

ing from impaction, not of the neck into the trochanteric region, but of the lower fragment of the shaft into the upper. The record of a case I shall presently give shows how readily the error of diagnosis may be made in life, and how important it is to establish it.

3. My next specimen is from the collection of Trinity College. At first sight, this is a fracture of the upper third of the shaft of the femur, which chiefly attracts attention by its great obliquity and by the horrible deformity which characterises its union. The fragments cross each other at an angle of 130° ; and a firm callus unites them, the oblique point of each fragment projecting nearly two inches above and below. The upper fragment, however, shows that the lower has split it as in the two preceding specimens, and that the lines of secondary fracture are precisely the same as in the first; while the summit of the great trochanter has had a wedge-shaped piece pressed out by the compression of the sides of its fissures, exactly as in the first specimen. The primary fracture starts from the front of the bone more than an inch below the level of the previous specimen; and no impacted wedge is seen as in No. 1. Either it is concealed by callus, or more probably is absent, the lower fragment being impacted *en masse* rather than pointwise into the upper. The base of the digital fossa and the neck are traversed by a fracture which, though completely detaching the neck, has led to no displacement.

4 and 5. Ea 558 and Ea 589 of the College of Surgeons' collection exhibit similar features; only in these instances the injuries have been caused by forces which acted with greater effect than in the previous cases. The lower fragment in each has been so violently driven into and against the broken surface of the upper, that the secondary fractures have separated completely; the neck, carrying with it a splinter from the front of the shaft, has been set entirely free. In each, the same vertical fracture ascends through the great trochanter and splits it in two.

6. Ea 564 of the College of Surgeons' collection, mounted in spirit, shows similar characters; but the details are not as easily made out, in consequence of the soft parts covering the bone and in part concealing the upper fragment. To an eye familiar with these dry specimens, it is clear, however, that the fissures of the upper fragment are similar to those they present, and the result of the same kind of force.

7. Last of the series is this specimen from the Trinity College collection. It at once reminds one of Sandifort's plate. The union of the fracture is of old date and most complete; but we can readily see the lines of the primary fracture, as in all the preceding, oblique from above, and in front, downwards and outwards; the impaction of the lower into the upper; the splitting of the upper; and the lines of fracture, passing vertically through the great trochanter, then into the digital fossa and neck. This specimen alone shows a comminution of the lower fragment as well as of the upper. A long splinter has split off from the outside of the bone, extending nearly to the lower third of the shaft along its outside.

I have now given the details of the seven specimens of this injury before the meeting, and have merely to note that, with the exclusion of the forms of fracture I have noticed at starting—that is, of comminuted fractures directly secondary to fractures of the neck of the femur external to the capsule, and of gunshot comminuted fractures—they are the only examples of comminuted fracture of the upper third of the femur in our Dublin collections. The testimony of Anger's plates, drawn from the Paris museums, leads directly to the same conclusion as to this being the most common variety of comminuted fracture of the upper third of the femur. I have failed to find any exception to the rule of these specimens in such of the museums of London as I have been able to examine. There only remains for me to give the details of a case of injury of the femur which I have recently observed, which, I have no doubt, is an example of this fracture.

A strong healthy man, aged about 32, slipped in stepping from a loft piled with grain on to the rungs of a ladder which led through a trap to the floor below. Failing to grasp any support, as the piled grain offered no fixed point, he fell with his foot between the uppermost rungs of the ladder, and remained entangled. How long he hung in this position he could not tell, as he stated that he became unconscious almost as he fell. He was found, as far as we could learn, about an hour and a half after his fall, by his son, a boy of eleven years of age. The boy stated that he found his father hanging by his leg from the ladder, with his shoulders resting on the floor (the total height of the ladder was only about six feet, and the man was nearly six feet in height). After being found, he lay on an extemporised bed in the store for two nights and a day, suffering great pain, but unwilling to move or give up personal charge of the store, which was under his care. He was said to be a perfectly sober man, and to have been sober at the time of his fall. On admission to Sir P. Dun's Hospital on the day but one after his injury, I found him lying with the limb everted and shortened

an inch and three-quarters; while the thigh was greatly swollen, and distended to the knee by effusion. Traction at the foot reduced the shortening to less than an inch; but the pain of any further effort in this direction became intolerable. During reduction, the trochanter descended and rotated with the shaft of the bone, while a portion of its posterior margin appeared to be displaced backwards. An osseous tumour could be indistinctly made out in the inguinal region over the lesser trochanter; and, during the extension of the limb, crepitus could, though with difficulty, be elicited. I felt satisfied that I was dealing with an extracapsular fracture of the neck of the femur, which had become unimpacted by the complete splintering of the trochanteric region. So satisfied was I of the correctness of the diagnosis, that I wrote it in detail on the bed-card. The limb, being put up in a long splint, lay fairly well; but the patient was most intolerant of a perineal band. One point in the case struck me as most difficult to explain: the occurrence of an extracapsular fracture of the neck of the femur, with fractures of the trochanters, from a cause such as the history of the case indicated. At first, I inclined to the idea that the history was incorrect; that the man had fallen right on to his hip, but that he failed to recollect it. Only direct cross-examination of his son, some days after his admission, removed all doubt of the truth of his statement. When the swelling subsided somewhat in the thigh, after an interval of a fortnight, I detected for the first time a point of bone projecting slightly to the outside of the shaft of the femur, near the junction of the upper and middle third. This point was shaped and directed so as to leave no doubt that it was the apex of the upper fragment of a very oblique fracture of the shaft, oblique from above downwards and outwards. Viewed in connection with the series of specimens I have presented, and particularly with the second instance, in which we have a similar kind of injury and a similar error of diagnosis, I think this case valuable as helping to explain the mechanism of the injury.

I believe that this case and the specimens I have exhibited and quoted establish the fact that the commonest form of comminuted fracture of the upper third of the femur is of a definite type—namely, a primary fracture, oblique from above and in front downwards and outwards, so as to place the lowest point of the upper fragment on the outside of the bone about the junction of its upper and middle thirds, and secondary splittings of the upper fragment, which include a fracture of the neck external to the capsule; that these splittings result from the impaction of the lower fragment into or against the structure of the upper, and that the pieces of the upper fragment may undergo more or less complete dissection or may remain firmly connected; lastly, that the primary injury results from indirect violence, and it may be chiefly from muscular action; while the secondary fractures are caused by the impaction of the lower fragment into the upper, most likely by the action of the muscles of the thigh.

NOTE ON TINNITUS AURIUM.

By SAMUEL SEXTON, M.D., New York.

ALTHOUGH not a disease in itself, tinnitus aurium is frequently a most distressing symptom of some aural affections, and not unfrequently it is the only one of which the patient is cognisant.

Those ringing or buzzing sounds, synonymous with tinnitus aurium, which are heard in the head or ears under certain circumstances, arise usually from the busy circulation in the immediate neighbourhood of the auditory conductive apparatus; and, in addition to these, but heard more rarely, are also the motions of the heart, the respiratory act, the throbbing of the carotid arteries in their bony canals, and the friction of the ossicula themselves in some anomalous conditions. Moreover, the phenomena which arise from these causes are subject to an increase by the existence of aural hyperemia, chronic and acute inflammations of the ear, flushings affecting this region, probably due to vaso-motor influences, the excitement of alcohol, quinine, and anæsthetics, and straining at stool or labour.

When tinnitus, however, arises from these subsidiary causes, it is never permanent until certain pathological changes, to be presently mentioned, have occurred in the conductive apparatus.

I shall not include among the enumerated varieties of tinnitus aurium the phenomena of autophony, sounds arising from supposed contractions of the tensor tympani muscle, or from foreign bodies present in the external auditory meatus; although from these two latter causes the most distressing kind of tinnitus results.

Strictly, therefore, sounds of an intracranial origin, or those, in other words, impinging on the drum-head, or ossicles, from within, are concerned in tinnitus aurium. The circulation of the blood here referred to, especially when abnormally active, may set in motion waves of sound that can, under certain circumstances, be heard by the patient

himself, some of which, in the healthy state of the auditory apparatus, are usually inaudible. Hence to such sounds only as are audible to the patient himself when the conductive apparatus is in an anomalous condition, should the term tinnitus aurium be applicable. Tinnitus, as a resulting phenomenon of the stimulation of alcohol, anæsthetics, quinin, straining at stool, etc., is probably dependent on temporary conditions only, which, not being pathological in their nature, are therefore excluded.

We will now inquire under what circumstances tinnitus aurium occurs. In other words, why does a person sometimes become familiar with the intratympanic sounds of the circulation, etc., which were hitherto inaudible to him?

Before entering into an explanation of this mooted question, the ground may be cleared up somewhat by recalling to mind the fact that otology has as yet been unable to demonstrate that the auditory nerve is liable to pathological changes which affect its physiological functions; and, therefore, when the tinnitus exists, the sound must arise beyond that region; hence we should seek for explanation in some anomaly in the conductive apparatus itself that enables it to transmit to the auditory nerve sounds usually inaudible.

It is believed by the writer that sounds of which tinnitus is composed have their origin in the circulatory fluid in the neighbourhood of the ear. Some of them, however, may arise from contractions of the tensor tympani muscle, and quite frequently they are found to depend on the friction which takes place during the excursive movements of the membrana tympani and ossicula. It is difficult to believe that new sounds are created by the nerve of hearing itself; and, with the exceptions just alluded to, there are strictly speaking no new sounds. It is probable, nevertheless, that in many instances the sounds of the circulation, when heightened as it were by certain unusual or anomalous conditions, can be heard by the normal ear.

It is to be presumed that the theory of hearing entertained by Edward Weber is nearly the correct one, as far as the mechanism of the conductive apparatus of the ear is concerned. Weber regarded the bones of the ear and the petrous portion of the temporal bone as solid, incompressible bodies, and the fluid of the labyrinth as an incompressible fluid; and the bones of the ear must be considered as solid levers, which transmit waves of condensation and rarefaction to the fluid of the labyrinth, moving it as a whole.* Adopting, then, the theory of Weber, we are to observe what takes place when these excursions become ineffectual disease. In almost all cases, we have tinnitus aurium, associated with the ensuing deafness.

The pathological anatomy of the various anomalies of the membrana tympani and ossicula in disease affords an explanation of the usual symptoms of deafness, including that of tinnitus. The normal excursions of the mechanism are no longer possible, the joints having become ankylosed or more or less separated, the membrana tympani having also suffered from anomalies which affect its plane, tension, texture, etc. Not unfrequently the ossicles are thus drawn from their normal position by the membrane itself, the displacements being easily detected by the eye when an examination is made through a speculum. In the stuffiness of a cold in the head, or the distension of the tympanum from mucous collections in acute aural catarrh, the anomalies just referred to are most decided, and the tinnitus is well marked. Guided by an anatomical knowledge of the parts, I should infer that the malleo-incudal joint was most liable to injury, and that perhaps fixation of the stapes in the fenestra ovalis was not much less frequent.

The moment the integrity of the chain of ossicles and membrana tympani is disturbed, the hitherto unheard sounds of the circulation are transmitted to the auditory nerve by means of conduction through the partly isolated chain of ossicles. In health this could not take place, for sound-waves are then only conveyed to the nerve when impinging on the drum-head by way of the external auditory meatus.

The impracticability of sound-waves of an intratympanic nature ordinarily being heard is made clear by the researches of Helmholtz, who has shown that outward movements of the membrana tympani may be extended considerably before any traction on the stapes through the chain of ossicles is possible.† Hence in health all sounds of the circulation arising *within* the head are usually too feeble to be heard, unless the meatus externus be occluded, as by pressure of the fingers, when the sound will be reflected *back* on the drum-head, causing it to make responsive excursions, the circulation being thus heard as tinnitus so long as the meatus is closed. It is, therefore, when the integrity of the conductive apparatus is no longer maintained, that sounds of the circulation in the neighbourhood of the ear, which were previously unheard by the patient, are now heard by him with greater or less distinctness, and they

are the source of the *ringing in the ears* which is then experienced. With this tinnitus, there is frequent coincident-friction sound of the ossicles.

It is thus seen that anomalies of the conductive apparatus, such as were just referred to, admit of the sound-waves of intracranial circulation creating a constant noise in the head of the patient. The sounds from the intracranial circulation should scarcely be designated as *noises*, for their pitch is musical, its quality depending in some measure on the force of the heart's action. The sounds which are sometimes designated as ticking, and are a frequent accompaniment of the singing, jar strangely on the ear, and should be classed as "noise".

The writer has been the subject of moderate singing in the ears for a long time, and has had, therefore, frequent opportunities for its study. When he is at work, or in the midst of a noise, the singing is unobserved; but when everything is quiet, and his attention is not drawn to any particular thing, the phenomenon is seldom out of mind. Sometimes, when first lying down in bed at night, the tinnitus increases, as it also does when he awakes suddenly. If he have been riding in a noisy conveyance, or standing near an engine letting off steam, or by the surf at the sea-side, there is afterwards for a time a continuance of the same sounds, the tinnitus seeming to assume the phase of the latest impression made on the organ of hearing. Patients from the different walks of life, describing the symptoms of tinnitus, are very likely to compare it to some sound with which they have long been familiar, as the surf, a waterfall, the wind in the trees, escaping steam, motions of machinery, etc.*

As might be expected, this symptom often carries with it great terror to the patient. He fancies that he is pursued by warning voices of impending death, or that the sounds are forerunners of some grave cerebral affection, or that they at least prognosticate an ever-advancing aural disease, which threatens total deafness.

The patient can usually be promptly assured, as regards these matters, of the simplicity and harmlessness of tinnitus aurium. When the patient once has this symptom associated with chronic diseases of the ear affecting the conductive apparatus, it seldom if ever entirely disappears, but it does not necessarily indicate activity in the aural affection, and is not prognostic, therefore, of advancing aural disease.

Tinnitus aurium is a symptom of frequent occurrence in old age, and may depend partly on trophic changes in the blood-vessels themselves or the tissues in which they are situated, thus altering the sounds of the circulation.

As intimated before, there are unmusical sounds sometimes heard in the ears in addition to the singing. These sounds are described by patients as resembling the ticking of a clock, the interrupted revolution of machinery, the puffing exhaust of a locomotive engine, etc. The unmusical sounds are not of so frequent occurrence as the singing, are seldom if ever experienced unaccompanied by the latter, and they are usually synchronous with the heart's action. I have witnessed the most striking examples in persons advanced in consumption, where the middle ear was the subject of a rapidly advancing purulent but painless inflammation, with breaking down of the structures composing the conductive apparatus. These patients describe noises occurring with the beating of the pulse, which resemble the tapping together of small pieces of wood or the like, or the ticking of a clock. In some instances these noises are affected by the position of the head of the patient, disappearing when a horizontal position is assumed, or they are in other instances only experienced in that position. These sounds are probably dependent in part on the concussion of the carotid artery, which, when transmitted to the ear, sets in motion the somewhat detached ossicles, giving rise to sounds of ticking, grating, etc. The presence of fluids in the tympanum would doubtless facilitate more or less the transmission of such vibrations. In some instances the singing tinnitus is not observed, while the ticking, etc., persists. Not unfrequently, I have seen examples where shaking the head seemed to occasion a rattling of the ear, in some instances the patient described the sensation *experienced as noises occasioned by something loose in the ears or head.

Most persons must have experienced hearing the beating of the heart when the meatus is closed by the pressure occasioned by lying with the ear on a pillow. When the anomaly of separated ossicles exists, the heart's action is often heard uninterruptedly during the waking hours: a disagreeable and often alarming sensation.

Hearing the pulsation of the carotid artery is familiar to everyone. In the absence of the drum-head, there is probably always less tinnitus, more or less fixation of the ossicles existing under these circumstances, especially of the head of the stapes in the fenestra ovalis, and the sounds of the circulation are not of sufficient intensity to be heard

* Vide Helmholtz, translated by Buck and Smith, New York, 1873.
† Helmholtz, *op. cit.*, page 33.

* Tinnitus aurium is beautifully described by Sir William Wilde: *vide* his work, page 91, American edition, 1853.

under these circumstances. An expression of wonderment can scarcely be suppressed in contemplating the mechanism of the conductive apparatus of the human ear; for, were the sounds of the intracranial circulation, or of the voice (autophony), heard at all times, the resulting interference with sound reaching the ear from without *via* the meatus externus would be too great to permit perfect hearing. The construction of the mechanism of the ear, however, is of such a character that no interference takes place so long as the integrity of the conductive apparatus, which in this connection should be regarded as inclusive of the petrous bone, remains in a normal state as an "incompressible whole".

In offering a new explanation of the origin of tinnitus aurium, contrary to that still held by eminent authorities, I will briefly allude to the course of investigation by which I was led to adopt my views. Although clinical observation has been the means of clearing up this subject somewhat, I am of the opinion that, when workers more competent than myself shall fully explore this subject from a physical rather than a physiological standpoint, their efforts will be rewarded by greater advances in this special field of otology than have hitherto been made.

My convictions, as I have already intimated, were reached mainly through clinical observations, the first result of my researches being the discovery that in certain individuals the acuteness of hearing was affected by the position of the head. A gentleman over seventy years of age was seen, who could not hear his watch ticking when it was laid upon his up-turned ear; but when the position of his head was reversed, and the ear held over the watch, he could hear it distinctly. Soon afterwards, my attention was directed to a youth who was quite deaf from a non-purulent inflammation of both drum-heads, probably involving the drum also, induced by salt water bathing, but was suddenly restored to good hearing for a short period of time by diving into the water of the Hudson. The temporary improvement seeming to be due to the pressure exerted by the water on the drum-membranes, I was led to repeat the experiment by condensing the air in the meatus externus, when a like result was obtained.*

Clinical experience like this led to the conclusion that many anomalies of audition, hitherto supposed by me to arise from abnormalities in the inner ear, were really due to pathological conditions of the conductive apparatus.

In some cases, rarefaction or condensation of air in the meatus externus will greatly lessen severe tinnitus, perhaps by temporarily readjusting the displaced ossicula.†

ON OSTEOMALACIA (MOLLITIES OSSIUM) OCCURRING IN A CASE OF CHRONIC DEMENTIA,

WITH ILLUSTRATIVE SPECIMENS OF THE AFFECTED BONES.‡

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THE specimens which are before me, and to which I am about to briefly call your attention, are interesting examples of an affection, which, though stated to be not an unfrequent accompaniment or complication of chronic cerebro-mental disease, is yet in my experience rare; and the facts of the case are such as, I believe, warrant me in bringing them before this Section of our Association.

Osteomalacia, or mollities ossium, as you are all aware, consists in a decalcification and gradual liquefaction of the bone-tissue, the etiological factors of this condition being, in the majority of instances, as yet obscure. It is characterised in the long bones by a gradual dilatation of the medullary canal, with thinning of the cortical substance, and which is, to a great extent, accompanied by a "fragilitas ossium", and often even by total softness and flexibility of the bones; and of this state the portions of the different bones on the table are well marked examples. They were taken from the body of a male patient, J. M., aged 55, for over fifteen years an inmate of the Cork District Lunatic Asylum, and for the last seven years of that period bedridden from contractions and rigidity of the lower limbs. He had originally been a soldier; and while in India some years before his admission to the asylum, he had, I presume in a paroxysm of mental alienation, removed the entire scrotum and testes. For several years subsequent to his admission, he was a lithe, active, and, I am told, a good-looking creature;

while the reputation of his dancing powers still followed him when he first came under my observation towards the end of the year 1873. He was then, and had been for some years, a bedridden and aged-looking cripple, with the peculiar effeminate physiognomy and scanty and almost colourless hair of those deprived of the organs of generation. As he lay in bed, the knees were fixed immovably in the flexed position, and the joint-ends of the bones appeared enlarged, but this was only comparatively so, from the degree of emaciation to which the thighs and legs had been reduced; the former were partially flexed on the pelvis, and quite immovable. He very frequently complained of intense pains, which he located in the knees principally, and would cry out lustily if any manipulation were attempted on them; though in general he was one of the most uncomplaining and self-satisfied patients I ever knew; lying always on his back, from which he could by no means move himself; answering invariably, when questioned as to his condition, with a smile that he was quite well and hoped to be soon able to rise. He could use the arms and hands, and was scrupulously neat and clean in his habits and surroundings. He never allowed himself to get wet or dirty; and it may be to this that his complete immunity from any trace of bed-sore during the seven years he so lay is to be attributed. He was, as I have just remarked, emaciated to an advanced degree; all the muscular groups of the limbs and the trunk being equally involved. His appetite was excellent; and, during the four years I knew him, he never suffered from any acute illness or functional disturbance of any organ. His mental condition was characterised by mild though persistent dementia, accompanied with delusions, which, curiously enough, were frequently of a most amatory nature. He knew the names of some of those immediately attending on him, while he entirely mistook the identity of others, though he recognised their appearance. He frequently fancied that the devil came to torment him when the apparently arthritic pains came on.

On Friday, November 30th, 1877, when paying my morning visit to the asylum hospital, I found him in his usual condition, contented and good-humoured; but on my return to the dormitory where he lay, in a little time, having passed along the wards, I found that, during that time, a strange fatality had occurred. The room which he occupied was a small associated dormitory, which, on the occasion in question, was being dusted down by a fellow-patient, a generally harmless and quiet young man. While the latter was thus employed, our patient requested him to desist, as he disliked the dust and disturbance; and, in return, the other came over to his bed, and playfully threw himself on him, with the effect of at once breaking both thighs about their upper thirds and both lower limbs, the right being fractured in the middle, the left in the lower third. The position the limbs had now assumed was very strange-looking; the thighs were completely flexed on the body, and their anterior surfaces lay along the abdomen, the knees resting on the clavicles; the calf of each leg was in close apposition with the posterior surface of each thigh, and the heels touched the buttocks. He made no cry or complaint of pain, and said to me that "it was a thing of nothing"; movement, however, of the broken limbs caused sharp pain. As the limbs could in nowise be straightened, and as the diseased condition of the bones was now made evident, from the slight force which had been sufficient to do such extensive damage, small splints secured with bandages were applied, merely to give support to the powerless legs, which lay a dead weight on the abdomen. After about a week, however, the groin and lateral surface of the abdomen at the left side began to strip and inflame, while small eschars formed at the seat of the fractures of the femora. The knees were further raised and supported on a kind of bridge placed across the bed. On the next day, quietly and without any indicative signs, he died.

I made a *post mortem* examination of the body twenty-four hours afterwards, and removed the head and portion of the humerus, the head of the femur, and the knee-joint, all from the right side. On first inspection, the surfaces of the bones, beyond being slightly enlarged, presented no deviation from the normal condition. On touching them, however, they were found to be almost as fragile as rotten timber. Any of the bones of the lower extremities mentioned could with facility be cut through with a scalpel, and the vertebral column cut during the removal of the spinal cord was in a similar condition. The head of the humerus was equally soft; but the calvarium was not notably affected. On section of the bones removed, the medullary portion was seen to be vastly enlarged, and the cortical layer proportionally diminished in thickness, being, over the heads of the humerus and femur, reduced to the thinness of paper; the cancellous tissue formed at the expense of the cortical was extremely delicate and friable, and its trabeculae were everywhere loaded with a semifluid oily or fatty-looking material, which I have removed in great part by boiling. The cancellous tissue was not present in the shafts, but it made up almost entirely the heads of the bones, the morbid process being farthest advanced in the tibiae and

* *Vide* account of this case, *New York Medical Record*, January 13th, 1877.

† For a discussion on this subject, see paper by the author on the Relations of the Conductive Mechanism of the Ear to Abnormal Hearing (*Transactions of the American Otological Society*; Boston, 1879.)

‡ Read in the Section of Psychology at the Annual Meeting of the British Medical Association in Cork, August 1879.