Mollities ossium : (malakosteon, osteo-malacia, osteo-sarcosis, Knochen-Erweichung, rachitismus adultorum, rickets, or softening of the bones in the adult) / by Joseph Jones.

MOLLITIES OSSIUM

(MALAKOSTEON, OSTEO-MALACIA, OSTEO-SARCOSIS, KNOCHEN-ERWEICHUNG, RACHITISMUS ADULTORUM.

RICKETS, OR SOFTENING OF THE BONES IN THE ADULT).

BY

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MOLLITIES OSSIUM.

CHAPTER I.

HISTORICAL NOTES ON MOLLITIES OSSIUM.

THE peculiar condition of the bones, known as mollities ossium, is so rarely met with in the United States, that many experienced and aged practitioners have never seen a case; but one case was recorded in the largest American Medical Journal, during a period of thirty years from its commencement, and a careful examination of several of the largest American Medical Journals has added nothing to the list of cases; and even in the annals of European medicine we can scarcely find twenty-five well-marked examples.

It is doubtful whether the ancients were acquainted with this disease; we have been unable to discover in the works of Hippocrates, Paulus Ægineta, Aretæus, and other ancient writers, any observations which could be referred to mollities ossium.

If the statements of Sachsius and Petra à Castro are to be received as applying to this disease, it was known to the Arabs, under the name of Alachad and Alzemena, and was cured by Avicenna; some of the interpreters of Avicenna, however, regard the disease which he is said to have cured, as a paralysis of the limbs, rather than a softness of the bones.

Abbon, the monk, who lived in the ninth century, relates an extraordinary instance when a very large man was reduced by it to the diminutive size of a child. Abulsedda asserts that the body of the prophet Gatteb was without bones, so that his limbs could be folded up like a garment. Hollerius is thought to be the first medical writer who made mention of mollities ossium; he recorded the observation that there was a woman in Paris whose whole body was soft and flexible, and without solid bones. (*De Morbis Internis. Rara Quædam*, No. 7, 4to. Paris, 1609.)

John Baptist Morgagni, in his *Seats and Causes of Disease*, mentions several authors, as Fernelius (1500—1558), Ruellius Jacobus

Hollerius, Gulielmus Fabricius Hildanus (1560—1634), Peter Borellus (1620—1678), Thomas Bartholin (1616—1680), and Daniel Protenius, who had recorded observations apparently referring to this disease, but it is difficult to decide the nature of the softening, whether the result of syphilis, cancer, or rickets!

The first unequivocal observation which Morgagni quotes is that of Gabrieli, who in 1688, in dissecting the bones of a matron, found them universally softened and flexible, the long bones being converted into a soft, reddish flesh, apparently without tenacious fibres. Morgagni also quotes a similar observation of Courtialis, on another woman, whose bones could be bent, and resembled fungous and soft flesh, impregnated with a bloody serum.

One of the earliest and most distinct accounts of the disease was given by Bauda, in 1665, who, in 1650, observed for ten years the progress of the disease in the case of a citizen of Sedan.

Saviard, in 1691, and Lambert, in 1700, published cases.

Morgagni describes briefly a case observed and related to him by Valsalva, about the latter part of the seventeenth century, although it was not published until 1760. This case of Valsalva was that of a woman who had completed her fiftieth year, and was attacked with a pain in the lower jaw, attended sometimes with so large a flux of blood, that it was intended to have restrained the discharge by the application of the actual cautery, if it had not ceased spontaneously. In a little time after the woman began to be troubled with pain in her bones; with which having long been afflicted, she began, as often as ever she was moved, to complain that all her bones were broken; and, indeed, those who stood by her are said to have heard a cracking in her joints at that time. To this symptom another was afterwards added, that the bones of the lower limbs began to be bent, as if they were made of wax, and to be in pain, even on the slightest motion. At length, in examining her body after death, the ossa innominata, the ossa femoris and tibiæ, and those bones that make up the arch of the cranium, were found to be flexible, just as if they were made up of pretty thick paper; on their surface they were spongy, and at the meditullium, in some places, carious. Morgagni afterwards saw these bones, for Valsalva had preserved them, and describes the oblong ones as curved into the form of an arch, and those that composed the vault of the cranium depressed into the figure of a plane.

Morgagni further records the interesting observation that all of them were of a very bad color, and small, because they could not

be cleaned internally, giving an unctuosity to the fingers in handling them.

This observation, indicating that the bones had undergone fatty degeneration, has been confirmed, as we shall see hereafter, by more recent and extensive observations. This change was similar to that described by John Hunter, in the case of mollities ossium reported by Mr. Goodwin ("the component parts of the bone were totally altered, the structure being very different from other bones, and wholly composed of a new substance, resembling a species of fatty tumor, and giving the appearance of a spongy bone deprived of its earth, and soaked in fats").

Petit, Manchart, Platner, Haller, and others have recorded observations which might be referred to this disease; and Boerhaave mentions an instance in which a man who lived with his bones in a state of softness, and not without the most severe pains, had his bones after death similar to a pultaceous substance, like that which is prepared from bones in Papin's digester.

The case published by Sylvanus Bevan in the *Transactions of the Royal Philosophical Society*, in 1743; the case of Anne Elizabeth Queriot, of Paris, called also Madame Supiot, the details of whose history were given in England by Ambrose Hosty, by M. Morand, in England, and by Mr. Bloomfield; that of Mary Hays, reported by Pringle and Gooch, and several others, will be found recorded in the following pages:—

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CHAPTER II.

CASES ILLUSTRATING THE NATURE, PROGRESS, TERMINATION, AND ANATOMICAL LESIONS OF MOLLITIES OSSIUM.

My attention was directed to this singular disease by the following case—Miss Raney Drucilla Bozel—and after comparing this case with others, we thought that it would not prove an unprofitable task to bring forward such a collection of cases as would illustrate more fully than has yet been done, the main features of the disease. Such an inductive investigation of this rare disease appeared to be more especially appropriate, as the records of its history are scattered in fragments in journals and systematic treatises.

Case I. Miss Raney Drucilla Bozel, Nashville, Tennessee, October 1, 1868; was called by Mrs. Bozel to attend her daughter, Miss Raney Drucilla Bozel, age 18, of humble parentage, who had always lived in great poverty. At the present time the patient, Miss Bozel, together with her father, mother, and younger sister occupy a small room about ten feet square in a wooden building, erected by the U.S. Government during the war, at the foot of Fort Naglie; the entire family is supported chiefly by alms, the mother's

attention being taken up principally with the care of her sick daughter, and the father being aged, feeble, and afflicted with an eruption upon the skin, and an indolent ulcer upon the back.

The father, mother, and Miss Drucilla, all present pale, cadaverous faces, resembling those who have long been subjected to the action of malaria.

Miss Drucilla was born in Bedford County, Tennessee, three miles from Shelbyville, in a healthy locality, and her mother states that she was a healthy child up to the age of five years, when they moved to Southern Illinois, and settled on an island in the river, opposite Paducah, Kentucky.

The island lay in Madison County, Illinois, between the Tennessee and Ohio Rivers, was low, and subject to overflow. The island was overflowed the year after the removal of the family, and at this time the lower part of the house was under water, and the house occupied by the family, as well as the surrounding grounds, continued damp during a considerable portion of the spring and summer; the freshet occurred in the month of May. Shortly after her removal to this low, malarious situation, Miss Drucilla, who up to this time was an active, healthy child, was seized with the *ague*, and suffered with it for *eighteen months*.

The softening of the bones commenced just after the freshet, and whilst she was suffering severely with malarial fever, and whilst the house and surrounding lands were damp, and covered with the river deposit. The bones of the leg first became painful; poultices appeared to relieve the suffering temporarily. Then the jaws were attacked, became painful, and both the upper and lower jaw upon the left side became carious, and have continued occasionally to discharge pus and small fragments of bone up to the present time. The diseased surface sometimes heals up, but breaks out again.

About three years ago the left arm began to lose its bone, and has apparently lost all the earthy matter of the humerus for the space of some five inches. The mother states that this loss of the substance of the bone was attended with great pain.

At the present time the middle portions of the humerus of the left arm have apparently disappeared, or been converted into a flexible cartilaginous mass, only about two inches of hard bone remaining at the upper humeral and lower ulnar articulations. The arm can be bent at right angles to the natural course of the humerus, and it can be twisted around its centre; and it feels in this portion like a mass of flesh. The forearm and hand of the left

side present a natural appearance. The right humerus of right arm feels rough and enlarged, and is painful to the touch. Ulna of right arm apparently of natural length, but anterior portion projecting outwards, and the hand thrown inwards. Radius apparently destroyed, or converted into soft flexible material, throughout a considerable portion of its extent.

Right thigh and leg much less affected than the left. Knee-joint of right leg much swollen, with distinct veins; ankle-joint much deformed, the fibula projecting beyond the ankle, and the lower portion of the tibia converted into soft, flexible material, shortened and diminished in size. The marks of several ulcers are visible upon the right leg.

Left leg—tibia and fibula divided or absorbed in the region of the upper third, and large masses of a hard nature—like the callus of the fractured bones in healthy individuals—have been thrown out around the extremities of the bones. Her mother states that this bone was fractured at night, whilst the patient was lying in bed, and that the fracture was attended with an audible snap. If the statement was correct, the fracture was occasioned by the action of the muscles of the thigh, after the weakening and absorption of a large portion of the shaft of the bone. The correctness of the statement is sustained by the existence of callus around the extremities of the bones.

Left foot and ankle in place and of good shape.

Patient suffers with continued pain in left side of the head; sight in left eye much impaired, and eyeballs very prominent, as if the orbits had been thickened and the soft parts pushed forward. At times the pain in the head is said to be quite intense.

Complexion sallow, with leaden, jaundiced hue, and anæmic; the complexion of this patient resembles in all respects that of one who has been long subjected to the action of the malarial poison, and whose blood, liver, and spleen have been thoroughly affected by its action.

The effect of the mollities ossium has been to arrest the growth of the patient, for although eighteen years of age, she is only three feet nine inches in length, and weighs not more than a child of four years of age. In exhibiting the case before the medical class, I took Miss Drucilla out of the carriage and carried her up stairs into the amphitheatre in my arms, with as much ease as if she had been a small child.

Intellect clear, and spirits good and cheerful; talks most intelligently and cheerfully, and although confined entirely to the bed,

and unable to do anything for herself, is a great comfort to her mother, and a general favorite with all; and her mother told me that in their great poverty and distress, and in the numerous straits which befell them, she was her main stay for advice.

The softening of the bones does not appear to have had any connection with syphilis, as the patient was perfectly healthy up to the time of the appearance of the malarial fever, at the age of five, and her younger sister, born after the family left the unhealthy island on the Ohio River, is a fine healthy girl of ten years of age, with full well-formed limbs, and rosy, healthy countenance.

The ill-health of the father appears to be due to bad diet and the irregular habits and exposure incident to great poverty.

The menstrual function has never been performed by this patient.

I conceived the indications in this case to be:—

1st. The enrichment of the blood with those salts which were wanting, and which would more especially supply the elements for the bones.

2d. The improvement of the general condition by nutritious diet and the action of alteratives.

3d. The regulation of the bowels, which had been habitually constipated or costive.

4th. The restoration, or rather the establishment of the function of menstruation.

We sought to accomplish these results by the administration of fifteen grains of a mixture of equal parts of the phosphates of iron and lime in a cup of rich, fresh milk, three times a day; by an alterative plan of treatment, consisting of iodide of iron and iodide of potassium (℞. Syrup of the iodide of iron, f℥j; Iodide of potassium, ℥ij; Syrup of ginger, f℥viij.—Mix. Teaspoonful in wineglassful of water three times a day); and by the regulation of the bowels and uterus by the pills of aloes, rhubarb, and myrrh of the United States Pharmacopœia, and the administration in liberal quantities of digestible and nutritious diet.

Under this treatment, the menstrual function was established (in the language of her mother, "she became a woman"), the general health improved, and the head symptoms were alleviated.

In the latter part of December, my residence was destroyed by fire, and having to transfer my family to Georgia, and amid a pressure of cares and labors I lost sight of this case; previous to this, the mother was in the habit of calling at my office every day

for advice and assistance, and my visits also were at regular intervals.

I was subsequently informed by her mother, that Miss Drucilla died after a brief illness, on the 1st of February, 1869. I could gather nothing more than that the illness was brief, and that both the stomach and head were deranged about the time that the menses should have appeared.

The connection of this case in its origin, with a severe and prolonged attack of malarial fever, during exposure for months to a damp unhealthy malarious atmosphere, is interesting and important.

I have elsewhere shown that the malarial poison not only destroys the blood corpuscles more rapidly than any other febrile poison, but also *diminishes the phosphates of the blood.* (*Observations on some of the Physical, Physiological, and Pathological Phenomena of Malarial Fever, Transactions of the American Medical Association,* 1859.)

Rapid destruction of the bones, as well as of the integuments and muscles, has been sometimes witnessed as one of the results of the action of malaria upon the human system, and I have elsewhere recorded such cases (*Transactions American Medical Association,* 1859); and at the present time (March, 1869), I have in my wards in the Charity Hospital a case of chronic malarial poisoning, in which one leg has been destroyed by extensive ulceration, and the other leg is threatened by large ulcers. A careful examination of the histories of these cases demonstrated that the destruction of the tissues could be referred neither to the action of mercury nor to the effects of acquired or hereditary syphilis.

It is possible that in certain stages of malarial fever, and in certain states of the human system, acids, as the phosphoric and lactic, capable of acting upon the inorganic constituents (or mineral elements of the bones, phosphate and carbonate of lime, and phosphate of magnesia), may accumulate in the blood and structures, and cause a solution and absorption of the earthy matters. By numerous analyses of the urine in malarial fever, I have shown that during the chill, and at the very commencement of the hot stage, phosphoric acid disappears almost entirely from the urine, whilst the organic acids and sulphuric acid are increased; as the hot stage progresses, and the febrile action and the heat commence to decline, there is an augmentation of the phosphoric acid; the uric acid is either increased or remains at the normal standard during the chill, disappears almost entirely during the fever, and

then increases rapidly and rises to a high figure after the subsidence of the febrile excitement, and often continues for days two, three, and even six times more abundant than in the normal state. The salts of lime contained in the urine also undergo marked variations in quantity during the different stages of malarial fever, diminishing during the chill and first stages of the fever, and increasing as the febrile excitement declines. In the first stages of the paroxysm the phosphoric acid appears to be, to a considerable extent, free, and uncombined either with the alkalies, soda and potassa, or lime; after the continuance of those changes which result in the increased formation of phosphoric acid in the nervous and muscular structures, the insoluble phosphates of the structures appear to be dissolved, and hence the accumulation of the salts of lime in the urine. On the other hand, the chloride of sodium, a highly soluble salt, increases in the earlier stages, and diminishes in the urine during the intermission or remission.

The pale, sallow, anæmic hue of this patient, together with the rapid, feeble pulse, and periodic febrile excitement, indicated profound alterations in the composition of the blood, and derangement of the nutrition of the organs and tissues.

It is not unreasonable to refer the origin of the disease in this case to the derangement of the blood and nutritive act by the presence and continued action of a specific poison, especially as this disease is known to originate most frequently amongst the ill-conditioned and ill-fed inhabitants of large manufacturing towns, and in females whose menstrual function had been deranged for long periods of time, or whose forces had been depressed by the demands made upon the nutritive elements by repeated pregnancies.

In a word, we are disposed to refer the origin of the disease in this case to constitutional derangements, rather than to a strictly local disease of the bones.

This conclusion is further sustained by the fact that a large proportion, if not all the cases of mollities ossium heretofore reported, exhibited marks of constitutional derangement, fever, wasting, and abnormal condition of the urinary secretion preceding and accompanying the local disease in the bones.

We cannot regard the osseous tissue solely from a chemical point of view; neither is it correct to regard it as a simple, uncomplicated texture. In addition to the phosphates and carbonates of lime and magnesia, which might be regarded as comparatively devoid of vitality, bone presents a complicated structure into which

the most highly vitalized and most complex tissues, as vessels and nerves, enter. The numerous cavities and canals which penetrate the fresh bones are not empty, but contain a true nutritive plasma, complex in its constitution, derived primarily from the blood circulating through the osseous tissue, and obtaining its physical and chemical elements directly from that fluid, and, in common with all the other fluids of the body, subject to physical laws of endosmosis and absorption, and to chemical changes. The investigations of Virchow, Donders, and Hope have even rendered it probable that the bone-corpuscles and their prolongations are lined by a membrane, and cannot, therefore, be viewed as simple excavations in the compact structures.

It is not unreasonable, therefore, to refer certain structural alterations of the bones to derangements of the blood, from which the nutritive fluids and plasma of the cellular spaces are derived. While an excess of earthy salts in the blood, conjoined with an increased alkalinity, may tend to the deposition of phosphates, on the other hand an increase of acid in the blood, whether received from the alimentary canal by absorption, or from the mal-assimilation of the elements of the nutritive fluids, or from some arrest or perversion in the process of secretion, would tend to the solution of the mineral constituents of the osseous system.

In the following case, reported by Sylvanus Bevan, the softening of the bones was preceded and accompanied with a frequent and copious discharge of urine, gradual wasting of the body, hectic fever, quick, feeble pulse, thirst, pains in the shoulders and limbs, and loss of appetite. After the continuance of these symptoms during the period of two years, accompanied with great emaciation, the patient was attacked with an intermittent, which appeared to alter the character and quantity of the urinary discharge, and, after the relief of the intermittent fever, the appetite returned, the breathing became freer, and the hectic fever was much lessened; but the pains in the limbs continued, and, after being confined to her bed for several months on account of the weakness and pains in her limbs, the bones of the legs became soft and pliable.

Case II.[1]—The wife of one B. S., in the year 1738, was taken with a diabetes, with the usual symptoms, viz., a frequent and

[1] An Extraordinary Case of the Bones of a Woman becoming Soft and Flexible. By Mr. Sylvanus Bevan, F. R. S. Philos. Trans., vol. xlii., 1743, No. 470, p. 488.

copious discharge of urine, a gradual wasting of the body, a hectic fever, with a quick, low pulse, thirst, great pains in her shoulders, back, and limbs, and loss of appetite. She continued thus two years, much emaciated, though using the common medicines; at which time she was attacked with an intermittent, which soon left her; after which the diabetes gradually decreased, so that in a few months she was free from that disease, but the pains in her limbs still continued. She recovered her appetite, breathed freely, and her hectic much lessened, though she had some appearance of it at times.

About eighteen months since, she had such a weakness and pains in her limbs, that it confined her to bed altogether; and in a few months the bones in her legs and arms felt somewhat soft to the touch, and were so pliable that they were bent into a curve; but for several months before her death they were as limber as a rag, and would bend any way with less difficulty than the muscular parts of a healthy person's leg without the interposition of the bones.

April 12, 1742, after a tedious illness, she died, near the age of forty, and, with the consent of her friends, a post-mortem examination was made. On raising the cutis, the membrana adiposa was found much thicker than was to be expected in a person so much emaciated; the sternum and ribs, with their cartilages, were very soft; and all the cartilaginous parts of the ribs, at their articulations, from the clavicle downwards, were doubled over each other, on the left side, about an inch. On raising the sternum, he found the lungs adhered close to the ribs for four or five inches on each side, but were more loose and flaccid than usual, and much less in size; her heart was of the common size. Upon viewing the liver, it was found to be at least a third part larger than common; the spleen was about half an inch in the longest part, and a quarter of an inch thick; the intestines were very much inflated. She had appearances of several anchyloses formed in the small joints, viz., carpal and metacarpal bones; but, on laying them open, Dr. Bevan found them only like a thin shell. The cartilaginous epiphyses of the bones were entirely dissolved, and no parts of the heads of the bones remaining but an outside not thicker than an egg-shell.

On making incisions in her legs and arms, five or six inches long, Dr. Bevan found the outer laminæ of the bones soft, and become membranous, about the thickness of the peritoneum, containing, instead of a bony substance, a fluid of the consistence of honey, when it is thick, of a reddish color, not at all disagreeable

to the smell. There was no appearance of any bones in her leg and arms, except near the joints, which were in part dissolved, and what remained were very soft and full of holes, like a honeycomb; also the bones of the head would easily give way to the pressure of the fingers. It is remarkable that those parts of the bones that are most compact and hard were first dissolved, while their heads, which are more spongy and soft, had not so entirely lost their substance.

When she was in health she was five feet high, but after her death she was but three feet seven inches in length, though all her limbs were stretched out straight, which is seventeen inches shorter than she was in health.

In the following case of Anne Elizabeth Queriot, of Paris, reported by Ambrose Hosty, the disease occurred after pregnancy, and was attended with great pain and weakness in the limbs, with an abundant white chalky sediment in the urine, which fermented strongly with acids; dead, œdematous state of the flesh; rough, scaly skin; increased heat, cough, laborious respiration and spitting of blood, and black sputa which stained the napkins, and also with a peculiar sweat, which stained all the linen that touched her skin. The attendant physician supposed that the phosphate of lime was discharged both by the skin and kidneys, and in the sputa.

Case III.[1]—Anne Elizabeth Queriot, aged 35, native of Paris, was married in the year 1746, was brought to bed in 1747, and for the first time complained of great weakness in the small of her back, loins, and thighs, and could scarcely walk. A second lying-in, a year after, removed her complaint for about six weeks; after which it returned. In the year 1749, being two months and a half with child, she was seized with a loss of blood, and miscarried. Two months after, she fell on her left side, which gave her great pain in her leg, thigh, and hip of that side, and made them swell; but there was neither fracture nor dislocation. Her pains, after some time, abated; but the weakness of her limbs continued.

She was a third time with child, which revived her former pains, and caused her pains all over her body, with a swelling as before. This confined her to her bed, yet her pregnancy terminated favor-

[1] The Case of Anne Elizabeth Queriot, of Paris, whose Bones distorted and softened. By Ambrose Hosty, M. D., of Paris. Philosophical Transactions, 1753, vol. xlviii. p. 26; Abridgment of Phil. Trans., vol. x. pp. 313–316.

ably, after which the swelling went off; but her limbs were so weak that she could not stand upon her feet.

In about six months after her last lying-in her pains returned worse than before; and about the same time an abundance of white chalky sediment appeared in her urine, and the forefinger of her right hand was observed to be distorted towards the little finger, which was the first appearance of the dissolution that ensued. Soon after, the lower extremities began to turn upwards gradually, and almost in a parallel line with her body, and continuing till, in nine months, her lower limbs were turned upwards. All the bones were affected, especially the thorax, which had lost its natural form and capacity, and she was altogether miserably distorted.

This miserable state was attended with exquisite pains, and according to the seat of them the patient used to say, "Now, such a part works." Sometimes they abated, and then she felt so sore as not to bear being touched; and during this ease from her pains, a quantity of the aforesaid sediment passed by urine, though little or none passed during her sufferings. It was quite cretaceous, and, reduced into a fine powder, fermented gently with acids. She could bear no covering but a few napkins, both from inward heat, and to avoid loading her breast. Notwithstanding her preternatural posture, the evacuations by stool and urine were regularly and easily performed. Her flesh seemed dead and œdematous, the skin rough and scaly, so that a mortification was often apprehended. She had a cough, a laborious respiration, and sometimes a spitting of blood, from the coarctation of her breast, all its bones plying inwardly. She was capable of no other motion than turning her head on both sides, stirring her left arm in the shoulder-joint only, and separating her fingers, but not bending them. She had her menses regularly till about three months before her death. She generally had a low fever, inward heat, sweats, and restlessness. Her fever ran very high in August, attended with delirious headache, raving, and subsultus tendinum. A little before her death, came on a deafness, a dimness of sight, a scalding of her eyes, and a constant dropping; violent pains in her head—in short, a great weakness in all the organs, which showed how much the head was then affected.

The distortion of her limbs went on so fast in August and September that almost every day something new was observed; especially the left foot, during that time, came down gradually near

eighteen inches from under her ear, where it lay before. It was also observed, in August, that her neck grew visibly smaller, the thorax much narrower. And then the napkins in which she spit grew black in the washing, and stained as from the mercurial ointment; though this cause was not suspected, as it could not be learned that she had ever used any mercury. In a month after he observed the same thing on all the linen that touched her skin. He got a napkin rubbed with soap, then dried, and afterwards washed. This method had almost taken off the stains, as it does those from the mercurial ointment. Her linen stained all the washing, like linen impregnated with it. These spots appeared on the linen a mixture of a cretaceous matter and grease. Since this remark was made, more of the white sediment was seen. This and the apparent nature of the stains, made him believe that it was then discharged by the spittle and the pores of the skin, and mixed with oily particles of her fluids, which had acquired a quality analogous to that of mercury, of staining all linen. Dr. Hosty was also led to think that this sediment was the earthy matter that gives the bones their solidity and hardness, which had been dissolved by the same vitiated quality of the fluids, and evacuated by the emunctories already mentioned.

After great sufferings she died the 9th of November. Her body was opened in the presence of some of the most celebrated anatomists and academicians of Paris. The operation was begun on the left tibia, cutting on the fore-part of it from below the knee to its basis. It was wonderfully altered; more or less soft in all its length; in some points entirely dissolved, and its sides not thicker than the gristle of the ear. The spongy substance of its extremities supple, yielding to the least pressure. The reticular matter was quite destroyed. The peroné was entirely dissolved in the middle, and only slight marks of its extremities remained. Instead of marrow, they found in all the bones a red, thick matter, like coagulated blood, mixed with grease. The rotula was entire, but very soft and spongy; the condyles of the femur the same. All the cartilages were found in their natural state. The head of the humerus was much diminished and flattened, its middle part very small, pliable, softened in all points, yet in some friable.

The cubit and radius suffered the same alterations with the humerus. By stretching all her limbs they laid them straight; but they soon after returned to their former curve. The phalanges of the fingers were not so much softened, but were easily cut and

bent like whalebone. The femur was rather a fleshy body than a bone; its cavity was filled with a reddish suet, instead of marrow, which accumulated in different points, and bulged out the fleshy sides. The capacity of the pelvis was much diminished; the bones that composed it were softened, thickened, and contracted. The spine kept its natural form; the vertebræ soft and supple. The sternum and all the cellular bones seemed solid, but could bend, and were easily cut. The ribs, though softened, were still friable. Some of them, towards the sternum, were doubled over each other. The clavicles seemed almost cartilaginous. The shoulder-blades were much thicker than natural, less broad, and entirely disfigured. The two protuberances called acromion and coracoides, almost joined. The skull bones were easily cut in slices, and were twice as thick as in their natural state. Both plates were joined in one, and no traces at all of a diploe. Their substance abounded with an extremely diluted serum, easily squeezed out by a gentle pressure of the fingers. The sutures almost obliterated; the bones of the basis and face shared in the calamity. The teeth hard as usual. The dura mater was incorporated with the bones. The brain not softer than ordinary; its right hemisphere was by one-third larger than the left, and hence, perhaps, the weakness of her left side, often manifested by pains, aches, defluxions, heaviness, falls on that side, and every illness which she had from her infancy, beginning in some part of it. When young, she fell on her head down two pairs of stairs. The membranes that separate the two hemispheres of the brain were much thicker than common. In fine, all her bones were so soft that the scalpel, with very little force, ran through the hardest of them, even the rocky apophysis of the ear bone, so called from its excessive hardness.

Nothing extraordinary was found in the viscera; but their size diminished by the compression, and a universal cachexy.

There could be no cause assigned of this woman's disorder, as she gave no signs plain enough to prove either a scurvy, pox, or king's-evil, either hereditary or acquired; her parents having lived healthy, the one to the age of eighty, and her mother being then alive aged sixty, and in good health. She had three children, who died of disorders common to their age; one, four years old, died of the measles.

In the following case of Mary Hays, reported by John Pringle,

the patient suffered first with chlorosis (green sickness) and suppression of the menses, and was then seized with pain universally, attended with feverish symptoms.

Case IV.—Mary Hays,[1] of Stoke-Holy-Cross, near Norwich, gave the following account, June 21, 1752: That she was born Jan. 11, 1718, and never married, nor was addicted to any kind of intemperance; that her father was unhealthy a great part of his life, but she knew not what disease he was subject to; that her mother died when she was a child, but she did not remember having ever heard of her being unhealthy; that she herself was always considered as a healthy, strong girl, till about fifteen years of age; then fell into the green sickness, and took various medicines to no purpose; that this disease, as far as she could recollect, was all she had to complain of, doing the ordinary work in a farmer's house till October, 1748. She then was seized with pain universally, attended with feverish symptoms. Thus she continued seven weeks, after which the pain was chiefly confined to her thighs and legs, but not increased by external pressure.

In September 1749, she broke her leg as she was walking from the bed to her chair, without falling down, and heard the bones snap. The fracture was properly treated, and regard had to her disposition; but the callus was generated, the bones growing flexible from the knee to the ankle in a few months, as did those of her other leg. Soon after those of her thighs were visibly affected in like manner. Both legs and thighs then became œdematous, and subject to excoriate, discharging a thin yellow ichor. The winter after breaking her leg she had symptoms of the scurvy, and bled much at the gums.

Many eminent physicians, who were of opinion that this disease of the bones might arise from acidity abounding in the blood, prescribed for her, but without effect, unless the regularity of her menstruation for the last eighteen months may be attributed to a chalybeate medicine, though medicines of that nature had no effect formerly, when she was in a condition to take exercise and regularly persisted in the use of them.

For some considerable time past she had found little alteration in her complaints in general, though her appetite and digestion were rather better, but that the difficulty of breathing, which she had

[1] A Remarkable Case of Fragility, Flexibility, and Dissolution of the Bones. By John Pringle, M. D., F. R. S. Philos. Trans., 1753, vol. xlviii. p. 297; Abridgment of Philos. Trans., vol. x. pp. 406–408.

long labored under, gradually increased, and the thorax appeared so much straitened as necessarily impeded the expansion of the lungs.

Her spine became much distorted, any motion of the vertebræ of her loins gave extreme pain, and her thighs and legs were become entirely useless, which wholly confined her to bed in a sitting posture; and the bones she rested on, having lost their solidity, were much spread. Also the ends of her fingers and thumbs, by frequent endeavors to lift herself up for ease, became very broad and flat. Then she measured but 4 feet, though before this disease came on her she was about 5½ feet high, and well shaped.

This is the best information that could be obtained from her own mouth, and what was observed in the case before and at the first mentioned time, when she readily consented to the examination of her body, etc., after death.

From that time to her death, which happened July 6th, 1753, the chief thing she complained of, and what the people about her observed, was a gradual increase of difficulty of breathing, a wasting of flesh, a cessation of her menstruation for the last four months, a tendency in her legs to mortify, which had *long been anasarcous,* and excoriated almost all over; she retaining her senses perfectly to the last moment of her life, and dying without showing the least signs of the agonies of death.

Two days after death, her limbs being first well stretched out, she was exactly measured, and found wanting of her natural stature more than 2 feet and 2 inches. Then the thorax and abdomen were opened, the sternum being entirely removed, with part of the ribs, in order to gain at once a full view of these cavities, and discover how the viscera there contained had obstructed each other in their respective functions. The heart and lungs were sound but flaccid, and much confined in their motion, to which the enormous size of the liver contributed in some measure, extending quite across the abdomen, and bearing hard against the diaphragm. The lungs did not adhere to the pleura, nor was the liver scirrhous, but faulty only in bulk. The mesentery was sound, except only one large scirrhous gland on it. The pleura extremely small. Nothing else was found observable in these cavities.

The skull was not opened to examine the brain, as intended, through want of time, the minister waiting at the church for interment, and the relatives becoming impatient; but the operators had no reason to suspect any defect there, from any previous complaint.

All her bones were more or less affected, and scarcely any would resist the knife. Those of the head, thorax, spine, and pelvis nearly to the same degree of softness. Those of the lower extremities much more dissolved than those of the upper, or of any other part. They were cut quite through their whole length without turning the edge of the knife, and much less resistance was found than firm muscular flesh would have made, being changed into a kind of parenchymatous substance, like the soft dark-colored liver, only meeting here and there with bony laminæ, thin as an egg-shell.

Those bones were most dissolved which in their natural state were most compact and contained most marrow in their cavities, and the heads of them were last dissolved.

This perhaps is the more worthy of observation, as it held good throughout, and looks as if the wonderful change they had undergone might be caused by the marrow having acquired a dissolving quality, for it was evident that the dissolution began within side, from the bony laminæ remaining here and there on the outside, and nowhere else, and the pain not being increased at first by external pressure.

The periosteum was thicker than ordinary—the cartilages rather thinner—but nowhere in a state of dissolution like the bones. The day after this examination some of the whole substance of the leg and thigh bones, that was entirely dissolved into a kind of pulp, was sent to an ingenious chemist, and by the experiments which he made he said he could discover neither acid nor alkali prevailing in it.

The disease in the following case, reported by Dr. J. W. Tenney, was preceded and accompanied by general weakness, emaciation, and copious discharges of urine, depositing an abundant light-colored sediment, and by suppression of the menses. The patient referred the origin of the disorder to exposure to a cold atmosphere and standing in snow in thin shoes after fatigue and profuse perspiration.

Case V.—Mrs. D. W., æt. 43, was the mother of five children. Her health had been but indifferent for the last fifteen months. She complained of general weakness, and especially in her lower limbs, emaciation, very copious discharges of urine depositing an abundant light-colored sediment. She had experienced some colic pains, and in walking her gait was rolling, bringing the centre of

gravity at each step directly over the limb on which the weight of the body was thrown.

Her menstrual periods had ceased for about eighteen months. The origin of her disorder she had always supposed to have been exposure to a cold atmosphere and standing in snow in thin shoes after fatigue and profuse perspiration. After that period hitting the foot, in walking, against the slightest impediment was sufficient to throw her down.

In November last, being troubled with neuralgic pains about the face and jaw, and supposing they might proceed from a decayed tooth in the under jaw, she requested that it might be extracted, but on attempting to raise the tooth with the forceps it was found necessary to desist and use rollers, as the bone seemed to bend though but slight force was used. A few days after it was found so difficult to extract the last tooth on the right side from the want of firmness in the bone and tension in the muscles that it was left in the socket. From this time the muscular strength of the patient failed fast, though her appetite remained tolerably good, and her stomach generally retained and digested her food, though it occasionally rejected all nourishment for a day or two. She became at length unable to support her weight or raise herself from the bed to which she was soon confined.

In the latter part of March her thigh-bone was found flexed at about a right angle near the centre. The patient was not sensible of it till it was accidentally discovered and supposed to be broken; but, upon bringing it into its natural position, no crepitation was perceived, and the extreme emaciation of the limb enabled us to satisfy ourselves that instead of being broken the limb was bent.

The outer limbs on examination, also, were found in the same condition, especially the long bones, which had so far lost their firmness as to be perfectly flexed from their position, which they would receive again by their elasticity.

The disease still continued its progress, the firmness of the bones diminishing till June 9th, when she expired. During this time the mental faculties remained bright, and with an unusually rapid flow of ideas; voice strong, pain not severe.

Autopsy 26 *hours after death.*—Corpse perfectly flexible; emaciation extreme; œdema of the lower limbs, and right arm, which had supervened during the last two or three days; fulness and hardness of the abdomen; thighs evidently shortened.

On cutting down upon the left femur, where the alteration of

structure had first showed itself, no fracture was found, but the bone had doubled over on itself in such a manner that without altering the general direction of the limb it had shortened it about two inches.

About two inches below the lesser trochanter, the bone formed a right angle by bending inward, producing a prominence which might have been mistaken for the greater trochanter, while the limb was covered by the integuments. The neck of the bone was also bent, approximating the head of the bone to the greater trochanter. The bone was so soft in every part as to be easily pierced by a scalpel. The cartilage covering the articulating surface was in its natural state, but much harder than the bone. On laying open the medullary cavity, the medulla was found disorganized, very much resembling coagulated blood. This cavity was much larger than common, and the osseous substance much diminished. It was so thin and devoid of earthy matter as to be easily compressed by the fingers, so as almost to obliterate the internal cavity.

The external surface of the bone was less diseased, the osseous matter remaining being principally upon the outside. This bone was entirely detached and preserved.

The bones in the other parts of the body were examined, and found more or less in the same condition. The right humerus and femur seemed equally flexible, and had not retained their shape; the bones of the legs and forearms, though retaining their shape, could evidently be bent considerably and recover their position, though, if the strain was carried beyond a certain point, the texture was broken, and it would not recover its position, though a perfect fracture would not take place.

The phalanges of the fingers, the tarsal bones, the bones of the pelvis, the cranium, could all be pierced by a scalpel. The bones of the spine were so soft that the vertebræ could be cut into or their processes cut off with more facility than if they had been cartilage. The ribs of the right side had doubled over upon themselves, in a manner similar to the femur, so as to shorten them about an inch and a half, and materially diminish the capacity of that side of the thorax.

The muscular texture of the body was materially altered. It was pale, flabby, and so destitute of fibrin that it could be easily torn; even the tendinous portions of the muscles possessed little more strength than the loose cellular tissues of the body.

This appearance, in a greater or less degree, existed through the whole muscular tissue. The heart, for instance, was flabby, and could be easily cut with the finger-nails, especially the right side. The uterus was in the same state, though not to the same degree.

The nerves retained their natural form, hardness, and strength. The brain was not examined, as no symptoms during life indicated any disease of that organ. The lungs were healthy, though the common observation that they were softer than natural might be applied to all the internal organs. The omentum had a dirty appearance, and rough, gritty feel. Coats of the stomach healthy. Kidneys healthy.[1]

It is worthy of note that in the preceding case the *muscles* were altered as well as the bones; and in this softening and perhaps *fatty degeneration* of the muscles we find additional and conclusive proof that the origin of the disease cannot be referred alone to the local changes in the bones.

If the disease was dependent upon an inflammation and alteration of the periosteum, we would not find this membrane so uniformly healthy and unaltered.

That the blood and bloodvessels are active in the changes of the bones, without any true inflammatory action, appears to be clearly shown by the fact that the wasting proceeds from within outwards, from the most vascular to the less vascular.

The following case of mollities ossium, reported by Thomas K. Chambers, M.D., is interesting, as affording a portrait at an early stage of the disease, when it has rarely been a subject for observation, and as indicating that the degeneration of the bones was preceded by that of the muscles, and that the degeneration of the two tissues was dependent upon the same crasis.

It is also worthy of note that the degeneration was least advanced in the external circumference of the bone, and perfect fat-vesicles were found in both bone and muscle.

CASE VI.[2]—The case was that of a young woman, twenty-six years of age, admitted into St. Mary's Hospital in March, 1853. She had never been able to follow any calling, on account of weak health. The principal features of the case, in the early stage, consisted in defective muscular power, the flesh of the body feeling

[1] Case of Mollities Ossium. By J. W. Tenney, M.D., of Webster, Mass. American Journal of the Medical Sciences, vol. xxvi., 1839, pp. 506–509.

[2] Lancet, March 25, 1854. Ranking's Abstract, 1854, vol. i. p. 114.

exceedingly soft and flabby, the calf hanging down flaccid and baggy. During her residence at St. Mary's Hospital the bones of the back and limbs were examined several times, without any deviation from the natural state being discovered.

Spontaneous fracture, first of one femur and afterwards of the other, occurred at St. George's Hospital, and subsequently very marked changes in the osseous structures took place. Thus, in April, 1853, the right arm became painful to the touch, and paralytic; in May the same misfortune happened to the left upper extremity; in June the pelvic arch gave way; in July the ribs on the right side fell in, and she began to suffer much from dyspnœa and cough; in August the bones of both arms were quite soft; towards the end of October the distortion of the lower parts of the trunk was so great that the feces could not be expelled. She died in November.

The bones throughout the whole system were found soft and unresisting, and a sharp instrument could be readily passed through them. A section of the tibia was of the color of muscle, and presented to the knife scarcely more resistance than brain, its shape being retained by the aid of the tough periosteum.

The microscope exhibited the bone as consisting of large fat vesicles, some containing a white, others a reddish oil. The parts next the periosteum, which felt gritty, presented, when examined under a quarter-inch glass, some islands of opaque bone, the bone-corpuscles being indistinct, and the canaliculi not to be discovered.

The addition of hydrochloric acid caused a slight disengagement of gas.

The muscular fibre presented everywhere the characteristic degeneration.

In the preceding case the muscular system, as well as the osseous, had undergone fatty degeneration.

Mr. Samuel Solly has described two interesting cases of mollities ossium, which agree in their general symptoms with those previously recorded.[1]

Case VII.—The first case described by Mr. Solly was that of a young woman, aged twenty-nine, who, having enjoyed good health in early life, began to decline at nineteen, after an attack of scarlet

[1] Medico-Chirurgical Transactions, vol. xxvii.; 2d series, vol. ix., 1844, pp. 441–455. Medico-Chirurgical Review, April, 1845, Am. ed., pp. 448–450.

fever. She suffered pains in the back, and passed urine with a whitish sediment, and her spine began to yield. The clavicle, which was fractured from a slight cause, had united again. The spine began to yield about the age of twenty-four or twenty-five; the patient began to stoop, and could not support herself in the upright position for any length of time. At this time she had paralysis of the right hand, which took place suddenly, and lasted about fourteen days.

A visit to Gravesend was proposed by her friends, but in crossing King William Street she fell down and struck her knee against the curbstone. For this accident she was admitted as an out patient at the Western Dispensary, and continued so about six months. She derived benefit from bathing the knee with salt water, and the limb was restored sufficiently to enable her to walk. After this she kept a day-school, but became nervous and desponding. Her friends remarked great difference in her manner, her disposition seemed changed from an open and amiable temper to one of restlessness and suspicion. They became fearful that she was going out of her mind. She still, however, continued to conduct her school with her usual attention and care.

In May, 1839, being exposed to damp, she had an attack of acute rheumatism, when she was placed under the care of Mr. Dutton, of York Street, Bryanstone Square.

She was confined to her bed for six weeks, but during the course of her disease she complained very much of pain over the head, but particularly at the posterior part. She was occasionally violently delirious. At the approach of convalescence, mania set in, and during its existence she attempted to commit suicide.

In August, 1839, she was removed to St. Luke's Hospital. At this period her general health was better than it had been for some time, and her appetite was good, but the catamenia had ceased for about three months. She was much deformed about the hips and shoulders, but not in her extremities.

Her mother reports that she was able to walk for about six months after her admission into the hospital. Though suffering a good deal of pain, her mind was improving, and hopes were entertained of her speedy and total recovery, when she slipped down and suffered much at the time, but there was no fracture, and the injury was considered of so slight a nature that the surgeon of the institution was not consulted about it. But from this time the mother states she was not able to stand alone; she was carried, or

pushed herself from place to place on her haunches, and, though she frequently screamed violently as if in pain, she had no fit, nor did she lose her senses. She was not unruly, nor at all maniacal, but worked with her needle in her usual quiet manner. The progress of the disease affecting the condition of the lower extremities was evidently the sole cause of her inability to walk. The head was now first observed by her mother to be enlarged, and the eyes to project, caused no doubt by the thickening of the walls of the orbits. After remaining at St. Luke's thirteen months she was discharged incurable, but not paralytic; on this point, I took care to assure myself particularly. From this hospital she went to the Marylebone Infirmary, where she remained five weeks, from thence she was removed to the Islington Infirmary, where she remained two months, but Dr. Solly was not able to gain any particulars of importance regarding her condition in those institutions. She was then sent to the Lunatic Asylum at Hoxton for six weeks, was again received into the Islington Infirmary, from whence she was sent to Hanwell on the 11th of April, 1842.

At the time she was received into this asylum, she was much emaciated and enfeebled, with loss of power in her lower extremities, and two or three months before her death the bones of the extremities were observed to lose their natural direction and become curved. Subsequently fractures took place from the slightest causes. She suffered excruciating pain during the whole time she was in the asylum, which she referred to her bones; she did not suffer from spasm of the muscles, as many of these cases do, and the urine, during the whole time she was at Hanwell, was clear and natural. Her appetite was good, and all the functions duly performed, with the exception of the catamenia. Large doses of morphia and other sedatives were administered, to procure sleep and relieve pain. Her mental aberration was extremely slight. Her sufferings were terminated by death, on the 28th of October, 1842.

Post-mortem examination of the body, Hanwell, October 29th.—Height, measured after death, four feet two inches, great emaciation. Head large in proportion to the size of the body; chest very much deformed, pinched up, and projecting anteriorly, very narrow from side to side; the ribs appeared widened, the pelvis extremely narrow, spine curved forward almost at a right angle in the upper dorsal and cervical regions. Both clavicles broken and bent at an acute angle; head of one humerus swollen, shaft of the left broken

and bent; radius and ulna slightly swollen, the right radius broken; the lower extremities enlarged at the epiphyses; ossa femora on both sides broken, that on the right side in one place, that on the left in two; the fractured portions were held together by the periosteum, but there was no attempt at union, nor appearance of callus; tibia and fibula on both limbs bent; all the bones of the extremities could be fractured with the slightest force; by merely pressing them between the finger and thumb they gave way and cracked like a thin-shelled walnut. A longitudinal and transverse section of the long bones showed that the osseous structure of the bone was nearly absorbed, a mere shell being left. The interior was filled with a dark grumous matter, varying in color from that of dark blood to a reddish-light liver color. I could not detect any pus globules in it under the microscope. The bones of the vertebral column and ribs were similarly affected; cranium very much thickened and at least half an inch in diameter, so very soft as to be easily cut with a knife, and very vascular; the two tables were confounded, and the diploë obliterated. Thin slices of the cranium, under the microscope, showed that a considerable alteration had taken place in its ultimate structure. The laminated structure of the outer and inner tables was extensively absorbed. The Haversian canals enormously dilated, and the osseous corpuscles diminished in quantity. Joints all healthy; cartilages perfectly natural. Weight of brain 2 lbs. 5½ ozs.; arachnoid membrane milky and slightly thickened. The brain as well as the viscera of the chest and abdomen were perfectly healthy.

Chemical analysis of the bone by Dr. Tuson:—

Medulla.

Animal matter	24.78
Phosphate and carbonate of lime	1.83
Water	73.39
	100.00

Bone.

Animal matter	18.75
Phosphate and carbonate of lime	29.17
Water	52.08
	100.00

In the preceding case the parents were healthy, both of whom were living at the time of the report; the mother aged 61, and the father 66. She lost one sister at the age of 21, of apoplexy,

and a brother at the age of 38, of diseased liver, and some affection of the head. She enjoyed a good state of health up to the age of 16; was well developed and inclined to be corpulent; her mental faculties were remarkably acute, and at the early age of 16 she held the situation of governess in the family of a colonel in the army. It is worthy of note that the disease supervened after an attack of scarlet fever (soon after the age of 19), and that whilst in the earliest and most active stages, the urine contained a whitish sediment, in the latter stages, this excretion was clear.

In the second case reported by Mr. Solly, the urine was found on examination to contain a large quantity of phosphate of lime, between three and four times the quantity of healthy urine. The examination of the bones after death showed an excess of fatty matter, deficiency of the phosphates, and disproportion of the medullary cells to the substance of the bone. The left kidney contained a calculus, consisting solely of the phosphate of lime.

The following is the report of this case by Mr. Solly:—

Case VIII.—The patient was a female, Sarah Newbury. I found her sitting up in bed; her countenance very cheerful, and, excepting its extreme emaciation, not unhealthy. Her mind was very active, and all her answers to my questions clear and intelligent. She is thirty-nine years of age, and has been married nine years and a half to a strong, healthy man in the police force; has never had any children. Her height, at the time of her marriage, was about five feet five inches and a half; her general figure slight. She was born in Dorsetshire, but was in service for fourteen years in London, as a housemaid, previous to her marriage. She was always able to do her work with ease. Her general health has been good, though, she says, she never was particularly strong or robust, and has been subject to sick headaches. She has been always regular at her monthly periods, but has suffered both before and after marriage from the white discharge. She considers that her health has been failing her for about three years, but more than that time. In May, 1840—that is, about three years and a half ago—she was seized with a violent pain in her back when she was stooping; and after that she had a strange sensation down her right leg, as if a pea was rolling down. She does not remember any other circumstance relating to her general health, until June, 1841, when she had rheumatic pains in her limbs, but never any true rheumatic fever, nor any swelling of the joints.

From this time she constantly suffered from what she considered rheumatic pains, and was so feeble on her feet that in February, 1842, she had a fall—which, in fact, she says she had been expecting every day—when her left thigh was much bruised; but she did not feel anything give way; but in consequence of the bruises she was confined to her room. After this, she occasionally suffered a great deal of pain in her limbs, which, she says, seemed to be in her bones; and she was not able to walk unless on her left leg, and with assistance, dragging the right after her. In the April following—that is, about two months after the accident—when her husband was lifting her from the fireplace to carry her to bed, she says she suddenly felt the most excruciating pain, just as if her thighs were being broken in a thousand pieces; and her husband told me that he felt her thighs give away, and that they were suddenly drawn up; and from this time she has been entirely confined to her bed. She says that the muscles of her arms were now painful and swollen, but by rubbing them with oils she relieved them.

Her present condition, October 2, 1843: I do not perceive anything abnormal in the appearance of the bones of the head or face. The countenance is emaciated. There is a lateral curvature of the spine; in the dorsal region the convexity is to the right, the concavity to the left. In the centre of the lumbar region the spine curves forwards; the inferior vertebræ, with the upper portion of the sacrum, projecting backwards; the lower portion, with the coccyx, turns suddenly forwards, forming almost an acute angle. On the left side the ribs project backwards to their anatomical angles; from that point they are bent directly forwards, forming an acute angle, which projects posteriorly, looking at first sight like the spinous processes of the vertebræ in a very thin person; the side of the thorax from the angles being flattened or slightly concave, and the lateral diameter of the chest much diminished in consequence. This latter deformity has evidently been produced by her lying altogether on the left side, either on a pillow or on her arm. The clavicles have both been fractured and reunited, and are bent at a right angle in the centre. The bones of the arm and hand are all natural. I could not examine very accurately the ilia, but I perceived that they were evidently folded inwards. Both thigh bones are broken. The lower portion of the left is twisted round, so that the patella faces inwards, as represented in the drawing. The right thigh is bent completely at an acute angle in the centre. The lower portion turned outwards.

The tibia and fibula of both legs, and the rest of the bones, appear quite healthy.

I now made her an out-patient of St. Thomas's Hospital, for she refused to come into the house, and I prescribed for her a simple bitter infusion, as her appetite was failing. This, however, she refused to take; and I received a letter from her a few days afterwards forbidding my visiting her any more. I mention this to account for my losing sight of the case until the 12th of April, 1844, when her husband called on me to request that I would admit her into the hospital, which I did on the following Tuesday.

April 15, 1844. Present condition: The disease has been progressing, but not very rapidly.

The countenance is rather more emaciated, and both maxillæ appear narrowed from side to side. The alveolar cavities of the superior incisor teeth are softened, allowing them to protrude forwards, and she is not able to bite with them. The right humerus has given way in the centre, and the arm lies perfectly useless in the bed. It cannot be moved without giving her great pain. The radius and ulna are not apparently altered, but the metacarpal bones and phalanges are quite soft. The whole hand is rather swollen and puffy, and its natural appearance changed.

The thorax is much narrower. On the left side there is a depression about the circumference of an orange, the centre of which is occupied by the fifth rib—about an inch and a half from its junction with its cartilage; in this depression the action of the heart can be distinctly seen and felt. Its sounds are natural. I think that the spine is rather more curved than when I saw it in October. I do not perceive any particular alteration in the lower extremities, though it is most probable that the right thigh-bone has become more flexible, as previous to her removal to the hospital the foot was drawn completely over the head—the same position as represented in the case of Madame Supiot. She complains of the heat, and likes to have very little clothing, as much produces a sense of suffocation; she perspires very freely. I inquired of the sister whether she ever shows any particular desire for salt, as has occurred in similar cases, but I learn that she does not.

April 15. On her admission she was allowed wine and arrow-root, a mutton chop, and a pint of porter daily, and was also ordered the infusion of orange-peel, a rhubarb pill when necessary, and an opiate at night if required.

20*th*. On this day she died suddenly, without any circumstance

having occurred during her stay in the hospital that I considered worthy of note, as illustrating the pathology of the case. I procured some of her urine, which was found on examination to contain a large quantity of phosphate of lime. Mr. Heisch, who examined it, says, "between three and four times the quantity of healthy urine."

She was too suspicious and irritable to let me venture to take any blood, even in the smallest quantity, during her life. As, however, it was perfectly liquid after death, I had no trouble in procuring some for examination under the microscope, but it did not exhibit anything unnatural. Dr. Rees kindly analyzed a portion of it, but he informs me he detected nothing abnormal. The immediate cause of her death appears to have been asphyxia. Mr. B. Travers saw her in her last moments, and he says the laboring condition of the respiratory organs was very painful to witness. She took a little wine about twenty minutes past six, when her sister noticed some difficulty of breathing, and the patient stated she thought she was sinking; she then became purple, and struggled some little time before she expired.

21*st*. *Post-mortem examination fifteen hours after death.*—Thermometer 60° Fahr. 10 A. M. General appearance of the body: great emaciation; integuments of the head and face and upper part of the neck, livid. As regards the state of the limbs, in addition to what has been reported during life, it was found that the radius and ulna on the right side had given way about the middle, and that the metacarpal bones and phalanges of the same hand were all flexible. On the left side all the bones of the upper extremity appeared in their natural condition, inasmuch as their form was not altered; but in testing their strength they yielded to a very slight force, and they might be bent in almost any direction, the laminated shell breaking off short. In the lower extremities the tibia and fibula of the left side yielded about two inches from the knee-joint; below this point they were firm. Those on the right side resisted pressure, and though they were not so heavy or hard as in a healthy subject, the disease had evidently made very little if any progress in them.

Head.—Calvarium very soft; dura mater excessively adherent, and, when torn off, innumerable vessels poured forth their blood in large quantity. The under surface of the calvarium was more vascular than I scarcely ever remember to have seen it, and all the vessels were full of dark blood.

Some serous effusion within the cavity of the arachnoid.

The brain was healthy throughout; the hemispherical ganglion was natural in appearance, neither pale nor dark-colored.

Thorax.—This cavity was so much diminished in its transverse lateral diameter that a skewer passed from one side to the other, through the intercostal space between the fifth and sixth ribs, gave only four inches. On the right side there was a general depression of all the ribs; but on the left, the fourth, fifth, and sixth ribs were especially bent inwards, immediately over the heart. It was in this hollow that the heart could be seen pulsating during life. The serous membranes of the heart and lungs were all healthy.

The right lung was compressed to about one-fourth of its natural size, presenting the appearance which it does when hydrothorax is present, for it was excessively congested, and almost impervious to air; very much consolidated, but not from inflammatory effusion. The left lung was also diminished in size, but to not more than half the extent of the right; it was likewise much congested. The heart was natural and full of blood.

Abdomen.—Intestines tympanitic, venous congestion of the liver; spleen small, and rather sanguine; pancreas healthy.

The lacteals were distended with chyle, which presented the ordinary granular appearance of this fluid.

The thoracic duct was almost empty; the fluid which it contained consisted of granular matter similar to that of the lacteals, and also some chyle-globules, which were of the usual character. Different parts of the sympathetic nerve were examined, but they presented nothing unusual in their appearance.

The left kidney contained a calculus of considerable size, which, on examination, was found to consist solely of phosphate of lime.

Female organs healthy.

Sections of the bones.—The bones of the skull were not thickened; they were very vascular and soft, though by no means so much so as in the first case; they contained, in small quantity, the same kind of red substance which was observed in the former case. Their sections exhibited a similar open, reticulated texture as that in the skull in the first patient.

A section of the radius exhibited very beautifully the progress of this disease; at both extremities there was merely an unnatural degree of vascularity, though the vessels forming it were not very red. The head of the bone was more injected than the lower end

of it; at the lower part of the upper third, the cancellated structure had been partially absorbed, and its place occupied by the red grumous matter. So little of the earthy matter had been removed, that the bone retained nearly all its natural firmness.

Sections. The sternum.—Externally this bone did not seem much altered in firmness; it was not at all altered in form. But internally the disease had advanced rapidly, absorption of the earthy matter having taken place in patches, and the red substance occupied its place. The appearance it exhibited has been very beautifully represented by Mr. Kearney.

Ribs.—It was evident from the external form of these bones that they were extensively diseased. Only one was divided, which was interesting, from its showing the disease in various stages of development.

Spine.—The same appearance in these bones as in the rest.

Thigh-bones.—The right one alone was divided, and in this the disease had made such progress in the centre of it that the whole of the osseous matter had been removed, and nothing but periosteum and membranous matter left; while at the upper part of the lower third of the bone the red matter was abundant, exhibiting various hues, from a deep Modena red to a bright scarlet crimson, the osseous laminated shell remaining, but almost as thin as a wafer; then towards the condyles a portion of the bone was nearly of its natural color, only yellower and softer, from an abundance of fatty deposit. The extremity of the bone, to the extent of about one-third of an inch, was of a bright red color, contrasting beautifully with the clear, healthy color of the cartilage. This redness was evidently the effect of inflammatory injection of the vessels.

A section of the head, neck, and upper third exhibited, to a certain extent, the same appearance as a corresponding section in the case of Caroline Stephens. There was, however, a difference of considerable interest, in a pathological point of view, in illustration of the course of the disease.

The cells which contained the red matter were distinct throughout the section, but in some of them this matter had become entirely absorbed; a transparent serum occupied its place. The head of the bone was completely hollow, and filled with serum; there were two other smaller cavities at the lower portion of this part of the bone, filled in the same manner.

The red matter I examined carefully under the microscope, with

my friend Mr. Birkett, of Guy's, who has drawn up the following report of his observations:—

"From the cellular spaces of the cranial bones a soft, reddish, gelatinous solid could be removed. It mingled readily with water, rendering the fluid turbid. In it I could see cells with nuclei of two kinds. The first round, and clearly exhibiting a nucleus and nucleolus; they were, however, few in number, and certainly could not be said to compose the mass of the solid, which apparently contained a delicate fibre of fatty matter. The second kind were very clear, their edge being remarkably distinct, and the clear oval outline inclosing *one* bright *central* nucleus, *rarely two, never more.* There was a tendency to elongate into the caudate cells, but this appearance was very rare. Many other cells of irregular figure and shape, some with, others without central nuclei, existed.

"Large cavities existed in the body of the vertebræ, filled with a dull, oily, reddish matter, and which contained a great number of cells having an irregular outline, and some a very distinct nucleus, rendered more distinct by dilute acetic acid. I could find no distinctly caudate cell, as in the cranial bones, and the identity of these cells with pus-globules (for they appeared larger than pus-globules commonly are), or the commonly called nucleated cells of malignant disease, was difficult to determine; in the femur I saw nothing but fat-cells and blood-disks."

"The red colored matter in the bones," says Mr. G. Rainey, of St. Thomas's Hospital, who also examined it, "consists of a multitude of roundish bodies, almost the size of the blood corpuscles, each of the bodies being filled with a minutely granular substance. Besides these bodies it contained also fat globules, but no regular fat vesicles, and it appeared to be wholly destitute of any fibrous or cellular structure."

Mr. Simon, of King's College, examined portions of the bones, and thus expressed himself in a note to me on this subject: "My examination was not at all satisfactory as to the ultimate nature of the disease. There was great excess of the natural fatty matter, and disproportion of the medullary cells to the substance of the bone; in parts there was apparently extravasation of blood, which may have arisen from violence. I was unable to discover any new cell formation, at least any mature one; cytoblasts were exceedingly plentiful, so as to suggest the probability that some such formation was in progress, but nothing further, with the exception

of some two or three apparently detached young fat cells. Decidedly there was no show of growing cartilage."

After a careful consideration of all the facts, and especially by comparing the appearances after death with the symptoms during life, of this awful disease, Mr. Solly was led to believe that it is of an inflammatory character, that it commences with a morbid action of the bloodvessels, which give rise to that severe pain in the limbs invariably attendant on this disease, but more especially in its commencement, and exhibits itself after death by an arterial redness of the parts. The absorbent vessels are at the same time unnaturally excited, and the earthy matter of the bone is absorbed and thrown out by the kidneys in the urine, which excretion is sometimes so abundant, as we have seen in the last case, that it clogs up the calices and pelvis of the kidney and forms there a solid calculus.

Mr. Solly concluded that the enormous hypertrophy of the bones of the skull in his first case, as also in that of Madam Supiot, demonstrated that it is an active disease, and not a mere atrophy. Indeed, he supposed that the inordinate vascularity of the bones of the skull, though unaccompanied by increase of thickness in his second case proves nearly as much; and he had no doubt but that if this patient had not died so suddenly, but had survived another twelvemonth, a similar thickening of the skull would have taken place. It is interesting, in relation to the pathology of the brain, to observe the effect of this disease of its solid covering in the case of Stephens, where the intellect was deranged. Whereas in the latter instance recorded by Mr. Solly, the mind remained perfect to the last, where the skull was not altered in its dimensions.

Dr. Thomas Blizard Curling has recorded the following case of mollities ossium, under the head of Eccentric Atrophy of Bone:—

Case IX.[1]—Catharine Burne, aged 72, was brought to the London Hospital from the workhouse at Poplar, February 18th, 1833, in consequence of a fracture of the right femur. She had been an inmate there since the 18th of September, 1827, and had been bedridden for nearly four years, on account of paralysis of the lower extremities. The hip and knee-joints had been in a state of flexion so long that it was impossible to straighten them, and for some

[1] Observations on some of the Forms of Atrophy of Bone. By Thomas Blizard Curling. Medico-Chirurgical Transactions, 1836, vol. xx. pp. 356–373.

years she had experienced great pains in the knees and thighs. She had been subject to hysteric fits, also to a slight cough, and ever since her last confinement had been troubled with incontinence of urine, in which secretion nothing peculiar had at any time been remarked. Her appetite had always been good. On being turned in bed by a nurse, on the morning of the day that she was sent to the hospital, her right thigh was suddenly fractured.

About a fortnight after her admission, whilst being moved in bed, her right humerus was also broken. The arm was placed in splints, but from this time she gradually sunk, and died on the 19th of March. On examining the body, the lungs, abdominal viscera, and mesenteric glands were found healthy, but the heart was rather flabby. There was considerable calcareous deposit in the lumbar and iliac glands, and a fistulous communication between the vagina and bladder. Between three and four ounces of serum escaped from the cavity of the arachnoid; and between the layers of that part and the dura mater covering the upper surface of the brain, some tubercles were found. All the articulations were in a healthy state. The periosteum was everywhere normal, except over the trochanters, where it was entirely detached, owing, most probably, to inflammation induced by the pressure to which they had been so long subjected. The bones of the skull and pelvis might be cut with a strong knife, but the ribs and vertebræ were only slightly affected, being scarcely less firm than usual. The femur consisted of a thin shell of bone filled with medulla, its cellular structure being entirely obliterated, except in the head of the bone and at the trochanters, where there was a slight appearance of cancelli greatly enlarged. Some dark spots were observed at different parts of the interior, which were found to be produced by extravasated blood. The fractured extremities of the right thigh bone had a slight ligamentous connection. The tibia also consisted of a mere shell of bone, elastic, and yielding under the finger like a thin piece of ivory, the cancelli being removed, and the interior likewise filled with medulla. Although only a thin lamina of bone remained at their extremities for the attachment of the articulating cartilage, that structure was not in the slightest degree affected. The tarsal and metatarsal bones, and the bones of the phalanges of the toes were much less firm than in the natural state, and their cellular texture enlarged. The humerus was firmer than the thigh bone; it did not yield to pressure, and in order to make a section of it, the use of a saw was necessary; whereas all the bones of the

lower extremities could be readily cut with a knife. The walls, however, of the bones of the superior extremities were preternaturally thin, and their medullary cavities evidently enlarged. Upon making section of the different bones, patches of a light-red color were remarked at different parts, and these, upon inspection with a magnifier, were found to arise from the minute vessels of the medullary membrane being highly injected with red blood. The oily substance with which the bones were filled closely resembled the medulla of an old subject, and several of the bones having been placed for some months in water to macerate, it was converted into adipocire, a beautiful specimen of which was afforded by a section of the humerus.

It is to be regretted that it was impossible to obtain a fuller account of her state of health, and of the different secretions at an earlier period of the disease.

From a review of all the circumstances connected with this and other forms of atrophy of bone, Mr. Curling concludes that the wasting of the osseous tissue is here the result of defective nutrition, and not of increased activity in absorption. If it were owing to the latter action, continues Mr. Curling, we should expect that the wasting process would go on most rapidly in the cancellous and vascular parts of bone, whereas we find that the denser parts, and those of inferior vascularity, are most rapidly removed.

Again, the disease appears first in the bones of the lower extremities, for the same reason, probably, that all morbid changes consequent upon defective nutrition, or a feeble circulation, commence oftener in the depending parts.

According to Mr. Curling, the various appearances presented by the medulla which is sometimes described as vitiated, or as being of a reddish color, and resembling flesh, liver, or tallow, is owing to slight modifications in the secretion, together with some degree of increased vascularity in the medullary membrane, or to the medulla being mixed up with blood accidentally effused, as would readily happen if there was much distortion. Mr. Curling was satisfied, from his examination of the bones in this disease, that the matter with which the bones are filled is nothing else than an increase of the true medulla, somewhat altered in appearance, but very slightly in its essential characters.

M. Saillant, in a case which he brought before the Faculty of Physic in Paris, in 1792, calls the disease medullary gout. Indeed, rheumatism has frequently been considered as giving rise to

it. All the cases have been accompanied with severe pains in the limbs, and many of them preceded by severe rheumatic attacks. M. Kilian asserts that the most common exciting cause is violent cold, produced by getting wet through, especially during menstruation, or the presence of the lochia; he also enumerates sudden fright, grief, misery, and poverty. The most severe cases, according to this author, occurred in women confined in damp prisons.

Mr. Howship remarks in reference to this disease, that it is "the effect of a morbid action in the capillary's arteries upon the medullary membranes within the bone; and most probably the progressive absorption of the bone itself was merely one of the consequences of the long continuance of the malady."[1]

If the view expressed by Mr. Solly be true, that mollities ossium is of an inflammatory character, it is evident, however, that the altered state of the osseous tissue is essentially different from that which commonly occurs in inflamed bones. Thus, in inflammation of the bones, the periosteum is always more or less involved, and the appearance of extravasation of blood in mollities ossium may arise, in part at least, from the fractures and distortions of the bones.

It is well known that in bad cases of scurvy the bones occasionally become so brittle that they are broken by the slightest causes, and do not unite again by callus, as long as the scorbutic state continues. And in some cases of scurvy the callus of old fractures is destroyed after it had been formed. Boyer, in his *Lectures on the Diseases of the Bones*, states, that if the bones of a scorbutic person be boiled, the periosteum separates very soon, lamellæ scale off, and, in some cases, the bone dissolves entirely. They also fall into powder if kept for some time, but particularly if exposed alternately to heat and moisture.

It is also well established that in this peculiar state of the system induced by sameness of diet, and salt food, the smallest injuries, and even vaccination, may be attended with the most extensive and foul sloughing and gangrenous ulcers, involving in one common destruction integuments, muscles, nerves, vessels, and bones.

The origin of this state of the system is clearly referable primarily to changes induced in the blood, and secondarily to the perversion of nutrition and the degeneration of the solids.

In like manner it would appear to be more philosophical to refer that peculiar state called mollities ossium, to derangement

[1] Edinb. Medico-Chirurgical Transactions, vol. ii.

of the blood and nutritive processes in its origin, rather than to a peculiar disease of the bones, originating solely in the osseous system. In many of the cases there would even appear to be some connection between this disease and scurvy. The case related by Mr. Goosh and Dr. Pringle to the Royal Society in 1753, had symptoms of scurvy, and bled much at the gums. Madame Supiot, for two years before the disease commenced, had been in the habit of eating a pound or a pound and a half of common salt in the course of a week, without any vehicle. In this case the gums swelled much, and were separated from the teeth, allowing them to fall out. In the case of Sarah Newbury, there was no bleeding of the gums, but the teeth became loose in consequence of the softening of the maxillæ.

Again, the disease is frequently attended with symptoms of a remarkable kind, which can only be referred to changes in the blood and vascular system. Thus, in the case of Madame Supiot, it was noticed that, when the bones were softening, the urine deposited a white, chalky sediment, which came away after her pains, and ceased towards the termination of this protracted case, when scarcely a bone remained for the disease to prey upon. Both the urine and saliva stained the linen black. In the case of James Stephenson, recorded by H. Thompson in his *Medical Observations and Inquiries* (vol. v.), for the first two years of the disease, the urine deposited a whitish sediment, which, upon evaporation, became like mortar, and the patient, a shoemaker at Wapping, voided three or four small jagged stones some time after a complaint in his loins.

In the case related by M. Saillant, the urine was high-colored, turbid, and fetid, and the hands and feet were constantly covered with an unctuous humor, which, as it dried, thickened into scabs. In the case reported by Mr. Howship, the perspiration was abundant, and possessed an unusual fetid odor. In another case reported by M. Saillant there were copious sweats, and an almost incessant salivation.

All these circumstances seem to indicate that the blood was loaded with something which was necessary to be eliminated by the skin, kidneys, and salivary glands.

These symptoms sustain the view advocated by Meischer and others, that the earthy parts of the bone, after being absorbed, are excreted with the urine, in which they deposit a white sediment, cretaceous and soluble in acids, and that this solution of the earthy parts of the bones is dependent on an acid diathesis, as exhibited in acid eructations, vomiting, and sweats.

CHAPTER III.

RELATIONS OF MOLLITIES OSSIUM TO FRAGILITAS OSSIUM.

WHILST it is true that the bones become fragile in certain stages of mollities ossium; and whilst a certain degree of fragilitas ossium occurs in old age, and in some cases in the latter stages of syphilis, and in certain cases of cancer, where the whole mass of fluids is infected, and the virus attacks the bones, destroys the vital parts, and renders them brittle—at the same time there is a true fragilitas ossium, distinct from these diseases and from mollities ossium.

I have enjoyed the rare opportunity of seeing these two diseases at the same time and in the same place, and of comparing the two diseased actions.

The following case of fragilitas ossium came under my observation in Nashville, just at the time when I was treating the case of Miss Raney Drucilla Bozel.

CASE X.—Marshall Lewis; dark mulatto; age, 24; Nashville, Tennessee, 1868. His father and mother stated that, when about two years of age, Marshall was attacked with typhoid fever in the fall of the year, during an epidemic of this disease which prevailed in the neighborhood. The case was somewhat protracted, and the attending physician administered calomel daily in small doses. The child recovered entirely, and enjoyed good health. When three years of age, Marshall accidentally fell out of the door (the house being built on the ground and low), and caught on his hands. His legs striking the door-sill, were fractured short off about the middle. The attending physician set the legs in pasteboard splints, and directed that they should be wet with vinegar, which caused the splints to slip off, and the bones of both legs united irregularly. Since this time he has had numerous fractures, numbering in all near *fifty*. The slightest fall produces fractures of the leg or thigh-bones. Several fractures have occurred during play.

At the present time Marshall enjoys excellent health; has never been sick, with the exception of the attack of typhoid fever.

Weight, 150 pounds; has weighed near 170 pounds, but at that time was more active in his habits (followed his trade of boot-making) than at the present time, when he leads a sedentary life, studying his books diligently and endeavoring to acquire an education.

Chest large, full, and well developed, with powerful muscles. Height of Marshall, 4 feet 4¾ inches. Breadth of shoulders, across from the outer border of one humerus to the outer border of the other, 18 inches. Circumference of chest, 40 inches. The well-formed chest is supplied with powerful pectoral muscles, and long, muscular, strong arms. Length of body from crest of ileum to top of head, 26 inches; from crest of ileum to bottom of head, 26¾ inches. The latter measurement is not one-half what it should be, owing to the numerous fractures and bending of the legs and thighs. Arms powerful and long; length of arm from shoulder to end of wrist, 32 inches. Hands large and powerful. Right forearm has been broken near the wrist-joint, and in the elbow-joint, which is considerably deformed. The left forearm has been fractured twice.

The great size of the muscles of the arms and chest appears to be the result of the constant use of crutches in walking—cannot walk without crutches.

The thighs have been fractured so often that they are bent like bows. The leg bones were in early childhood broken about the middle, and the upper fragments projected anteriorly, forming almost right angles with the lower fragments; and the ends of the projecting bones are covered with a hard, thick, shining, horn-like skin, although they do not strike the ground in walking. The length of the right thigh is only 15 inches, and that of the right leg about 16 inches. Feet quite small; the patient wears No. 2 shoes. Length of foot, 8 inches; breadth across sole of foot, 3¼ inches. Thighs, although misshapen and bent like a bow, with large masses of callus thrown out along the femur, are still large and muscular, whilst the muscles of the legs are greatly wasted.

The parents were disposed to regard the brittleness of the bones as due to the typhoid fever and calomel, but nearly one entire year had been passed in good health before the appearance of the fragilitas ossium; and in addition to this, in reply to various inquiries relating to constitutional and family diseases and tendencies, I was informed that the niece of Marshall's father has had numerous fractures, being afflicted in a similar manner with Marshall,

although she has borne children and is apparently stout and healthy.

Mother of Marshall, a powerful, hardy, black negro woman, age 52, has had twelve children, all of whom were vigorous and strong. Those of her grown children whom I have seen are large and healthy. Father of Marshall, a stout, light mulatto man, 52 years of age.

The points of interest presented by this case, as distinguishing it from mollities ossium, were:—

1st. The fractures were attended with little or no pain, and healed rapidly by the formation of callus.

2d. The general health of Marshall Lewis appeared to be perfect, and there were no marks of cachexia or of a scrofulous or syphilitic taint.

3d. The appearance of the same brittle state of the bones in a niece of his father's indicated a constitutional origin of the disease, or rather that the brittleness of the bones was hereditary.

Dr. Paull, of London, has recorded a striking illustration of the hereditary brittleness of bones and their repeated fracture in members of the same family. All the members of a family residing in the commune of Offenbach have had fractures; three of them have each had two fractures; another three; one has even had as many as five fractures of one or the other extremity; and to produce these injuries no considerable violence was in general requisite. The father and grandfather before them had fractures of the limbs. Dr. Paull, moreover, described this family as a very healthy one, without any scrofulous or other perceptible taint. It is remarkable that not one of them suffered a fracture before the age of eight, so that one might suppose that this peculiar fragility of the osseous matter was developed only towards the age of puberty. Dr. Paull conceived that the condition of this fragility consisted in some change of the chemical constituents of the bones in their relations to each other.

It has been frequently observed that men addicted to the use of brandy often experience fractures (in consequence of a degree of brittleness induced in the bones), which require a long course of treatment to insure their consolidation. Dr. Paull met with this fragility of the bones in a subject of this kind, a man 54 years of age, who hung himself at Yorchlengen; the ribs, particularly snapped like glass, and a very moderate force sufficed to fracture the long bones. But if fractures in these old drunkards are cured

only very slowly, precisely the contrary was the case in the family above mentioned; for in every instance that occurred in it the fracture was very speedily consolidated, so that generally the callus was perfectly firm at the end of three weeks. When the same bone has been broken a second time, it has never occurred at the seat of the callus.[1]

We are justified by these cases in assuming the position that there is a state of the osseous system correctly indicated by the term fragilitas ossium, which cannot be referred to the syphilitic, scrofulous, or cancerous cachexia, and which exists with perfect health, and the repeated fractures are rapidly united by callus.

CHAPTER IV.

RELATIONS OF MOLLITIES OSSIUM TO RICKETS (RACHITIS).

Upon a superficial view, rickets and mollities ossium appear to be closely connected on account of the flexibility of the bones and the fractures upon slight causes which characterize both diseases. Some authors, led by these general resemblances, have regarded the latter disease as rickets attacking the adult. A careful analysis and comparison of the phenomena of the two diseases, however, will show that the resemblances of the two affections are far exceeded by their differences.

A deficiency, actual and relative, of phosphate of lime in the osseous system, characterizes both mollities ossium and rickets; in the former, however, the skeleton, originally normal in structure, loses its earthy matter, becoming fragile, soft, and pliable; in the latter, the osseous structure is abnormal from the first or from an early age. Guérin found that of 346 cases of rickets, 209 were affected between the first and third year, these were congenital; 34 occurred between the ages of four and twelve; 148 were males and 198 females. Cases of congenital rachitis have been mentioned by Hippocrates and other writers.

[1] Dublin Hospital Gazette, Feb. 1st, 1846. Ranking's Half-Yearly Abstract, vol. iii. p. 83, 1846.

Mr. Tamplin[1] has described a skeleton affected with rickets in a seven months' fœtus. Rickets has been observed in the young of wild animals (lions and tigers) born during the captivity of their parents. The disease appears to be intimately connected with a marked cachexy of the system, which seems to be identical with the scrofulous, and to be induced by insufficient nourishment, combined with bad hygiene, and damp, foul air. The process of dentition also, by the disturbances which it causes in the alimentary canal, and by the drain which it establishes upon the mineral constituents of the blood, tends to develop and aggravate the disease.

On the other hand, mollities ossium attacks adults, and especially women after they have commenced child-bearing. In the sixteen cases collected by Mr. Curling,[2] thirteen occurred in females, and only three in males; eleven were fatal between thirty and forty; in none did the disease show itself before puberty; but two patients were above fifty years of age, and several of them were delivered of children during the progress of the complaint.

The softening of the bones is slow and gradual in rickets, and unaccompanied by pain, while in mollities ossium it is sudden and rapid in its progress, and accompanied with great pain.

Sir Charles Bell,[3] in his *Lectures, illustrated by the Hunterian Preparations*, quotes from the "Medical Observations and Inquiries" a remarkable case of mollities ossium, where a man going up stairs struck his toes against a step, and broke his thigh-bone. The surgeon attended, with all proper appliances, to the thigh-bone, but the usual period expired without union being discovered at the fractured part. A consultation being called, on raising the leg the thigh-bone broke again in the hands of the surgeons. The disease proceeded to such an extent that the flexor muscles twisted the bones, so that the heels were drawn back of the head, and the trunk itself, before death, became greatly flexed.

Mollities ossium progresses, in almost all cases, to a fatal issue; in rickets, after a time, the abnormal condition is cured by treatment, or the progress of age; earthy matter is deposited in even more than its due proportion, the skeleton becomes solid and strong, and the general health may be entirely restored.

If the patient outlive rickets and die afterwards, it will be found,

[1] Lectures on the Nature and Treatment of Deformities. Am. ed. pp. 156–157.

[2] Medico-Chirurg. Trans., vol. xx. p. 336.

[3] London Lancet, March 15, 1834, p. 918.

upon dissection, that the bones have assumed great weight and density, and, in some instances, the cavities of the cylindrical bones are said to have been filled up with earthy matters. And it has been noticed, in some instances, that such persons on recovery from the disease, acquire a surprising degree of strength. Sir Charles Bell[1] mentions an individual by the name of Farrel, known on the streets of London as "Leather-coat Jack," who would throw himself under a hackney-coach, and allow the wheel to go over him, for a pot of porter. This short, deformed man, who had been afflicted with rickets in his youth, exhibited great feats of strength, bearing an anvil on his breast, and carrying the tallest men by placing his arms under their thighs. Sir Charles Bell also cites the extraordinary manifestations of strength by another dwarf, and rickety subject, called the "Little Hercules."

The general health in mollities ossium is hopelessly impaired, the flesh and strength diminish daily, and in some cases the muscles undergo fatty degeneration. The observations thus far recorded have not been sufficiently numerous or accurate to decide the question whether the degeneration of the muscles is always present in this disease. The fatty degeneration of the muscles in those cases in which it has been observed can with great reason be referred to the action of the same causes which induced the softening and degeneration of the bones.

The pale color of the muscles in some cases of rickets appears to be due to the anæmic condition of the system, rather than to fatty degeneration of the muscles; and we have just seen that after recovery from this disease, the muscular strength, so far from being impaired, is often wonderfully increased.

In mollities ossium, the loss of earthy matter in the osseous system is rapid, and is frequently attended with a copious phosphatic deposit in the urine, and the bones do not simply lose their earthy constituents and become reduced to their cartilaginous flexible tissue, but there is an actual change in the living cellular elements of the bones, and a progressive degeneration, so that in many cases, the bones consist finally of an external shell filled with oily or lardaceous matter held in membranous tissue. Though pathologists are still in doubt as to the exact nature of the change of the osseous system in this disease, the observations of Mr. Solly and of Mr. Dalrymple have shown the existence of a process of active

[1] London Lancet, March 15, 1834, p. 918.

change, as manifested in the afflux of blood to the parts affected, and the abundant cell growth. Mr. Dalrymple has found, by microscopical observation, that the bone corpuscles are considerably enlarged. Enlargements of the Haverseian canals and of the lacunæ is observed; the cancelli are loaded with large oil drops, often tinted red, and, combined with thin, numerous cells, varying in size from the $\frac{1}{1200}$ to $\frac{1}{500}$ of an inch in diameter, containing a rounded nucleus, also varying much in size, and occasionally showing various stages of division and of endogenous development. And whilst there is a diminution of the earthy constituents, there is at the same time some important change in the animal basis of the bone; it no longer yields healthy gelatin, and is saturated with oil, which, to a great extent, is not contained in cells, but lies as a free fluid in the cancelli and medullary canal, and readily drains out, when the bone is placed in an inclined position. The color of the oil is also peculiar, presenting bright yellow, pink, and deep crimson hues. These changes are probably owing, as Bennett has said, to an exudation from the bloodvessels, mingled with more or less extravasation of the colored corpuscles, in which new cells are developed, combined with fatty transformation of the albuminous and fibrinous materials.

Virchow has traced fatty degeneration in inflamed bone as a part of the process of softening which precedes its expansion or absorption. Very often small fatty molecules appear in the bone-corpuscles; and Virchow has traced their enlargement, and the gradual softening, disintegration and final liquefaction and separation of the proper bone-substance immediately surrounding and including each corpuscle. Analogous changes have been traced by Goodsir and Redfin in cartilage; and Virchow has pointed out their relation to fatty degeneration as a part of the inflammatory process. And these changes in inflamed bone are of special interest, inasmuch as they are the results of the same process as that by which normally the medullary spaces and areolæ of growing bone are formed, and by which mollities ossium is supposed to be produced.

On the other hand, the softening of the bone in rachitis should be regarded as arrested development of bone, with an increased growth of cartilage-cells. In this disease the whole bone is soft, easily cut with a knife, and preternaturally flexible; cancellous texture of a brown or reddish hue predominates, and is at first filled with a serous liquid, which may be squeezed out, as if from

wet leather; after some time the serous or albuminoid liquid occupying the tube and cancelli is transformed into a gelatinous substance, which is gradually organized into a cartilaginous state. The power to separate and deposit bony or earthy matter appears to be entirely wanting in the organic cells of the osseous system in mollities ossium, whilst in rachitis this power is only temporarily suspended or arrested, and is resumed with increased energy after the removal of the diseased state.

CHAPTER V.

RELATIONS OF MOLLITIES OSSIUM TO CANCER.

MOLLITIES OSSIUM, in that, as far as is known, it is not amenable to remedies, but pursues its career steadily, unaffected for good by medical treatment; and in that there is in this disease an increased cell-generation in the affected structures; and, still further, in that, in recorded cases of cancer, some of the bones have been found in a state closely resembling, if not identical with mollities—bears a stronger resemblance to cancer than to any other disease.

The brittleness of the bones in cancer has long been observed. Thus, the celebrated Levesius, more than a century ago, in dissecting the body of a woman sixty years of age, who had labored for some time under a cancer of the breast, and who had broken the os humeri, and, soon after, the os femoris also, by a slight effort, found the bones not carious, but dry and fragile, with the medulla, in like manner, dry, friable, and quite loose from the parietes of the bony cavities.

In a case which recently came under my observation in the Charity Hospital, of cancer of the breast in an aged negro woman, several of the ribs on both sides were soft, cartilaginous, and readily cut with a knife. Cancerous deposits were found also in the liver and spleen.

In the following case, recorded by the celebrated Percival Pott, it will be observed that softening of the bones was attended with fever, great muscular debility and pain, and the formation of steatomatous and scirrhous tumors.

Case XI.[1]—In November, 1737, a gentleman, aged 27, complained of a swelling in the inside of his right thigh. On examination, it appeared to be an encysted tumor of the steatomatous kind, lying loose between the sartorius and vastus internus muscles. Mr. Pott took it out, and the patient got well in six weeks. After this he continued well for near a year, except that he complained at times of a slight pain in the joint of that hip, which went off and returned at different times. He then fell into such a disposition to sleep, that no company nor diversion, nor his own endeavors to the contrary, could keep him awake after eight or nine o'clock in the evening, if he sat down. This continued on him for three or four weeks, and then the pain in his hip became worse. The cold bath, flesh-brush, horseback exercise, a course of æthiops mineral, cinnabar, of antimony, gum guaiac, calomel, purgatives, and mineral waters, as well as travelling and change of climate, afforded no relief. Periodical heat and thirst returned every night, with a quick, hard pulse.

In September, 1739, the sight of his left eye became dim, and the dimness gradually increased until the sight was lost, and the ball of the eye was enlarged and thrust forward out of the orbit.

Tumors appeared in different parts, five or six on his head, two or three in his back, and one in the neck, all lying just under the skin.

December 2d, 1739, his chief complaints at this time were excessive languor, inability to move his right hip, and when moved by another person, a very acute pain in it, an incapacity of sleeping when in bed, an intense thirst in the night, with a quick hard pulse.

After subjecting himself to several courses of treatment, with cinnabar, of antimony, mercury, and other remedies, without any benefit, and being reduced extremely low, he abandoned physic. The inguinal glands of the hip became much enlarged, the patient lost all power of stirring or helping himself, and died May 2d, 1740.

For a considerable time before he died he was nourished by fluids only; yet as soon as ever they were received into the stomach, in however small a quantity, they gave him acute pain at the bottom of his belly, just above the pubes. Upon dissection, Mr. Pott found

[1] An Account of Tumors which rendered the Bones Soft. Communicated to the Royal Society by Mr. Percival Pott, Surgeon, 1740. Vol. xli., No. 459, p. 616. Abridgment, vol. viii. pp. 464–467.

the tumor which he had taken out of his thigh two years before ossified in the inside.

On dissection, the first thing that offered was a large tumor on the sternum, which had been perceived about three months before he died. It was as large as a turkey's egg, and so hard and immovable that Mr. Pott was in doubt whether it was upon or under the bone. On removing the skin, it appeared covered by the expansion of the tendons of the intercostal muscles and the periosteum; this coat being taken off, it was of a suety kind of substance for about half an inch deep, and below this was a kind of cartilage intermixed with a great many bony particles. Mr. Pott then shaved off all this diseased body even with the surface of the rest of the sternum, but found no bone, it being quite dissolved and confounded with the mass of matter that composed the tumor, which was equally protuberant within the thorax, and composed of the same materials.

Parts of the fifth and seventh ribs were dissolved in the same manner, into a kind of substance between bone and cartilage, with a thin coat of steatomatous matter.

Within the cavity of the thorax were thirty-seven of these diseased bodies, most of them attached either to the vertebræ or the ribs; and wherever they were attached the cortex of the bone was destroyed, and its internal cellular parts filled with diseased matter.

Immediately above the diaphragm, was a large scirrhous body, lying across the spine and the aorta, the latter of which lay in a sinus formed in its lower part; it had no attachments to any other part, and weighed 13½ ozs.; and from its situation must have taken its rise from *some* of the lymphatic glands lying about the thoracic duct.

From the origin of the aorta from the heart quite up to the basis of the cranium, all the bloodvessels were surrounded with these scirrhous bodies, and the thyroid gland was diseased in like manner, and bony within. On the left side was another of these bodies, made out of the glandulæ renalis, weighing 9¾ ozs.

On the right the glandulæ renalis was in a natural state, but the cellular membrane which surrounds the kidneys was filled with a large cluster of these bodies of different sizes, some of them entirely suety, others intermixed with bony particles; three or four of them were attached to the body of the kidney, and there was a sort of cartilage beginning to ossify.

The pancreas was quite scirrhous and very large. One very

large tumor sprang from the spongy body of the third vertebra of the loins, the bony texture of which was so dissolved and mixed with the matter of the tumor, that the knife passed through it with great ease. The inner side of the os ilium, all the ischium and pubis, were covered with these appearances, and on removing them the bone was found in the same state as the sternum and ribs. The middle of the right os femoris was surrounded with a mass of the same matter, and the bone underneath in the same state.

In the bottom of the orbit, surrounded by the recti muscles, was a pretty large steatoma which occupied the protrusion of the eye, and by pressure on the optic nerve caused the blindness.

In diffused cancer the whole bone may be softened by the distension of its cells with the material of soft cancer, the cancelli may be partially or completely absorbed, and general disintegration of the bone induced. And it would appear that some cases described as mollities ossium were really instances of diffused cancer of the bones. And in the close resemblance of the two affections must be found the grounds upon which some authors have classed mollities with cancer. This confusion is not to be wondered at when the obscurity and difficulty which surround the history and investigation of cancer of the bones are considered.

Professor R. W. Smith, of the University of Dublin, has recorded a remarkable case of cancer in the bones, a brief outline of which we give.

Case XII.[1]—The patient was a female, æt. 63, of sallow complexion and very unhealthy appearance.

Four years before her death, and eight after the catamenia had ceased, she began to suffer from lancinating pains in the left breast, and a small hard tumor formed near the nipple, and very soon became adherent to the skin, was uneven upon the surface, and after some time the axillary glands became enlarged and indurated. The tumor underwent no further changes for two years and a half, when a scab formed upon its surface, upon the separation of which, a very superficial ulcer not as large as a shilling remained; this sore never increased either in extent or depth, and yielded but little discharge. In fact, during the remainder of her life, the diseased breast attracted no share of her attention, and the lanci-

[1] Dublin Hospital Gazette, March 15, 1855; Ranking's Abstract, No. XXII., July to Dec. 1855, p. 113.

nating pains which were first experienced latterly ceased altogether. Severely, however, and almost unceasingly, did she suffer from pains, which she conceived to be of a rheumatic character, in all her bones; she had cough and pain in the right side; her appetite failed, her sleep deserted her, and her flesh wasted away; she was for a long time before her death completely bedridden; she could not endure that any one should touch her; and her efforts to move herself in the bed were, upon several occasions, followed by fracture.

She died exhausted by pain and suffering and in a state of complete emaciation.

The post-mortem examination, which Dr. Smith conducted with the greatest care, proved most interesting, and revealed an immense extent of cancerous deposit limited to a single system; for, with the exception of a tubercle about the size of a small nut in the liver, the organs, in all the cavities, were perfectly healthy; while, upon the other hand, nearly the entire skeleton from the head to the feet was pervaded with cancer.

The cranial bones in several places had been softened and absorbed; the left clavicle was fractured external to its centre, and the anterior of the bone was occupied by scirrhous matter, from its sternal to its acromial extremity; the left humerus was broken in its centre, and the cancerous deposit filled the medullary canal from the head of the bone down to its lowest extremity; both the right and left thigh bones were fractured and in portions absorbed and universally infiltrated with the cancerous structure—the medulla of the bones of the legs presented a most unhealthy appearance; the ribs contained numerous deposits of scirrhus in their interior, and several of them were fractured; the disease occupied the spinal column from the lower part of the cervical region to the sacrum, the cancellated tissue of the bones had disappeared and its place was occupied by a firm, elastic, scirrhous structure of uniform consistence and of a roseate hue; and the bones of the pelvis were entirely converted into a scirrhous structure.

The characters of this heterogeneous deposit were precisely the same in all the affected bones; it was white, firm, tough, and dense in its texture, highly elastic, and cut like cartilage; it in no respect differed from true scirrhus as it is seen in the human breast. The osseous tissue in contact with it had suffered no alteration but such as resulted from absorption.

It is evident that such a case as the preceding was involved in

obscurity during the life of the patient and simulated closely mollities ossium in many of its symptoms.

In a case of secondary cancer in the spine and other parts after removal of scirrhus of the breast, reported by Mr. Cæsar Hawkins,[1] the centre of the neck appeared a little sunk forwards, as if the upper vertebræ had been depressed in that position. Upon dissection, the body of the fifth cervical vertebra was very irregular on its surface, and was softened throughout, with much enlargement of the cells of the cancelli, which was filled with a sanguineous pulpy fluid; the two adjoining vertebræ showed a lesser degree of the same morbid structure. Mr. F. Holmes[2] has recorded a case of cancer of the bones after scirrhus of the breast, in which some of the ribs were perfectly flexible; and in a case of well-marked cancer of the pelvis,[3] he found a condition of the innominate bone bearing an almost equally close resemblance to mollities.

CHAPTER VI.

CONSTITUTION OF THE BLOOD, CONDITION OF THE TEMPERATURE, PULSE, AND RESPIRATION, AND THE CHARACTERS OF THE URINE, IN MOLLITIES OSSIUM.

Constitution of the Blood in Mollities Ossium.—As far as our information extends, no analysis has been made of the blood in this disease. The future investigator should direct his attention not merely to the determination of the albumen, fibrin, and red corpuscles, but should endeavor to determine whether any special acid or salt exists in the blood in excessive quantity. A careful search should be instituted for lactic and phosphoric acid, and for lactates and phosphates.

Temperature, Pulse, and Respiration in Mollities Ossium.—In like manner, we have no critical observations upon the state of the temperature, circulation, and respiration in this disease, and we know but little beyond the general observation that the pathological phenomena are attended by fever.

[1] Medico-Chirurg. Trans., vol. xxiv. p. 45.
[2] Path. Soc. Trans., vol. xi. p. 219.
[3] System of Surgery, vol. iii. p. 671.

Progress and Termination of Mollities Ossium.—The various functions appear to have been duly performed in most cases, unless interfered with by the distortion consequent upon the yielding of the bones; and pathologists have distinctly stated that the internal organs were found in a healthy condition after death, thus showing that the disease is not associated with any particular lesion of important viscera.

The progress of mollities ossium appears to vary greatly, the bones becoming soft in some cases in a few months; more commonly, however, the disease goes on for many years before the death of the patient.

Condition of the Urine in Mollities Ossium.—The observations which we have already recorded establish the fact that the phosphates are frequently in excess in the urine of this disease. We need an extended series of analyses of the urine, collected during definite periods of time (twenty-four hours) and at stated periods in the progress of the disease.

The most complete and interesting examination of the urine in this disease was made by Dr. Henry Bence Jones.[1] It is to be greatly regretted that, in his analysis, Dr. Jones selected an arbitrary quantity (1000 grains), instead of the whole amount excreted during twenty-four hours.

This case was reported both by Dr. William Macintyre[2] and by Mr. Dalrymple.[3]

The following is an outline of the report of this case by Dr. Macintyre.

Case XIII.—A tradesman, aged 45, came under Dr. Macintyre's care on the 30th of October, 1845. He had suffered for upwards of twelve months from excruciating pains in the chest, loins, and back. When first seen, he was much emaciated; the pain had become fixed in the left lumbar and iliac regions, and the patient, in consequence of the great agony produced by moving the body on the thighs, was constantly in a semi-flexed position. There was exquisite tenderness on pressure at the brim of the pelvis in front. Nothing very satisfactory could be made out regarding the abdo-

[1] On a New Substance occurring in the Urine of a Patient with Mollities Ossium. By Henry Bence Jones, M. A., F. R. S., &c. Philos. Trans., 1848, p. 55.

[2] Case of Mollities Ossium and Fragilitas Ossium accompanied with Urine strongly charged with Animal Matter. Med.-Chir. Trans., vol. xxxiii., 1850.

[3] Dublin Quarterly Journal, 1846, p. 85. Path. Soc. Trans., 1846–7, p. 148.

minal and thoracic organs, except that the cardiac impulse was too strong, and the præcordial dulness too great, without cardiac murmur.

The patient attributed his illness to a strain, but it appears that for some time previously he had been subject to wandering pains about the breast and shoulders. The urine of this patient was submitted to the examination of Dr. Bence Jones, with the following result. The free acid was increased, the phosphates were in much larger amount than in health, and were loaded with a peculiar form of animal matter resembling albumen in its chemical composition, coagulable by heat, but not by nitric acid.

The following table presents the general characters of the urine, as determined by Dr. Bence Jones:—

Date.	Specific gravity.	Earthy phosphates in 1000 parts.	Reaction.	Precipitates, &c.
Nov. 1, 1845.	1034.2		Slightly acid.	Sediment of phosphate of lime, oxalate of lime, and urinary casts.
" 3, "	1043.2	5.68	Acid.	Urate of ammonia, phosphate of lime, and urinary casts.
" 7, "	1039.6	5.65	Slightly alkaline.	Phosphate of lime, and casts.
" 8, "	...	...	....	Heavy deposit of phosphates.
" 9, "	1037.2	...	....	Loaded with urates.
" 18, "	1039.6	...	Acid.	Urate of ammonia, phosphate of lime, and oxalate of lime.
" 27, "	1031.3	8.05		
" 29, "	1037.9	8.24		
" 30, "	1042.7	11.85	Slightly acid.	No fibrinous cylinders.

The complete analysis of 1000 parts of urine, on the 18th of November, gave—

Water	890.72
New substance (resembling albumen)	66.97
Urea	29.90
Uric acid	0.96
Earthy phosphates	1.20
Chloride of sodium	3.83
Sulphate of potash	2.10
Alkaline phosphates	4.45

The following are the conclusions arrived at by Dr. Bence Jones, after a careful examination of the peculiar albuminoid substance in the urine:—

1st. This substance is an oxide of albumen, and from the ultimate analysis, it is the hydrated deutoxide of albumen.

2d. In this case of mollities ossium, 66.97 parts of this hydrated deutoxide of albumen were passing out of the body in every 1000 parts of the urine. Hence, therefore, there was as much of this peculiar albuminous substance in the urine as there is ordinarily albumen in healthy blood. As far, then, as the albumen alone is concerned, each ounce of urine passed was equivalent to an ounce of blood lost.

3d. The peculiar characteristic of this hydrated deutoxide of albumen was its solubility in boiling water, and the precipitate with nitric acid being dissolved by heat, and re-formed when cold. By this reaction a similar substance in small quantity may be detected in pus and in the secretion from the vesiculæ seminales.

4. This substance must again be looked for in acute cases of mollities ossium. The reddening of the urine on the addition of nitric acid, might perhaps lead to the re-discovery of it; when found, the presence of chlorine in the urine, of which there was a suspicion in the above case, should be a special subject of investigation, as it may lead not only to the explanation of the formation of this substance, but to the comprehension of the nature of the disease which affects the bones.

This patient died on the 2d of January. On the following day, Dr. Jones saw that the bony structure of the ribs was cut with the greatest ease, and that the bodies of the vertebræ were capable of being sliced off with the knife.

According to Mr. Macintyre, the sternum, ribs, and cervical, dorsal, and lumbar vertebræ were found soft and brittle; the cancellated structure loaded with a blood-red, soft, gelatiniform substance, which, under the microscope, was found composed of granular matter, oil globules, nucleated cells, with a few caudate cells, and blood disks. The thoracic and abdominal organs presented nothing unhealthy. The patient's death took place without any satisfactory opinion having been arrived at as to the nature of the case.

We do not gather from the record of this post-mortem whether the kidneys were diseased; the appearance of the modified albumen may have been due to the existence of Bright's disease of the kidneys. Future inquiries should determine whether this substance is characteristic of mollities, and whether the lactic acid, and

lactates and sulphates, as well as the phosphates, are increased in the urine.

Marchand[1] analyzed the urine of a child with osteomalacia three days before its death. The fluid was invariably acid, and contained, in 1000 parts—

Water	938.2
Solid constituents	61.8
Urea	27.3
Uric acid	0.9
Lactic acid and lactates	14.2
Phosphates of lime and magnesia	5.7
Other substances and loss	13.7

Not only were the earthy phosphates, in this instance, five or six times as abundant as in health, as was the case in one of the instances of this disease recorded by Mr. Solly, but what is especially interesting, in its bearings upon the nature of mollities, the LACTIC ACID and LACTATES *were greatly increased.*

CHAPTER VII.

COMPARISON OF THE CHEMICAL COMPOSITION OF THE BONES IN MOLLITIES OSSIUM WITH THAT OF HEALTH, AND VARIOUS DISEASED STATES—GENERAL CONCLUSIONS.

NOTWITHSTANDING the comparative simplicity of the analysis of bone, much remains to be accomplished before the true nature of its alterations in various diseases are determined with accuracy. Unfortunately, many analyses of morbid bones are unaccompanied by any minute or accurate history of the case. In such a disease as mollities ossium, it would be of the greatest importance to determine whether, in the resorption of the bone-earth, the strongly basic phosphate of lime is replaced by a less basic salt.

The neglect to ascertain the quantity of the carbonate of lime in the fresh bone, or in the earthy constituents, by the direct determination of the carbonic acid, as well as the employment, in most analyses of bones, of the older method of Berzelius for the deter-

[1] Simon's Animal Chemistry, Am. ed., p. 511.

mination of the phosphate of lime, has left it doubtful whether it exists in bone at $8CaO, 3PO_5$ or $3CaO, PO_5$.

The following tables will present the most important results obtained by chemists, and at the same time furnish data for the determination of the characteristic changes in mollities ossium.

Becquerel and Rodier give the mean composition of human bone, as deduced from fifty-four analyses, made by different experimenters, as follows:—

Phosphate of lime	54.07
" magnesia	1.20
Carbonate of lime	7.40
Fat	1.35
Soda and salts of soda	0.93
Cartilage	35.05

Lehmann represents the constitution of compact osseous tissue, as deduced from the best analyses, as—

Phosphate of lime	57
Carbonate of lime	8
Fluoride of calcium	1
Phosphate of magnesia	1
Mineral constituents	67
Cartilage	33
	100

The comparison of the composition of the bones in mollities ossium with that of health, reveals the following marked changes:—

1. Increase of fat.
2. Decrease of phosphate and carbonate of lime.
3. Relative increase of organic or cartilaginous matter.

Whilst the fat in healthy bones may vary between one and two parts in the hundred, in mollities ossium, on the other hand, according to Prösch, the fat varies from 5.26 to 11.63; according to Lehmann, from 29.18 to 34.15 parts; according to Von Bibra, from 4.15 to 13.28; according to Marchand, from 6.12 to 9.34; according to Garrod, 20.35.

In health the phosphate of lime may vary in different bones; in the adult, between 54 and 60 parts in the hundred; in mollities ossium, according to Bostock, it reached only 13.6 per cent.; according to Prösch, it varied between 13.25 and 33.66; according to Bogne, it varied between 23.23 and 28.11; according to Ragsby, 17.48; according to Lehmann, it varied from 17.56 to 21.02; ac-

cording to Von Bibra, from 46.79 to 55.01; according to Marchand, from 12.56 to 21.35.

In health the carbonate of lime may vary in different bones from 7 to 8 per cent.; in mollities ossium, according to Bostock, it reached only 1.13 per cent.; according to Prösch, it varied between 5.95 and 4.60; according to Bogne, between 0.94 and 1.07; according to Ragsby, 6.32; according to Lehmann, between 3.04 and 4.08; according to Von Bibra, between 4.94 and 7.49; according to Manchard, between 3 and 3.70 per cent.

In healthy adult bones the cartilage may vary between 32 and 36 per cent.; in mollities ossium, according to Bostock, it reached 79.75 per cent.; according to Prösch, it varied between 49.77 and 74.64; according to Bogne, between 63.42 and 70.60; according to Lehmann, between 41.54 and 50.48; according to Von Bibra, between 29.17 and 32.54; according to Marchand, between 61.20 and 75.22; according to Rees, the animal matters varied between 67.50 and 73.87; according to Garrod, 58.37 per cent.; according to Buisson, 54.37 per cent.

It remains that a comparison should be instituted between the composition of the bones in health, in mollities ossium, and in various diseased states, in order that we may determine whether these changes are characteristic of the disease under consideration.

The results of some of the most trustworthy analyses, by the best chemists, will be found in the following tables:—

TABLE.—*Composition of Healthy Bones (Human) according to Von Bibra, Berzelius, Thomson, Marchand, Valentin, and Lehmann.*

Author of analysis.	Subjects.	Bones.	Phosphate of lime and fluoride of calcium.	Carbonate of lime.	Phosphate of magnesia.	Salts insoluble in water.	Cartilage.	Fat.	Soda and chloride of sodium.	Organic matter in cartilage.
Von Bibra,	Male fœtus, 6 to 7 months	Femur	53.46	3.06	2.10	1.00	40.38	traces		
"	" "	Tibia	53.46	3.10	2.00	1.07	40.37	traces		
"	" "	Humerus	53.15	3.05	1.96	1.02	40.82	traces		
"	Female fœtus, 7 months	Ulna	57.63	5.86	1.10	0.60	84.78	0.63		
"	" "	Radius	57.67	5.89	0.99	0.67	34.08	0.50		
"	" "	Clavicles	56.95	5 75	1.07	0 73	34.54	0.96		
"	" "	Scapula	57.13	5.99	1.12	0.62	34.33	0.82		
"	Infant, 2 mos.	Tibia	57.54	6.02	1.03	0.73	33.86	0.82		
"	" "	Ulna	56.35	6.07	1.00	1 65	34.92	1.01		
"	" 9 mos.	Femur	48.11	6.12	0.97	1.23	47.71	1.86		
"	" "	Tibia	48.53	5.79	1.00	1.24	41.50	1 92		
"	" "	Humerus	50 15	6.13	1.00	1.30	39.54	1.89		
"	" "	Ulna	48.06	6.20	1.01	1.24	41.79	1.79		
"	" "	Radius	45.38	5.11	0.95	1 07	45.65	1.83		
"	" "	Ribs	42.32	5.60	0.89	1.09	48.55	1.15		
"	" "	Scapula	42.61	5.08	1.92	1.10	48.36	1.93		
"	Female child, 5 months	Femur	59.96	5 91	1.24	0.69	31.28	0.92		
"	" "	Tibia	59.75	6 00	1.34	0.63	31.34	0.95		
"	Girl, 19 years	Femur	54.78	10.90	1.34	0.83	31.15	1.00		
"	" "	Humerus	54.84	10.82	1.26	0.79	31.37	0.92		
"	Woman, 25 yrs.	Femur	57.12	8.90	1.70	0.60	29.54	1.82		
"	" "	Tibia	57.18	8.93	1.70	0.61	29.58	2.00		
"	" "	Humerus	58.03	9.04	1.59	0.59	29.66	1.09		
"	" "	Ulna	57.52	8.97	1.71	0.67	29.14	1.99		
"	" "	Radius	57.38	8.95	1.72	0.63	29.43	1.89		
"	" "	Ribs	52.91	8.66	1.40	0.60	33.06	2.37		
"	" "	Clavicles	56.35	8.88	1.69	0.59	30.66	1.83		
"	" "	Vertebræ	44.28	8.00	1.44	0.53	43.44	2.31		
"	" "	Fibula	57.39	8.92	1.63	0.60	29.49	1.97		
"	" "	Scapula	54.76	8.58	1.53	0.51	32.90	1.73		
"	" "	Metacarpus	57 77	8.92	1.58	0.61	29.23	1.89		
"	" "	Cranium	57.66	8.75	1.69	0.63	29 87	1.40		
"	Man, 25 years	Femur	59.63	7.33	1.32	0.69	29.70	1.53		
"	" "	Tibia	58.95	7.08	1.30	1.70	30.42	1 55		
"	" "	Humerus	59 95	7.76	1.09	0.72	29.28	1.28		
"	" "	Ulna	59.30	7.35	1.35	0.73	29.98	1.29		
"	" "	Ribs	56.66	6.64	1.07	0.62	33.97	2.04		
"	" "	Cranium	38.43	8.00	1.40	0.90	29 92	1.35		
"	" 58 years	Comp't sub. of femur	58.23	8.35	1.03	0.92	31.47	1.35		
"	" "	Spongy bone of femur	42.82	19.37	1.00	0.99	35.83	1.35		
"	Woman, 62 yrs.	Femur	61.17	4.46	1.29	0.90	28.03	2 15		
"	" 76 yrs.	Femur	57.36	7.48	1.10	0.97	33.16	0.93		
Berzelius,	Human bone	Bones	53 04	11.30	1.16	..	37.17	..	1.20	
Thomson,	Human	Femur	48 67	14.00	0.49	..	39.72	..	2.50	
"	"	Femur	51.12	9.77	0.63	..	35.93	..	0.59	
Marchand,	Man, 30 years	Femur	53.26	10.21	1.05	..	32.25	..	1.17	
Valentin,	" 38 years	Tibia	52 93	7.66	0.25	..	38.02	..	1.10	
Lehmann,	" 40 years	Humerus	56.61	9.20	1.08	..	..	..	1.72	51 52
"	" "	Radius	52 25	9.76	1.06	..	..	..	1.72	33.76
"	" "	Ulna	53.98	9.51	1.07	..	..	..	1.38	33 23
"	" "	Femur	58.93	9 28	1.09	..	..	..	1.44	28.61
"	" "	Fibula	52.99	9.33	1.06	..	..	..	1.44	34.13

Composition of Bones in Mollities Ossium (Osteomalacia).

	Vertebra. (Bostock.)	Vertebra. (Prösch.)	Costa. (Prösch.)
Phosphate of lime	13.60	13.25	33.66
Phosphate of magnesia	0.82	....	....
Carbonate of lime	1.13	5.95	4.60
Sulphate of lime and sulphate of soda	4.70	0.90	0.40
Cartilage	79.75	74.64	49.77
Fats	....	5.26	11.63

An analysis, by Bogne, of the bones of a man, aged 32 years, who died from osteomalacia, yielded the following results:—

	Scapula.	Radius.	Femur.	Patella.
Phosphate of lime	26.92	28.11	23.50	23.23
Carbonate of lime	0.98	1.07	0.97	0.94
Phosphate of magnesia	5.40	6.35	5.07	5.03
Cartilage and vessels	65.85	63.43	69.77	70.60
Soda, iron, and loss	0.85	1.05	0.69	0.64

Ragsby analyzed a rib in this disease, and found—

Phosphate of lime and magnesia	17.48
Carbonate of lime and salts	6.32
Cartilage, vessels, and fat	76.20
Specific gravity	0.721

After the removal of the fat, Lehmann found—

	1.	2.	3.
Phosphate of lime	36.86	31.71	35.87
Other salts	4.96	7.91	5.68
Cartilage	58.16	60.36	58.4

In two cases of osteomalacia, occurring in persons aged about 40 years, Lehmann found—

	(1)		(2)	
	Femur.	Costa.	Femur.	Costa.
Phosphate of lime	17.56	21.02	18.83	19.14
Carbonate of lime	3.04	3.27	3.83	4.08
Phosphate of magnesia	0.23	0.44	0.54	0.60
Soluble salts	0.37	0.63	0.43	0.41
Cartilage	48.83	50.48	41.54	42.43
Fats	29.18	23.13	34.15	32.65

The three following analyses of bone in mollities ossium was made by Von Bibra:—

	Tibia of a woman aged 75 years.	Femur of a woman aged 83 years.	Femur of a man aged 61 years.
Phosphate of lime with a little fluoride of calcium	55.01	46.79	53.25
Carbonate of lime	4.94	6.37	7.49
Phosphate of magnesia	2.01	1.20	1.22
Salts	0.31	1.37	1.35
Cartilage	29.17	30.99	32.54
Fat	8.56	13.28	4.15

Marchand found the bones of the child, whose case has been noticed under the head of the changes of the urine in mollities ossium, composed in the following manner:—

	Vertebra.	Radius.	Femur.	Sternum.
Phosphate of lime . .	12.56	15.11	14.78	21.35
Phosphate of magnesia .	0.92	0.78	0.80	0.72
Carbonate of lime . .	3.20	3.15	3.60	3.70
Sulphate of lime, Sulphate of soda . .	0.98	1.00	1.02	1.68
Fluoride of calcium, Chloride of sodium, Iron and loss .	1.00	1.20	1.00	2 01
Cartilage	75.22	71.26	72.00	61.20
Fat	6.12	7.50	7.20	9.34

In a paper published in the twenty-first volume of the *Medico-Chirurgical Transactions*, Dr. Reese demonstrated by analysis that the different bones of the adult human skeleton in health contained animal and earthy matter in different proportions. Subsequently, Dr. Reese had an opportunity of examining some bones affected with mollities, and the following is the result of careful analyses of three specimens from the same adult subject; they are compared with those obtained from healthy bones:—

	Mollities.		Health.	
	Earths.	Animal matter.	Earths.	Animal matter.
Fibula	32.50	67.50	60.02	39.98
Ribs	30.00	70.00	57.49	42.51
Vertebra	26.13	73.87	57.42	42.58

Dr. Reese observes: "On examining this table it will be observed that in the diseased, as well as the healthy bone, the fibula contains more earthy matter than either the ribs or vertebra; and the ribs more than the vertebra; thus we have the same order preserved in health."

It may be noticed that the vertebra and ribs in health approach very nearly in their proportions of animal and earthy matter; while in mollities a considerable difference exists between them in this respect. This indicates that though the bones are all acted upon by the absorbents in mollities, yet that the absorption does not go on equally in the bones, some being acted on more than others. There is, however, an approach to an equality of action; for, notwithstanding that the diseased bones have lost about half their earthy matter, yet they keep the same order as regards proportional constitution which we observe in health, viz., the fibula

containing more earthy matter than the ribs, and the ribs more than the vertebra.

Having ascertained, by previous experiment, that the earthy matter obtained from the long bones of the extremities contains, as nearly as possible, 86 per cent. of phosphate of lime in health, and that the earthy matter from the trunk bones contained, on an average, 83.03[1] per cent., I determined on mixing together the earths obtained from the fibula, ribs, and vertebra affected with mollities, and subjecting them to analysis. This bone-earth, on examination, proved to contain only 78 per cent. of phosphate of lime. There is evidence here that the absorption of earthy matter by disease is accompanied by a decrease in the proportion of phosphate of lime to carbonate. This would seem to show that the absorbents carry away earthy matter containing a very large percentage of phosphate of lime, for were it otherwise, we should never find bone earth containing so small a percentage as 78 of that earth; the smallest in health being 81.2 of phosphate, to 18.8 of carbonate of lime. That the carbonate is absorbed together with the phosphate of lime in certain though small proportion in these processes, is proved by the fact that bones, even those most changed by the absorption of their earthy matter, are not very greatly removed from healthy bone-earth in the general average proportion of phosphates and carbonate of lime. (*Guy's Hospital Reports*, No. 8, April, 1839; No. 9, *Medico-Chirurgical Review*, July 1st, 1839, pp. 246—247, Am. ed.)

The carbonate of lime in the bones analyzed by Dr. G. O. Reese may have been derived from the burning of some organic acid, as the lactic, during the preparation of the bone-earth for analysis, and without the clear demonstration of the existence of the carbonate of lime as such in the bone previous to incineration, we cannot lay much stress upon its apparent or relative increase when compared with the phosphate of lime.

Solly[2] has given the following analysis of the medullary membrane and osseous substance of an individual affected with osteomalacia. The analysis of the affected bone was made by Dr. Tuson.

	Medullary matter.	Osseous matter.
Animal matter	24.78	18.75
Calcareous phosphates	1.83	29.17
Water	73.39	52.08

[1] This average was drawn from results obtained from seven specimens; the extremes were 81.2 and 85.0.

[2] Medico-Chirurgical Transactions, vol. xxvii. p. 435.

The chemical examination of a case (detailed by Dr. Ramsbotham, in the reports of the Pathological Society[1]) by Dr. Garrod, yielded—

Fatty matter	20.35
Gelatin yielding matter	58.37
Carbonate and phosphate of lime and phosphate of magnesia	21.28

M. Barruel, Jr., found 18 parts of earthy salts, and 82 of organic matter, in 100 parts of bone affected with osteomalacia. The bones of the forearm, which were less softened, afforded 29 of salts, and 71 of organized matter, per cent.

Dr. Buisson, in a thesis published in 1851, gives the following analysis of the inferior extremity of the femur of a female suffering from osteomalacia. She was thirty eight years of age, and her bones had been fractured more than eighty times.

Cartilage	54.37
Phosphates	39.16
Carbonates	6.47

These analyses, says the author, prove that the same results are obtained, whether the bones be softer or more fragile than in health. In all cases there is a considerable decrease of the organic matter. (Simon's *Animal Chemistry*, p. 601. Becquerel and Rodier, *Pathological Chemistry*, p. 507. Rokitansky's *Pathological Anatomy*, vol. iii. p. 144.)

On the other hand, as the basis of comparison, we have given the composition of healthy bones.

Von Bibra has made the most complete analyses of human bone, and the results of his elaborate labors are especially valuable, as serving the purpose of comparison with diseased bones, as he has carefully separated and determined the proportion of fat; whilst the analyses of Berzelius, Thomson, Marchand, Valentin, and Lehmann, do not furnish the proportions of this important constituent of healthy bones. The determination of the proportion of fat in the healthy bone, assumes a position of transcendent importance as the starting point for the determination of the amount and character of the alteration and degeneration of bone in various diseased states, and especially in those diseases of the osseous system which, like mollities, is associated with *fatty degeneration*. The results of the analyses of Von Bibra will be found in the following table, together with those of several other distinguished chemists.

[1] Reports, &c., 1847–48.

TABLE.—*Chemical Composition of Diseased Bones in Rachitis, Caries, Necrosis, Osteoposis, Sclerosis, Exostosis, Osteoid Tumor, Arthritis, and Callus. By Lehmann, Ragsby, Von Bibra, Pelouze, Valentin, Lassaigne, Marchand, and Simon.*

Author of Analysis.	Disease.	Bones.	Phosphate of lime and fluoride of calcium.	Carbonate of lime.	Phosphate of magnesia.	Salts insoluble in water.	Cartilage.	Fat.	Organic matter.
Lehmann,	Rachitis	Tibia	32 04	4.01	0.98	0.75	54.84	5.84	
"	"	"	26.94	4.88	0 81	1.08	60.14	6.22	
"	"	"	28.13	3.75	0.87	1.01	58.77	6.94	
Ragsby,	" child	Scapula & humerus	15.60	2.66	2 66	0.62	81.12	6 94	
Von Bibra,	" "	Ulna	48 83	7.42	1.23	1.82	35.61	6.09	
Pelouze & Fleming,	" "	Dorsal vertebra	13 60	1.13	0.82	1.82	79.75	6 09	
"	" "	"	13.25	5.95	0 82	1.82	74.64	5 26	
"	" "	Ribs	33 30	4 60	0.82	1.82	49.77	5.26	
"	" "	Cranium	26.92	5.40	0.98	0.85	65.85	11.63	
"	" "	Radius	28 11	6.35	1.07	1.05	63.42	11.63	
"	" "	Femur	23.50	5.07	0.97	0.69	69.77	11.63	
Marchand,	" "	Patella	23.23	5.03	0.94	0 64	70 60	11 63	
"	" "	Vertebræ	12.56	3.20	0.92	1.00	75.22	6.12	
"	" "	Radius	15.11	3.15	0.78	1 20	71.26	7.50	
"	" "	Femur	14.78	3 00	0.80	1.00	72.20	7 20	
Valentin,	Caries, man	Tibia	34 38	6.63	1.18	1.91	..	7.20	55.88
"	" "	Vertebræ	33.91	7.60	0 38	3.27	..	7.29	54.83
"	" girl	Femur	39.39	4.62	0.52	1.17	..	..	54.39
"	" "	Tibia	45.45	5.68	1.18	2.06	..	..	45.62
Von Bibra,	" man	Metacarpi	49 77	7.24	1.11	0.30	37.97	3 61	
"	" "	Metacarpal bones	31.36	4.07	0.83	0.30	59.36	4 08	
"	" "	" "	49.36	8.08	0.98	0.40	37.47	3.71	
"	" "		51.53	5.44	3.43	0.91	35.69	3.00	
"	" "	Femur	54.98	5 97	3.70	0.89	31.44	3.02	
"	" woman	"	45.14	5.03	2.40	0.82	42.34	4 27	
"	" man	Patella	39.22	6 87	0.50	2.10	29 23	22.09	
"	" girl	Tarsus	45 77	3.77	1.45	1.10	38 62	9.29	
"	" woman	Vertebræ	44.05	3.45	1.02	1.70	41.42	8.36	
"	" man	Tibia	47.79	6.44	1.30	2.00	28.57	13.60	
"	Necrosis	Phalanges	72.63	4.03	1.93	0.61	19.58	1.22	
"	" "	Bone	60.77	4.03	1.93	..	..	1.36	38.87
"	" "	Fracture	67.33	4.03	1.93	..	..	1.09	31.58
Ragsby,	Osteoposis	Cranium	55.80	5.59	1.93	..	..	..	38.61
"	Sclerosis, man	"	54.10	10.45	1.00	1.04	33.41		
"	"	"	48.20	7.45	..	0.25	44.10		
"	"	"	50.29	7.20	..	0.25	42.51		
"	"	"	55.52	5.95	..	0.26	38 27		
"	"	Femur	53.21	8.30	..	..	38 49		
"	" syphilitic	"	57.20	6.50	..	..	36.30		
Lassaigne,	Exostosis	Thickened bone	36.3	6.5	..	14.2	36.30	..	43.0
"	"	Exostosis	30 0	14.0	..	10.0	36 30	..	46.0
Simon,	Osteoid tumor	Knee-bone	38 85	2.70	0.58	0.78	58 91	1.16	
"	" "	"	8.00	0 62	0.21	0.39	87.04	3.61	
"	" "	"	9 20	0.64	0.21	0 72	86.20	3.21	
Marchand,	Arthritis, tophaceous deposit	Femur	42.12	8.24	1.01	2.31	86.20	..	46.32
"	" "	Radius and ulna	43 18	8.50	0.99	1.37	86 20	..	45.94
Lehmann,	Arthritis, chronic gout	"	35.16	8.41	1.31	2.93	38.14	12.11	
"	" "	"	35.83	9 82	1.05	2.03	38 20	13 37	
"	" "	"	37.02	8.99	1.13	1.82	40 03	9.15	
Lassaigne	Callosities	"	33 3	5.7	1.13	11.3	40.03	..	50.0
"	"	"	32.5	6.2	1.13	12.8	40.03	..	48.5

In the preceding table it will be seen that, in rickets, according to the analyses of MM. Pelouze and Fremy, it appears that the decrease of calcareous matters was even greater than in individuals suffering from mollities ossium; and in the analysis by Marchand,

the calcareous salts, and especially the phosphate of lime, are greatly diminished, and the proportion between the organic and inorganic matters is precisely the inverse of what it is in health. The analysis of bones affected with rachitis yields, therefore, results similar to those announced for mollities ossium, viz., decrease of phosphate of lime, and increase of the cartilaginous and fatty matters. It will be seen, however, that the fatty matters are increased much more uniformly, and to a far greater extent than in mollities ossium.

In caries there is a marked decrease of the proportion of phosphate of lime; in some cases a slight increase of the carbonate of lime; no appreciable change in the proportion of the phosphate of magnesia and soluble salts; normal proportion of cartilage, and a frequent and decided increase of adipose matter.

The few analyses in necrosis indicate a slight diminution of the cartilaginous substance, an increase of calcareous salts, and the normal proportion of adipose matter.

In the tophaceous deposits of chronic arthritis there is decrease of the phosphate of lime, increase of the carbonate of lime, and great increase of the adipose matter.

Whilst, therefore, this comparison establishes analogous changes in the bones of certain diseases, as caries, necrosis, and arthritis, at the same time we have a demonstration that mollities ossium is especially characterized by the degeneration of the osseous structure into fatty matter. We cannot agree with those pathologists who see nothing in this disease but a fatty degeneration of bone. In those diseases, as caries and arthritis, in which we have a similar change, but to a less degree, we have inflammatory action; and the true and most important question with reference to mollities ossium is the determination of the causes which led to such an alteration of the bones as led, not merely to the absorption of the earthy salts, but also to the effusion of inflammatory products in the bony structure, and their final conversion into fatty matter, as in those diseases which are, in their inception, truly inflammatory.

The view that the earthy phosphates, in mollities ossium, were removed by some acid generated in the living system, was suggested at an early day in the history of the disease; and, in fact, this idea appears to have been suggested by the effects of acids upon healthy bones in rendering them flexible like cartilage.

Dominic Gagliardi, who, discoursing upon the observation of Gabrielli upon mollities ossium, in 1689, supposed that the earthy

matter, or bony *gypsum*, as he called it, is softened in consequence of its being alkaline, by the acids which are thrown into the vessels of the bones; and that from hence it is that persons subject to rheumatic and arthritic pains, but peculiarly to pains from the "lues venerea," are also subject to have their bones become soft. This statement led to the experiments of softening the bones by means of acid liquors.

Morgagni adopted the same opinion, and conjectures that a *humor* is carried into the bones, which is capable of softening them, and refers to the experiments of Ruysch, who showed that acid liquids would remove the earthy particles, and render the bones so soft and elastic as to be bent into any shape.

Ruysch, in recording his experiments, makes the following application in the form of a query: "Does it from hence appear in what manner that memorable disease was brought about wherein a virgin, in France, being affected, had all her bones softened down like paste?"

More recently Marchand has propounded a chemical theory of mollities ossium and rickets, which is a further elucidation of the old idea of the action of an acid humor in the blood. This theory of Marchand we have thrown into three propositions as follows:—

1. The diseases which exert the greatest influence over the condition of the bones, altering them from their normal state, are scrofulous affections, to which rickets and mollities ossium may be considered as belonging.

In these two diseases, the earthy matter of the bone becomes diminished, and the bone falls into a state such as if it had been macerated in muriatic acid; supple; flexible, and ill-adapted to serve as a support to the other organs of the body. The cartilage itself undergoes an essential alteration, and is incapable of being converted by boiling into gelatine.

2. Concurrently with these changes, phosphate of lime is eliminated in large quantities with the urine. This salt, otherwise little soluble, and discharged generally in small quantity by the kidneys, is, according to Berzelius, readily soluble in lactic acid; anything, therefore, which causes a superabundance of this acid in the system, is capable of depriving the organism of a large share of the earthy matter of the bones.

Sugar of milk, grape sugar, starch, and gum are readily converted into lactic acid, but they are so in the stomach only when

digestion is ill performed, in which case lactic acid may be an abundant product in the system.

3. Rickets and mollities ossium, therefore, are not essentially diseases of the bones, but seem to be the result of imperfect digestion or nutrition; to improve which is consequently our first indication.

None of the substances readily converted into lactic acid should be taken, as sugar, starch, gum, etc., nor even milk (rickets are often the consequence of children having been too long suckled), but animal food and such other as is freely digestible, should be chosen, in aid of which we ought to employ such medicines as may restore the general tone of the system.

This chemical theory of Marchand is sustained by the discovery of increased quantities of lactic acid and lactates in the urine of rickets and mollities ossium; and by the actual discovery of lactic acid in the diseased bones of the latter disease.

C. Schmidt proved clearly that free lactic acid was present in the fluid of the cylindrical bones in this disease; and Lehmann states that the fluid occurring in these bones exhibits *very often*, although not invariably, an acid reaction. Weber, who alone appears to have investigated the composition of the phosphate of lime contained in these bones, found in addition to carbonate of lime $\frac{3}{8}$ basic phosphate of lime, and believes that phosphate of normal bone ($3CaO,PO_5$) is converted by means of the free acid into this less basic salt.

The singular and painful disease of the jaw-bones, produced by the fumes of phosphorus and phosphoric acid,[1] renders it probable that in mollities ossium, most of the pain and irritation of the bones may be caused by the liberation of phosphoric acid in the phosphate of lime which has been subjected to the action of the *free* lactic acid.

[1] For an interesting account of the Diseases of Workmen engaged in making Lucifer Matches, see American Journal of the Medical Sciences; Oct. 1846, N. S. vol. xii. p. 525.