitate from the muriatic solution by ammoniac (*a*) was boiled in potash, and after being collected and dried was again boiled in acetic acid; the residual fluid was then precipitated by carbonate of soda, and the precipitate was collected and calcined at a red heat (*d*).

Considering the precipitate by pure ammoniac (*a*) as a mixture of the phosphates of lime and magnesia, and the last precipitate (*d*) as pure magnesia, the quantity of phosphate of magnesia in the former precipitate was estimated. The second precipitate (*b*) was supposed to be carbonate of lime, and from the quantity of sulphate of barytes in the third precipitate (*c*) the quantity of

sulphate of lime in the bone was ascertained.
The respective quantities were nearly as follows :

Phosphate of lime	-	67,2
Sulphate of lime	-	28,2
Carbonate of lime	-	5,6
Phosphate of magnesia	4	

100,0

The composition of the entire bone will be as follows :

Cartilage	- - -	57,25
Jelly and oil	- - -	22,5
Phosphate of lime	-	13,6
Sulphate of lime	-	4,7
Carbonate of lime	-	1,13
Phosphate of magnesia	82	

100,00

The usual tests for iron were employed, but there was no indication of its presence.

Knotshole Bank, near Liverpool,
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