Lectures on the structure and physiology of the parts composing the skeleton, and on the diseases of the bones and joints of the human body : preceded by some observations on the influence of the brain and nerves, delivered before the Royal College of Surgeons of London, in the summer of the year 1820 / by James Wilson.

Contributors

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LECTURES

ON THE

STRUCTURE AND PHYSIOLOGY

OF THE PARTS

COMPOSING THE SKELETON,

AND ON THE

DISEASES OF THE BONES

AND

JOINTS

OF

THE HUMAN BODY,

PRECEDED BY SOME OBSERVATIONS ON THE INFLUENCE OF THE

BRAIN AND NERVES,

DELIVERED BEFORE THE

ROYAL COLLEGE OF SURGEONS OF LONDON,

IN

THE SUMMER OF THE YEAR 1820.

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BY JAMES WILSON, F. R. S.

Professor of Anatomy and Surgery to the College, Lecturer of Anatomy and Surgery at the Hunterian School in Great Windmill Street,
And one of the Vice Presidents of the Medico-Chirurgical Society of London.

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TO

SIR WILLIAM BLIZARD,

F. R. S.

MY DEAR SIR,

IN dedicating this volume to you, I offer it as a small tribute of my admiration of the manly and liberal spirit, which has invariably marked your conduct as a Member of the Court of Assistants of our College, as one of our Examiners, and as Chairman to the Board of Curators of the Museum.

The professional distinctions, which you have so deservedly acquired, have always redoubled your labours, and your philanthropic mind has ever directed them to subjects of public utility.

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Accept I beseech you, with your usual kindness, this acknowledgement of my respect and esteem, and believe me ever,

My Dear Sir,

your much obliged sincere Friend,

and obedient Servant,

JAMES WILSON.

George Street, Hanover Square,
September, 1st. 1820.

TO THE READER.

THE Lectures which compose this volume are presented to the Public from the same motives, that induced me to lay before them the discourses delivered last year, at the Royal College of Surgeons, on the Blood and Vascular System; the favourable reception of which, has become an additional motive for the present publication.

In the introductory observations I have stated my reasons for the selection of the subjects of discourse, and the manner in which I thought it became me to treat on them, before an audience so peculiarly constituted, as the one assembled in the Theatre of the College.

It having been suggested to me that a concise description of the figure and shape of the different classes of human teeth, would render the observations which I made on their structure more generally useful, I have added such description in an appendix, at the end of the volume.

It was my intention to have subjoined, in a similar manner, a concise account of those symptoms which mark the different situations of the head of the femur when the hip joint is dislocated, and to have mentioned the treatment which each kind of dislocation required; but the accurate practical observations, in the treatise lately published on these subjects by Mr. Astley Cooper, have rendered my doing so superfluous.

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LECTURE I.

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INTRODUCTORY OBSERVATIONS.

ON THE INFLUENCE OF THE MIND ON THE BODY BY MEANS OF THE BRAIN AND NERVES.

MASTER AND GENTLEMEN,

ON reflecting how slow has been the progress of the sciences from their first dawn, and how long the intervals that have occurred between the marked points which have added to their brilliancy, we are led to the proper appreciation of the merits of those men, who from industry, genius, or talents formed by a combination of both, have added more useful information to some particular science during their lives, than had been accumulated in several preceding ages.

Accidental or untoward circumstances, the ignorance or envy of cotemporary rivals, or the caprice of some leading individuals, may for a short time retard the decision of the public as to the true value of the most useful discoveries; but as that decision is sure to be eventually just, the time given for the consideration of merit must add dignity to the ultimate award.

This is strongly exemplified in the British Government's concurrence with this College in forming such estimation of the labours and talents of John Hunter, as to raise a monument honourable to the memory of the individual, and useful not only to our country, but to the world. The government having purchased his anatomical preparations, presented them to our College, and liberally aided us in erecting a building fit for their reception, where they have been arranged and augmented by donations and other means, so as now to form a grand national museum, containing the most valuable materials, when properly studied, for the extension of the knowledge of anatomy and physiology, and consequently for the improvement of medicine and surgery.

In furtherance of these views the Governors of the College have ordered thirty lectures to be annually delivered, and our Board of Curators, to render these more generally useful, have this year shortened the period of their duration by directing that three lectures should be delivered in each week, instead of two as formerly, and also that the lectures on human anatomy and surgery, and those on comparative anatomy should be delivered on the alternate weeks.

The department allotted to me is human anatomy and surgery.

In arranging the discourses which I had the honour to deliver before you during the last summer, I endeavoured to make the subject of the six anatomical and physiological lectures, on the foundation of Arris and Gale, coincide with the matter of the nine surgical lectures, which were to be illustrated by the preparations in our Museum. The blood and vascular system were then selected for the anatomical; and the action of inflammation, and diseases of the blood vessels, for the surgical lectures.

In the present series of lectures I propose to make the structure and formation of bone and teeth, and some of the uses of the skeleton, the subject of the anatomical and physiological lectures; and the derangement and diseases of bone, the subject of the Museum lectures.

In the discourse of this day however, I must beg permission to depart a little from the proposed plan, by making some general circumstances respecting the nervous system the subject of our recollections; for this system is as extended as the vascular; and like the vascular, affects or is affected by the healthy and diseased actions of the body; and therefore in the consideration of the diseases of the body must often necessarily be referred to. It was my intention to have included these observations in the physiological lectures of the last series, but the allotted time for them did not admit of the introduction.

The mode of the minds influencing the body by means of the brain, spinal marrow and nerves, affords ample scope for the ingenuity of the moral and of the natural philosopher. The opinions which have been promulgated, the essays which have been written, and the disputes which have taken place on this subject have been both numerous and interesting; but notwithstanding, there is no subject which we are at present less acquainted with, and none which promises a less favourable result to our future inquiries.

We are convinced that there is a principle within us, which feels, which thinks, which reasons, which makes us acquainted with external objects, and from which the original source of all our voluntary actions seems to be derived. We know that this principle has a system of laws peculiar to itself; but equally regular and certain with the other laws of nature; we know that in consequence of its union with the body certain effects are produced, which none of the other laws of nature, so far as we are yet acquainted with them, or with the effects produced by them, will enable us to explain. Numerous occurrences convince us that this principle acts constantly and powerfully on the body by the intervention of the brain and nerves; but how or in what manner, we know nothing certain. The abilities of many of the most celebrated Anatomists and Physiologists of the past age and of the present, have been exerted to obtain more information on this important subject; very many animals have been sacrificed as victims in this pursuit, and some new facts have been lately ascertained; still many opinions remain which are neither confirmed so as to be established, nor absolutely confuted, so as to be rejected. For the most important of these facts we are indebted to the experiments of Bichat, Le Gallois, Phillip and Brodie. The result of these experiments, and the opinions founded on them have been so ably arranged and narrated by Doctor Cooke in the Croonian lectures, delivered by him last year at the Royal College of Physicians, and since published, that I need only refer you to the work, as containing a sufficiently ample abstract of what has been yet atchieved by ancient and modern discoverers; and strongly feeling the justice and force of his concluding observation on the nature and uses of the nervous system, I shall take the liberty to quote it here: he says, "of the ultimate nature or essence, either of mind or matter, or of that compound which we call the nervous system, we know nothing; but of the laws by which it is governed, or rather the circumstances by which it is influenced, we know enough to enable us, in some degree at least, to understand the nature and causes, and to explain the phenomena of many of its morbid affections."

All Physiologists seem to have agreed that brute animals possess this principle to a certain degree, viz. so far as it is connected with many of the vital actions; but its powers of reason and intelligence in them have been doubted. Brutes certainly possess these powers in much lower degrees than men; but if we deny the existence of reason, although less perfect in brutes, our proofs of mankind possessing it must be lessened. In the more perfect quadrupeds, all of us must have seen instances both of memory and judgment. Dogs, horses, and the whole of the ape tribe, possess these qualities to a considerable degree; and the elephant is said to possess them to still greater. The memory and reason of brutes as they approach the lower orders become more and more obscure, and in the lowest order of animals we have no traces of either quality remaining, nor can much difference be perceived between some of them and vegetables. In the present inquiry I shall not enter into arguments used in proof of the materiality or immateriality of this principle, nor into the distinction which some Physiologists pretend to make between the degrees of it possessed by brute animals or men; for all the knowledge which we require of it here, is the nature and extent of its connexion with the healthy and diseased actions of an animal body.

It is not my intention in this place to describe the minute structure of the brain, spinal marrow or nerves. Such description is unnecessary, because this audience is already acquainted with the anatomy of these organs, and were they not so, this theatre is not fitted for demonstration; nor is the time either in quantity or allotment adapted to the undertaking. It will be sufficient for my present purpose to observe, that the brain in man is larger in proportion to the bulk of his body, than it is found to be in other animals: on the table is placed the brain of an adult human body, behind me are placed brains of the elephant, horse, ox, lion, tyger, porpoise and other animals; and from what we know of the size of their bodies, the proportion of brain in comparison of the human is small, although its quantity varies in different classes of animals from other circumstances than their mere bulk of body. I need hardly remind you that the spinal marrow is continued from the brain, that the nerves pass from both in pairs, and branch out so as to be destributed to every part of the body; that one peculiar nerve, on each side of the trunk of the body, viz. the intercostal nerve or great sympathetic, communicates with the brain and all the spinal nerves from the head to the pelvis, and has several swellings, termed ganglions, formed in its course, from which nerves pass to the vital viscera. It has been lately discovered that the trunk and branches of the intercostal and parvagum nerves are composed of fibres, in appearance most irregularly connected to each other, nearly the same as in ganglions, and not continued in regular longitudinal packets as in the other nerves. The two preparations which are now produced shew very distinctly the difference between them and other nerves.

The fact that the nerves convey the influence of the mind to the muscles to perform voluntary actions, and also carry impressions from different parts of the body to the mind in the brain, is proved by the division of the whole of the nerves going to any moving part; for such part cannot then be excited to motion by the will, nor do irritations applied to it, or injuries inflicted on it, produce either sensation or pain. It is therefore not doubted but that the sensibility of any part of the body depends upon its connexion to the brain by nerves. The nerves, however, have no power of themselves to produce sensation, it is the effect of their being immediately acted on by some impression communicated from other objects. The sensations conveyed by the nerves are of various kinds; and some parts of the body, from particular structure, joined to some peculiar properties possessed by their nerves, are affected by stimuli, which no other parts or nerves are susceptible to receive and to convey to the brain. Thus by the mechanical organization of the eyes and ears, joined to some peculiar properties in their nerves, the optic nerves are stimulated by light to convey the figures of external objects to the mind; and the auditory nerves to convey distinct sounds; from the structure of the nose, and the peculiar nature of its nerves, smell is conveyed to the mind; and from the tongue and mouth, and the peculiar qualities of some branches of the fifth pair of nerves, we have the property of taste. The most general sensation is that of feeling, the skin possesses this more accurately than the internal parts of the body, and even in the skin, this sense is more exquisite in some particular places than others, as in the extremities of the fingers, and tips and sides of the tongue; this in some degree depends upon a more numerous supply of nervous filaments, and also on habit having accustomed these parts to attend more accurately to the perception of this sense. The sensation of feeling, when carried too far for distinct perception, becomes pain.

We find that the irritability and sensibility of parts are not necessarily in the same proportion; for the gall bladder, and bladder of urine are very susceptible of pain from unusual impressions; but their irritability is adapted to their contained fluids, so as not to be excited by the acrimony of them.

It appears that to produce very distinct sensation, a certain quantity of time must be allowed: in proof of which it has been observed, that men wounded with cannon or musket bullets have fallen without feeling at first either pain or any sensation in the wounded part; if the ball has great velocity this is often the case; but if it is nearly spent, the pain produced is considerable. Light may be too intense to be born by the retina, and the impression will not then produce distinct vision, but pain. When very quick motion is given to a luminous body, the sensation of its form will not be distinct; for example, a stick lighted at one end, and twirled quickly round in the dark will appear as a circle of fire: which proves also that an impression must continue to act some time on a nerve after its immediate application, as in the last instance, until the circle was completed. There are also proofs that certain impressions may be applied too slowly to produce distinct sensation, or even pain. Instances have occurred where a large proportion of the cerebrum, and some of the organs of sense have been slowly destroyed by scrofula, without sensation having been much affected. I have even known a scrofulous abcess form in the cerebellum, without having been attended with pain, and until the last hour, without having affected the senses of the patient.

It has been the opinion of some Physiologists that many parts of the body do not possess any sensibility whatever; and it is well known, that bones, cartilages, tendons, ligaments, and some of the membranes possess, in the sound state, very little of this quality; but it is equally well known, that when these parts are affected by disease, they are very sensible to pain. It cannot be doubted that there is very considerable difference in the degrees of sensibility possessed by the different structures of the body; but we may reasonably conclude that all of them either in a sound or morbid state possess some, and that this degree may be occasionally increased or diminished.

The brain appears to be the seat of the intelligent and reasoning principle; for although the larger nerves, and even a great part of the spinal marrow should be divided or obstructed, the functions of this principle, so far as respected memory and reason, would still be unimpaired; which should not be the case did it reside either in the nerves or spinal marrow. Many instances of diseased spines prove this; for in cases where the spinal marrow is compressed or even destroyed, reason and memory will still remain entire, when the parts of the body which received their nerves from below the seat of the disease have been deprived of sensation and voluntary motion; and we know from repeated experience that the loss of memory and reason, as well as sensation and *voluntary* motion will follow the sudden and general compressure of the brain. I say of voluntary motion, for recent experiments have most satisfactorily ascertained that motion, both from natural and artificial stimuli, may be produced and continued for hours after the animal has had the head removed from its trunk; and it has been long known that the hearts of amphibious animals will continue to contract and relax for many hours after the removal from their bodies.

If the brain is but partially compressed, only the senses and actions of those structures will be lost, whose nerves arise from, or communicate with the part where the pressure is applied; as sight when the origin of the optic nerve, and hearing when the origin of the auditory nerve is pressed on; or the action of respiration when that part of the spinal marrow from which the eighth pair of nerves have their origin is compressed, and which of course must be attended with death should the pressure be continued beyond a few seconds. Experiments made on living brute animals have proved these facts, and in the human body they have been also proved by the pressure of small and indolent tumours which have been long in forming; for the brain fills the inside of the cranium so completely, that a very small addition if made quickly would produce the effect of general compression. I have met with instances in dissecting the human brain, where the point of compression has been very limitted, but acting on a part from which a nerve originated belonging to some organ of sense, whose function before death had been lost, and where no deficiency was found in the organ itself.

Various conjectures have been formed concerning what part of the brain this principle resides in; but it is almost needless to say that the whole are evidently chimerical. From experiments which have been made on living animals it has been ascertained that a very considerable portion of the cerebrum may be removed without life being destroyed; but no nerves pass from any part of the cerebrum to structures whose constant action is necessary to the support of life. Parts of vital importance are supplied with nerves which arise from, or are connected with the medulla oblongata. The nerves forming the eighth pair arise from that part of the brain, and as to those forming the sixth pair, if their origin is disputed, their connexion with that part cannot be doubted.

The destruction of the medulla oblongata, or pressure continued a short time on it so as to obstruct its functions, are well known to produce death. I have opened the heads of many people who have died apoplectic; in some I have found much blood extravasated on the surface, and in others in the substance of the brain. Where the blood was thrown out so as to affect the cerebrum only, in most instances the patients have lived some hours or even days, although deprived of all marks of sensation and voluntary motion; but when the medulla oblongata has had blood extravasated in its substance, or when blood has been so extravasated as to press violently on its surface, either a speedy or immediate death has been the usual consequence. This effect arises from the nerves of the vital viscera being connected with that part of the brain.

The actions of the viscera and parts immediately connected with them have been called involuntary. One particular circumstance regarding them I shall mention here, which is, that when the brain is injured to so great a degree as to deprive the patient of sensation and voluntary motion, these involuntary actions will often continue to be performed for a considerable length of time, as in cases of apoplexy, or in fractures of the cranium attended with compression of the brain; but if the communication between the brain or spinal marrow and the organs performing these actions is obstructed by compression for a certain period of time, or is destroyed by a division of the nerves, these actions will soon cease. It is true that the action of some particular viscus will continue a considerable time after all connexion between it and the brain has ceased; for example, that of the heart, which will go on for a long period after that organ has been removed from the body, and by artificial breathing, when the head of the animal has been cut off, can be made to act for several hours; but unless respiration is continued the action of the heart will not go on, and the natural action of respiration will cease when the head is removed. Thus although the action of the heart is not immediately dependant on the brain for a constant and uninterrupted supply of nervous influence, it is dependant on the lungs for its power of carrying on the circulation; when the communication between the brain and the organs of respiration is cut off, that action so far as it is dependant on powers originating in the animal ceases, and circulation with it; renew respiration by artificial means and the circulation also will be renewed. Vital actions being thus dependant upon one another, and some of them being immediately dependant on the brain, particularly respiration, which does not take place until after birth, proves, that to preserve the whole, a communication with the brain by means of nerves is after birth indispensably necessary. From Le Gallois' experiments and those of Mr. Brodie, it appears, that if proper precautions are taken to prevent death by hæmorrhage, removing the whole of the brain would not destroy life excepting by stopping respiration; for by artificial breathing the animal is made to live so as to have the circulation, secretion, and digestion continued; but it loses by the removal of the brain sensation, and the power of willing its actions. Decapitation thus destroys life by preventing the action of the muscles of respiration.

The will has no power over any of these actions, excepting that of respiration; but passions of the mind certainly affect them much. The pulse is sometimes rendered more quick, and sometimes more slow by such passions, and the blood often determined to a particular place, as to the cheeks in blushing; anxiety quickens the pulse; fear has produced so great a contraction of the external arteries that no appearance of colour derived from the blood has been visible.

From the experiments of Le Gallois some curious facts have transpired, adding to the proofs of the principle which determines and regulates all the acts of the animal functions residing in the brain, and shewing that although life and powers of motions may emanate from the spinal marrow, the willing and direction of the motion proceeds entirely from the brain. He found that when the head of a lizard had been removed, the animal continued to live and move its body and limbs for days; its motions however were all irregular and without meaning. He also states, that when the spinal marrow is divided at the occiput, the head and the rest of the body remain alive; but that there no longer exists the power in the animal of governing its motion, the head living as it were without a body, and the body without a head. Le Gallois further states, that in those cases where animals walk about and regulate their motions after decapitation, the division has been made not merely in the spinal marrow; but that some of the posterior part of the brain, in which from experiments he infers this faculty resides, has been left adhering to the spinal marrow.

That the formation and subsequent growth of parts do not depend upon the brain is sufficiently ascertained by those whimsical fœtuses which have been born without any brain, but in all other respects perfect. In one of these monstrous productions, which I particularly examined, and which Dr. Clarke has given a description of to the Royal Society, neither brain nor nerves were found. The substance when cut into, appeared in most places to be a confused mass of flesh and bone; but two feet, with the bones of one leg and thigh, and a portion of intestine were tolerably well formed, although neither heart nor stomach were discoverable in it. It thus affords a proof, that from the action of vessels, without the assistance of heart, brain or nerves, almost every part of the body can be formed: for skin, adipose and cellular membrane, muscle, tendon, ligament, bone, cartilage and intestine were found distinct and perfect in structure, in this monstrous production. I have seen, in other instances of monstrosity, a complete deficiency of nerves in the two lower extremities; notwithstanding which, in all other respects, the limbs were perfectly well formed. Life therefore does not depend, before birth, upon brain and nerves.

From these and other cases we may infer, that the brain and nerves are in no way concerned in the formation or growth of the child while in its mother's womb. We do not know what use they can be of until after birth; the fœtus in utero can be exposed to no external impressions which would require the aid of nerves to reach the brain; and we have no reason, or grounds for supposing it capable of volition, or sensation; and although it has motion, we have no proof of that motion arising from consciousness. Several parts of the body are formed in the fœtus while in utero, which can be of no use to it until it leaves that state. The lungs, stomach, and organs of generation and of sense are instances of these; but all these become necessary to the perfection of the actions which must go on in the animal after birth; it is therefore more than probable that the brain and nerves are of the same nature.

Fœtuses without brain, die on birth, for the whole of the vital actions then become dependant upon one another, and respiration in particular, which only begins at birth, seems to be wholly dependant upon the brain ; and the functions of the brain and lungs seem to begin at the same moment.

Mr. Lawrence has published an account in the fifth volume of the Medico-Chirurgical Transactions, of a child born without brain, who lived four days ; the medulla spinalis was however continued for about an inch above the foramen magnum, forming a soft tumour, about equal in size to the end of the thumb, and as all the nerves of the head, from the fifth to the ninth pair, were connected with this, it may, of course, be considered to have been part of the medulla oblongata. This fœtus moved briskly at first, breathed naturally, and was not deficient in warmth until its powers declined ; it also voided urine ; and had three dark coloured evacuations by the anus.

That the regeneration of removed parts does not depend upon the nerves, I have seen repeated proofs of, in some experiments made more than thirty years ago by Mr. Otto. This gentleman divided the whole of the nerves going to the hinder extremity of a dog, so completely, that the animal expressed no pain when a red hot iron was applied to part of the leg, and continued so long as to burn it to the bone ; notwithstanding this, inflammation, suppuration, sloughing, granulation and cicatrization took place, and the healing up of the sore was as perfectly performed, and as quickly, as one in another dog, whose nerves were not divided, but to whose leg the hot iron was in a similar manner applied. In a third dog, under similar circumstances, a piece of flesh with the skin covering it, an inch square and very nearly half of an inch deep, was removed, the wound also filled up and healed.

In one of the experiments made by Mr. Otto, twelve hours after the nerves of one of the hinder extremities had been divided, the thermometer was applied to the lower part of each limb, and it was found that the heat was several degrees greater in the limb where the nerves were divided, than in the sound limb.

Mr. Brodie has found, that after removing about one quarter of an inch of each of the three great nervous trunks supplying the hinder extremity of a dog, from which operation the limb became immediately benumbed and paralysed, the wounds suppurated, and healed as readily as if the nerves had been entire. He also found, that having cut the claws belonging to each of the four feet of the dog, at the end of seven weeks, when he measured the growth of the claws, those of the paralysed limb had grown equally with those of the three sound limbs. After a similar division of the nerves on a Guinea pig, the tibia was broken; and the bone, notwithstanding readily united. These facts prove also that nutrition does not depend on the brain or nerves. If the nerves going to any particular muscle are divided, that muscle will shrink and gradually become less; but this does not arise from want of nutrition, but because the muscle is not used; the power of calling it into action by the will being lost.

Experiments have also proved, that many animal secretions can go on in parts from which all communication with the brain by nerves has been cut off. Many circumstances shew, however, that several of the secretions are influenced by passions and ideas of the mind, as tears, semen, and even milk. I have known sudden anxiety, in an instant, stop the usual secretions that take place in the mouth, so that a parched tongue has immediately occurred.

That the living principle is distinct from the nervous system, and is independent of sensation, and consciousness is examplified in the state of a fresh egg before incubation. The torpid animals afford some further illustration of this, as they are preserved from putrefaction by some power during their torpid state, which does not appear to be connected with their nervous system, or even with their circulation. Some animals exist, in which no appearance of brain or nerves has been discovered, either by accurate dissection, or by the microscope. The principle property possessed by these animals, is the converting certain substances, which they receive as food, into a part of themselves; they therefore do not require that complicated structure which is necessary to more perfect animals. The organ by which this assimilation is performed, viz.

the stomach, is in all these animals very large, forming often a very great proportion of their whole bulk; indeed, excepting in having a stomach, there is nothing peculiar to distinguish some of them from vegetables; and brain and nerves in any vegetable have never been imagined to exist.

These animals may be supposed to select the food taken into their stomachs; but brain and nerves are not more necessary to produce this action, than they would be to induce the tendrils of the creeping plants to cling for support to the bodies with which they come in contact. The action of receiving food may proceed as much from instinct, as the action of sucking does in a new-born animal immediately upon the nipple being placed in contact with its mouth; for we cannot suppose that a new-born animal is acquainted, philosophically, either with the mode of forming, or use of a vacuum. By instinctive actions of animals, I mean those actions which are necessary to the support of life, and which are the immediate effect of some external impression, but are independent of consciousness. In human beings, however, and in some of the more perfect animals, an action which arose from instinct, may afterwards become an action of volition; thus a child sucks at first from instinct; but afterwards it may suck from choice.

The nervous system, from the above named circumstances, is regarded by many Physiologists merely as an appendage to life; but by some others it is thought to impede the operation of life, and to tend even to shorten its duration, and they adduce some facts, which seem to prove, that simple life will not only survive sensation; but will survive it longer, when the animal receives a blow by which its whole nervous system is instantly destroyed, than when killed by hæmorrhage, suffocation or any other violence which produces its death more slowly. When fishermen mean to crimp fish, to render them longer susceptible of the operation, they stun them by a violent blow on the head immediately on taking them from the water. This practice originated from humanity, and has been continued from interest; for it is found that in fish so treated, the power of the muscles of contracting, not only continues longer, but that much stronger contraction takes place, and the fish keep for a longer period free from putrefaction. A salmon, for example, when taken out of the water soon dies, its muscles lose all power of contracting in less than half an hour; but if its brain is destroyed immediately on its being caught, its muscles will continue to shew signs of irritability for twelve hours. This is attributed to the powers of simple life, not having been exhausted by the pain which the salmon would have felt in dying, had it continued possessed of sensation.

Even animals of warm blood are rendered more disposed to go into putrefaction when the nervous influence has been greatly used before death; for from the long exertion of this influence in an ox, which has been driven far, and killed before it could be recruited by rest, its carcase soon putrefies, and seldom is capable of being preserved by salt.

In our own species, one of the principle functions of simple life, viz. digestion, will, occasionally, indeed generally, go on better and more regularly in some diseases where the exercise of the senses is in a great measure suspended, than in a common state of health. Thus we find in patients, labouring under hydrocephalus, and in idiots, many instances of appetite and digestion being increased.

There can be no doubt, but that excessive exercise of sensation or thought, produces fatigue, and tends to exhaust the powers of life as much as long continued and violent muscular motion; it has therefore been inferred, that the action of the nerves whether employed in sensation or volition, instead of being the source of animal life, tends greatly to wear out its powers. Celsus has so clearly expressed himself of this opinion, as to make it the chief cause of the first improvement of medicine. He says, in the beginning of the preface to his first book, "Ergo etiam post eos, de quibus retuli, nulli clari viri medicinam exercuerunt; donec majore studio literarum disciplina agitari cœpit, quæ ut animo præcipue omnium necessaria, sic corpori inimica est. Primoque medendi scientia, sapientiæ pars habebatur, ut et morborum curatio, et rerum naturæ contemplatio, sub iisdem auctoribus nata sit: scilicet his hanc maxime requirentibus, qui corporum suorum robora inquieta cogitatione, nocturnaque vigilia minuerant."

These observations, however, should be confined to those cases where the exercise of the nervous influence producing sensation, thought, or voluntary motion has been excessive, and continued for a long time without being recruited by sleep; for the exercise of these powers in a moderate degree must be conformable to the intention of nature, and therefore must be salutary.

When these powers have been fatigued, nature has provided the means of recruiting them by sleep. In perfect sleep, there is a complete suspension of voluntary motion and consciousness; but the involuntary actions go on without intermission and are incapable of fatigue. It seldom happens we are in so perfect a sleep, that thought, memory, sensation and voluntary motion are completely suspended at the same time: occasionally some of these are not suspended, but only lessened and performed confusedly. This takes place in dreams, for in them, the mind thinks on absent objects, and sensation being suspended, the present are not perceived by it; voluntary motion being also suspended, the actions of which we dream, are therefore not actually performed. Indeed the sensation of present objects may be suspended when we are awake, while thought is busily employed; thus a man absorbed in solving a difficult mathematical problem is completely inattentive to external objects.

In sleep, there is not only a cessation of voluntary motion; but also of those involuntary motions which proceed from diseased action; thus the shaking in palsy is suspended, also the involuntary contraction of the muscles which takes place in chorea.

We find, (and it is really a melancholy reflection,) that one third part of our life, upon an average, is spent in sleep. Some people, from habituating themselves to a certain limited time of sleeping, have been able to recruit the powers both of body and mind, with a much less quantity of sleep than others. John Hunter, whose mind and body were constantly deeply and actively employed, for many years, kept up his great and almost unequalled mental powers, by giving up four hours out of twenty-four to sleep. There is some resemblance in this between sleep and food; for a man in this country consumes a larger proportion of food, than would content an Indian of the same size and bodily strength. Much of the time given up to sleep is not in reality necessary, but acquired by custom, certainly more profitable in the breach, than in the observance. But in every human body, while awake, the exertions of the nervous system exhaust the vital powers so much, that a certain quantity of sleep becomes as necessary to recruit them as a certain quantity of food; and we could no more exist for any great length of time without the one, than without the other.

The involuntary actions, upon which life depends, are so contrived by nature as not to require this recruit by sleep, and suffer very little alteration during its continuance. The pulse and respiration are rather fuller, and slower, than when the person is awake, and digestion has been supposed not to be performed so quickly, but perhaps more perfectly. The body lying in an horizontal posture may contribute to these differences.

It may not be improper here to remark, that both sensation and voluntary motion are considerably influenced by custom and habit; so that those actions of the body, which at first required an exertion of the will to produce them, at length are performed without the mind being attentive to them, or even appearing conscious of their going on; and though the power may be retained by the will, when it is attentive to them, to begin them, or stop them at pleasure, yet they may become so far independent, that they only can be performed in a certain way, unless a continued exertion is used to break through this habit, as in an acquired aukward gait, or some other unwished for action.

We find also that the powers of any of the senses may be increased, by the mind directing their attention to the discrimination of some peculiar impressions. Thus, one man will distinguish some minute or particular object better and further off than another; a second will distinguish with more accuracy the variety and nicety of sounds; others will possess the power of touch, taste, or smell in greater degrees than those who have less cultivated the particular sense.

When but little attention is paid to any particular impression, the force of such impressions gradually diminishes, and at last loses all effect. A man who has resided most of his life in a quiet country situation, on arriving in a city, is surprised and confused at the noise and bustle which surround him; but in a little time these make no impression either on his ears or eyes: or a person unaccustomed to noise coming to reside near a set of bells, is perhaps at first much annoyed by them; but in a little time, unless he attends, he does not even know when they ring.

In these very limited observations on the nervous system, I have purposely avoided any statement of what the different opinions have been on the structure of the brain, the disposition of the nerves, and the nature of the ganglions. Much still remains to be ascertained in the structure, and still more in the uses of these organs. Very ingenious theories on both, are to be met with in the works of our modern Physiologists; but elaborate discussions of these, suit not with this place, or with the time of this audience.

As a further investigation of these important subjects appears to be, at present, actively carried on, by those thoroughly fitted by their extensive general information, and well founded knowledge of the animal economy, to discover what more can be known, I have endeavoured to confine the foregoing discourse to circumstances already sufficiently proved to justify their being used as the means of informing us of the nature, so far as nerves are concerned, of those diseases or accidents, on which it is my duty here to treat.

Finis

LECTURE II.

ON THE STRUCTURE OF BONE, PERIOSTEUM, AND MARROW.

THE necessity of preserving a thorough knowledge of the relative situation of the parts composing the skeleton, must be obvious to every surgeon; and the important advantages to be gained by occasional references to that part of our bodies, must, I think, be admitted as a sufficiently powerful motive for influencing the selection of the natural and morbid appearances of the bones, for the subject of the present annual series of lectures. I have adopted it the more readily, because it allows me, in producing our preparations of their diseased structure, to follow the order of arrangement contemplated by John Hunter, in the formation of the museum, as nearly as other circumstances will permit.

Various subjects might have been chosen more likely indeed to excite the attention of hearers, who wish to devote an idle hour in search of what is to surprise by its novelty, or entertain by its allusions to some favourite theoretical discussion of the present day. But surprise and amusement were not the motives which occasioned the establishment of these lectures, nor would the attempt to produce them be borne long by this audience; and it would degrade the lecturer and the audience to admit that any lesser object than the diffusion of surgical knowledge, founded upon the basis of anatomy, was the motive of our assembling in this theatre.

It is not to publish peculiar and speculative opinions that the gown is conferred upon the professor, but to designate him as the member of the college, who is deputed to bring before this audience, what demonstrative proofs the museum and his own resources afford of the natural and diseased structure of animal bodies to remind it of the practical inferences which have been already drawn from them and acted on; and if possible to suggest others, which, though less generally known, can be applied to the alleviation or cure of those diseases which come under the Surgeons care.

With such views of the utility of the selected subject and the duties of the lecturer, I conceive that any apology is unnecessary for the risk I may incur of tiring the audience by anatomical description unnecessarily lengthened; but I must here beg permission to state, that it is not my intention to describe the particular shape, or features of any one bone, or the minutiæ of the treatment of any single case of disease. The observations I mean to make on structure, will apply generally, and those on treatment, chiefly to principles of cure. I shall endeavour in the descriptions to pass over, or touch lightly on those circumstances which present themselves to every eye, and are known to all, and which, although necessary to be commented on in an elementary discourse, would prove tedious and useless here; and dwell only on those which will enable us best to discriminate the nature of, and thus assist us to remedy, the deranged or diseased structure for which our surgical aid is required.

Every animal, endowed with loco-motion, possesses some fixed points to which its muscular fibres are connected. Those that only creep have muscles attached to different parts of their skin, which by their alternate contraction and relaxation, act upon it so as to produce the required motion. Animals which are to move with velocity by steps or bounds, are supplied with some hard substances, either within or without their bodies, which serve as fulcra and levers for the moving powers, so as to regulate and add force to their actions. Thus some have scales, some have shells, and others have bones.

Bones when conjoined form the skeleton, and are met with in all the more perfect classes of animals, affording in them support and protection to the soft and fleshy parts, regulating the shape of the body generally, and constituting in fact the bases on which all the other structures of the animal rest.

Although more authors have treated on bones than on any other part of the animal system, and have rendered what relates to their particular shape and figure, as well known at remote periods as at the present, it is only lately that we have had any founded knowledge of their composition, particular structure, or mode of formation.

To allow of bones being appropriated to the above mentioned uses, they must be formed of a hard inflexible substance, incapable of being suddenly altered as to length, breath, or thickness, so as to enable them perfectly to preserve their shape; and accordingly we find that inflexibility and tenacity of form are the leading characteristic qualities of bones.

Although bones are more uniform in appearance than soft parts of the body, they are found, upon examination, to possess nearly the same kind of structure, so far as regards blood vessels, absorbents and nerves; but as their uses require that they should be hard and compact, a much greater proportion of solid saline matter enters into their composition. Thus the two principle ingredients in bones, are a hard saline, and a soft animal substance; the first being necessary to their hardness and solidity, and the other to their formation, growth, and support.

The late Doctor George Fordyce in his lectures, in the year 1784, observed, that there was an earthy matter in bone different from common calcareous earth; but the peculiar properties of which he acknowledged he was then unacquainted with. This was afterwards discovered to be chiefly the phosphate of lime. In 1799, a paper of Mr. Charles Hatchet was published in the Philosophical Transactions in which several ingenious experiments were related, that were made by him to ascertain the composition of shell and bone. From these experiments it was ascertained that bones, besides the phosphate of lime which formed the principal part of their composition, also contained carbonate of lime and a small quantity of the sulphate of lime. The animal matter in bone has been found by chemical analysis, to be similar to that of the soft parts of the body.

The degree of hardness in some bones is much greater than in others; it also varies in different parts of the same bone; where it is greatest, more of the saline matter is deposited, and more of the animal substance where it is less. Soft bones, having more animal substance, are more vascular than hard bones: the bones of young growing animals possessing more vessels than those of full grown animals, are therefore softer.

If a full grown bone has been steeped for some time in diluted muriatic or sulphuric acid, it will on examination be found to have become soft, and to have lost nearly one third part of its weight, from the acid having acted on and removed the saline part; but the animal substance not being in the same degree acted on, the bone will retain nearly its original size and figure; it will now readily bend in any direction, and, if a cylindrical bone, will admit of being tied in a knot, as in the produced specimens of a rib and fibula from an adult person.

When the animal substance of a bone is destroyed by fire, the shape and size of the bone are still preserved; but it becomes so brittle as to break on a slight touch. These facts shew how intimately the saline and animal parts must be mixed with each other.

The colour of fresh bones will vary from several causes, as from their containing different proportions of oil or other animal substance; or from being more or less vascular: from the last cause the bones of a fœtus are always more red than those of an adult. The colour in a living adult bone is of a bluer white than it is in a dead bone; the blood circulating in the vessels gives it this tinge.

The colour will also vary from other circumstances. The bones of a young animal, which has been fed for some time on madder, will be found of a red colour. This fact was first discovered by accident; but has been made useful in illustrating the nature of the growth of bone. From many experiments which have been made, and repeated, it is ascertained, that growing bones readily become red when the animal feeds on madder; but that adult bones are only slightly tinged with this colour; and when the animal ceases to feed on madder, the bones after a time lose the red colour. These facts have been adduced to prove, that during life, a constant renovation of the body takes place, and this most actively in the early part of existence, but very limitedly in old age. Bones of young pigeons have had a rose coloured tint communicated to them in twenty-four hours, and have acquired a deep scarlet colour in three days; while the bones of adult pigeons have taken several days to be perceptibly coloured by this substance. The extract of logwood has also been found to alter the colour of bones; when mixed with the food of young pigeons it communicates a purple tint to their bones.

Why bones should be coloured by madder has been very satisfactorily explained by Dr. Rutherford, and illustrated by reference to the effects of those substances called mordents, employed by the dyers for fixing the colours.

Mr. Gibson, of Manchester, several years ago published a very ingenious paper in which, without denying that absorption and renovation constantly took place in an animal body, he asserts that the explanation of the change of colour by chemical attraction takes away the proof of those two great actions, so far as the colouring of bones by madder is concerned. He made some experiments with phosphate of lime previously tinged with the madder root, and then exposed for half an hour to fresh serum, at the temperature of 98° By this operation he found that the serum gradually acquired a red tinge, while the phosphate of lime was proportionably deprived of colour; and that when lime so tinged, was exposed to the action of distilled water, under similar circumstances, no change took place. He infers from this, that when the animal has madder mixed with its food, the blood becomes highly charged with it, and imparts the superabundant colouring matter to the phosphate of lime contained in the bones already formed, as it circulates in their substance and moistens them throughout; but as soon as the animal has ceased to receive the madder, and the blood is freed from the colouring matter by the excretions, the serum then exerts its superior attraction, and by degrees intirely abstracts it from the phosphate of lime, and the bones again become white.

But we find that alternate strata of red and white bone can be formed, and it is the new bone which is chiefly coloured; and we find also that many weeks indeed months will elapse before the bones lose their red colour. It is easy to conceive that the phosphate of lime may be acted on, so as to become tinged with madder while both are circulating in the blood, and be deposited by the vessels after having obtained this colour; but it is not easy to conceive by what means the serum is to act on that already deposited, or how the removal of the colouring matter from the bones can be satisfactorily accounted for but by absorption; I know of no way, in which the serum could soak through the vessels to affect the colour of those particles of the phosphate of lime already deposited and forming part of the bones.

The cut surface of the complete section of a bone exhibits two different appearances; towards the outer part, it is firm and compact; and on the inside, it is spongy and cellular. I need not say that in cylindrical bones this spungy part has been called cancelli, and in flat bones as in those of the head, diploe. Cylindrical bones are generally narrower about their middle than at their extremities; at that part, their substance consists more of the compact matter; but towards the broader extremities, cancelli form the largest proportion of it. In certain parts of the more irregularly shaped bones, neither cancelli nor diploe are to be found, the whole substance being compact.

A bone appears to be fibrous on its surface; this is seen in all bones which have been long exposed to air, sun, and rain, also in growing bones, and more particularly in bones which have been boiled for some time in Pepin's digester. In cylindrical bones the majority of these fibres are longitudinal; but in flattened bones they are usually radiated in their direction.

In a section, the bony matter seems to be deposited in irregular laminæ or plates joined together by masses of the same substance, but very irregular in size, direction and shape; this is best seen towards the extremities of the bone. The compact part of the bone, and the substance of it forming the irregular processes of the cancelli, appear to be porous. These pores are very discernible when the animal part of the bone is destroyed, but in the fresh bone they are filled up with animal matter.

In the compact part of the section of a bone, the appearance of laminæ or plates is very obscure, and often not distinguishable; but certain cavities are met with, seeming to run in a longitudinal direction and nearly parallel to each other. They are different in length and diameter, and have transverse or oblique canals communicating with and connecting them, some of which communicate also with the larger cavities of the cancelli in the middle of the bone. These have been called Haver's canals.

Towards the middle internal part of the bone, the osseous matter is formed into irregular processes, taking uncertain directions, and sending off an infinite number of small bony filaments, which pass inwards and by uniting with each other form a beautiful reticulated texture, viz. the cancelli. The cancelli are coarser towards the outside, and more delicate towards the middle. In some bones the cavities of the cancelli are very large; indeed in some quadrupeds there is an extensive cavity in the body of the bone without any bony filaments intersecting it, or spreading through it. Thus the thickness of the filaments forming the cancelli, and the interstices which they leave between them, vary much in number, figure and size.

Most of the cylindrical bones enlarge towards one or both of the extremities; and near those parts, they possess little of the compact substance on

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the outside, but much of the cancelli on the inside.

It is in these enlarged extremities that the bony plates are the most distinctly seen, appearing to separate from each other as the thickness of the bone increases. These are the usual appearances met with in viewing the sections of dry bones. In fresh bones much more is to be seen.

It is very necessary that bones should possess great vascularity, for although they are very hard in their substance, they are by no means passive in the animal economy; in every part of them are found true secretory organs, which separate from the blood that peculiar saline substance which afterwards, when deposited, forms so large a part of their own composition; and in particular parts, organs are found that secrete the marrow which fills up the internal cavities.

The vascularity of bone is proved by the hæmorrhage which takes place in dividing living bones; and from ocular demonstration and injections in dead bones.

The arteries belonging to full grown bones are not so numerous as these vessels are in many of the soft parts, and they are still fewer in the bones of aged persons; but in youth, when the bones are forming and increasing, their vascularity is as great as that of most of the fleshy and glandular parts of the body, and granulations from bone are as vascular as those which arise from any of the soft parts.

In cylindrical bones many arterial ramifications enter the pores on their outer surface, from the periosteum ; besides which one or more larger vessels enter by separate foramina, and in the cancelli, and in their progress to it, send branches to every part of the bone, as well as to the membrane which secretes and contains the marrow. In flat bones, arteries enter from every part of their surface which is covered with periosteum. Small arterial branches anastomose in bone as they do in other parts.

The veins of bone appear to correspond with, and to accompany the arteries.

I have not injected, or seen injected, the absorbent vessels of bone so as to have had ocular demonstration of their existence ; but the smoothing of the edges of the divided bone in stumps after amputation, and the process which takes place in exfoliation, are sufficient proofs that bone is well supplied with them. Bones can enlarge their size and keep the relative proportion of their parts, only by the arteries depositing proper materials in some places, while the absorbents remove materials formerly deposited from others.

Nerves can be traced into bones, so that of them we may have ocular demonstration; but even were this wanting, the excruciating pain experienced in inflammation and diseases of bones, and the sensibility of the granulations arising from bones would prevent us from entertaining any doubt of nerves entering into their composition. The nerves of bones, however, are few in number, and their sensibility in their natural state is not very great; but when in a state of disease, from the unyeilding-ness of the materials affording great resistance to distention, much pressure is produced, and the pain in consequence is very considerable.

The periosteum, or membrane which is in immediate contact with the external surface of bone, is composed of fibres running in every direction, the majority of which however have their course parallel to the body of the bone, excepting at those parts where large tendons are attached, there they run in the direction of the tendinous fibres.—

The periosteum is generally considered as possessing two laminæ; the outer lamina having coarse and strong fibres, and being very irregular in its degrees of thickness; the internal lamina having more minute and firm fibres, which generally run in the direction of those on the surface of the bone to which it adheres; and it is much thinner than the outer one.—These laminæ are so closely connected, that they cannot be separated without destruction of many of their fibres; and the separation affords no proof, that the periosteum was originally formed as consisting of two laminæ, for with a little more trouble we might divide it into five, six, or even a greater number.

The fibres of the outer lamina of the periosteum covering some bones, are evidently continuations of tendinous and ligamentous fibres; of this, the periosteum covering the fore part of the sternum is a well marked instance; and in other parts the fibres of this lamina run in the direction of the tendons and ligaments inserted into the bone to which it belongs, and it is thicker in these places. In birds, whose tendons are black, the periosteum is black also; on these accounts some Physiologists have considered periosteum as composed of tendon and ligament; but very thick periosteum is met with on parts of bones not in the immediate neighbourhood of, or at all connected with either ligament or tendon, as on the inside of the body of the femur, and of the tibia: these instances prove, that although the periosteum receives many additional fibres from tendon and ligament, it is not intirely formed from them.

Although much connected with tendon, the colour of the periosteum is not so bright, nor is the surface so smooth; for it has cellular membrane adhering every where to its outer surface, to connect it according to circumstances loosely or firmly to the surrounding parts.

The internal surface of the periosteum adheres to the bone by vessels and a number of white filaments; and in the minute spaces between these, a gelatinous adhesive substance is sometimes found,

A similar membrane, continued from the periosteum, passes over and adheres to the cartilages which connect certain bones with each other, as the cartilages joining the bony part of the rib to the sternum, and although its name is here necessarily altered to perichondrium, its structure continues the same. In shape the periosteum must correspond to the bone which it covers, it is smooth where the bone is smooth, and rough where the bone is so.

The periosteum receives its arteries from the neighbouring trunks in its vicinity, and transmits the blood, in smaller branches, from them into the bone. Like to tendon or ligament, it is not very vascular for its own support, but possesses more vessels than either of these parts on account of the bone being supplied from it; indeed, during the formation of the bone, it is crowded with vessels. The veins correspond with the arteries; and the trunks of its absorbents are the same with those of the bone which it covers.

The nerves actually distributed to the periosteum are very few in number, so that it possesses very little sensibility, if any, in its natural state. Formerly it was supposed to be possessed of this quality to a very great degree, for the purpose of giving notice of any injury having happened, or being likely to happen, to the bone. Dr. William Hunter having observed the great similarity which the periosteum bore to tendon and ligament, and being convinced from experiments that these substances did not feel in their natural state, was the first Anatomist in this country who taught that the periosteum was not a sensible membrane, when unaffected by disease. He mentioned this publicly in his lectures in 1746.

Soon afterwards, Baron Haller and several other Physiologists began to make experiments on the sensibility of these and similar parts; and inferred from these experiments, that neither tendon, ligament, nor periosteum were in their natural state endowed with that quality. Dr. Hunter formed his opinion chiefly from two strongly marked instances which had occurred to his observation in the human body. Haller's experiments were made upon brute animals. These were not so conclusive as the instances of Dr. Hunter, for quadrupeds cannot tell us what they feel, we can only guess at it from their barking, howling or other signs of uneasiness; but some quadrupeds will exhibit all these signs when they are first touched, before they are hurt, and others, although much tortured, will become sullen, and will not utter a howl or groan. We shall afterwards have occasion to remark, that although the periosteum is not sensible in its natural state, it becomes highly so in certain diseased actions.

Many uses, besides the one already confuted of having been given to bones to warn them of injuries, have been ascribed to the periosteum. One has been that it was to set limits to the growth of bone; the fallacy of such supposition must be evident from this, viz. that bones which have concave surfaces as readily assume their proper figure as those whose surfaces are convex: the periosteum might be supposed to act on the latter; but could not on the former; for there a tendency to fill up, or shoot out, would make the periosteum looser. It has been supposed to be useful in preventing attrition between muscles and bones; this may be one of its uses, but not the principle one; for periosteum is found where there can be no attrition between muscle and bone, as on the shin or inside of the tibia.

Another use ascribed to it has been, that it strengthened the junction of the epiphyses to the body of the bone.

The periosteum has the accidental use of connecting the epiphyses, in growing bone, to the body of the bone until both are firmly united; but that this use is only accidental, appears from periosteum covering bones which never had epiphyses, and remaining after firm union in those which have. In an experiment made on this subject, it was found that it required the weight of 550lbs. to detach an epiphysis from a growing bone, from which the periosteum was not removed; whereas when the periosteum was taken off from the corresponding bone of the other side, 119lb. detached the epiphysis.

One great use of periosteum appears to be to give tendons and ligaments a better hold on the bone.

If tendons were united to bones abruptly and at once, when pulled suddenly and forcibly, they would have been liable to break at the bone, or to tear away a part of it with them; but as the fibres of tendon spread upon, and mix with those of the periosteum to a very considerable extent, by so doing they obtain a hold of more of the bone, and are fixed at a greater number of points.

Another use of periosteum is to sustain the branches of blood vessels going to the bone. Bones are very porous, and vessels enter those pores; now as the muscles are constantly moving upon the bones, such motion would be apt to tear through the vessels before they could enter the pores; by the periosteum the vessels are confined, they ramify in this membrane, and are distributed to the bone at a much greater number of points.

The cavities of most of the fresh bones belonging to men and quadrupeds are filled with the oily substance termed marrow: in many birds some of these cavities are filled with air. In most respects marrow is similar to fat: those animals whose marrow is very soft, have their fat soft also, and vice versa. Like fat, marrow is contained in little vesicles; when viewed in the microscope it appears to be oil contained in small bags of a globular form. A vascular membrane is found to line the cavities of bones, and to branch off into processes which pass every where through and are supported by the cancelli; the small vesicles, which the marrow is contained in, are attached to and belong to this membrane; the vessels of which appear to have the power of separating the marrow from the blood. This membrane, being very vascular, transmits also some few vessels to the bone, but has very little adhesion to it; it is, however, almost inseparably connected with the marrow. It has been called the membrana medullæ, and sometimes the periosteum internum ossis.

The processes of this membrane are more diffused, and the cells more numerous and smaller towards the extremities than in the middle of a cylindrical bone; and as the membrane is very vascular, it gives to the marrow of these parts a more bloody colour. The great degree of redness which the marrow of young animals has, in comparison with the marrow of adult or aged animals, is dependant on the greater vascularity of this membrane. When the marrow is removed from the bone of an ox where the cavity is large, this membrane separates readily from the inner surface of the bone, and remains with the marrow; it then may be separated from the oil, by steeping the whole in very hot water and compressing the mass gently. The reason of marrow being softer than fat is, that the membrane being surrounded and protected by bone is thinner; in marrow there is consequently more oil and less membrane.

Mr. Howship, who has presented several papers on the nature and formation of bone to the Medico-

Chirurgical Society which have been published in their Transactions, has discovered by the assistance of the solar microscope, that the longitudinal and transverse canals found in the compact parts of cylindrical bones are lined by a fine and vascular membrane, and that they contain, likewise, always one, often two blood vessels, viz. an artery, or an artery and a vein. He has found also that a medullary substance is deposited between the membrane lining the canal and these blood vessels; this he ingeniously supposes is secreted by the vascular membrane, and placed so as to give the artery the power of occasionally dilating and increasing its action for the purpose of carrying on its natural functions as well as other functions which might arise from disease; and which power it would not have possessed, had it completely filled the canal. This discovery reconciles the opinions, formed from appearances, entertained by different Physiologists as to the nature of the contents of these canals. Havers and Monro considered them only as medullary canals; other Anatomists believed that they merely gave insertion to ligaments, or passage to blood vessels. Mr. Howship has found that both marrow and vessels are contained in them.

A variety of opinions have been entertained concerning the use of marrow. One has been that it rendered the bones less brittle; but many obvious facts shew that this is not the case. It has been asserted that it was deposited in the cavities of the bone to make part of the lubricating fluid found in the cavity of joints; but it cannot reach these cavities, and there is no oil in the composition of synovia.

The use of marrow appears to be the same as that of fat, viz. it is a nutritive substance laid up under favourable circumstances and at convenient times, until the constitution may want it. Nature has providently ordained, that a quantity of such materials should be stored up in the body, so as to be used when food cannot be procured, or when from disease the stomach cannot digest it. It would have proved highly inconvenient to have had this substance accumulated only in one part, and as interstices were found in many parts of the body, in these were placed the vesicles for containing oil, which thus possesses spaces that otherwise would be useless. Bones were not made hollow for the purpose of containing the marrow, but for giving certain firmness and strength with the least quantity of osseous matter. This matter seems to be produced with difficulty, and it is long before bones are fully formed, they are therefore made hollow that they may be stronger with a limited quantity of bony matter, and marrow is deposited in the hollow part, not from any relation it has to, or use it can be of to the bone, but merely that it might fill a vacant and otherwise useless space.

LECTURE III.

ON THE FORMATION OF BONE; THE STRUCTURE OF CARTILAGE AND LIGAMENTS; THE PROPERTIES OF SYNOVIA, AND ON THE STRENGTH AND MOTION OF JOINTS.

IN the production of bone, some circumstances occur which differ materially from the means which nature employs in the formation of other parts of our bodies, most of which possess nearly the same structure, from the beginning to the end of life. Thus no essential difference is met with in muscles or tendons, excepting in the qualities of firmness and strength, which increase as the animal approaches to maturity, and decrease as it declines into old age. The structure of the viscera, blood-vessels and nerves continues nearly the same from their first origin; but the parts which form the skeleton, previously to their arriving at the state of perfection, undergo a remarkable change. Bones are not met with in the early periods of the growth of the fœtus; either membranes or cartilages are deposited in those situations, which afterwards are occupied by bones; these substances, by a gradual change, being replaced by or converted into bones.

As the fœtus is immersed in a fluid and suspended by the funis, strong muscular attachment and action are not necessary to produce locomotion; in the earlier period of fœtal life, bones therefore are not wanted, indeed the fœtus is more pliable without them, and can more readily become adapted to the different situations it may happen to be placed in.

The examination of fœtuses at very early periods has ascertained that flat bones are formed from membranes; and that spherical, cylindrical and irregularly shaped bones are formed from cartilages.

The skull of a fœtus under two months, is found to be nearly membranous; the very little bony matter it then contains being placed in spots, which are generally situated in or near its basis. About this period the membrane becomes more vascular in those parts from which the fibres of the different bones of the cranium afterwards shoot. A degree of opacity then takes place in the membrane, and fine bony threads soon after this may be seen shooting from a centre towards a circumference; these seem bound together by other bony fibres, so that the appearance of a fine net work is produced. The intervening spaces of these fibres are at first filled up with numerous blood vessels, which deposit osseous matter until the perfect bone is formed. During this process the pericranium and dura mater, particularly the latter, are highly vascular, and cannot be separated from the growing bone without some tearing of their substances. I have before me a series of preparations shewing these facts. It does not from these appear, that the membrane is changed into cartilage, but that the bone forms immediately from the membrane.

The cartilaginous substance, which is the temporary substitute for the other classes of bone, is smooth and solid, it is possessed of much elasticity, and is of a bluish or pearly white colour. When cut into, it shews a uniform smooth substance throughout, without visible fibres, and without any hollow or cavity like that in bone which contains the cancelli and marrow. Small canals, however, are to be discovered in it immediately before its change into bone takes place.

This cartilage has very little vascularity until the process of ossification begins; vessels are then found to run in the newly formed canals, and to pass by minute ramifications into the substance of the cartilage, not for the purpose of nourishing it, but for carrying on the actions necessary to change it into bone, which are now beginning to take place in the middle of its substance. It is at first covered with perichondrium, which also at this period increases in vascularity. The qualities which I have mentioned render cartilage a very proper substitute for bone at first; it is flexible, preserves the shape and gives sufficient support to the soft parts connected with it; it allows of muscles to be fixed to it for motion, and when pressed on yields to the pressure; but recovers itself very readily on the pressure being removed.

In the patella, in the bones of the carpus and tarsus, and in all epiphyses where cartilage is a temporary substitute for bone, we find that the change into bone begins in the centre of the cartilage. In the shaft of cylindrical bones it appears to begin on the surface. In bones of regular shape, ossification begins at one point; in more irregular bones, at two, three, or more points. By cartilage becoming transparent when dry, and bone remaining opaque, the opportunity is afforded of observing the commencement and progress of this interesting process.

At first, canals are perceived in the cartilages lined with a vascular membrane, arteries are soon discovered running in these canals and ramifying more minutely in the part where ossification is to begin; a small knob of bone then appears to be deposited in a corresponding cavity; and the portion of the cartilage round it becoming very vascular, small arteries may be perceived passing into this knob. The canals containing the arterial trunks running to this part, soon seem to be lined with osseous matter, giving to them the appearance of bony tubes; this may arise from the vessels of the above mentioned membrane depositing osseous matter between its inner surface and the contained arterial trunk, or small lateral branches from this arterial trunk may deposit the bony matter. These changes are very satisfactorily seen in the cartilage of a young elephant when beginning to be converted into bone. The preparations now produced are from that animal, the knobs are seen at the extremities of the bony tubes in some places, and in others the tubes surround the knobs, appearing to branch from them something like to coral. The nucleus or knob gradually increases in size. We know not whether the canals in the cartilage originally exist in it, and are increased in size as the cartilage enlarges, or whether they are formed by the action of the absorbents from the surrounding parts which shoot into them with the other vessels; we know, however, that they contain arteries, and from the analogy of other parts, we are intitled to conclude that they also contain veins and absorbents. These absorbents reaching the centre of the cartilage, may remove a part of it; and into the space thus produced, the arteries may secrete the matter which forms the solid part of bone. These actions go on, the absorbents removing and the arteries depositing until the cartilage is wholly absorbed, and the bone rendered perfect. When the nucleus is even of a small size, it is found to have a compact lamella on its outer circumference and to be cancellated internally; the arteries and absorbents which enter it must therefore continue to deposit and absorb, on and from the different surfaces, so as to mould the bone into the structure and form intended by nature. As the patella is a bone which is not completed for many years and has cartilage substituted for it until several months after birth, a series of these bones at different periods, admirably illustrate the progress of those actions which take place in forming the perfect bone. Bone while forming, possesses as much vascularity as most other parts of the body, and when formed, a sufficient number of vessels remain to carry on its proper functions, but these are not required to be so numerous as in some other parts.

The osseous matter, thus deposited, was circulating in the blood, and by the action of the arteries separated from it. I have formerly observed, that the greatest part of it was phosphate of lime, and lime is found by chemical analysis in all animal and vegetable substances united to phosphoric acid. The proportion which the quantity of it in the circulation bears to the whole blood has been estimated very differently. It most probably varies much at different times. Some constitutions seem more disposed to separate and deposit this osseous matter than others; for in some people, concretions, of which phosphate of lime is the chief component part, form in different glands and in their ducts, more particularly in the salivary ducts; and in other people, those large bony tumors, called exostoses are formed. On the other hand, in certain constitutions, less of this matter is separated from the blood, as in some cases of rachitis and molities ossum.

It is clear that the arteries cannot form a complete bone of themselves, the absorbents in this formation must be as active as the arteries. A bone, for example, in increasing its size, could not retain its natural shape, so as to have its cavities and processes preserved in their proper distances from each other, did not the absorbents remove from some surfaces of the component parts, while the arteries deposited new matter on others.

Osseous matter is not added by being squeezed into the interstices of a bone, and by distending and separating the parts increasing its size; but is gradually laid on in different laminæ, and deposited in the largest proportion where the bone is to be increased. If a young animal, a pig for example, is fed on madder for two months, for the succeeding two months is allowed no madder, and after this fed for the same period on madder a second time, then killed and the bones examined, two laminæ of a red colour, the outermost of the deepest red, will be found, divided from each other by a lamina of white bone; these laminæ will not be confined to the surfaces of the entire bone, but will be, although more indistinctly, seen in every surface in the interior part surrounding a cavity, which is broad enough to bear examination.

An experiment made by John Hunter, elucidates the manner of bones increasing in size. He laid bare the ~~femur~~ tibia of a young growing animal, into which he made two holes, one of these near the upper and the other near the under joint; having measured the distance between them very accurately, he placed a shot in each of them, and allowed the wound to heal; two months after this he killed the animal, and found that although the bone was much lengthened, the distance between the two grains of shot continued exactly the same.

Ossification does not take place equally fast in all bones; the ribs and clavicles, long before birth, are completely converted into bone, while the bones of the carpus, tarsus, and more particularly the patella, are not completed until some years afterwards. There are certain parts of bones which are not formed at an early period, indeed, not till after birth; of this kind, are the canal belonging to the meatus auditorius externus, the mastoid process, the projections of the frontal sinus and some other parts.

In the preparations which I now produce, and which I made several years ago, the bodies of the vertebræ are seen entirely cartilaginous at an early period; and at a later, the bone is seen to form in the very centre of the cartilage as it does in the patella: some of these preparations are from fœtuses under two months.

It has been stated, and said to be confirmed by observation made in the solar microscope, that the shaft of cylindrical bones, and more particularly the metacarpal bones do not form at first from cartilage, but that ossification begins, and forms a round tube before any cartilage appears. Bone, as in the skull, can form from membrane, but at this early period none of the soft parts are sufficiently distinct, when dried, to enable us in the microscope to judge with sufficient accuracy of the particular nature of the part which we submit to its powers. So far as the naked eye, or common magnifying glasses will enable a judgment to be formed; in the phalanges of the fingers, as well as in the other cylindrical bones, it has always appeared to me, that when viewed in the fresh state, a species of cartilage preceded ossification, which cartilage might or might not have been formed from a membrane, but the membrane I have not seen.

I have before me several preparations made from fœtuses at the most early periods that the parts would admit of dissection. In these I find a substance similar to cartilage, shaped like the future bone, and ossification beginning in the middle of it as to length; not indeed in the centre of the cartilage, but rather on its circumference, and forming a short bony tube. This substance can only be seen as cartilage in the fresh state, for all but the spot of bone shrinks when dried, and cannot be distinguished from membrane.

I have contrasted the appearance by preserving one limb dried and the other in spirits.

In most of the cylindrical bones, and in all those which are of an irregular shape, ossification begins at more than one point, viz, one in the middle of the body of the bone, on its surface, and one or more in the centre of the cartilages at each of the extremities; these last being epiphyses. The body of the bone begins to ossify first; the commencement of ossification in the epiphyses is much later. In them it begins, as in the patella, in the centre of the cartilage, and increases towards the body of the bone, and at last becomes inseparably united to it; but in many cylindrical bones so slowly, that several years are required for the complete removal of the cartilage and the production of firm bony union. The distinction between the parts which are epiphyses and the body of the bone, although well marked at first, are lost in the adult when the formation of the bone is complete.

Several theories have been formed cencerning the use of epiphyses, but none of them are perfectly satisfactory. It has been said, that epiphyses accellerated greatly the growth of bone; this is plausible; but it does not appear that those bones are of a slower growth, or take longer time to arrive at perfection, which have no epiphyses, than some of those which possess them at each extremity, indeed in some of these last the ossification is later in being completed, than if the whole bone had ossified from the body only. Epiphyses are also found in the last phalanx of the fingers where the bones are short and small, and where it cannot be supposed that epiphyses are necessary to accelerate their growth. They have been said to prevent bones growing out too far; this is too absurd to require any other confutation, than by asking, what are to set bounds to the growth of the ephiphyses themselves.

The opinion of Albinus is, that epiphyses are useful in giving a larger, rounder, and more precise shape to the extremities of cylindrical bones, and projecting parts of more irregular shaped bones, than could have been effected so well from distant points of ossification. This appears to be confirmed in the coracoide process, acromion, and spine of the scapula, in the trochanters of the thigh bone, and in the vertebræ; but we find in other parts, bones whose extremities are not epiphyses, and which, notwithstanding, shoot out into rounded projections. This last, however, is the most plausible opinion as to their use.

It appears that cartilage is a very useful temporary substitute for those bones which have powerful muscles attached to them, at least during the early period when the animal is not subjected to much or strong motion, but when it grows and is liable to more and stronger motion, a harder substance than cartilage becomes necessary to support the weight and preserve the shape of parts, as well as to form those fulcra and levers which increase muscular power. Bone is therefore produced, and by the action of vessels; but we know not how secretion, in the immediate separation of substances from the blood, is performed in any one structure or gland. The secretion of osseous matter from the blood, not only takes place in the first formation of bone, but is constantly, although slowly, going on during life, the old bone being absorbed, and new bone formed in its place. Bones which have been once tinged with madder, in time losing such tinge, prove this.

As the skeleton consists of many bones, and these of various sizes, differing also materially from each other in figure and in the degrees, as well as the nature of their motion, it will be expedient in this place to take some notice of the properties of those materials, which connect them together in the formation of the joints. A joint may be said to be an accommodation of natural surfaces in bone with or without motion.

The joints of an animal body are never formed by bone alone; for, with few exceptions in any class of animals, and none in the human body, unless the bones were joined firmly together by some strong substance, they would be luxated on every sudden or violent motion of the muscles affixed to them. Ligaments are therefore provided for connecting them together. That bones may move freely on each other, it is necessary that the moving surfaces should be covered by some smooth substance not likely to be rubbed down by constant attrition: cartilage is provided for this purpose, and which being also possessed of great elasticity, diffuses friction and prevents or at least, lessens the force of any violent jar. To allow of and preserve free and easy motion of the joints, it is necessary that the surfaces both of ligament and cartilage should be constantly moistened with some lubricating fluid. Synovia is, therefore, secreted in their cavities.

Cartilage is of a middle nature, in consistence between flesh and bone; it is smooth, and white, with something of the appearance of transparency; it is very tenacious of its form, and is the most elastic substance in the body. When cut into with a sharp knife it seems to be uniformly smooth throughout, no fibres are seen, nor are there any vacuities, so that it very much resembles size or any firm jelly. These properties are common to every kind of cartilage; but there are cartilages formed to answer different purposes, which vary a little in minute structure. I have already mentioned the properties of the cartilage peculiar to young animals, and which is a temporary substitute for bone.

There is a second kind of cartilage which supplies the place of bone during life, giving a determined shape and firmness to parts where bone would be inconvenient; from its elasticity it allows of considerable variation of figure, yielding to any force applied, it is not liable to fracture, and when the force is removed it immediately recovers its proper shape. Of this kind, are the cartilages belonging to the nose and ear, also those of the larynx and trachea.

A third kind of cartilage passes from one bone to another, adhering by its extremities firmly to each; it answers a similar purpose to the increase of the extent of one of the bones, with the additional advantages of allowing of motion, and taking off the effect of jar. The cartilages of the ribs are of this class. These cartilages are covered with perichondrium, they possess fewer vessels than the cartilages, which are substitutes for bone; but more than those which cover a surface of bone subject to friction. When they have been steeped long in water, a laminated texture may be observed in them.

A fourth kind have been called inter-articular cartilages; these are found in the cavities of joints. They are somewhat moveable themselves, and are placed between so as to allow the bones some motion on each other. Some of these have no immediate connection with the bones forming the joint; but are attached only to the inside of the capsular ligament. They slide freely between the moving parts, and assist in adapting them more perfectly to each other. In some joints they extend only over a part of the space between the bones, as in the knee joint; in others they extend over the whole, so as to prevent the bones touching each other with any part of their articular cartilaginous surfaces, thus dividing the joint into two distinct cavities, as in the joint of the jaw, or between the sternum and clavicle. Other cartilages of this class are fixed at one extremity to the cartilaginous crust of the bone so closely, as to seem almost prolonged from it, as in the wrist below the ulna. By long maceration in water, a laminated structure is more distinctly seen in this kind of cartilage than in the two preceding species; but it appears to be less vascular.

There is a fifth kind of cartilage, named the articular. Articular cartilages are those crusts which firmly and almost inseparably adhere to the surfaces of bone which are opposed to and move on each other in joints, or which cover the surfaces of bone over which tendons and ligaments slide; thus the surfaces which come in contact are never mere bone with bone, or mere bone with tendon and ligament, the bone being in every case covered with cartilage when another bone or tendon is to move on it; and with ligament when soft parts only are to have motion on it. In some joints the whole of the surface of the bone within the capsular ligament is covered with cartilage, in others only the parts of bone which move on each other, the remaining part, as in the hip joint, being covered with ligament. These crusts are not every where of an equal thickness in the same joint; but are always thickest where the force of pressure is the greatest.

This kind of cartilage, like the others, appears pefectly smooth on its surface, and also when its substance is cut into. But if the patella, or any other bone on which it is thick is allowed to macerate in water until putrefaction takes place, a fibrous structure will be discovered; the fibres shooting from the surface of the bone outwards, and being as distinct as, and much resembling, the threads of cut plush or velvet. This structure was first discovered by Dr. William Hunter. From this arrangement of the fibres, the friction which the cartilage is subjected to, must always be applied to their extremities furthest from the bone.

The inter-articular, and articular cartilages are the least vascular parts of our bodies; after the bone belonging to them has been fully formed, no blood vessels have been seen to ramify in their substance, so that they do not appear to be vascular in the same way that other parts are Dr. Hunter seemed inclined to think that their vascularity was similar to that of the cornea of the eyeball, their vessels not being apparent in the natural healthy state, but becoming evident in inflammation. Inflammation has, however, proved that vessels exist in the cornea, but nothing has shewn them to exist in the articular or inter-articular cartilages. Madder, which when made part of the food of the animal, renders the bones red and tinges the cartilages of the ribs, produces no effect whatever upon these cartilages. In a paper which Dr. Hunter presented to the Royal Society at an early period of his life, he observed that the articular cartilages had a circular vascular border formed by their perichondrium, and he conceived that he had proved the vascularity of these substances by having injected a vessel which passed from this border into the articular cartilage of the patella; he therefore inferred that cartilages covering the moveable extremities of bones had no blood vessels on their surface, because no vessels in that situation could remain, for they would always have been liable to be torn and broken by the friction of the parts, and even when at rest, the pressure on them must have stopped the circulation of fluids through their cavities, that the vessels therefore dropt in from this circular border, and then took their course between the bone and the cartilage. He soon found, however, that he was mistaken, and that the cartilage which he had injected was one belonging to the patella while still a growing bone, in which a considerable portion of the original cartilage that had been substituted for bone remained unchanged.

The cartilages of joints are probably only vascular in a sufficient degree to preserve life, they certainly are not sufficiently so to exist long under disease, or to exfoliate, as bone. In what has been called exfoliation of cartilage, the separation does not take place in the substance of the cartilage, the cartilage either is first converted into bone, and by that change becomes sufficiently vascular to exfoliate; or the separation takes place in the bone to which the cartilage formed a crust. Cartilages when exposed never granulate, nor will they unite with granulations from other parts. Nerves have not been traced into these permanent cartilages;

they appear to possess no sensibility whatever. Some parts of the body which shew no sensibility in their natural state are rendered very sensible in disease; but cartilages are not rendered sensible by disease; cartilage in this resembles the cuticle and nails, and is the least alive of any part of our bodies.

The elasticity possessed by cartilage is greater than that of any other animal substance; this property is not dependant on life, nor is it altered by death, until putrefaction takes place.

The membrane which lines the capsular ligament and secretes the synovia may be injected to great minuteness, and may be seen to pass some little way on the edge of the cartilage; it soon becomes inseparably connected with the cartilage, and then its vascularity suddenly ceases; at least no vessels can be shewn beyond this by the most minute injections. I have never been able to trace a natural membrane passing over the surface of any of the articular cartilages.

From what has been stated, the use of cartilage in joints must be obvious. It is a substance possessed of great smoothness, little vascularity, and very considerable elasticity. It is adapted much better than any other animal substance to give smoothness of motion, and to prevent the abrasion which would necessarily take place, did such hard and inelastic substances as bone move on each other. From not possessing much vascularity and

Query) is there not pain in dislocation of the Cartilages of the Knee joint having no sensibility, it is not liable to diseases breeding in itself, and it can bear great presure without pain or injury. From its elasticity, the friction in the joint becomes more diffused, and from covering the ends of bones and surfaces which move on each other, it prevents, or much lessens the effect of collision or jar from jumping, or any other violent motion, the force of the shock being gradually spent from the cartilage yeilding to it. In addition to the above mentioned properties, the inter-articular cartilages adapt surfaces more perfectly to each other in the different motions of the joint; indeed they seemed formed for this express purpose, although they are productive of many collateral advantages.

Ligamentous cartilage is another substance which enters into the composition of certain joints. It appears as if it were made up of tendons, ligaments, and cartilage blended together, and possessing something of the structure and properties of each. In being fibrous, it resembles the two first, and in being elastic, the last of these substances. It is more vascular than cartilage, and possesses some sensibility in the diseased, but none whatever in the natural healthy state. Of this structure is the substance which surrounds the sockets of the thigh and shoulder bones; by its addition the brims of these cavities are rendered much more projecting, and the cavities of course deeper than they appear in the skeleton, and by being so allow of more strength and motion to be combined in the joints. The edges of the sockets being covered by this elastic substance are protected from the chance of fracture in the sudden or violent motion of the limb in certain directions, it gradually breaking the force of collision by yeilding to it.

The ligaments which we have here to name the structure of, are strong compact fibrous substances, connecting bone to bone.

Ligaments are of a white glistening colour, but neither so bright, nor so smooth as tendons, they have not so much motion as tendons, and therefore do not require to be so much polished. In structure, however, they are very similar to tendons and appear to be something between tendon and periosteum. Many ligaments appear to be continued intirely from these substances: the strong ligament connecting the patella to the tibia affords a good instance of this. Ligaments are more flexible and not so hard as cartilage, and with one exception, they possess no elasticity, they therefore do not yeild when pulled, but resist until torn through. They are made up of packets of fibres interwoven and running in various directions, but the largest proportion pass in the direct line between the parts which the ligament connects; these longitudinal packets may readily be separated from each other by maceration. Ligaments are more vascular than tendons, they receive their arteries from trunks in their immediate vicinity, these anastomose with each other, but no single branch runs to any great distance. They have veins and absorbents.

Nerves are not numerous in ligaments; but I have frequently seen nervous filaments enter them, and ramify in their substance. In their natural state they do not possess much sensibility, but when diseased they are very susceptible of pain.

The ligaments belonging to joints are the inter-osseal, the lateral or corroborating, the inter-articular and the capsular.

The inter-osseal pass between the long bones of the fore arm, and between the long bones of the leg. In structure they are similar to the other ligaments, but are more markedly continued from the periosteum. Their use is to allow of more motion, to increase the surface for muscular attachment, and to lessen the weight and bulk of the limb.

The lateral or corroborating ligaments adhere to the outside of some part of the capsular ligament, and pass like bands between two bones, or from one particular part of a bone to another part. They are always found in a ginglymus joint. They have the same structure which ligaments generally possess. Their use is evidently to increase the strength of the joint, and to limit its motion in certain directions. Their shape and course must thus differ in every joint.

The inter-articular ligaments are situated within the capsular. They are of various shapes, and they are placed so as to form a firmer connexion between the bones, and restrain motion in particular directions. They are on the whole firmer and stronger in consistence than the other ligaments.

The capsular are those ligaments which connect and include the extremities of bones so as to form joints, making with the bones a bag without any visible outlet. These ligaments are coarser and looser in their texture towards the outside, and firmer and denser towards the inside. They are affixed firmly to the bones, and are in part continued into the periosteum and tendons, which happen to be inserted near them, so that they never appear to terminate abruptly at the boundary of the cavity of the joint. They are lined by the synovial membrane, which formerly was described as the inner coat of these ligaments.

The capsular ligament of some of those joints which possess rotatory motion is so loose as to permit the received bone being subluxated, or placed on the edge of the socket, without any tearing of its own substance. This, however, is not likely to happen unless some considerable degree of force is applied; for the capsular ligament receives considerable addition of strength from the tone of the muscles surrounding it and pressing on it, and from many of their tendons being inserted into it; it is necessary also for the accommodation of surfaces, and for motion, that the cavity of the joint should be a vacuum, the pressure of the atmosphere will therefore aid the muscles in keeping the internal surfaces of the joint properly in contact. It is necessary that the capsular ligament of a joint possessed of rotary motion should be loose all round, otherwise the motion in certain directions must be limited. In a ginglymus joint the capsular ligament requires to be loose only on the fore and back parts.

The comparative strength of the capsular ligaments belonging to the joints of the two extremities, will be greater in the lower, as the bones of that extremity have to support the weight of the body.

Some Anatomists have attributed to certain muscles the peculiar action of drawing the capsular ligaments in such directions as to prevent them from being bruised or pinched, by being jammed between the moving bones. Tendons, are certainly so united to these ligaments, that when they move, the ligaments move with them; but this seems to be more an accidental, than a particular use; for the smoothness of the internal surface of these ligaments, and the lubricating fluid contained in their cavities render them so slippery that it would be next to an impossibility for them to be caught between the moving parts.

Capsular ligaments are inelastic, for were they not so, a greater exertion of muscular strength would have been necessary to move the joint, and being necessarily inelastic they are formed loose in particular parts, so as to admit of motion without being overstretched.

The synovial membrane, which forms the inner boundary of the joint, lines the capsular ligament, and is connected to it by dense cellular membrane; it is not, like the capsular, continued into the periosteum, but is reflected, from the part where the capsular ligament is attached, over the bones until it reaches the edges of the articular cartilages, to the surfaces of which it is firmly and almost inseparably connected; but it is loosely connected from where it leaves the capsular ligament to these cartilages. It in many respects resembles the pleura, peritoneum and other reflected membranes lining the circumscribed cavities of the body. It is very vascular and very dense; the first is necessary to it as a secreting membrane, the last as a containing one; for it secretes the synovia, and contains it afterwards. It possesses considerable sensibility in the diseased, and some in the natural state. In certain joints a quantity of fatty matter is found, the synovial membrane is reflected over this fatty matter, and also over the inter-articular ligaments, so as to give a smooth surface to all these parts. It is generally considered as being reflected over the surface of the articular cartilage, I have not been able to demonstrate it being so; it has always appeared to me to pass some little way on the edge of, and to become inseparably connected to the cartilage, and then lost. I have seen a membrane pass over the cartilage in a diseased state of the joint; but that membrane I have always considered as being adventitious, and formed in consequence of the disease, and not as an alteration of a natural membrane.

Some Anatomists have asserted that the synovia is secreted by small glands situated in the capsular ligament so as to be pressed on by its motion, and that it is conveyed into the joints through small openings of the inner membrane. Doctor Havers has published an account of, and even given figures of glands in the knee joint, which he describes as being situated in the fatty substance under the patella; he says that they are to be met with in other joints, and are of a roundish form and in clusters, he describes the size, number, and shape of their clusters as dependant on the interstices of the joints. Dr. Hunter asserted that he never could discover any lacunæ, or other ducts in the inside of the capsular ligament, or any distinct glandular structure in its substance such as Dr. Havers described, nor did he find any in the fatty matter. Instead of this fatty matter being formed for the seat of synovial glands, he was convinced that it was of the same nature and formed for the same purpose, as fat in other parts of the body. Like fat, it is contained in vesicles situated in a fine and vascular membrane, and may be boiled down to oil, it possesses all the properties of fat, and is absorbed in certain cases of disease where the fat in other parts of the body is absorbed. It is deposited in some joints where interstices were to be filled up, not as being necessary to motion, but to fill up what otherwise would be a vacant and useless place.

The synovia is secreted by the membrane lining the joint; it does not appear that either fatty matter or glands are necessary to its secretion, for neither of these are found in the shoulder joint, which has much synovia and great motion. We meet with no fat in this joint, only because there is no vacant space where it can be deposited.

The synovia is a viscid fluid, not unlike the white of eggs; it is found in joints and also in the cavities of the bursæ mucosæ. It is transparent and readily mixes with water; the largest proportion of it, in fact, being water; when putrefaction has taken place, it appears to be almost intirely water, but it contains also a mucilaginous part. Dr. Hunter thought that this fluid did not contain either serum or the coagulable lymph of the blood; and further stated, that no heat would coagulate it; but from experiments which I witnessed, and which were made by Dr. Baillie, it was found that synovia, exposed to a boiling heat for some time, became covered with a fine transparent pellicle of a substance like jelly; and when concentrated acids were applied to it, it became opaque, of a yellowish white colour, and a small quantity of sediment having the same colour was deposited. A paper moistened with synovia repelled flame, as if it had been moistened with water. Since that period synovia has been analysed by Mr. Charles Hatchett, who, by evaporation, obtained from 960 grains of synovia only 21 grains of residuum, the rest being water: his experiments have also clearly proved the existence of a small quantity of phosphate of lime in synovia.

The quantity of synovia secreted in health is merely enough to lubricate the surfaces of the joint so as to procure easy motion; but like other cavities, those of capsular ligaments, may have the se-secretion of their inner surfaces increased in disease, thus forming the hydrops articuli. And in a similar manner the cavities of the bursæ mucosæ may be distended with fluid

Having thus given a concise account of the nature of those parts which enter into the composition of joints, I shall only further remark that the strength of joints will be found to depend, first upon the form and size of the surfaces of the bones applied to each other; some having very small surfaces applied, others merely sliding upon each other, and many having large projections which are received into proportionably deep cavities: it is also occasionally dependant on processes, of an advantageous shape for ligamentous attachment, projecting some way from the moving surfaces of the joints. It is dependant also on the closeness or looseness of the ligaments, and on the circumstance of their being thick or thin. In some joints we find muscles and tendons so placed as to strengthen in a very great degree the capsular ligament, and at the same time to regulate the motion of the bones. This is remarkably the case in the joint of the shoulder, which is possessed of more motion than any other and which, comparatively for its size, is the weakest in the body when deprived of the contraction of those muscles whose tendons are inserted into its capsular ligament; but which is a very strong joint when it receives assistance from such contraction. It thus appears that the strength of some joints relative to muscles, is much greater than their absolute strength, or that which is dependant on bones, cartilages and ligaments.

The mobility of joints is dependant on the extent of the articular cartilages and the smallness of the surfaces at any one time in contact, as in the shoulder joint, where only a portion of the head of the os brachii can at any one time be received into the glenoid cavity of the scapula; also on the looseness of the capsular and other ligaments, so that absolute strength and great mobility are incompatible in the same joint. Thus in parts where great strength is necessary as well as much motion, as in the spine, or hands and feet, we find many joints, with but little motion, but each joint possessing great individual strength, so that in the part generally we find the two important advantages of strength and motion combined, the motion arising from a number of joints, and the strength from limitation of motion in every single joint.

LECTURE IV.

ON THE STRUCTURE, FORMATION, AND TIME OF APPEARANCE OF THE TEMPORARY AND PERMANENT TEETH.

IN the formation and structure of teeth, so many curious and interesting circumstances occur different from those we meet with in the production of bone, that I trust I shall not be considered as introducing irrelevant matter by making dentition the subject of one of the six anatomical lectures.

The danger which often precedes the appearance of the teeth in infancy, the pain which attends their diseases in every period of life, and the inconveniences which we suffer from their loss, justify me in doing this, and were any other motive necessary, I might state, that this subject, having occupied much of the time of John Hunter, both useful and splendid preparations of the teeth of the different classes of animals are to be found in the museum, and therefore are proper for our consideration here.

The numerous varieties in the structure and appearance of teeth present a very extensive field for the labours of the comparative Anatomist, and have been already treated on in the lectures delivered in this place by Sir Everard Home, Mr. A. Cooper, and Mr. Lawrence, many of the circumstances noticed by them, peculiar to the teeth of animals not human, will therefore only be used by me to introduce observations drawn from analogy, and tending to explain what relates to the teeth of our own bodies.

It is well known that the teeth are generally placed in the mouth and inserted into sockets in the upper and under jaws ; but nature appearing to delight in variety has placed those of some animals in the stomach ; the lobster affords us an instance of this. ' The varieties in the number of teeth which different animals possess, and in their size and shape, we can have some conception of from the specimens before us. Some fish have several hundred small teeth, placed regularly in separate rows ; other animals have only two teeth in each jaw, but these are of a large size, as in the elephant.

All teeth are properly adapted by nature to the food which the animal is to be supported on, so that the two classes of graminivorous and carnivorous animals may be readily distinguished by them. Carnivorous animals having their teeth pointed for catching and tearing their prey to pieces, as in the dog, lion and mammoth ; while graminivorous animals have those in the front of the mouth formed with sharp edges for cutting and dividing, and those in the back part flat and adapted for grinding, as in the horse, cow, and elephant. The human body is supplied with teeth adapted to prepare either animal or vegetable food for the action of the stomach, possessing certain properties partly of the teeth of carnivorous, and partly of graminivorous animals.

The alveolar processes, in which the teeth are placed, are formed by two thin plates of bone in each jaw. These plates are further removed from each other at their posterior extremities, than at the anterior or middle part of the jaw. They are united together by thin bony partitions going across, which rise rather higher in doing this than the alveolar plates; the plates being a little depressed or scollopped between each transverse partition; this is observable in the whole length of the alveolar process of the upper jaw, and on the forepart, particularly, of the under jaw. These transverse partitions form as many distinct sockets as there are teeth in the anterior part of each jaw; but at the posterior part, the teeth having more than one fang or root, each of these has a distinct socket. These sockets are not so deep in the aged, as in the adult or young person.

In each jaw the alveolar process forms about one half of an elliptical figure. On the fore part of the lower jaw its situation is perpendicular; but it projects inwards at the posterior part, and forms a smaller ellipsis than the body of jaw itself describes.

These processes are to be considered as belonging to the teeth rather than to the ossa maxillaria; for they form with the teeth, grow with them, and disappear when the teeth are removed; they are moulded exactly to the fangs of the teeth, and these two parts have such a mutual dependance on each other, that the loss of the teeth is invariably attended with the removal of the alveolar processes, and had we no teeth we should have had no alveolar processes. The jaws of people from whom teeth have been removed shew this; and in old people who have parted with all their teeth, their alveolar processes have also disappeared.

The red vascular substance called gum, covers and adheres firmly to the external part of the alveolar processes, and also to the necks of the teeth; but has its extreme border towards the body of each tooth rather loose. It extends also between the teeth, covering the transverse partitions, of course rising rather higher where it is attached to the sides of the necks of the teeth, than on the fore or back part. When the gum is destroyed the teeth appear much longer.

The gum has something of a cartilaginous hardness and elasticity, so that before the teeth in children cut through it, it performs their office, and seems formed for this purpose, having a hard ridge running through its whole length. In old people the gum performs the office of teeth more imperfectly, as in them it has not this ridge. The gum is nearly insensible to allow of this.

The chief use of the gum is to unite the teeth to the jaw; and to render the union more secure, it has some degree of yielding motion, which breaks the jar that would be communicated by immediate bony contact, of course lessens the chance of fracture either of the teeth or their alveolar processes. The division of each tooth into body, neck and fang, or fangs is well known, and requires no more than this brief mention.

When a tooth is extracted, there does not appear at first to be any periosteum on the fang upon a superficial view; but if steeped for a short time in water, it shews a membranous covering extending over the fang from the apex to the neck. This membrane is thin and vascular, and belongs equally to the socket as to the tooth, lining one, and covering the other; it leaves the socket and extends upon the neck where the gum is attached, but never covers the body of the tooth. It produces a firmer attachment between the teeth and the socket, and by allowing the one a little motion in the other, it prevents, or greatly lessens the communication of jar.

Two very different structures are to be observed in the substance of a human tooth, both of which are apparent on its outer surface, the body being incased in the structure, termed enamel, and the fang consisting of what has been called bone. The enamel appears on that part of the tooth external to the gum. The bone is covered by the edge of the gum and inserted in the socket; but it also forms the interior of the body of the tooth: this is the most distinctly seen when a longitudinal section of the tooth is made.

The enamel has been sometimes called the vitreous and sometimes the cortical part of teeth; Dr. Blake calls it the cortex striatus. It is by much the hardest part of our bodies, and is divided with great difficulty. It is of a bluish white shining colour, and when broken, it appears to be fibrous and striated; the fibres being directed from the surface of the bony part of the tooth, to which they are attached by one of their extremities, directly outwards. The enamel is, in the human tooth, placed only on that part which is subject to friction in the mastication of our food, and the end of the fibres being the only part which acts on the food, tends to prevent the tooth from being worn down. The enamel is thickest where the friction is greatest, viz. on the cutting edge or grinding surface of the tooth; it becomes thinner on the sides, and terminates gradually at the neck. On the cutting edge, and grinding surface, it is nearly of an equal thickness, and is consequently of the same form with the part it covers. It is very apparent on a common section of the tooth; for both its colour and the arrangement of its fibres readily distinguish it from the bone; and if a flat iron, red hot, is applied to the divided surface of the tooth, the bony part will from the burning become black, while the enamel will be very little altered. Or if a tooth is filed and steeped in a solution of silver in nitrous acid, the bony part becomes very black, while the enamel retains its white colour.

The enamel is not vascular, and there is not the smallest appearance at any period, of its having possessed circulating fluids.

John Hunter never found it to be tinged, even in the youngest growing animal, with madder. In confirmation of this, I shall add, that in many instances I have seen the bones of a young animal coloured with madder to as high a degree as possible; the bony part of the tooth has been strongly tinged, but on no one occasion did I ever find the enamel altered in the least. Dr. Blake says, that in one instance he met with the enamel tinged, and that he has a very beautiful specimen of the grinder of a young pig which had not appeared through the gum, the bony part of which is tinged of a most brilliant red colour, but the cortex striatus although tinged, is but slightly so, in comparison with the bony part; he therefore says, that John Hunter's experiments and observations on this subject he has shewn are not just. Dr. Blake owns, however, that he has frequently seen teeth, the cortex striatus of which was said to be highly tinged by the animal feeding on food mixed with madder; but on carefully examing them he found, that the external surface only was highly stained by grinding the food; for, when broken across, the internal part of the cortex striatus was scarcely tinged, and also the external colour was easily washed off.

All the facts and experiments, which I have seen, confirm the observation of John Hunter, and most of the facts related by Dr. Blake do not militate against it.

When the enamel is steeped in a weak acid, it dissolves intirely, without leaving, as bone would, any animal substance. The enamel had been supposed to be a carbonate of lime, but Mr. Charles Hatchet's experiments clearly prove, that it consists of phosphate of lime, cemented by a small portion of gluten.

The bony, or rather the ivory substance of a tooth, constitutes the principal part of its bulk, for it forms the whole of the fang and the inner part of the neck and body. The tooth reçeives its shape from it; the enamel incasing and being moulded as it were, to that part which forms the body and a small portion of the neck, so that when the enamel is removed, the shape of the tooth, with the exception of the body being less, remains the same as before.

In colour, the bony part is more yellow than the enamel, and has not its shining appearance, but resembles more common bone. It differs, however, in several circumstances from bone; it is much firmer and more compact; it is also more incorruptible; for teeth have been frequently found in Roman and Saxon sepulchres perfectly free from decay, when all the other bones have mouldered into dust.

When the bony part of a human tooth is fully exposed by a longitudinal section, it appears to be fibrous. The fibres are disposed in laminæ running from the apex of the fang towards the base, or cutting or grinding surface of the tooth; they form small arches at the angles, uniting the side to the base, and are continued across the base so as to join the fibres of the other side, extending nearly horizontally in doing this across the upper part of the cavity of the tooth.

This substance resembles ivory much more than bone. It is very different in its formation from bone, forming on a pulp as will be shewn afterwards. It is produced something like a shell on the pulp, and although the pulp is highly vascular at the time, it can be separated from the pulp without any apparent violence, and no vessels are to be seen passing from the pulp into it; it therefore has not been proved by injection to be vascular. It will while forming receive a tinge from the animal being fed on madder; but only that part of its subtance, actually formed at the time will take this tinge; so that by feeding a pig for a limited time on madder, desisting for a similar time from using the madder, feeding it again, and again desisting, we shall find, in the bony substance of its teeth, four strata, alternately red and white. Teeth after they are perfectly formed will not become tinged with madder, nor when once tinged will they lose their colour. These circumstances are materially different from those which take place in bone; for in bone a continual change is going on, but such change is not perceptible in teeth. Teeth have no apparent change from age, excepting the alteration they suffer in shape from abrasion. They are also, although slow in being completed, finished in every part at the time of formation, and from that time cease to increase in size. They do not grow softer in those diseases in which bones become soft.* The bony part of a tooth, however, possesses an animal substance which remains and retains the original form after the saline part has been removed by steeping the tooth in an acid; this part is soft and flexible, but more compact than the animal substance in common bone. This animal substance makes it probable that some fluids pass into the bony part, but not in a way that yet has been discovered. Another circumstance belonging to the bony part of a tooth which favours the opinion of vascularity, is, that occasionally the fang becomes soft, and sometimes unites itself firmly with the jaw.

The chemical analysis of this part of the teeth, affords nothing materially different from that of bone generally, viz. it gives phosphate of lime, carbonate of lime, and a small quantity of the sulphate of lime. The animal substance is similar to that of other parts of the body.

Every tooth has an internal cavity extending

* Although this is generally the case, I have met with one solitary instance of the bony part of the teeth having become softer than usual, in a patient whose bones were affected with rickets.

nearly the whole length of its bony part, and so shaped, that a cast of it would very much resemble the outward form of the tooth in miniature.

The cavity begins by an opening at the point of the fang, and is there very small; it gradually becomes larger as it approaches the body of the tooth, in the middle of which it ends. If there are two, three, or more fangs, there are as many openings, each leading into a canal in the middle of one of the fangs, which canals meet and unite in forming one large cavity in the centre of the body of the tooth. This cavity has a smooth internal surface; it does not, like the cavities in bones, contain cancelli and marrow; but is filled with a vascular substance similar to the original pulp. This substance has been sometimes called the internal periosteum of the tooth; but it is not a membrane merely lining the cavity; it is a soft organised mass filling it up. Some anatomists have described vessels shooting from this substance into the bony part of the tooth. John Hunter denies that such vessels have ever been seen. I have injected the teeth of growing, and even of adult animals frequently, so as to shew the pulp to be very vascular; but never could trace vessels passing from it into the bone.

The arteries which enter the cavities of the teeth are branches of the internal maxillary artery. Those which supply the teeth of the upper jaw come off from the neighbouring ramifications of this trunk; and those which supply the teeth of the under, arise from the branch named the dentalis inferior, which enters the canal on the back part of the ascending process of the jaw, and comes out at the foramen mentale. The veins join the trunks corresponding to these arteries. Absorbents have never been traced into the cavities of teeth; but if the pulp contains arteries and veins, from analogy we may conclude that it also contains absorbents. John Hunter says that he never could trace nerves even to the beginning of the cavity, although, from the pain felt in the toothach it cannot be doubted that nerves enter into it. I have very distinctly traced nervous filaments into the canal in the fang. Those which supply the upper jaw are chiefly ramifications of the second branch of the fifth pair of nerves; while those which supply the teeth of the under jaw, are from the third branch of fifth pair, a ramification of which enters the canal with the artery and comes out also at the foramen mentale.

The number of adult teeth, when complete, is thirty-two; sixteen of which are placed in each jaw. But the number has been known to vary from twenty-eight to thirty two. They are generally equally divided between the two jaws; but I have seen in a person of fifty years of age, who had not lost one of the permanent teeth, sixteen in the upper, and only fourteen in the under jaw.

There is much difference in the figure of the teeth; they are, however, in pairs, those of the right side resembling those of the left, and those in the upper jaw very nearly resembling those of the under in situation, figure, and use.

Teeth have usually been divided into three classes, viz. into incisors, canine or eye teeth, and grinders. John Hunter conceived the following classification would be more appropriate in the adult person, viz.:

Incisores, comprehending the fore or cutting teeth.
Cuspidati, the canine or eye teeth.
Bicuspides, or two-pointed grinders.
Molares, or grinders with four or five points.

The number of each class in each jaw being, four incisores, two cuspidati, four bicuspides, and six molares; the most backward of these at the extremities of each row have been called dentes sapientiæ.

The incisores and the molares are the most unlike; but there is a regular gradation both in growth, and form from the one to the other.

The teeth in the upper jaw are generally, almost always, so situated as to project over those of the under, more so, however, at the fore part than at the sides.

At the lateral part of each row, the surface of contact, in the shut state of the mouth, from behind forwards, is convex in the upper jaw, and proportionably concave in the under. On the fore part, the edge of each row is single, and this terminates with the cuspidati, for it is double from the first bicuspis to the dens sapientiæ.

To dwell on the form and relative situation of these different classes of teeth would not be compatible with the nature of the lectures expected to be delivered in this theatre.*

Children are seldom born with any teeth; but after two years of age, and from that period to nearly seven, they possess twenty, which are called the temporary or milk teeth. These are shed to make room for the adult set.

The temporary teeth are divided into eight incisores, four cuspidati, and eight molares; and these are similar, allowing for difference in size, to those bearing the same names in the adult set. When the temporary molares are shed, their places are supplied by the bicuspides. It often happens that previous to any of the temporary teeth being shed, the first grinders of the adult set have cut the gum, making the number of complete teeth in the child's mouth to amount to twenty-four.

The teeth begin to form long before the infant's birth. In a fœtus of three or four months, the alveolar processes are separated from each other by a cavity deeper and narrower in the front, and wider and more shallow towards the back part; ridges appear on the sides and crossing the bottom, marking those places, which afterwards become distinct cells. The artery, with its correspondent vein accompanied by the nerve, all of which are to supply the

* Although I could not introduce a description of the form and relative situation of the human teeth into the Lecture delivered at the College, a short account of them will be found at the end of this volume. I have added this account, hoping it might render what has been said on the teeth more generally useful.

future teeth, are placed in a groove running along the bottom of this cavity. The alveolar plates project more as the teeth grow, deepening the canal between them, and the ridges which are to form the partitions for the future teeth, shoot out from the bottom and sides; they cross the canal, forming first hollow arches immediately under the inner part of the gum, which arches extending laterally and being aided by bone crossing chiefly from the external alveolar plate, contract, and cover the upper part of the cells, and thus give a firm support to the gum before the teeth appear through it.

Nature employs very different means in forming the two substances of which teeth are composed. The bony or rather ivory part being formed by a vascular pulp; and the enamel being formed by a fluid, secreted by the inner surface of the bag containing the pulp, and which afterwards becomes hard and solid by crystallizing on the outer surface of the bone soon after its formation.

Placed in the cavity between the alveolar plates, there is thick and vascular membrane, divided into as many bags or cells as there are teeth forming at the time. It consists of two laminæ, the outer of which is thicker, more spongy, softer and less vascular than the inner. The preparations produced shew these circumstances, and I am more anxious that they should be attended to, as an author of an ingenious work on teeth, objecting to John Hunter, having stated that the external lamella is soft, spongy, and with few vessels, and that the inner is firmer, and very vascular, asserts that the external is full of vessels, and that the internal is more tender and delicate, and seems to contain no vessels conveying red blood, at least that he could not discover any such, even though assisted by a very subtile injection. It will, however, be proved that both lamellæ are vascular, and that no membrane whatever can exceed in vascularity the internal lamella; this may be seen in many preserved specimens of injections and dissections which I have made of growing teeth in the jaws of children.

Very early in the formation of teeth, three or four small pulps are found in one cavity, but as their size increases, partitions, first membranous, and then bony, shoot between them, forming different cells, each lined with a vascular capsule containing one of these pulps, in shape resembling the body of the future tooth. The pulp is tolerably firm in its texture and almost transparent; it is, however, very vascular, and both its arteries and veins can be highly injected from the membrane surrounding and containing it; these vessels pass to it from that part of the membrane which lies in contact with the bottom or deepest part of the socket: at this part only the pulp adheres to, and is connected by vessels to the membrane. The rest of the cavity between the inner lamella of the membrane and the pulp is filled with a viscid transparent fluid, not unlike the synovia of joints.

This fluid appears to be secreted by the vessels on the internal surface of the membrane, and afterwards by crystallization forms the enamel.

The pulpy substance grows nearly as large as the body of the future tooth before the bony part begins to form.

The beginning of ossification takes place in one or more points according to the kind of tooth, on the surface of that part of the pulp nearest to the gums. As the ossification increases these points run into each other, and a thin shell of bone then forms on the side of the pulp, covering every part of it excepting the surface where the vessels enter. In the incisores, the ossification generally begins in three points, the middle being the highest and first seen. In the cuspidati, it begins in one point in each. In the bicuspides, it begins in two points, one external, which is the highest and appears first, and one internal. In the molares, by four or five points, and when five, three are situated towards the cheeks and begin first, as do the external points when there are but four.

These points of ossification seem to have but a slight adhesion to the surface of the pulp on which they are formed; even when the ossification is very much advanced, the ossified part, I have already stated, can readily be separated from the pulp without the appearance of vessels being torn through passing from one to another, although the outer part of the pulp has a beautiful network of vessels on it, and adheres most to that part of the bony substance which was last formed.

The ossified part gradually increases in thickness, new strata being added to it internally; and in proportion as it increases the pulp decreases in size. When the bone has covered all the pulp excepting the side where the vessels enter, the pulp contracts a little and forms the part called the neck of the tooth. From this place the fang begins; the internal membrane of the socket adhering firmly to the neck of the tooth, and preventing the fluid in its cavity from reaching the outside of the pulp which is to form the fang. From this part the alveolar plates adhere firmly to the membrane covering the fang; and as the fang is gradually formed, it pushes the cutting edge or grinding surface of the tooth towards that part of the cavity next to the gum; the portion of the membrane pressed on is absorbed, so is the bony arch which supports the gum, the gum is then absorbed and the tooth appears externally. The sides of the alveolar processes lengthen and rise as the fang grows, continuing to embrace the neck of the tooth. In the first formation of the pulp it has no process corresponding to the fang; but when the body of the tooth is ossified, the pulp is lengthened into the fang; the body of the tooth is therefore formed first, and the fang is added afterwards. When there are two or more fangs, the ossification is continued from a corresponding number of points in the pulp.

It was the opinion of John Hunter and others, that the enamel was produced, nearly in a similar manner, from a soft vascular membrane placed in the same capsular, and opposite to that which formed the ivory or bone of the tooth. This opinion John Hunter adopted, from having found a vascular membrane, in a young elephant, sending processes between the pulps of the growing teeth, and having the same situation respecting these pulps which the enamel afterwards possessed in the full grown tooth; for the enamel in the elephant, and many graminivorous animals is not confined to the outside of the tooth, but strata of it pass through its substance. These processes, it has been since found, are not in any respect similar to the pulp which forms the ivory part; they are continuations of, and are of the same structure as the membrane which contains the pulp, and which secretes the fluid that by crystallization on, and adhering to the bone forms the enamel. In the elephant, and in the grinding teeth of graminivorous animals generally, after the fluid is secreted and crystallized so as to form the enamel, the membrane which secreted it, is converted into bone. Thus in the elephant, on a section of the grinder tooth, we find on the outside common bone, formed from the membrane which secreted the enamel being converted into that substance; then enamel, afterwards the ivory formed from the pulps; and several layers of these are met with in the same tooth. In the human tooth the membrane which secretes the enamel is absorbed, and therefore we have no common bone in such tooth.

The fluid secreted by the inner membrane of the capsula and contained within its cavity, by the absorption of the thinner parts, becomes inspissated to a proper state for crystallization, which takes place on the external surface of the bony part of the body of the tooth, now formed on the pulp. The enamel is formed, and covers the body of the tooth before the fang begins to grow; as the fang forms, the body of the tooth is pressed towards the gum, and the periosteum, adhering from the neck of the tooth over the whole fang, leaves no cavity where fluid, secreted by the internal membrane of the capsula, could come in contact with its outer surface, so as to adhere to and crystallize on it; There is, therefore, no enamel on the fang.

I have already stated, that as the fang increases in length, it presses the base of the tooth against the mouth of the socket in which the tooth is formed; the bone between the tooth and the gum is from this pressure absorbed, and the base of the tooth now comes in contact with the gum. It here generally irritates and gives pain; the gum from the pressure inflames, and the compressed part is gradually absorbed. This is, in common language, called cutting the teeth.

The pressure on the inside of the gum, in some instances, before it produces absorption, irritates and inflames that substance, so as to excite suppuration; this is occasionally attended with very violent symptoms, the whole system of the child appearing to be affected by it. These symptoms are generally relieved by cutting fairly through the gum and setting the matter and the tooth at liberty. I have known several instances of lives having been saved by attention to this state of the gum, and by the performance of the simple operation which will relieve it, particularly in those children where there is a disposition to formation of water in the ventricles of the brain; and when properly performed, I have in no one instance observed the least future inconvenience to attend it.

The adult or permanent teeth are formed nearly in the same manner as the temporary teeth, but each tooth has its distinct bony cell and capsula, from the beginning. These cells are situated either at the inside of the socket containing the fangs of the first set of teeth, but still distinct from them, or in the root of the coronoid processes in the under jaw, and in the great tubercles of the upper jaw. In general, a small opening or canal can be traced from each of these cells to that edge of the socket formed by the internal alveolar plate of the temporary tooth, which the tooth now in the cell is to succeed. This canal of course runs behind the fang of the temporary tooth, and terminates close to its neck. Through this opening which is immediately under the gum, Dr. Blake states, that the membranes of both sets of teeth continue to be connected. He supposes that each capsula, containing a tooth, was formed by a process of the original membrane which lined the alveolar plates, for he says, "When the rudiments of the temporary teeth are tolerably advanced, the internal part of the gum, or rather the upper part of each membrane destined to form one of the temporary teeth, sends off a new sac. These sacs, situated as just now described, are each at first contained in the socket of the one to which it is to succeed; and are so intimately connected with the membranes of the temporary teeth, that they cannot be separated without tearing one or both, and may be torn with the first set out of the socket." He says also, " we have seen the membrane of the posterior temporary grinder, and that of the anterior permanent grinder intimately connected together and contained in the same socket, but as the permanent grinder advances and the jaw increases in length, a process is sent backwards from the upper part of its membrane, which at first is contained in the same socket. This process gradually swells into a sac, in which is contained the pulp, whence the middle grinder is to be formed; and as the ossification advances the parts become separated by a bony partition, the connexion, however, is still kept up. When the membrane of the middle grinder is tolerably advanced, it sends off a process in a similar manner, to form the sac of the posterior grinder or wisdom tooth."

It has been supposed, that this connexion of the capsula, remaining perfect, might be useful in regulating the future position of the succeeding permanent teeth; and this has been given as a reason why the gums should not be lanced, without great consideration and attention in the performance of the operation, so as not to injure the connexion with the permanent tooth which is to succeed the one set free. Allowing the consequences of such injury, these can, at all times, easily be prevented, by making the incision through the gum nearer to the external than to the internal alveolar plate. I have not been able to trace the lateral connexion between the capsulæ of the grinders, but I have often seen the communication between the membranes surrounding the necks of the temporary teeth, and those forming the capsulæ of the permanent teeth by which they are to be succeeded.

The order of formation and appearance of the milk teeth without the gums are subject to great variety. Some children have been born with teeth, but these have been found to be imperfect and without fangs, consequently have soon been detached; and other children, although enjoying perfect health, have not cut a single tooth until the end of their second year. What is said on this subject must therefore not be considered as applicable to every case, but only generally, and of course subject to variety.

In a fœtus about the third month, the groove between the alveolar plates is lined with a membrane, containing in its cavity four or five pulpy substances on each side, not however very distinct. By examining a fœtus at the fifth month, these will be found to have increased in size and distinctness very rapidly, so that small points of ossification may be seen beginning on the edge of the incisores, the anterior teeth being the most complete.

In a fœtus of seven months, the pulp of the sixth tooth on each side has begun to be formed, and is then situated, in the under jaw, on the inside of the coronoid process, and in the upper in the great tubercle. The ossification gradually increases and the formation of enamel takes place.

About the sixth, seventh, or eighth month after birth, the middle incisores of the lower jaw begin to pass through the gum, but often later, and sometimes, though rarely, sooner than these periods. The middle incisores appear soon afterwards in the upper jaw. In a month or sometimes longer after this, the lateral incisores of the under jaw appear; then those of the upper. About the twelfth or fourteenth month, sometimes sooner, the first molares of the under; then the corresponding teeth of the upper jaw appear. The four cuspidati are usually protruded through the gum the last; thus the cuspidati and the second grinders will sometimes appear at the same time, and this is usually between the twenty and twenty-fifth months, so that at, or soon after two years of age, the twenty temporary or milk teeth are found in the mouth.

These teeth are shed between the years of seven and fifteen, and are succeeded by the permanent or adult set. It formerly was supposed, that the temporary teeth were pressed out by those which were to succeed them lengthening, and otherwise increasing in size. This is certainly not so; for were it so, the shedding tooth must rise in proportion to the growth of the succeeding one, and stand in the same proportion above the rest; this would have been obviously inconvenient, and never happens. It is well known that a shedding tooth, when loose, projects no more beyond the gum than any other. The preparations here produced clearly shew, that the alveolar process, with its partitions forming the sockets, and the fangs of the shedding teeth are removed by absorption; while the new teeth, accompanied by their alveolar plates and partitions surrounding the beginning of their fangs, shoot out and increase in proportion to each other; thus, as the fangs lengthen, their sockets deepen. The change it is clear is not acomplished merely by mechanical pressure; for some of the permanent teeth remain enclosed in their bony cells, even after their corresponding temporary teeth have been shed. If the jaws of a child about four years of age are examined, the temporary incisor teeth will be perfect as to their fangs, but the permanent incisor teeth, as yet possessing no fangs, will be found in a cavity extending behind the fangs of the temporary teeth, and near to the opening of the nose in the upper jaw, and to the base of the bone in the under jaw. Their alveoli grow with their fangs, and the greater part of the cavities, in which their bodies were first placed, are also absorbed, before they take their proper and permanent situation in the mouth. The preparation which I now produce of a shedding and growing tooth in the jaw of a horse, shews the effects, very decidedly of this absorption, the temporary tooth having lost the whole of its fang, and not exceeding half of an inch in length, although originally more than two inches; the permanent one being below it, and nearly of the original size of the shedding tooth, which now, from the absorption of its fang, projects no more than it did when complete as to its length.

John Hunter states, that he has seen two or three jaws, where the second temporary grinders were shedding in the common way, without any permanent teeth underneath them; and in one jaw where both grinders of each side were shedding, he met with the same occurrence. He states also, that he had known temporary teeth shed later than usual, and not replaced by permanent teeth. Mr. Cruikshank was consulted by an eminent dentist on the case of a person who, at thirty years of age, lost the only teeth he ever possessed, and which were not replaced by others. These circumstances shew that the temporary teeth are not removed merely by the pressure outwards of the succeeding teeth: but they also prove that the succeeding teeth have some influence in producing or regulating the absorption both of the fangs and the alveolar processes of the first set, for in these instances the temporary teeth had remained twenty or thirty years. The absorption of the fang is not in exact progression from the apex to the body of the shedding tooth, for marks of this action will be found on the whole circumference of the fang, particularly on the side of it turned backwards or towards the socket of the succeeding tooth.

The formation and time of appearance without the gum of the permanent teeth are also subject to some variety. The only difference between the time of their appearance in each jaw is, that the teeth of the lower one are generally more advanced and consequently appear first.

The formation and appearance of the permanent set, are not regularly backwards from the first incisor to the dens sapientiæ, but they begin from two points on each side of both jaws, viz: the first incisor and the first molaris. The teeth between these two points make a quicker progress than those behind. In this statement I do not exactly follow the account given by John Hunter, although in most particulars I have found it to correspond with the examinations made by myself; but I here state the result of my own observations, as I believe few people have more frequently injected and examined these parts than I have done.

The pulps of the middle incisores and first molares, of the permanent teeth, appear in a fœtus of seven or eight months; and I have found the pulps of the cuspidati before the period of birth; but more generally, the pulps of the lateral incisores and cuspidati appear soon after birth. The pulps of the first bicuspides, I have found in the beginning of the fourth year; and the pulps of the second bicuspides, in the same year, or about the beginning of the fifth: John Hunter states their appearance to be two years later. The pulps of the second molares I have usually found about the fifth year, and those of the dentes sapientiæ frequently before the eleventh year. All these are found in distinct cells and are surrounded by their own capsulæ.

The first and second incisores and cuspidati, begin to be formed deeper in the jaw, and on the inside of the corresponding temporary teeth, which they are to succeed. The first and second bicuspides are placed under the first and second temporary grinders, which they are to succeed. The first molares are behind these, but are now nearly ready to cut the gum. The second molares of the lower jaw form directly under the coronoid processes, and those of the upper in the great tubercles; in these parts the dentes sapientiæ also begin to be formed.

About the seventh or eighth years, the adult incisores and first molares cut the gum. The cuspidati seldom do this before the eighth year. About the tenth and eleventh, the bicuspides appear; these are sometimes later. The second molares appear in the mouth, from the twelfth to the fourteenth year; and the dentes sapientiæ, from the nineteenth to the twenty-fifth. I have known them appear so late as the thirtieth.

Teeth have sometimes protruded through the gum late in life, and have been called a third set; this has been supposed to happen from some of the temporary teeth not having been shed until long after the accustomed period, and the permanent teeth not having formed in the usual time; for the set is never complete, and when confined to one jaw the teeth are obliged to be extracted on account of the mischief they would do to the opposing gum. Supernumerary teeth are occasionally met with, although not often, they are usually incisores or cuspidati. The incisores and cuspidati are sometimes so irregularly placed, as to have the appearance of a double row.

In one instance, in a person of fifty years of age, I have seen in each jaw two or three grinder teeth in the front of the mouth: this person had formerly a hare lip, but the palate was perfect. She never had incisor teeth.

I cannot conclude this subject without bringing to your recollection some observations of John

Hunter, respecting the growth of the two jaws, as this growth is different in some respects from that of bone generally.

The jaws increase in every direction until the bodies of six teeth in each side are tolerably well formed, but after this they do not increase between their symphises and the sixth tooth. From this time the jaws lengthen only at their posterior ends, so that the teeth formed at first in the coronoid processes, or tubercles, get at length completely before these parts.

In a young child, the cavity in the temporal bone for the articulation of the lower jaw is nearly in a line with the gum of the upper jaw, and for this reason the condyle of the lower jaw is nearly in the same line; but afterwards, by the addition of the alveolar processes and teeth, the line in the gum of the upper jaw descends considerably below the articular cavity, and for that reason the condyloid process is then lengthened in the same proportion.

In old people who have lost all their teeth, the articulation comes again into the same line with the gum of the upper jaw; but in the lower jaw, the ascending processes and condyles cannot be diminished for accommodating it to the upper, so that it necessarily projects before the gum of the upper jaw at the fore part. The two jaws, however, remain opposed to each other where the grinders were situated, and where the strength of mastication lies.

There are two sets of teeth, because the fœtal jaw is not large enough to contain the number sufficient for the adult.

Teeth, even with men, are occasionally used as instruments of offence and defence. In most quadrupeds they are formed partly for these purposes.

A secondary purpose which human teeth serve, is giving clearness and distinctness to the sound of the voice. Those people who lose their front teeth have their voice considerably injured; this may partly depend on the tongue and other organs of voice not being able immediately to adapt themselves perfectly to the alteration: in time we know that the voice regains some of that distinctness it at first lost.

There are many very curious and interesting circumstances in the formation and structure of the teeth of graminivorous animals which I have scarcely touched on here, as they belong to the department of comparative anatomy.

LECTURE V.

GENERAL OBSERVATIONS ON THE HUMAN SKELETON, AND ON THE PARTICULAR SITUATION AND CONNEXION OF THE SPINE, PELVIS, AND THORAX.

TO remedy those injuries which may happen from accidents, and to be enabled to cure the diseases which take place in bones, we must not only know their shape and structure, but also their particular connexion with each other. And as it is easier to comprehend a reference to what is placed before us, than to what remains only in the mind's eye, I shall perhaps stand excused for prefacing the remarks, intended to be made on the diseases of bones, by some general observations on their arrangement, motion and uses when they are combined and forming the skeleton.

The skeleton is well known to be an assemblage of those hard parts, which sustain and give general shape to an animal body. In animals of white blood, and which have no vertebræ, it is formed of shell and placed exteriorly. In animals possessed of vertebræ, it determines the proportion and form of the body, and, although not situated externally, it often encloses the most important organs of the animal.

In the skeleton of the human body we find a structure, most admirably adapted to give firmness, support, and determined shape to the whole fabric, protection to those softer parts upon the regular and uninterrupted action of which life immediately depends, to afford levers to increase the powers of the muscles, and fixed points to limit, or give proper direction to their actions. To possess these qualities the skeleton must necessarily be composed of a number of bones; a few, even one might have given support and determined shape, but many are necessary when strength and motion are combined.

The stature of the human skeleton may differ a little in different nations, and we have often before us, as now in this assembly, great variety in the stature of those of the same nation. In the museum there is the skeleton of a man, whom some of us have seen alive, the height of which is eight feet two inches. I have seen a perfectly well-formed skeleton of an adult person, which measured only thirty-five inches. A dwarf was lately exhibited in London of a lesser height, but his head was disproportionably large. There may have been some individuals a few inches taller, and others a few inches shorter than these; but we have no authentic records of the human stature exceeding nine or at most ten feet; and every known fact is in opposition to the opinion that mankind were formerly larger than we now find them; the variety of exceeding large or very diminutive persons having at all times been confined to individuals. I believe no doubt now remains, but that the fossil bones which have been described as belonging to the human species, which have exceeded their proportions of the above mentioned height, had formed part of the skeleton of the elephant, the mammoth, or some other quadruped now unknown.

It is well known, that the strength, thickness, and muscular impressions of bones are different in skeletons of the same height; and that women generally and unactive men have less degrees of these qualities in their skeletons, than those whose lives have been active and labourious. In the museum of Mr. Brookes there is the skeleton of an adult woman, the bones of which do not exceed in thickness those of a child of three or four years of age, although in length, they are equal to those of a woman not remarkably short. And in the museum of Dr. Wm. Hunter was preserved the skeleton of a very short man, the strength and thickness of whose bones I have not seen exceeded by those of the strongest and tallest men.

In the view which it is proposed now to take of the skeleton, I shall begin with the trunk, as the basis of muscles and muscular action, upon which the head and other extremities move, and to which they are affixed; considering it also as the largest, strongest and most immoveable part, on which the others, although perfectly distinct from each other, are entirely dependant.

It has been most satisfactorily proved, by the attentive observation and comparison of the form of the human skeleton with those of animals most nearly resembling man, that the natural attitude of the human figure, in a state of progression is erect, and that it is not so in other animals. Among the many peculiarities proving this, the form and shape of the human spine are the most strikingly remarkable; for in the erect position the spine becomes a pillar of support, bearing the incumbent weight of the thorax, upper extremities and head, and for this reason is largest at the bottom, where the most weight is to be supported. Indeed the size of the lumbar vertebræ and sacrum, being greater in proportion to the rest of the bones of the spine than in any other animal, and thus being adapted to support the increased weight, is sufficient to prove that the upright position is natural to man. The spine forms a chain of bones connecting together the pelvis, thorax and head; like the keel in a ship, making one whole of the several component parts of the skeleton; supporting the weight of the body in the upright position, and in the recumbent preventing the trunk from being lengthened. The bones of the spine are so generally found, and are so important, that they give a name to the most numerous and perfect class of animals, viz: vertebral animals.

In the admirable structure of the human spine, we have two most important qualities combined, these are strength and flexibility. It possesses this advantage, from consisting of several bones, so connected, that the degree of motion between any two is much limited; but the motion diffused through the whole is extensive and in every direction.

The bones which compose the spine support, lodge, and protect the spinal marrow; the spine having a canal for this purpose extending throughout its whole length, with perforations on each side between the vertebræ, to allow of the nerves passing out. The numerous joints of this structure prevent the spinal marrow from being overstretched, or compressed during the motions of the trunk, which would have happened at some particular part, had much bending motion been permitted between any two of the vertebræ; but as it is, the curvature must be regular and gentle, from being divided among so many bones.

To increase the strength and to limit the motion, there is a double articulation between each vertebra; one connecting the bodies of the contiguous vertebræ, and another connecting their articulating processes. In the loins, the surfaces of contact between the bodies of the vertebræ are flat and broad; and the lower articulating processes of each vertebra, being placed nearer each other and being convex, are received between and into concavities of the upper articulating processes of the vertebra below. In the back, the bodies are placed nearly horizontal, but the surfaces of contact between them are less than in the loins; and the articulating processes are nearly perpendicular, the under being placed behind the upper articulating processes of the vertebra below. In the neck, the lower part of the body of each vertebra, excepting the first, is shaped like a wedge, and is received into a corresponding concavity in the vertebra next to it, and the articulating processes are placed very obliquely.

The sacrum and os coccygis, forming part of the pelvis, are not concerned in the rotatory motion of the trunk. I have already stated that the sacrum is much larger, in proportion to the other vertebræ, in the human spine than in that of any other animal. This arises from the nature of its junction with the ossa innominata; it has to bear the weight of the parts above it in an unfavourable direction, viz: a transverse one; it is therefore formed proportionably large and strong. Its triangular shape, and the wedgelike articulation with other bones forming the ring of the pelvis, add to its strength; and while its concavity before and below increases the capacity of the hollow of the pelvis, its convex and projecting posterior and upper surface is admirably adapted to allow of origin to strong muscles, which ascend to support and give motion to the vertebræ forming the column above it.

The os coccygis consists of five small bones, in the human skeleton; but in quadrupeds, there are many bones below the sacrum, viz: all that form the tail.

In the quadruped, these bones are continued in the same line with the spine; but in the human body, the sacrum and os coccygis bend forwards so as to assist in supporting the pelvetic viscera when the body is seated, or when they are forced downwards by the muscles of expulsion. Had the sacrum and os coccygis proceeded in a direct line from the spine, they would have projected beyond the tuberosities of the ischia, and therefore would have prevented the weight of the body, when in a sitting posture, from being conveniently supported, as it now is, on those parts.

Although the motion is very limited between two contiguous vertebræ, the upper part of the spine, from the number and nature of the joints, possesses much motion and that very varied. The bones of the spine are connected to each other by strong external ligaments, and the under and upper surfaces of their bodies by the elastic intervertebral substance, the solidity of which diminishes gradually from the circumference to the centre, so that it becomes nearly fluid and incompressible in the middle, thus allowing, but limitedly, all the motions of a ball and socket joint, viz: a gentle bend in every direction, as well as a degree of rotatory motion. This structure also breaks the force of any jar, by gradually yielding to it, and from the elasticity it possesses, always tends to restore the vertebral column to the natural erect form. During the day when the body is erect, this intervertebral substance, yielding a little to the weight thrown on it, diminishes the height in the adult person, rather more than quarter of an inch, but this is recovered during night, when the body is recumbent.

The articulating processes, having sliding cartilaginous surfaces, limit the motion in certain directions, and by so doing, add much to the strength of the whole chain. When we bend forwards, the upper moved part is supported intirely on the bodies of the vertebræ; when we bend backwards, the articulating processes support much of the weight; when we incline to one side, the weight is supported partly by that side of the bodies, and partly by the articulating processes of the same side; but the erect position is the surest, as to maintain that, all these parts assist.

The transverse and spinous processes are admirably contrived for giving an advantageous insertion to those muscles which are to keep the spine erect, and occasionally to bend it. The tranverse processes also afford buttresses of support to the ribs. The hollows between the spinous processes and the angles of the ribs are filled up by the powerful muscles just now alluded to, and I shall have occasion when on the curvature of the spine from rickets to shew you, that the regular action of these muscles, when properly excited will do more, and with much more safety, towards removing or lessening the incurvation, than all the instruments which ever have been invented.

Between the dentata and atlas there is no intervertebral substance; but a pivot extends upwards from the dentata, on which the atlas moves round, and carries the head with it; between these two vertebræ there is therefore more rotatory motion, than between the whole of the others combined. The joint is one of the most beautiful construction, and permits of the head being turned more expeditiously to either side, than could have been effected by any other contrivance; and is so strengthened by various ligaments, as to admit of dislocation by no common accident, for should the pivot be driven from its proper situation, so as to press on the spinal marrow at this part, the derangement would be attended with death.

The great length of the transverse processes of the atlas, affords a very advantageous insertion to the rotatory muscles of the head. The atlas has no spinous process, for this process would have prevented rotation, by projecting between the muscles; or would have torn them in the attempt to produce it.

The surfaces of the corresponding articulating processes of the dentata and atlas are flat, to enable them to slide on each other in the rotation of the head; the capsular ligament connecting them is consequently loose. The superior articulating processes of the atlas, although nearly horizontal, are very concave to receive the condyles of the occipital bone, and rise high on their external brims, for strong connexion with the head. This rise prevents all rotatory motion of the head on the atlas.

Besides the external, and capsular ligaments, there is a strong ligamentous membrane, which lines the inner surface of the vertebral canal, extending the whole length of the spine.

Between the roots of the contiguous spinous processes, there is a particular elastic ligament, the state of which is quiescent when the spine is in its natural shape; this ligament, therefore, tends to restore that shape when the spine has been bent, and by so doing renders less muscular exertion necessary. In quadrupeds, where the spine is horizontal, this ligament is large and strong, and assists in keeping the head from falling to the ground.

I have seen two varieties in the number of vertebræ; one was in a Lascar, who had twenty-five, the additional vertebra was in the back, there were on each side thirteen ribs. The other was in an European woman who had only twenty-three vertebræ, she had eleven ribs on each side. As these varieties were met with in recent bodies brought for dissection, there could be no deception used, as there might have been in articulated skeletons; for in them a vertebra and two ribs might have been added or removed.

In the beautiful and elegant curvatures of the human spine, we can readily perceive how admirably each is adapted to its use. In the pelvis, the spine is hollowed in the front to contain the viscera, and projects behind to increase the power of the long muscles of the back. In the loins, it projects forwards, for the purpose of balancing better the weight of the body, throwing the pillar of support immediately over the centre of gravity rising between the thighs; as a secondary use, this projection supports the large bloodvessels and viscera of the abdomen: as the spine ascends, it makes a sweep backwards and becomes more flattened on the sides, to give room for the heart and lungs; this curve, with the two scapulæ and musles belonging to them, project considerably behind the centre of gravity.

It again bends forwards so as to become in the neck immediately in a line with the loins, thus balancing the weight of the body, and affording support to the æsophagus and blood vessels of the neck and head. It passes a little backwards before its termination, for the proper articulation with the head which is fixed on its upper extremity.

The deviations from these natural curvatures are not unfrequent; many of them being dependant on causes which may be removed, they will be noticed afterwards with other parts of the skeleton, which are affected by their bend. I have dwelt on the natural structure of the spine, perhaps too long, but it was, that the surest and simplest means of removing these deviations might be better understood.

The term pelvis is applied to the strong irregular ring of bone situated at the lower part of the trunk; and when the bones forming it are removed from the rest of the skeleton, and placed horizontally on a flat surface, a little forcing of the imagination, may suppose that they do bear some resemblance to an antique basin; but the term would more strictly apply to the appearance of the cavity between the bones, when bounded by the peritoneum, and viewed from the opened abdomen; for when thus viewed, the sides and bottom, as in a basin, run gradually so and imperceptibly into each other, that no precise boundary shews where the one ends or the other begins.

As a ring, the pelvis possesses more strength, for its extent, with a lesser quantity of bony matter, than it could have done in any other shape. It is in fact the strongest part of the skeleton, and the necessity why it should be so appears, when we consider, that in the erect position of the body, the weight of the thorax, head and upper extremities is supported by the sockets of the thigh bones, which are situated in its sides, and when we are seated, by the tuberosities of the ischia; for the extremity of the spine is but little pressed on in this position.

It is also the part to which the lower extremities are connected, and from its shape as a ring it allows of fixed points for the muscles descending from it to surround each extremity, and by their action to move it in any direction; and also to muscles which ascend from it on the trunk, and move the spine and thorax in every direction. It thus may be considered as the great centre of attachment for the voluntary muscles.

By its hollow form, it supports and contains some important viscera, as well as certain parts belonging to the organs of generation.

The aperture at the upper and fore part, communicates with the general cavity of the abdomen. The aperture at the under and back part, is partially closed by muscles and ligaments, which assist in supporting and protecting the contained parts; but which leave sufficient space for the termination of the larger excretories; viz: the bladder, and rectum in both sexes, and in the female the uterus.

In the erect position of the body, the pelvis is situated obliquely, the opening towards the abdomen looks upwards and forwards so much, that a line drawn through its axis would approach considerably nearer a horizontal than a perpendicular direction, and would strike on the apex of the os coccygis. The excretories therefore terminate before and below this line as the cavity of the pelvis projects downwards, and backwards from that of the abdomen. That part of the pelvis, which is in front when the body is seated, becomes in the erect position the lower part; thus the viscera rest on, and are supported by the ossa pubis, rather than on the soft parts which bound the lower and posterior aperture: in advanced pregnancy, the advantages arising from this are obvious. In quadrupeds, the cavity of the pelvis is in the same line with that of the abdomen, and from the horizontal position of the trunk, no inconvenience arises from this.

From the oblique situation of the pelvis, the thigh bones are so joined to it, that the line of support in the trunk coincides with that in the lower extremities. Had the axis of the pelvis been perpendicular, the thigh bones being connected with the middle of its sides, and the spine being attached to the back part only, the body would constantly have been inclined backwards by its own weight; but as it is, in the erect attitude, the spine becomes a pillar of support, rising through the centre of gravity and extending over and above the articulation of the thigh bones. This oblique situation of the pelvis should always be remembered in examinations of the diseases connected with it, and in the operations which may be required for their removal. From the pelvis being frequently viewed when in a detached state and placed on a table, a wrong impression is often acquired of its true situation in the skeleton, and the terms anterior and posterior, which seem to have been applied to it and to the parts belonging to it in its artificial position, increase the difficulties arising from this impression, so as sometimes, in the necessary examinations of the natural and diseased parts by the introduction of the finger into some of the excretory passages, and in the use of instruments in operations, to have produced very serious mistakes. We should therefore recollect that the position of parts, usually called anterior, is also inferior, and that called posterior is also usually superior. From the recollection that a line drawn through the axis of the pelvis in the erect position of the body, approaches nearer to a horizontal than a perpendicular one, the true situation of the pelvis, in regard to the rest of the skeleton, in any position of the body, need never be mistaken.

The pelvis rises high at the sides, these lateral projecting parts give support to the abdominal viscera, and allow of attachment to the strong muscles which move the thighs and trunk. Had the edge of the pelvis projected equally on the fore part, the cavity of the abdomen could not have so readily accommodated itself to the alteration in size which its viscera must occasionally undergo; as the bladder when full or empty, the uterus whether gravid or not, or the intestines when distended or contracted.

The ossa innominata are very wide in the human skeleton, and give origin to the strong and thick glutei muscles, which, covered by fat, form the hips, and constitute a marked difference between man and the animals which approach nearest to him in shape, and thus assist in proving that the erect and sitting attitudes are peculiar to the human race. The tuberosities of the ischia project for muscular attachment, and are rounded for supporting the body when seated; the larger glutei muscles, passing over them, form a convenient cushion for the more easily enduring the pressure of the weight. They also give attachment to two of the strong sacro-ischiatic ligaments, which form the bottom of the ischiatic notches. The spines of the ischia give attachment to two nearly similar ligaments. These ligaments connect the ossa innominata to the sacrum, and are more convenient and safer in doing this, than bone would have been; for by yielding a little to any force suddenly and violently applied, they lessen the chance of the bones being fractured, and in parturition they may on some occasions facilitate delivery. Similar observations will apply to the articulation of the ossa pubis at the symphysis, but in a more marked degree, as between these bones there is a connecting medium not very unlike that between the bodies of the vertebræ, viz: a substance consisting of smooth cartilage in immediate contact with the surfaces of the bones, but becoming fibrous nearer the middle; I have often seen a cavity in the centre containing a substance nearly fluid, and there is a large proportion of cartilage at the under part. All this connecting structure is covered by strong ligaments. The space under the arch and between the descending rami of the pubes, lodges part of the external organs of generation, some of which are attached to the inner surfaces of these bones.

The great sciatic notches afford convenient openings for the larger trunks of nerves and blood vessels to pass through, which supply the back parts of the lower extremities. The foramina thyriodea between the ischia and pubes, allow the pelvis to possess more surface and strength, with a less quantity of bony matter and weight. They are filled up by ligaments which afford extensive surfaces for muscular attachment, and by so doing produce a saving of bone, for bone seems to be formed with more difficulty than ligament.

The acetabula are situated on the sides of the ossa innominata near the under part, and are much deeper in the fresh body, than they appear to be in the skeleton; their edges are rendered prominent by a quantity of elastic ligamentous cartilage, which structure increases the strength of the joints, and lessens the chance of the edges of the acetabula, being on any occasion broken off. The acetabula have a deficiency of bone on their inner edges, but in the fresh body the ligamentous cartilage extends all round, leaving a hollow underneath it, in which the fatty substances belonging to these joints play; and this structure allows to the thigh bones more latitude of motion inwards, than they could have had, if the edges of the acetabula had been bony all round.

The only decisive marks by which a female skeleton may be distinguished from that of a male, are to be found in the pelvis, and arise from the obvious cause of the female possessing a proper frame to become a mother. The bones of females generally are smaller, more delicate, and the muscular impressions are less distinctly marked on them, than on the bones of males; but these differences are accidental and may be met with in men as well as in women, as in those of a slender make, and who have not been in the habit of using laborious exercise; while those of women accustomed to hard labour shall be strong and well marked.

The pelvis of a male appears stronger, thicker and much more clumsy than that of a female, it contains more osseous matter, this indeed holds respecting all the bones, but not in so great a degree.

The pelvis of a female, at and below the linea innominata formed by the lower part of the inside of the ileum and ridge of the pubes, is much more capacious from side to side than in the male. The entrance or brim of the cavity is also more oval, the greatest diameter being from side to side. In the male it is more triangular, and the greatest diameter at the brim is from the fore to the back part. There is not much difference in the breadth of a male and female pelvis, belonging to skeletons of nearly the same height, if measured from the anterior part of the spine of the ileum, to the corresponding part of the opposite side; the difference in breadth is chiefly confined to the basin like part of the cavity. The symphysis pubis is broader in the female, and the angle underneath it is much more obtuse; the space between the descending rami of the pubes is consequently larger. The sacrum is broader and turned more backwards, this also adds to the capacity of the cavity. The os coccygis is more moveable and much less bended forwards. The tuberosities of the ischia are farther distant from each other and from the os coccygis; and as these three points are farther asunder, the notches between them are consequently wider, and there is of course a much greater extent of space between the os coccygis and pubes.

In consequence of the cavity of the pelvis being wider in women, the superior articulations of their thigh bones must be farther removed from each other; this occasions their peculiarity in walking; as they have more trouble to preserve their centre of gravity from falling too much to one side, when the leg is raised.

The intention of the whole of these peculiarities is evidently to allow of a sufficient space for the procreation of children, and a free passage for them at the time of birth.

The thorax, in addition to the twelve dorsal vertebræ, is well known to be composed of twenty-four ribs and the sternum.

In shape, it forms a flat irregular cone, adapted to the important viscera contained within it, as well as to the attachment of muscles belonging to the upper extremities, and the head. This shape is also convenient and necessary for the motions which the ribs possess in respiration.

The size and form of the cavity of the thorax, cannot be known by viewing the entire body, for the muscles attached to the arms, give an appearance of breadth to the upper part of the trunk, which the cavity does not possess. The cavity is very narrow above, it widens as it descends; it is the least deep on the fore part, corresponding there to the length of the first and second bones of the sternum; behind, the depth is greater, as it answers to the extent of the twelve dorsal vertebræ; and still deeper at the sides from the obliquity of the ribs.

The narrow part of the cone is open above, to allow of the trachea and æsophagus to pass into the thorax: also to give passage to the important blood vessels belonging to the upper extremities and the head. The thoracic duct also passes through it, as do the nerves which supply the vital viscera of both the cavities which are situated in the trunk.

The viscera contained in the thorax, cannot, without danger, be exposed to pressure, nor can their actions be long interrupted without endangering the loss of life; nature, therefore, in placing the heart and lungs in a bony cage, has protected them from injuries which might arise from common accidents, and has made the bones forming this cage subservient to respiration, by giving them such shape and connexion, as to render their motion capable of enlarging and diminishing the cavity of the thorax; and has formed their surfaces smooth on the inside, to admit of the viscera possessing a free and sliding motion in this and other actions.

The ribs are crooked bones, extending obliquely from the sides of the spine to the middle line of the body before, and consisting of two parts, each bone having a cartilage of some extent added to its anterior extremity. The cartilaginous portions of the ribs, with the exception of those belonging to the first and twelfth, are placed so far in a different direction to the bony portions, that they ascend to join the sternum, while the bony portions descend as they pass forwards from the spine.

Besides the curve, each rib has a twist, which prevents it, from touching a flat surface with its whole length at once. In making its curve, the rib is more bent at one particular place, which is called its angle; the rib passes backwards until the angle, and from this part it inclines forwards. The crookedness of the ribs decreases from the first to the last. The length and twist of the ribs increase from the first to the seventh, and then both decrease. The angle, which in the first rib is placed where it leaves the spine, increases in distance from the spine until the ninth rib, it then becomes indistinct; in the middle ribs, the distance of the angle is about an inch and a half from the spine.

The seven superior, or true ribs are fixed by their own cartilages immediately to the sternum, The five inferior, or false ribs are not immediately continued to the sternum; but are attached, from the twelfth, successively to each other, and to the cartilage of the seventh rib. The greater degree of motion each true rib possesses, the longer is its cartilaginous portion.

One use of these cartilages is the prevention or lessening of any jar, affecting the bones, being communicated to the viscera; another is preventing the ribs from being fractured, to which accident by laying hollow they must otherwise have been much subjected; a further use of the cartilages, is to restore the ribs to their natural position after they have been elevated or depressed in respiration. Each rib, with the exception of the first and last, is articulated in a socket formed by part of the bodies of two contiguous vertebræ, and it forms another joint with the transverse process of the lowermost of these, this process becomes a buttress of support to the rib, and prevents it from being dislocated backwards when force is applied to the front of the chest.

The ribs are not continued to the pelvis, for had they been so, they would have greatly interrupted, if not intirely prevented, respiration, the expulsion of the urine or fæces, the occasional increase of bulk in particular viscera, and the bending of the body forwards, or to either side.

The important action of respiration is performed by the muscles which move the ribs and sternum, and by the diaphragm. In respiration, the ribs are raised, and the diaphragm is pressed downwards, by which means the cavity of the chest is enlarged. The elevation of the ribs may enlarge the cavity of the chest so much in inspiration, as to be sufficient to support life without the assistance of the diaphragm, and this sometimes is done, in advanced pregnancies and dropsies when the contents of the abdomen prevent the diaphragm from pressing downwards. The diaphragm also may effect a sufficient enlargement of the cavity of the thorax to support life, without the ribs; this sometimes happens in inflammations of the pleura, when the motion of the ribs adds much to the pain, to avoid which, the patient endeavours to keep the ribs at rest. We have a remarkable proof of the diaphragm having carried on respiration unassisted by the ribs, in a skeleton in our museum, where the whole of the ribs are anchylosed, and must have been so a long time before the person's death. On all common occasions, however, the diaphragm and the muscles which raise the ribs, act together. The first rib is nearly fixed, and placed horizontally; the remaining ribs, as they pass forwards, incline in succession more downwards, so as to increase the breadth of the intercostal spaces by separating from each other. The muscles of inspiration raise the ribs, and at the same time turn their lower edges outwards; this motion elevates the lower part of the sternum, and carries it forwards; thus the whole transverse diameter of the chest is increased. If the ribs had not inclined downwards, but had passed horizontally from the spine to the sternum, they could not, by being carried upwards, have had any effect in enlarging the transverse diameter of the chest. The ribs rotate on the axis of their posterior extremities, which produces the effect of raising, and pressing outwards the sternum at the lower part. The cartilages, connecting the ribs with the sternum, must, by this action, be twisted to a small extent, and when the muscles which raised the ribs cease to act, their elasticity, endeavouring to regain their natural shape, depresses the ribs, consequently the lower part of the sternum is carried downwards and backwards, and the transverse diameter of the chest is lessened; in doing this the cartilages are assisted by the muscles of expiration. In strong expiration, these muscles depress the ribs much lower than the point to which the cartilages from their elasticity bring, and would leave them; and when so, the muscles of expiration are opposed instead of being assisted by the elastic property of the cartilages.

LECTURE VI.

ON THE SITUATION, CONNEXION, MOTION AND USES OF THE UPPER AND LOWER EXTREMITIES, AND OF THE HEAD IN THE SKELETON.

THE bones of the two superior extremities are fixed to the sides of the upper part of the trunk; from which, when they hang down, the position of the body being erect, they extend as low as the middle of the thighs. In animals whose skeletons approach nearest to those of men, as in the tribe of simiæ, the pectoral extremities, when their bodies are placed upright, extend in most instances below the knees, and in many as low as the joints of the ankles; but there are some small monkeys in which they are much shorter than the hinder; although in by far the greatest number of such animals the pectoral extremities are the longest.

In the human body they are so moveable, that the hand can be applied to any part of the external surfaces of the trunk and head; and, with a little assistance from the other joints, can be applied to any part of each other, or of the lower extremities, In the construction of the pectoral extremities man has a decided advantage over other animals. In quadrupeds they are chiefly used in progressive motion, sometimes in assisting the animals in catching, holding and tearing their prey, and occasionally in removing insects, or any extraneous matter that might adhere to their skins, or the hair or wool which covers them; but in man they form admirable instruments, much connected with the mind, and under the immediate guidance of the will, by which we possess the powers of giving and receiving, of feeding, of defending ourselves and of attacking others, in short of accomplishing all those efforts of art, suggested to us by our own in-invention, or communicated to us from the talents and experience of others. The joints are found to bend in one direction, evidently for allowing a co-operation between the two extremities, and they are numerous, that the range of motion might be considerable and varied, and that the motion might also be performed with more force and strength. These extremities are placed at the sides of the thorax and attached to its upper part, that their motions might also be immediately under the influence and direction of the eyes.

The upper extremities are evidently more connected with the affections of the mind, than the lower; as the gestures of the hand have been employed, in all ages and in all nations, to express these affections, forming a kind of universal language.

How are these "admirable instruments" made the tools of the most brutish arts, suggested by depraved invention. Reader, would any one believe me if I told him yesterday, that I should this day see the statue of King William the third prostrate in the Dirt? How

The mechanism of the hand did not escape the observation of the antient Physiologists. Aristotle so much admired its construction as to call it the organ of organs, and instrument of instruments.

It has also been well observed by a French Surgeon and Anatomist of the last century, when treating on this part of the body, "that if nature has given something very particular to every animal, either to defend itself against others, or to preserve itself from outward injuries or accidents, we may affirm that man has received two things preferably to all animals, viz: reason and the hand; the one for council and conduct, and the other for execution."

The bones of the shoulder are the clavicle and scapula. Some anatomists have classed one, others both of these, with the bones belonging to the trunk; but as the principal motion of the thorax, viz: that of respiration might be carried on without them, and as the proper motion of the extremities could not, Anatomists are now agreed in ranking them as belonging to the upper extremities.

The clavicle is placed almost horizontally, but a little obliquely, between the sternum and scapula, at the upper and anterior part of the thorax; the sternal extremity being a little lower than the scapular.

The scapula is placed at the upper and back part of the trunk, extending from near the spine outwards; and downwards from the second rib to the

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seventh. The cavity of the shoulder joint situated in this bone faces outwards; and the arms hang downwards from it by the sides of the trunk. The clavicle forms a joint with the acromion scapulæ, where the two bones form the basis of the upper and outer part of the shoulder. The clavicles keep the scapulæ apart from each other, and hinder them from coming too forwards when moving on the trunk; they also prevent the scapulæ from moving too near each other behind. The situation which they occupy is advantageous for the insertion of certain muscles, and allows them to afford protection to the trunks of the larger blood vessels and nerves, which pass under them to the arms.

In those quadrupeds which use their pectoral extremities chiefly for progressive motion, and not to hold substances by, or to climb, the clavicles are intirely wanting. The scapulæ in these animals are placed more forwards on the sides of the chest, they are therefore much nearer each other; and the glenoid cavities face downwards, and thus become adapted for supporting the weight of the fore part of their bodies; so that, in the standing possition, these extremities form nearly right angles with the trunks to which they are affixed. Animals which employ the pectoral extremities for other purposes than merely walking, as all those which occasionally use them as hands or wings, possess clavicles. In most birds the clavicle is single, extending from the breast bone to each of the wings.

The clavicle is the only bone of each upper extremity immediately articulated to the trunk; and the joint between them, although not a large one, admirably combines limited, but varied motion, with strength and safety. The capsular ligament is thick and strong; but still loose enough to admit of some motion in all directions; it is much strengthened by the corroborating ligaments, particularly by the inter-clavicular one, which extends behind the sternum. In the joint, the surfaces of the sternum and clavicle are covered, each with a distinct cartilaginous crust; and between them, extending across the whole of the cavity, is interposed an inter-articular cartilage; these cartilages acting as so many springs, by breaking the violence of the jar, prevent any force used by, or applied to the upper extremities, endangering either the bones or the viscera of the chest. The rhomboid ligament, extending between the sternum and cartilage of the first rib, adds much to the strength of the connexion.

The clavicle, in its course to the acromion of the scapula, passes over the root of the coracoid process of that bone, and is connected to it by a strong ligament of some length and thickness, viz: the conoid ligament; it then forms a joint with the acromion, and articular cartilages cover the corresponding surfaces of each bone, and sometimes an interarticular cartilage is found between them. The ligaments of this joint, allow a sliding limited motion to the two bones. The fracture of this bone, being not an unusual accident, I have dwelt a little on its connexion with the other bones. At the shoulder, the motion of the clavicle is considerable, for it possesses some rotation, and will form a circle and move in all the radii of one.

The scapula is, with the exception of the joint between it and the clavicle, attached only by strong muscles to the trunk. These muscles fix it sufficiently as a fulcrum to the bone of the arm; they also allow it to alter its possition, so as to form a socket in a proper direction, and adapted for the head of the os brachii to play in, in all its great variety of motions. This connexion of course allows an increase of motion to the arm, and from the fleshy attachment the bone possesses to the trunk, of these motions being performed with less jar against the breast. The motion of the scapula is considerable; for besides moving directly upwards, downwards, outwards, inwards, and in all the intermediate points, it moves so on its centre, as to elevate or depress the arm affixed to it, giving to the arm also a degree of rotatory motion outwards and inwards.

The arm has only one bone, which in the erect possition extends downwards, from below the acromion of the scapula, on the side of the trunk until it nearly reaches the pelvis; but from which its body and lower extremity can be moved extensively in every direction: the lower extremity forms a joint with the two bones of the fore arm.

The head of the os brachii is placed obliquely between the upper extremity and inner side of the shaft, and is much larger than the glenoid cavity, which can therefore only receive a part of it at one time. The capsular ligament is loose to admit of motion in all directions; so that the strength of the joint depends on the action of the muscles surrounding it and adhering by their tendons to its capsular ligament; also in part to the tendon of the long head of the biceps flexor cubiti muscle, which enters the joint and passes over the head of the bone. It has more variety of motion than any other bone in the body; it rotates, forms a circle, and moves in every direction from a centre; but the capsular ligament of the joint is so loose that it will admit of the bone resting on the edge of the glenoid cavity without being torn.

The head of the bone faces inwards and a little backwards. When in the glenoid cavity, the upper extremity of it projects some way beyond the clavicle and edge of the acromion scapulæ, and easily may be felt a little below them, through the substance of the deltoid muscle; when dislocated, of course, a vacancy will be found in the part occupied by the head of the bone in the natural state.

In the quadruped, from the glenoid cavity facing downwards, and the os brachii being perpendicular, the weight of the body of the animal is supported on the surfaces of the two bones; but from the glenoid cavity in the human body facing outwards, and the head of the os brachii inwards, it is very clear, that all the weight born perpendicularly by the last bone, must be thrown on the capsular ligament of the joint, and not on the surface of the glenoid cavity. The supra spinatus muscle having its tendons passing over the upper part of the capsular ligament, and the tendon of the long head of the biceps flexor cubiti, passing directly over the head of the os brachii, are of great assistance in enabling this joint to bear any weight thrown on it, which is to be supported by the bone when placed parallel to the trunk of the body, and so are the infra supra spinatus and teres minor muscles, if the weight is thrown upon the bone when raised and carried forwards.

The great tuberosity is placed on the outer, and rather on the anterior part of the bone, its greatest projection corresponding pretty accurately to the axis of the head. The lesser tuberosity is situated lower down and more inwards, the biceps groove being on the forepart of the bone between them.

Near the lower extremity of the os brachii the breadth increases, and those irregular projections called the inner and outer condyles are formed. The inner of these is the most prominent, and from it many of the flexor and pronator muscles of the fore arm, also the brachio-cubital ligament pass off. From the outer condyle some of the extensors and supinator muscles are continued, so is the brachio-radial ligament. Between these and within the capsular ligament of the elbow joint, on the fore part, is the lesser triangular cavity which receives the coronoid process of the ulna, and limits the motion of flexion; and behind, is the larger and deeper cavity which receives the olecranon of the ulna, and limits extension. The lower surface of the bone, bending a little forwards, and being divided into the trochlea which articulates with the ulna, and into the rounded projection, on which the radius plays, need not be described here, every one present being acquainted with its form and appearance.

The fore arm, consisting of the ulna and radius, makes at the elbow joint an obtuse angle with the arm. This jöint, so far as the os brachii and ulna are concerned, forms a complete hinge; but in it, the radius is so articulated with the other bones, as to move with the ulna in flexion and extension; and also by possessing the power of rotation on the axis of its upper extremity it produces those most useful and necessary motions called supination and pronation. The bones of the fore arm are connected to each other nearly their whole length by an interosseal ligament, which allows of the above mentioned movements, and also affords an extensive surface for muscular attachment, with much less weight and bulk of limb than bone would have done.

The ulna is the longest of the two bones, and is articulated above to the trochlea or pulley of the os brachii; its larger sigmoid cavity being moulded so as exactly to correspond to that surface; and this pulley being oblique, the fore arm, when bent, is not carried directly towards the arm, but is inclined a little inwards, or towards the trunk of the body or the other arm, as it must be carried in such direction to make the hand generally useful. In animals whose pectoral extremities are chiefly intended for progressive motion, the pulley is not oblique but straight.

The projecting form, and disposition of the upper edge of the olecranon, and coronoid process of the ulna, and these parts being received in the cavities above the articular cartilage of the bone of the arm in extension and flexion, add greatly to the strength of this joint.

Indeed the strength of the elbow joint is chiefly dependant on the corresponding forms of the articular portions of these two bones. The olecranon projecting backwards, becomes a lever, which increases very considerably the power of the strong extensor muscles of the fore-arm inserted into it, by placing their tendons much behind the centre of motion in the joint. Descending from the olecranon, on the back part of the bone, is a flat triangular surface, on which we support weight when leaning on our elbow.

No part of the radius, in the extended state of the arm, passes higher up than the surface of the lower part of the os brachii, but in the flexed state, it slides forwards a little on the rounded head to which it is articulated. The radius, whose upper cartilaginous surface resembles a horizontal section of the bone hollowed in the middle into a shallow cup like shape, receives only a part of the rounded projection of the extremity of the os brachii at any one time; being too small to receive the whole at once, it therefore moves extensively on it. That part of the circumference of the head of the radius, which is placed towards the ulna, is also covered with cartilage, and is received into the lesser sigmoid cavity of that bone, and included in the common capsular ligament of the joint. The neck of the radius is long, the capsular ligament is attached round it, but very loosely, so that it allows the bone extensive motion in flexion and extension along with the ulna, and also considerable rototary motion on the axis of its upper extremity or head. Below the capsular ligament and near the interosseal one, on the forepart of the bone, a tubercle is placed to which two of the principle muscles which turn the palm of the hand forwards are affixed. When the arm, without any muscles being in action, hangs by the side of the body the radius crosses the ulna, so that the back of the hand is in front; the supinator muscles change this position and place the palm of the hand forwards; when so, the two bones of the fore arm no longer cross, but are parallel to each other.

At the wrist the ulna is not placed in contact with any of the carpal bones; but its lower extremity, which is small, plays upon an inter-articular cartilage extended from the edge of the radius; the destruction of this cartilage occasions the notch which we perceive at the inside of the wrist in the skeleton.

The radius at this place is so much enlarged, as to form the whole of the immediate articulation of the fore-arm with the carpus; two bones of which, viz. the os naviculare and lunare, are received into a depression at its lower extremity, and in supination and pronation move round with it, and in either state are capable of flexion and extension on it. This bone has also a sigmoid cavity, which receives within it part of the semicircular cartilaginous edge of the lower part of the ulna, on the circumference of which it moves, describing part of a circle and carrying the hand with it, while the upper extremity rotates on its own centre.

Both the radius and ulna, besides the capsular ligament of the wrist, have strong ligaments at the sides, passing down from projections called their styloid processes.

The hand is made of the bones of the carpus, metacarpus and fingers, amounting to twenty-nine bones in all. These are so connected that we have in this part great strength and much variety of motion conjoined. The eight bones of the carpus are placed in two rows; the moving surfaces applied to each other, are covered with cartilaginous crusts, these acting as so many springs, recoil when struck, and thus enable the hand to give a strong blow without receiving any injury itself by inflicting one.

The carpus is convex on the back part: from being arched, it is of greater strength, but the bones forming it possess very limited motion on each other. From two projections on each side, which render it hollow in front, the strong annular ligament, which binds down the tendons of the flexor muscles while it adds strength to the wrist, passes across and is firmly affixed to the bones at the extremities of each row.

The four metacarpal bones, where their bases are attached to the last row of the carpal, have scarcely any perceptible motion; but their cartilaginous surfaces prevent any injurious effect from collision when violent motion is used by the hand. They are convex towards the back, and concave on the fore part, this renders them useful in grasping. They have oblong heads which bend a little forwards, or at least extend a little upwards on the anterior part of the bones; these are received into shallow cavities at the base of the first phalanx of the fingers, and would, from this form of joint, admit of motion in every direction, did not strong corroborating ligaments pass from flattened surfaces on the sides of their heads to the bases of the bones of the first phalanx of the fingers, and limit, although they do not intirely prevent, lateral motion. The spaces between these bones, lodge the interosseal muscles which produce this lateral motion.

The three phalanges of the fingers are of different lengths; the first of each finger being generally a third longer than the succeeding one, and the second in the same proportion longer than the third. They are connected to each other by double ginglymoid joints, but the lateral motion of which is limited by the strong ligaments placed on their sides.

The form, size, and articulation of the thumb give advantages to the human hand which the extremities of no other animals, employing their feet as hands, can possess. With the other fingers, the thumb is adapted to spread over an extensive surface, and to grasp objects of a very large, or very small size. The hand indeed forms a most complete and varied instrument; but its uses have been so often, and ably commented on, and are so well known, that any further enumeration of them would prove both tiresome and unprofitable here.

The general conformation of the lower extremities in man, and their so much exceeding in length, thickness, and strength, those of the animals which approach nearest to him in shape, strongly indicate that he alone has been formed by nature for progressive motion in the erect state. Should this be questioned, let comparison be made between them, as to the breadth of the pelvis, the form of the

And is he the better for that? he was made perfect, but has fallen from his first estate.

acetabula, the size and strength of the glutei muscles, the disposition and length of the thigh bones, the nature and extent of their articulation with the tibiæ, the length of the legs, the shape, size and position of the heels, the extent of the soles, and strength of the feet, when all doubts must immediately cease.

The thigh has but one bone, but that one is the largest and strongest cylindrical bone in the body; its length, in a well proportioned adult, is about one fourth of the person's height.

At the knee joint there is a bone, which, excepting in being detatched, corresponds much to the olecranon of the ulna in the elbow joint. The leg possesses two bones; and the foot several. So that the bones of the lower extremities in some things resemble those of the upper, and have many of the advantages which these last possess; but as they are intended more for progressive motion, than grasping substances singly or co-operating with each other in this action, the joints are formed, not as in the upper extremities to bend one way, but alternately forwards and backwards; and as they have to support the weight of the body they are made stronger, and have consequently more limited degrees of motion.

The situation of the thigh bone is not perpendicular, but oblique; its head is connected with a socket placed in the side of the pelvis; the neck of the bone projects outwards from this, and forms a very obtuse angle with its body, increasing much the distance between the upper part of the one thigh bone and its fellow on the opposite side. The body of the bone inclines inwards as it descends, so that the lower portions of the two thigh bones are, when we stand erect, placed very near each other. In this position, a line passing directly upwards from between the knees, would join the lower part of the vertebral column where it ascends from the pelvis. From this obliquity of the bones, room is left between them, at the upper part, for the external organs of generation, and for the outlets of the reservoirs of the excrements, viz: of the rectum and bladder; and also for the large and powerful muscles of ~~ab~~- d duction.

The obliquity of the two thigh bones allows our walking to be performed quicker, straighter, and in less room; for if the thigh bones had extended in a perpendicular direction from the pelvis, the knees being then at a greater distance from each other, we should have been obliged to describe some part of a circle in taking a long step; (this we see is done by very fat people,) more difficulty also would have been incurred in walking, that is, we should have been in greater danger of falling in raising one leg from the ground, our centre of gravity being too far removed from the base of the other leg; but from the knees being near each other, a very slight degree of motion adjusts this.

A large proportion of the round head of the femur is received within the acetabulum; but some part of it, and the whole neck of the bone which is also placed within the capsular ligament, are in every position of the thigh situated on the outside of that cavity. The capsular ligament of the joint is strong, but must necessarily be loose to allow of motion in every direction to the bones which it connects; the motion backwards is the most limited. A strong inter-articular ligament runs from a small depression in the head of the thigh bone to a depression in the acetabulum, leading from its middle towards the foramen thyriodeum. The strength of the joint is very great, depending on the depth of the acetabulum and the thickness and firmness of this ligament.

The rotatory motion, which the body of the thigh possesses, must depend on the extent to which the head of the bone can be turned inwards and outwards in the socket; many strong muscles are fixed in the trochanters, passing to them from the pelvis for this purpose; and which either rotate the thigh on the pelvis, or when the thigh is fixed, the pelvis on the thigh; for either, from the nature of the joint, can move on the other with great facility; by which means we have the power of completely balancing the weight of our body when thrown upon either of the thigh bones. Besides this rotatory motion of the shaft of the femur, it can move in all the radii of a circle, and describe an extensive circle with its lower extremity. When the head of the bone moves round its own axis, from the obtuse angle formed between the neck and the body of the bone, this action must produce the effect of progression in the body of the bone; this is therefore the usual motion in walking.

In one of those people, who have been educated early in life to exhibit feats of agility, I have seen the thighs so far separated as to form obtuse angles laterally with the erect trunk of the person; and in the Eastern countries, in Persia for example, it is usual for all people to bend the knees, so as to sit upon their heels; it would be long before an adult inhabitant of Europe could make this attitude become a posture for resting the body.

Although the body of the femur descends obliquely from the pelvis to the knee, the lower extremity of the bone where it projects to form the condyles is placed horizontally on the upper part ot the tibia; the internal condyle is longer than the external, to admit of this. The condyles towards the forepart of their under surface are flattened to support weight and have a hollow between them, forming the pulley on which the patella plays; behind they are formed into two rounded knobs which extend upwards some way on the back of the bone; These knobs, in the flexed state of the knee, form shallow ball and socket joints with the upper surface of the tibia and the semilunar cartilages, and allow rotatory motion to the knee in the bent state, although it can possess none in extended.

The patella gives all the advantages of a most complete pulley. It is connected to the pelvis and thigh by strong muscles and ligaments, and to the tibia by ligaments only, but by one of the strongest ligaments in the body. It removes the tendons of the powerful extensor muscles inserted into it further from the centre of motion in the joint, and sliding from below the femur, where it is placed in the bent state of the knee, to the fore part, by means of the ligament attached to the tibia, it carries this bone with it, and causes it to be placed perpendicularly under the lower extremity of the femur. It thus increases the power of the muscles, and greatly facilitates the extension of the leg.

Although each leg consists of two bones descending perpendicularly from the thigh, only one of these is employed in supporting our weight in the erect position when we stand on a flat surface; it is tibia which does this. The tibia also projects so as to form the inner ankle. It is the bone which forms the joint of the knee with the femur and patella; its articular surface above is, of course, broad to be adapted to the condyles of the thigh bone. The semilunar cartilages, placed within the joint on the circumference of this surface, deepen a little the cavities which receive the condyles, and two strong inter-articular ligaments, called the crucial, pass from the femur to the tibia and limit extension, and also rotatory motion when the knee is bent. The knee, in enabling us to shorten our bodies, and in rendering running, walking and leaping easier, forms a joint of very important use.

The fibula, at its upper part, makes a distinct joint with the under part of the head of the tibia, and at its lower part, forms the outer ankle. The connexion between the bones of the leg at the upper part, is by capsular and other ligaments, inclosing two inclined and nearly plain cartilaginous surfaces possessing a limited sliding motion on each other. The bodies of these bones are connected by a long interosseal ligament, which does not, as in the fore-arm, allow of rotatory motion to one bone on the other; but is of use in giving an extensive surface for muscular attachment, with lessened weight and bulk to the limb. The part of the lower extremity of the fibula, which is placed above the ankle joint, lies in a shallow hollow on the outside of the tibia, and is connected to that bone by strong and short ligamentous fibres; the motion between these bones is therefore very little, it is merely enough to lessen the force of any jar, by yeilding a little to its violence. In the fore-arm, the bones are connected with views favourable to extensive and varied motion; but in the leg, principally, with views to strength in supporting weight, and facility of balancing it properly in removing the centre of gravity from one point to another, so as not to endanger the body by a fall.

The foot, divided into the tarsus, metatarsus and toes, is not, as the hand is, continued in the same line with the bones above it; but is united nearly at right angles to the leg. It is much larger on its standing surface in man, than in quadrupeds of the same size which are assisted by their pectoral extremities in the support and loco-motion of their bodies. It is arched for firmer support; and in the hollow of the arch, the blood vessels, nerves, and some of the muscles of the toes are conveniently lodged and secured from pressure. The tibia throws the weight of the body upon the astragalus, which is situated in the middle and at the top of the arch; this diffuses it among other bones until it rests at last upon the heel and the heads of the metatarsal bones, but chiefly on those of the great and little toes. The sesamoid bones assist in supporting weight, and in increasing the power of the flexor muscles belonging to the great toe. The long lever which the os calcis forms in projecting backwards, increases to a very considerable degree the power of the strong extensor muscles of the foot, which are inserted into the lower half of its posterior extremity.

The metatarsal bones, and those of the toes increase the breadth of the foot in standing, and also enable it to grasp objects. The natural actions of the foot are much cramped by wearing shoes; but still we perceive that in climbing a hill or walking on a very uneven and rough surface, there is an endeavour in the toes to grasp the shoe, which is a proof that, were they not confined, they would grasp the ground. In climates where shoes are not worn, the inhabitants have much more freedom of motion in their feet, so that many of them can use their toes in taking up substances from the ground; and in people who have been born without hands, there have been instances of the toes being educated and brought to perform work, which is with difficulty executed by the fingers. I have seen a woman , who supported herself by cutting out highly-finished watch papers, using the instruments she employed with her toes. The hind feet of some of the tribes of monkies are adapted to be used as instruments of climbing and prehension, for some of them have an imperfect thumb; but this adapts them less for walking unless by also using their pectoral extremities. In the disposition of the great toe, when compared with that of the thumb, it is clearly seen, that nature in the foot of man had views more directed to strength and support to than motion; the metatarsal bone belonging to it runs parellel to the others, and possesses very little motion on the tarsus; while the first phalanx of the thumb which is correspondent to this bone, is placed upon the carpus more forwards, so that it may in grasping be brought in opposition to the fingers; it is also articulated by a double ginglymoid joint which allows of very extensive and varied motion.

The advantages of having the moving surfaces of the bones forming the foot covered with cartilage, are evident when we take into consideration the jar that otherwise would be communicated to the limb above, by jumping, leaping, or any other sudden and violent motion.

The joint of the ankle permits no rototary motion when the foot is either bent, or at right angles to the leg; when in these positions the foot is generally employed in supporting weight, and rotatory motion would diminish its stability; but when the leg is raised and the foot is extended, a narrow portion of the astragalus is brought into the hollow formed by the bones of the leg, so that the toe can be pointed to either side; the advantages of this in walking are most obvious.

The great toe projects so as to give the fore-part of the foot something of a wedgelike form; this seems to be useful in walking in deep sand, or grass, the feet are then placed so that the great toe points directly forwards. It has been supposed by many Physiologists that turning the toes outwards, was not natural to man, but the effect of education; many powerful muscles however have a tendency to rotate the whole limb so that the toes shall be in that direction, and the feet being inclined a little outwards, will be found on trial, to give to the body a firmer support and more facility of motion than if they had been pointed directly forwards.

The variety of important organs placed within or upon the bones of the skull, require that this part of the skeleton should be strongly joined to the trunk, but so skilfully, that every variety of motion should be preserved between them, and by structures that would most effectually prevent the occasional violence the trunk must necessarily be subjected to, injuring or deranging the part where the mind is supposed to reside, at least where the principal organs, by which the mind is affected from, or affects other parts of the body or things external to it, are lodged: for here are placed the brain and principal nerves, the organs of vision, hearing, smelling, and taste, the beginning of the organs of respiration and digestion, and part of the organ of speech. The skull is placed therefore on the top of the vertebral column, thus occupying the highest part of the skeleton as the most convenient situation for the exercise of the faculties of these organs, and that it may posses all the advantages which the number of joints, the elasticity of the connecting materials, and variety of motion in the spine can give.

So much information has been communicated regarding the external form of the heads of men of different nations, and of different passions and intellects; and such comparisons have been made between the human head and those of various animals, by John Hunter, Camper, White and others; so much also has been lately, and ably said on these subjects by Cuvier, Blumenback, and by the late Professors of our own college, that I well may be excused from bringing these topics again before you. I shall now only observe that as the cranium forms a case of bone exactly adapted to the brain and its membranes, the bones of it are solid to protect this important organ from pressure or any external injuries, and are arched for greater strength: that the shape of the arch is different in different nations, and in different individuals of the same nation; and that this, on some occasions, depends on the treatment the skull receives in early infancy; proofs of which we have in the heads of the Caribs, and some of the tribes of the Indian nations; for with some of these the forehead pressed backwards constitutes a beauty, and is therefore forced in that direction in the infancy of their children; while with others, lateral pressure is used to the skull, as a lengthened head produces an impression more consistent with their ideas of beauty than a round one.

The sutures found in the skull, connecting the several bones which form it immoveably to each other, may, in the adult, render the shock arising from any sudden violence less felt; or should the force be great enough to produce a fracture, the sutures may, on some occasions, prove useful in setting limits in its extent. In the fœtal state the bones not being united by a resisting medium, admit of easier passage to the head of the child through the pelvis of the mother, as they lap over each other and thus diminish its size. Perhaps also the skull is formed of separate bones, that its ossification after birth might sooner be completed from beginning at a variety of points.

The organs of sense and part of those of respiration and speech, are admirably disposed among, and are supported by the bones of the face.

In mastication, the motion of the lower jaw is not confined to opening and shutting the mouth, as in the badger and some other animals; but its condyles can be brought forward, together or separately, and made to perform a grinding rotatory motion essentially necessary to prepare our food for the proper organ of digestion. The glenoid cavity and tubercle anterior to it in the temporal bone, and the moveable inter-articular cartilage between them and the condyles of the lower jaw, demonstrate how well the joint is fitted for its necessary actions.

In concluding the anatomical and physiological part of the lectures of this season, I beg to repeat, that the observations which I have introduced on the skeleton, were made more with the view of assisting the memory in the recollection of useful knowledge formerly acquired, than on any supposition, that the parts forming it had not been previously studied by the members who compose this audience.

LECTURE VII.

ON RICKETS AFFECTING THE BONES GENERALLY; BUT MORE PARTICULARLY AS AFFECTING THE SPINE AND PELVIS.

IN submiting to your consideration the following observations on the diseases and accidents happening to bones, and to those structures which are the most immediately connected with them, I request permission to remind you, that the lectures in this theatre are not delivered to students who have every thing elementary in their profession still to learn, but to those who have been already instructed in its first principles, and that they are also listened to by Surgeons who have long been engaged in the practice of their honourable and useful art; that I feel it therefore most difficult when addressing such an audience on any particular disease, to determine what are the circumstances relative to it, which I should either intirely omit or touch very lightly on, and what are those on which it might be expected that I should extend my remarks. Without some elementary observations, the account of any disease must be liable to misconception; but in this place to dwell on subjects merely elementary, or on the minutiæ of practice, would be to underrate the acquirements, and waste the time of those who honoured the Lecturer by their attendance.

In every science it is only by the study of particular facts, that we arrive at the knowledge of general and established principles. The preparations in our museum afford many, and much valuable materials for observation on the nature of diseased structure in bones; but to make these observations useful, they must be connected with some principle. In attempting to establish such connexion, I disclaim all pretence of instructing many now present, whose means of information, and years of experience may have equalled, or perhaps exceeded my own; but I feel, that by connecting the observations suggested by the view of the materials we possess, with some general principles, I shall render the whole more useful to our profession and consequently to the public.

Until the structure of bone had been ascertained, the diseases affecting it were considered to be of a singular and peculiar nature. This opinion seems to have arisen from bones not being subject to that rapid and spontaneous dissolution, which takes place in all other substances composing an animal. We are indebted to John Hunter for much valuable information on the nature of their diseases, and for a more rational mode of practice in the treatment and cure of them. In their treatment, we now recollect that bones have life, nerves, vessels, circulating fluids, and nearly the same general structure as the soft parts of the body; although their active powers of life, and extent of vascularity are less, on account of their requiring a greater degree of solidity, and stronger cohesion of their component parts.

We know that the diseases of bone must necessarily be of longer continuance, and the time of their cure more tedious than similar diseases of the soft parts: for the large proportion of phosphate of lime, which enters into their composition and mixes with their animal substance, being without powers of life or motion, must render the performance of all their internal actions more difficult, and in most instances more slow.

Diseases in bone may arise, either from a difficiency of some of the materials which should enter into its composition, or from some unnatural action taking place in its substance. Rickets is a disease of the first kind. From the derivation of the name, rickets might be supposed to affect the spine only; but no part of the skeleton is exempt from some alteration of structure, or shape, when this disease has once taken hold of the constitution.

In rickets the bones lose their characteristic qualities of hardness and tenacity of form; for they bend under the weight which they were intended to support, or are rendered crooked by the effect of muscular action. In rickets the bones not only become softer, but sometimes, in very young children, they also become enlarged at their extremities near to the joints; this is more particularly observable at the wrists, and at the anterior portions of the ribs; the last mentioned symptom, however, is not so constant in young persons near to the age of puberty; for when they are attacked by this disease, the bend will often take place without much enlargement of the extremities of the bones.

This disposition shews itself in the early periods of life. The disease has taken place in the fœtus while in utero; but the more usual period of its occurrence is between the seventh or eighth months and the end of the second year: from which it has been supposed by some Nosologists, to be connected with, or to be affected by, the first dentition. I have often known it make its primary attack after this time. It not unfrequently attacks the spine a short time before the period of puberty, and it will also do this long after that period has passed. When it attacks after puberty, its effects are indeed usually confined to the spine, and considerable lateral incurvation of the vertebral column is produced in both sexes; but much more frequently in the female than in the male.

Rickets appears to be more connected with a scrofulous habit than any other; but its effects are distinct from those produced by scrofula. Like scrofula, it is found more frequently in cold, variable, and humid climates, than in those which, though cold, are not moist, or in those which are warm and dry. In this climate the occurrence of rickets is so frequent, that it passes in some parts of Europe by the name of the English disease; and is described as having originated during the beginning of the seventeenth century in Dorsetshire and Somersetshire, and from these counties to have spread over the world. There is no real foundation for this absurd supposition of its origin, or even that it is a new complaint; for both Grecian and Roman authors have metioned the kinds of deformity which the disease produces, as existing in their remote times. The disease had not been distinguished until the seventeenth century by any particular name from other affections which occasioned deformity of the limbs; but it probably has existed in every age, in similar climates to those we now find it in.

The softening of the bones in rickets has been variously accounted for. It has been supposed by some Nosologists to arise from an excess of acid decomposing the phosphate of lime; by others, from the constitution not providing enough of this material; some have imagined that it is produced by the absorbent vessels having a morbid disposition to remove too much of this phosphate after it had been deposited in the bones; others have supposed it to originate from the arteries of the bones being deficient in the power of secreting phosphate of lime from the blood, and thus not depositing it in sufficient quantity in their substance. But we possess no proofs of excess of acid, or of any acid whatever being generated; for none has been found peculiar to rickety patients by any chemical, or other tests yet known. In rickety constitutions there does not appear to be any deficiency of the phosphate of lime in the blood generally; for in incurvations of the spine a redundancy of osseous matter is often pressed out on the bent side. This matter, in rickety persons, is sometimes deposited in large quantities in parts not intended to be bony or even hard; and the urine of such persons is often found to be highly saturated with the phosphate of lime; moreover the absorbents do not remove it when deposited on the surface of the bones, or in parts external to them and unconnected with them. All these circumstances give greater probability to the opinion which presumes that the arteries of bones are deficient in the power of separating the phosphate of lime from the blood, so as to deposit it in sufficient quantity in their substance, than that any deficiency of this material exists in the body.

It has been observed that the teeth are not affected by rickets but remain hard when the jaws soften; this is generally so; but in one well marked instance of rickets I found that the bony parts of the teeth were much softer than usual, although none of them had assumed any external signs of decay.

The alteration from health in the substance of rickety bones, appears to arise intirely from a deficiency in the deposit of the phosphate of lime. In the cancellated part, these bones sometimes become so soft that they can be divided with a common knife ; the cells which contain marrow are enlarged, and the parts which are usually the most compact assume a cellular appearance ; when dried they are more transparent than other bones, and then shew that they possess less saline matter, appearing as if they had been steeped for a short time in a weak acid. The preparations before us distinctly exhibit the general appearances found in rickety bones when sections of them have been made.

In children of an early age there are certain constitutional symptoms which clearly indicate when this disease is present ; but when it attacks later in life it is marked more by the local affections it produces. In very young patients we generally find that the digestive powers are diminished, although the appetite is often good and even voracious ; the belly is swelled, there is much flatulency ; from the absorbent mesenteric glands being usually much enlarged and in a scrofulous state, the absorption of the chyle is not perfectly accomplished ; the body becomes emaciated, and the muscles more lax ; the countenance however is lively, the eyes bright, and the intellectual powers of the child generally appear beyond what are usual at its years. This last circumstance has been attempted to be accounted for, on the supposition, that from the softness of the containing bone, the brain would possess a more free circulation of blood, and be enabled to perfect its substance and actions more quickly, than when surrounded by an unyeilding case, so that the different senses would sooner have their assigned places, and also the structure of their organs sooner completed. This mode of arguing is not supported by any analogy which can be drawn from the state of the cranium in other diseases where the mental powers are either increased or diminished, and the fact may be more reasonably accounted for, by the attention which the little patient requires, placing it in more constant association with persons older than itself, and having from sympathy with its hapless state a greater share of their conversation devoted to it, thus as it cannot use its muscular powers, more opportunity and time are given for the exercise of the faculties of its mind. In some instances however of rickets, we do not find an increase of intellect, and in others the disease is attended with an evident diminution of it.

I don't agree

As the disease proceeds, the skin becomes dry and scaly, the teeth become black and decayed; the weight of the body cannot be supported in any position without producing curvatures of the bones; the natural functions of the internal organs are interupted, the lungs become tuberculated and consumptive, and hectic symptoms arise which are terminated by death.

The danger to life, for some deformity can seldom be prevented, arises from the number and situation of the bones affected by the disease. Rickets appears to be a disease of debility, and therefore is one which requires both medical and surgical attention. Nature often makes an effort to stop its progress, and this effort should be carefully watched for, and when discovered, seconded by our art. When the constitution is strengthened by good air, proper food, and other means, the disease will not only stop; but bones which have become crooked to a very great degree, shall without the use of any mechanical instruments recover so as to become perfectly straight; of this I have witnessed many instances in patients between five and twelve years of age; and have often found, in cases where the bend in the bones remained, that their substance acquired greater hardness and became stronger than other adult bones.

I have for many years past, when treating on this disease in my lectures on surgery, shown the providence and wisdom of nature in depositing abundance of osseous matter, when the bones begin to recover from the disease, at the part where it is most wanted, viz. on the inner part of the concave surface of their curve. The preparation I now produce to you is one of those, I have always shewn to prove those facts.

In the museum of Doctor William Hunter there was the skeleton of an adult dwarf, whose bones bore evident marks of having been rickety early in life; but which at his death were more compact, and stronger than any human bones I had ever met with: this person's strength, as he was in the habit of obtaining his livelihood by exhibiting proofs of it, was known to be very great.

Dr. Wm. Hunter whose experience in the diseases of children was most extensive, recommended in rickets, the constant use of those means which tend to strengthen the constitution; and he asserted that cold bathing corrected this habit more than any other remedy yet known, indeed that rickets, almost with certainty, could be prevented by the use of cold water; sea water, if the patient was near the sea, if not, spring water, the temperature of this being more constant than that of river water and the use of it generally bringing on a healthy glow. The children he observed should be dipped daily and only once at each period; they should be dried quickly, and friction by coarse linen, or flannel should be applied to their backs and limbs for a considerable time afterwards; that great attention should be paid to their breathing pure air of a regular temperature, to cleanliness, wholesome food, and the state of the digestive organs. Let me add that I have seen this system persevered in in many cases of rickets in all with some, and in most with very decided advantage to the patient.

The usual effects of the disease on the different bones are the following:---The skull is large in comparison to the rest of the skeleton, and the cranium forms a greater proportion of this enlargement than the bones of the face; it is also flattened at the top. The spine is incurvated laterally, but this affection will be noticed more particularly afterwards. When the cervical vertebræ are bent, the neck projects, and the head inclining backwards, appears sunk between the shoulders; from the curvatures of the spine the trunk is shortened, the ribs are flattened at the sides and much compressed together, and on the side to which the spine bends they form the projection or hump. The ribs are enlarged and thickened at their cartilaginous extremities; this, I have already stated, is more observable in very young patients than in those nearer to the period of puberty; their natural bend is altered, so that the chest appears more of a square than a conical form; the sternum projects and is often broader than usual, but bent in its middle. In infants, the deformity of the chest is often increased by the pressure the children receive when supported in the nurses arms. The ossa innominata have the spines of the ilia incurvated forwards, and are bent inwards where the ilia and pubes meet. The clavicles become very crooked, the scapulæ become shorter and more concave on their inner or anterior surfaces. The bones of the arms are bent outwards where the deltoid muscles are attached, and below this, sometimes, a little backwards. The bones of the forearms are rendered more hollow in the front from the action of the flexor muscles, and are sometimes bent in lateral directions; but the crookedness of the upper extremites, from the bones not necessarily supporting weight, is in general very considerably less than that of the lower extremities. The radius and ulna of each upper extremity appear to increase in thickness towards the joints, the radius particularly so at the wrist; the disease indeed often shews itself at first in such enlargement. It has been doubted, whether the appearance of enlargement of these bones at their extremities, did not arise from their bodies being smaller than usual; and it has been positively denied by some Nosologists, that they are enlarged at all. I have often found them soft and evidently enlarged; but, as in the spunginess of the sternal extremities of the ribs, more frequently so in very young children, than in those more advanced and nearer to puberty. The bones of the carpus are softer and a little more spungy, but the metacarpal bones and the phalanges of the fingers are seldom much affected.

The bones of the thighs are curved forwards and outwards from the action of the muscles behind and on the inside, in addition to the weight of the body, the muscles regulating the direction of the bend. The necks of the thigh bones, instead of obtuse, now form right, sometimes acute angles, with the shafts of the bones. The knees incline to each other; the tibiæ and fibulæ bend forwards and a little inwards, so that the middle of the inner surfaces of both legs touch each other, but the feet are generally separated and thrown outwards. These are the usual directions of the curvatures, to which weight, and the actions of the strongest muscles of the limbs naturally incline them; but much variety will be found depending on accidental causes. It is not uncommon to find the tibiæ and fibulæ, when much bent by this disease, to have become thinner in their bodies from side to side, but broader and flatter from before backwards, this is more apparent when the bones begin to recover strength enough to resist any further bend. The bones of the feet are seldom much affected, unless a scrofulous disposition attends the rickety one.

The numerous specimens of this disease, which I am enabled to lay before you, by giving you ocular demonstration of the effects produced by it on the different bones, will make a stronger and surer impression than any oral or written description of their altered appearance and form.

Many instruments have been invented to remove pressure from the bones of the extremities, and some of them are very judiciously contrived to produce that effect, but every Surgeon must use his anatomical as well as mechanical knowledge in their application, for when resorted to without this knowledge, they will often, indeed almost always, prove more injurious than beneficial. In very young children, instruments should never be applied to the limbs; they cannot either be necessary or useful, and by their weight, and by preventing exercise, they must tend to increase the general debility, and thus do much harm: their application therefore should be deferred until the bones of the trunk possess some firmness, and then be made only in cases where the larger bones of the limb as well as those of the trunk, are hard enough not to be injured by their additional weight, and the pressure necessarily made by them in correcting the distorted shape of the bones below.

Incurvations of the spine so frequently happen, and in females are productive of so much more serious consequences than mere deformity, that the commencement of such affection in that sex particularly, should carefully be guarded against, and when it has began, the mode of treatment intended to remove it should be most attentively considered, and when approved of, should not be delayed.

Incurvations of the vertebral column are of two kinds, one arising from rickets, in this the bend is usually to the sides; the other from caries of the bodies of the vertebræ; the bend in which is forforwards. It is to the first of these incurvations that the following observations are intended to apply.

In females, before and sometimes after the age of puberty, the spine not unfrequently inclines to one side, and does so without any of the other bones exhibiting a rickety disposition. In a constitution merely weak, the habit of remaining long in some particular leaning attitude will often bring on this inclination, and in a rickety one will always produce it. Thus a young person, devoting much time to learning an art, the exercise of which requires a peculiar position of body, as playing on the harp, the bones being soft, the sides of the vertebræ which are the most and longest pressed on become thinner, but project further outwards from the circumference of the column; while those which are less pressed on increase in thickness: there is no partial deficiency of the phosphate of lime on either side; but on the one to which the inclination is made the lime is added to the breadth or circumference of the bodies of the vertebræ, and on the other side to their thickness, or extent from above downwards.

When a bend has once been established, the superincumbent weight is thrown upon that part now in an unfavourable form for bearing it, and this of course increases the curve. Whenever there is a tendency to deviate from the perpendicular, the curve will continue to increase, or an attempt to counteract it, by a curve in another part of the spine and in the opposite direction, will take place. We thus find, that in rickets the spine is bent serpentinely and laterally, resembling the italic ʃ, and is not, as in caries of the vertebræ, bent suddenly and forwards; and we often meet with several of these lateral curves from the attempts successively made to support the weight more favourably by counteraction.

Although the spine is usually bent to one side in rickets, I have seen instances of the column being bent forwards in this disease, and the projection being directly backwards as it is in caries of the bones. A well marked instance of this kind is now in the museum attached to the school in Great Windmill Street.

As there are more curves than one ~~curve~~, it is clear that the altered shape of the spine cannot be owing to the greater contraction of the muscles on either side; nor can it arise from a partial deficiency of bony matter, as a redundancy of it is pressed out on the weak side. It is therefore a fair inference that the curve is produced by weight or pressure having been long or frequently applied to a particular surface of the bones, in constitutions, where although every part of the bones has an equal supply of the phosphate of lime, yet in all of them, that supply is less than in strong and healthy bones.

There are all the variations in this disease from the slightest bend, until the ribs, beyond their angles, being completely crowded together, come in contact with the spine, and as I have already stated are made to project by its pressure so as to form the hump. I have frequently known the spine curved to this extent, without the bones of the pelvis having been in the slightest degree affected, and where the persons have become the mothers of well-formed living children. In the late Dr. Hunter's Museum there were several trunks of this kind; and in the present collection of preparations in Great Windmill Street there are several of a similar nature; but in both collections, particularly in the one last mentioned, there are several well marked instances, where the bones of the pelvis are so distorted and bent inwards, that any unyielding body as large as a common sized wallnut could not pass between them, and where, when pregnancy had taken place in the persons they belonged to, such event must have been attended with the inevitable destruction of the mother or child.

In addition to the preparations belonging to our college, I have brought some of those alluded to for your inspection. The preservation of such bones affords most instructive lessons as to the propriety or impropriety of applying instruments, and when they are applied, as to the parts on which pressure should be made.

The affection of the vertebral column often begins after the pelvis is fully and well-formed, and therefore when it is not likely to be altered in shape, unless some constant and artificial pressure is made on certain parts of it. This fact in all cases of distortion of the spine in females should never be forgotten or overlooked. In them, the beginning of the incurvation of the bones of the back should most carefully be attended to, and I feel confident in asserting that if timely attended to, such incurvation may in general be removed or remedied without mechanical instruments being employed, or any other distressing and violent means being used ; and that by this timely attention, the lives of many mothers and children may be saved, in cases where either mother or child, or perhaps both, must otherwise have perished.

In most of the cases of incurvated spine, it is for some deformity of the trunk that we are first consulted, the parent and the patient being ignorant of the more serious consequences which have been now alluded to. It has been perceived perhaps that one shoulder is higher than the other; that one of the shoulder blades projects more than the other, or that one of the breasts is fuller, placed higher, and more prominent than the one of the other side; for appearances of this kind the surgeon is consulted, and the spine perhaps is never suspected of being their cause; but when the spine is viewed, which it should immediately be, and carefully too, for the whole extent of its length, these derangements may in general be easily traced to one or more incurvations having taken place in its course, and we shall often have the mortification to find that these incurvations have been much increased by stays, back-boards and other pretended supports which had been most injudiciously applied for their concealment or cure.

Although the curvatures of the spine may be readily seen, and easily felt by passing our fingers along the spinous processes when the patient stands before us, we shall often find, that when she bends forwards without external support, the lateral curvatures will disappear; and also that when she is admonished to hold herself erect, and makes the attempt to do so, she can immediately straighten her spine, and retain it a few seconds in its proper form: when this is so, we may entertain well-founded expectations of her perfect recovery; and when the spine cannot in either of the above attitudes be rendered perfectly straight, we may still entertain no doubt of being able to arrest the progress and ameliorate the effects of the disease, by calling the natural powers of the body into proper action.

I need not remind this audience of the wonderful and beautiful mechanism of the spine, and of the strength and motion it possesses from the combination of many bones and the action of many muscles; that masses of muscles, attached to it are placed between the spinous and transverse processes of the vertebræ and the angles of the ribs, for the purposes of supporting the weight of the head and upper extremities, and of varying the position of the chest and rest of the trunk. It is well known to all present that these muscles are formed equal in power on each side; and that on each side, they are equally employed to support the spine in the natural erect position of the body.

It is by calling these muscles into regular and frequent action, that the spine is to be restored to its natural shape and form in cases where from weakness or rickets, that form has been departed from.

Many very complicated, and some ingenious instruments have been invented, for taking off the weight of the head and upper extremities from the spine ; and were this the only thing they accomplished, they, in many cases might prove useful ; but they throw the weight elsewhere, and on bones, which, as well as the spine, may and do bend under it. In the application of all the instruments that I have seen which would admit of loco-motion to the body, the weight, although removed from the vertebral column, has been thrown upon the pelvis ; either professedly so, or in a way a little disguised ; and as the bones of the pelvis are not so hard in such patients as in persons who have no rickety disposition, the upper part or spine of the ilium on each side on which the weight is generally made to rest, is bent forwards, in consequence of which the pubes and ilia, where these bones form the fore-part of the brim of the pelvis, bend inwards and diminish the aperture of that cavity so much, that the head of a child cannot even enter it, which to be born naturally should pass gradually through it. The preparations which I now produce are frightful, but useful examples of this distortion of the bones of the pelvis.

I have examined very many cases of incurvated spines, happening in women in that class of life which would not permit of the purchase of expensive instruments, in which I have found the pelves so perfectly well formed, as to have allowed of the birth of several living children, although the incurvation of the spines had been very considerable and long confirmed.

I have examined others, happening to women, where I had the means of ascertaining that instruments had been used, in all of these, and in others where from similarity of appearance I could not doubt but that instruments had been used, I found the bones of the pelves irreparably injured, by having yielded to the additional burden thrown on them where they never were intended, and were therefore not calculated, even in a healthy state, to bear much weight. But the examination of the pelves before us will speak more than volumes, and show most strongly the great advantages which may be derived to the public, from their being preserved with other morbid preparations in a museum like ours, where every person inclined to form a just and impartial opinion of the nature of these diseases, and merits of their different modes of treatment, may view and fully examine their altered and diseased state.

Such instruments as are fixed to parts not belonging to the body of the patient, as to chairs, or the ceiling of the room, may prove useful in forwarding the cure, by taking weight off from the spine when she is standing or seated; but when instruments are supported by, or act by pressing on the pelvis, they produce much more evil, than by any possibility they can do good.

Placing the patient in a recumbent position on a horizontal plane, or one a little inclined, for a certain time every day, may assist in lessening the immediate cause of the curvature; and the couch on which she sleeps should be one which will preserve its level horizontal surface; a mattress, particularly a hair one, must thus be preferable to a feather bed. When seated, the chair may have an upright back, but no elbows or arms to it, for these would form a partial rest, which might prevent the muscles of the spine from being called into equal action, and it is by this equal action that the cure is to be effected.

I here beg leave to acknowledge my obligations to Mr. Grant of Bath, for the first hints I received of curing this affection of the spine by the regular and uniform action of the muscles belonging to it, and for a kind detail of his opinions on this subject. In an accidental conversation, he informed me, that he had proposed to cure the lateral incurvation of the spine by placing a weight on the head of the patient, on the principle of producing frequent and equal action of the vertebral muscles; but that he seldom could convince, either the mothers, or even the medical men whom he had met in consultation, that by this weight he should succeed in effecting his object. His practise immediately struck me as founded on just physiological principles, and I told him that I had then a favourable opportunity of beginning a trial of it. On that very day I began the trial, and the event in three weeks exceeded my most sanguine expectations of success. Several years have passed since my conversation with Mr. Grant, but I have tried the plan in very many instances during the last sixteen years, and in no one, where it was properly persevered in, have I found it to fail in preventing the further progress of the disease, and in many I have witnessed it effecting a perfect cure, at least so perfect that no deformity was perceived, nor inconvenience in other respects suffered.

The simplicity of the means of cure I have, however, found in some patients and their friends, to operate against a fair and sufficiently long trial of the plan being given. Some benefit has been received at first, they have been contented, and have not persevered longer than to arrest the progress of the disease; the disease has once more gained ground, but on returning to the plan and persevering in it, a cure has been effected. It is, therefore necessary that the principle of the cure should be understood by the patient and her friends.

This principle I have found to be soonest made intelligible to those who are not anatomists, by the following illustration, viz: If a finger is held up, and bent a little, a weight being placed on its tip, either will bend it completely, or oblige it to straighten itself so as to enable it to bear the weight when applied to it perpendicularly. Thus the spine being bent in one, or more directions, when a weight is added to the head, it directly and almost instinctively, by the actions of its muscles straightens itself to bear that weight; and this action often renewed, and persevered in for a moderate time, will recover the spine from the bend that otherwise must have increased; or in the attempt to remove it by instruments applied to the pelvis, their weight, and that of the body must have affected and distorted that part, the perfect shape of which is important, not merely to the symmetry, but to the life of the mother or to the existence of her child.

The weight may be used in the manner following: a small footstool, covered with a flat cushion, being inverted may be placed on the patient's head, the hollow between the feet of the stool will allow of some substance, varying between four and ten pounds in weight, for it may be necessary to increase it to the last amount although much less is generally sufficient, to be placed in it; the patient should be instructed to raise this with both her arms, and support it on the crown of her head, elevating the spine at the same time towards the stool while held over her head; she then, preserving the most erect attitude she can, should walk in a straight line as soldiers are taught to march, and for a time not exceeding ten minutes; this should be repeated occasionally during the day. By degrees she will learn to balance the weight, and this occasional exertion, giving the muscles their true action, will straighten the spine much more effectually and sooner than any mechanical instruments.

The patient should be frequently reminded by her attendants to sit upright, and the momentary attempt to do this, even if the attitude cannot be long persevered in, will prove useful in forwarding the recovery. Negroe women and basket women, who early in life have been accustomed to carry heavy burthens on their heads, are never crooked.

It is not to be expected, from the multiplicity of pursuits which must constantly engage the serious attention and occupy the time of a Surgeon who is actively employed in his profession, that he can often personally superintend the use of the means now recommended; nor is it necessary that he should superintend them, otherwise than occasionally. From the anatomical and physiological knowledge which he possesses, he may however give instructions to those whose daily habits and avocations place them frequently and for a long time in the society of the patient; as the mother, governess, or some confidential attendant, And could Dancing Masters be induced to study and teach the healthy and natural, as well as the graceful and artificial attitudes of the body, much real good might be done by their assistance. Some of these gentlemen, I am sure when convinced of the present and future advantage it would be of to their pupils, would not hesitate to adopt, as part of their professional business, the superintending of that kind of exercise which would preserve the body in the most perfect shape by exciting and keeping up the regular and equal action of some of its most important muscles; and it is with much pleasure that I find some of the best informed Masters of that profession have lately adopted it.

well done that knee haunt.

Before this audience I should not have ventured to have delivered my sentiments so strongly, as to the good effect of this treatment of incurvated spines arising from the softening of the bones, had I not, from repeatedly having witnessed it, been thoroughly convinced of its superiority to every other mode. If persevered in, those mischievous instruments which tend to the destruction of life, under the pretence of preventing the appearance of deformity, need never be had recourse to. In cases of incipient curvature, the plan of treatment I have now mentioned soon succeeds; where the curvature is great and has been long established, the time required will be proportionably longer.

Various other modes of exercising the chest and limbs in a regular, equal, and natural manner, will suggest themselves to every medical practitioner who has studied the formation of the skeleton, and the action of the principal muscles which are affixed to it and move its several parts upon each other. In pointing out these, and adapting them to the peculiar nature of the curvature, and the patient's constitution, he may be of very great use in expediting the cure; he therefore should occasionally visit the patient during the continuance of the above-mentioned plan, to watch over its progress, and to aid the constitution in acquiring health and strength, by whatever other means his professional knowledge and experience warrants him to recommend.

When the patient or her friends can be made to understand the principles of the treatment, and how the muscles of the trunk can be brought into regular and equal action, the plan can be carried on without the farther assistance of the Surgeon; but from the absurd opinions often entertained by those, who, having a little smattering of the knowledge of terms, would be conceived to know the whole arcana of anatomy and physic, much real mischief is done by their attempts at refinement, or adoption of what is to surprize by its intricacy and the difficulty of its application. The cure of these incurvations of the spine is to be effected by the simplest means; but it is sometimes more difficult to convince the bulk of mankind of the efficacy of these, than to persuade them to adopt complicated measures, which although some of them may have the appearance of ingenuity, will eventually lead to worse results, than even the continuance of the disease which they were proposed to remedy.

In stating these opinions, I may possibly be opposed by those who are interested in the use of instruments, whether invented by stay-makers or professional men. Should that be so, my only answer would be; before instruments are applied to relieve one part of the body, assure yourselves by carefully studying the whole fabric, that they will not be productive of injury to other and perhaps more important parts, and ascertain whether it would not be better to adopt natural means of cure, than to shackle nature by, and impose upon the patient, the crude imaginations of a zealous but perhaps half-informed mind. The Person who is honoured by being chosen a Professor of Anatomy and Surgery to this now highly respected College, must feel it an imperative duty to deliver, on practical and every other subject, those sentiments which, upon mature reflection, whatever authorities they oppose, he is convinced are founded upon reason and truth; and if he does this with a pure motive, he must be intitled to forgiveness even should it be ascertained that he had mistaken his intended foundation, and built them on fallacy and error. I have felt highly indebted to Mr. Grant for the hints I first received from him respecting the treatment of lateral incurvations of the spine, and as my own experience has fully confirmed the justice of his remarks, I have felt it my duty to acknowledge my obligations to him, and to state that which I have now done to you.

The use of the cold and shower bath will aid the effect of the above exercise. In children a large towel dipped in cold spring water, and allowed to fall from the top of the back part of the head to the lower part of the trunk will answer as a good substitute for the bath. The patient should be immediately afterwards well dried, and gentle friction used for some little time on the skin, in the direction of the spine. The internal use of the preparations of steel are often serviceable. So far as my own experience goes, I have found the ferrum ammoniatum on the whole more useful than any other preparation of that substance.

LECTURE VIII.

ON IMFLAMMATION, ULCERATION, SUPPURATION, AND GRANULATION OF BONE. ON SIMPLE FRACTURES OF BONES, AND ON THE NATURE OF THEIR RE-UNION.

IT is well known that more difficulty is experienced, in obtaining an accurate knowledge of the nature and extent of a disease affecting bone, than of one existing in a soft and more external part. In the last we are enabled to form some judgment, from certain qualities of the part perceptible to the sight or to touch, as swelling, colour, hardness or softness ; but in many of the diseases of bone, we can derive no advantange from external appearances, the depth of the situation, as well as the structure of the parts preventing this. These diseases are also rendered more complicated from the neighbouring soft parts, being affected by them, so that fistulous passages often extend from their seat to the surface of the body ; but from the appearance of which we can form no judgment of the extent of the disease in the bone itself, and often but little judgment of its particular nature, or rather of the state of the morbid action then going on.

From the structure of bones being now well known, it is evident that they must be susceptible of inflammation, both of the common and specific kinds; and of all the consequences of inflammation, as adhesion, ulceration, suppuration, mortification, and the subsequent separation of the dead from the living parts. Granulations are also known to arise from bone, to restore what portions of their substance may have been lost. The effect of these actions must, from the structure of bone, in some things be different from what occurs in softer and more vascular parts; and for the same reason, the treatment of the diseases must, in some things be different, and it may require to be varied in different bones: for all bones are not equally liable to become diseased, and the mere circumstance of their different degrees of firmness will vary their susceptibility, either to become so, or when that has happened, to be restored to a healthy state.

The hardest bones, when diseased, are in general the soonest cured; such bones are not sufficiently vascular to exist long under morbid action, less attempt is made in the parts towards recovery, they soon give up the contest by losing their principal of life; and then the surrounding living parts set up the process of exfoliation: thus, the singular circumstance occurs of hard bones, being sooner cured of disease than soft bones, by the diseased parts dying and then being thrown off. Specific diseases are more disposed to affect certain bones than others; thus syphilitic affections are usually found in hard bones; and scrofulous, more usually in soft. Cancer does not arise in bone; but occasionally extends from other parts to it, as from the substance of the breast to the sternum and ribs; very hard bones are rarely affected by the disease.

As it is only from difference in structure that the symptoms of inflammation in bone vary from those which take place in the softer parts of the body, much of what I had the honor to state in the series of lectures delivered last summer, relating to the causes and effects of inflammation generally, will apply to that action as arising in bone.

The action of the arteries is increased in the inflamed part of the bone, and the force of the circulation becomes greater, and as bone from its hardness naturally resists any alteration of form, the swelling of its substance takes place more slowly and is also more confined. In inflammation of other parts, the tumefaction is known to arise from more fluids being sent to them, and more secretion taking place in their natural cavities. In all probability, the tumour which arises in inflammation of bone is formed in a similar manner, viz: that there is an increased secretion and deposition of fluid in its natural interstices, but, that as the peculiar local action of its secerning vessels is the separating and depositing some of the phosphate of lime, much of this solid matter is also deposited with the extravasated fluids, and becomes hardened into bone. This deposition, when confined to the bone, affects some times only part of its surface; but it occasionally produces an enlargement of every part of its circumference; in either case the features of the bone, such as the marks of blood vessels, and the insertion of muscles or ligaments are not lost, at first, on its surface.

Mr. Howship, who has attended with much persevering industry to the appearance in the microscope, which inflammation of the substance of the bone assumes, has informed us that the first perceptible change consists in a uniform enlargement of the longitudinal canals, without any swelling of the general mass of bone; the membranous sheaths lining these canals then become thicker and granulated in their texture, the canals now lose their healthy appearance and present very unequal figures, the side appearing as if scooped out with a semi-circular chissel; after this the affected part of the bone swells and a quantity of ossific matter is deposited on the sides of the canals, which soon becomes so perfectly identified with the original bone, as to prevent its being clearly distinguished; the secretion of the phosphate of lime, he states, can therefore only be detected in the particles last laid down, although by estimating the aggregate thickness of all the parts making up the solid side of the bone, it may be proved to have received a considerable addition of this substance.

When active inflammation affects the outer surface of a bone, the pain is great in proportion to the violence of the inflammation, and will be increased by pressure, for the softer and more sensible contiguous parts always partake more or less of the inflammatory disposition.

Inflammation when it is attended with enlargement of the bone, more frequently takes place in adults than in young persons, and, unless in some specific cases where the enlargement is very slow, is usually accompanied with violent pain, although bone in its natural state possesses very little sensibility. The great resistance, which from structure, the bone must make to distension, will account for this. The pain attending it is more heavy than acute, it depresses much, and is not unusally attended by sickness and occasional vomiting. If the inflammation is violent, extensive, and continues long, symptomatic fever will take place, and this in time will be succeeded by hectic fever; the last is found to arise more frequently from diseases of bone, than from those of the soft parts.

Similar means to those employed in lessening inflammation of other parts of the body, will be found useful in abating or removing inflammation of the bone. The extent to which they should be used must depend upon the cause and nature of the action and our knowledge of the patient's constitution. The inflamed part should be kept free from motion, and of course, the irritating cause should be removed if possible, when discovered. Cupping and scarifications, the application of leeches to the skin near the part, and occasional venesections may be had recourse to with advantage. Blisters applied to the surface of the skin near to the affected bone will sometimes, by producing counter-irritation, lessen the original disease. The pain and tension of the neighbouring soft parts may be allayed by fomentations and poultices; but as it is unnecessary to tell this audience how inflammation is to be treated, I shall only further observe that when the patient's constitution is strong, and the inflammation is violent, drastic purges will often produce a favourable change; but that in a weak constitution, drastic purges should be used with caution, they may depress too suddenly and too much, for the necessary action requisite in the bone for its recovery after the inflammation has subsided; and that opium, when given in full doses, will often diminish the inflammatory disposition by the removal of pain.

After the inflammatory symptoms have been relieved, it is not unusual to find that the swelling in the bone becomes very indolent, and either remains stationary, or shews very little disposition to decrease in size. The throwing out of the fluids and deposition of the phosphate of lime seems to be a slow, and apparently difficult process, and in many instances the absorption of the last is still more so.

If the tumour has been large, the formation of it will frequently be succeeded by much weakness in the constitution; and when this occurs the patient's strength must be supported by food and medicines known to have that power.

When indolence appears in the part added to weakness in the system, it may be necessary to rouse the action both of the part and the system, by joining small doses of calomel to the tonics employed, not carrying the use of it however so far as to affect the mouth. I have seen in these cases, the muriated tincture of steel, and also the ammoniated steel of evident service.

Stimulant applications may be used to the skin in the neighbourhood of the swelling, such as the mild mercurial ointment with camphor, upon the principal of exciting the absorbents to increased action. As the application is made to the absorbents of the skin, it is not clear how those of the diseased bone can be excited by it; we find however that they are excited, and it can be explained only upon the following principle, viz. that vessels from the skin and the inflamed bone enter the same absorbent trunks, that the excitement to increased action is conveyed to these trunks by the vessels of the skin, stimulated by the application made to them; and that the trunks assuming more action, the branches, entering them from the diseased part, have some of this increased action also communicated to them.

Many other stimulating applications may be used, but which it must be unnecessary to particularize here.

The foregoing observations have been confined to the inflammatory action affecting the bone only; but in inflammations of bone, the neighbouring soft parts often partake of the same disposition and action, and become also changed into bone; this happens occasionally to the periosteum, cellular membrane, ligaments, and even muscles.

It thus appears that the trunks of those arteries, which detach the branches supplying the bone, send off also other branches to the neighbouring soft parts, which have not, in their natural state, the property of secreting the phosphate of lime; but in inflammation that property is also given to them, and they now assume the same action with the vessels supplying the bone, and deposit phosphate of lime in the natural interstices of the soft parts, and thus convert these parts into bone.

This disposition and action has been called by John Hunter, the adhesive ossific inflammation.

When it takes place, the bone loses of course its natural shape, its features, if not intirely obliterated, becoming materially altered. The adventitious bone, when formed by the periosteum, is after death easily distinguished from the original bone, it is not so smooth, and when a section is made, a line is commonly seen dividing them.

This process assists in the union of simple fracture, and it also becomes often the cause of the anchylosis of joints. It seems intended to assist in producing a union between broken and divided parts; but it sometimes unites those which ought not to be fixed on one another.

This process is seldom attended with much pain, it sometimes takes place completely without it, and the constitution seems to suffer but little alteration while it is going on. As adhesive ossific inflammation often takes place in the formation of other diseases, many of its effects will be noticed afterwards with those diseases which they accompany. I have now only stated so much of this action as is concerned in the union of simple fracture.

Inflammation of bone occasionally proceeds to suppuration and ulceration; indeed the suppuration of bone is invariably attended with ulceration, unless when granulations are forming, or formed.

There is no material difference between these actions in bone and in soft parts. Bone being organized animal matter, but mixed with a large proportion of the phosphate of lime. The abscesses which take place in the substance of bone, forming more complicated diseases, will be noticed afterwards.

We may infer that suppuration has taken place on the surface of an inflamed bone, by the violent symptoms of active inflammation lessening, by cold fits and shivering occurring, by a remission of pain, with an increased sense of weight in the part; but all these are fallacious, and no external marks of suppuration are at first to be observed, the disease affecting parts too deep either to be seen with the eye, or felt with the finger.

When bones granulate, the granulations at first appear exactly similar to those of the soft parts, and as in the soft parts, take place to restore any loss that the bones may have suffered. This process of restoring bone is very similar to its first formation. In the skull, membrane was first formed; so is it in the process of restoration, the granulations change into membrane and then into bone. In cylindrical bones, the granulations form first a species of cartilage, and this is changed into bone. Thus in the restoration of bone, nature is guided by the same laws as in the first formation. The appearance of the ossification of those granulations which arise from the surface of bone, is not similar to that of soft parts converted into bone by the adhesive ossific inflammation: for when carefully viewed in a microscope, the granulations appear to form a number of small points, like villi shooting outwards from the bone; the bases of these, first become similar to cartilage, then to bone. The preparations from the surface of granulating stumps, shew the extreme delicacy of the first bony threads, and also their mode of uniting laterally with each other.

Fractures of bones differ so widely from each other in various circumstances, that the same process of cure which nature uses to unite simple fractures, can rarely be employed in fractures which are compound. In the first, the bones are united by a process very analogous to union by the first intention; while the last often require granulations to affect their reunion.

The shape of the fractured bone, its situation, the direction of the fracture whether transverse or oblique, its simplicity or complicated nature, and the degree of injury done to the surrounding parts, in each particular fracture will require the treatment to be varied. For fractures must produce different effects, according to the nature and situation of the bones injured, and the manner in which the injury was inflicted. The immediate effects are the destruction of the offices of supporting and directing the muscles, the breaking and tearing of the vessels of the bone and marrow, the ends of the fractured bone lacerating and irritating the neighbouring parts, from which are produced ecchymosis, inflammation with its concommitants of swelling and pain, and sometimes suppuration, convulsions and gangrene.

The following observations are intended to apply to the least complicated, viz. the simple fracture of cylindrical bones not communicating with the cavities of joints, to shew the process used by nature in the re-union, and thus to hint at those occurrences which it is the Surgeon's duty to promote, or in some instances to prevent or remedy.

Fractures of cylindrical bones will happen with the application of less force to people advanced in life, than to adults, or even than to children. In old age the animal substance is not so regularly mixed with the solid saline part, more oil is deposited in the interstices of the bone, the regular organization particularly the vascularity is less; from these causes combined, the bone becoming brittle, breaks with comparatively little violence.

In children, so much more of the vascular animal part is mixed with the osseous matter, that their bones will often bend without breaking; or should the hard part give way, the animal part will prevent the broken extremities from separating.

This kind of fracture has been compared to the cracking of a green stick, in which, though the parts bend under any weight or force, the ends of the broken part do not separate. In a child, in whom I had set a fracture of this kind in the forearm, which was bent to nearly a right angle in its middle, I had an opportunity, twelve hours afterwards of examining the bone; (the child was three years old, and had fallen on the pavement, from a height of eighteen feet, and fractured its skull which produced its death.) The periosteum round the fractures was torn in part, the osseous matter of the bones had given way, but their animal substance had not separated.

The situation and connexion of some bones render them more exposed to fracture than others.

Thus the superficial situation of the clavicle between the sternum and shoulder, is a cause of it being frequently broken. The radius from its greater connexion with the hand is more exposed to fracture than the ulna, and the fibula, from lying hollow and forming the outer ankle, is much exposed to be broken a little above that part, and frequently is so.

A bone may be fractured by force or weight being applied to both its extremities, or by force applied to the part. We have an instance of the first, when in falling on the shoulder, the clavicle is pressed against the sternum, so that it bends and then breaks from the approximation of its extremities ; and another instance, when on falling on the knee, the femur is pressed against hard ground, and bent and broken by the weight of the body. In each of these cases the natural curvature of the bone contributes to produce the fracture, and regulates also at what part it is to happen. In these cases the fracture is generally a clean one, and the neighbouring parts although often much torn, are yet less contused than when the fracture happens from a blow. When external force is applied to a bone and breaks it at the part to which it is applied, the bone is likely to be more shattered, the direction of the fracture less certain, and the injury of the neighbouring parts, from contusion and laceration, much greater.

There are two symptoms, which, when found in the same limb, may be considered as unequivocal signs of a fracture having taken place; one is the shortness, bend, or other unnatural shape of the limb; and the other is the grating feel, or crepitation, when the broken surfaces of the bone are made to rub on each other; this last symptom, when found, of itself marks the case to be a fracture; but fractures, do sometimes take place where it cannot be distinctly perceived, this is so in those I have mentioned as happening to young children. Fractures will even take place in adults, without either the shape of the limb being altered, or a crepitus being felt. The tibia has been fractured transversely by a blow very near its upper extremity, and the bone if separated, has suddenly, by the motion of the muscles, or other causes more accidental, returned without surgical assistance so exactly to its former figure, that no bending has been perceptible, and the extensive broken surfaces at this part of the bone have supported each other in such exact contact, that no crepitus has been discovered; the exact situation of the parts rendering the search for it unnecessary. A case of this kind was related to me by a naval Surgeon, whose veracity I could depend on, and who shewed me the preparation of the tibia preserving the marks of fracture and reunion, which on the man's death in Greenwich Hospital some years after the accident, he had it taken from the body; had not the patient been a man in years, I should have thought that the epyphisis had separated from the body of the bone. The fibula is frequently

broken at the upper part of the long triangular surface above the outer ankle where it is covered by integuments only; the tibia, to the lower end of which it is bound by strong ligaments, keeps it in its place, and that bone bearing the whole of the weight of the body, the patient is able to walk so long as the sole of the foot is placed on a flat surface; but when the foot is placed on an inclined plane, the fibula can no longer support the pressure of the weight now applied to the side of the joint, it is therefore bent inwards at the fractured part, which always strains and sometimes produces a very dangerous dislocation of
Potts the inner ankle. Also when only the radius is fractured, the ulna acting as a splint, the shape of the fore-arm in some instances is not altered, and no crepitation is felt in bending or extending the arm; but on attempting the actions of pronation and supination, motions performed exclusively by the radius, the pain will immediately be increased, and the fractured surfaces will be found to grate on each other.

In fractures of the neck of the thigh bone within the capsular ligament of the joint, the crepitus cannot in every position be distinctly felt, as when the thigh has by the action of muscles been drawn upwards and shortened; for the broken extremity of the bone is then in contact with, and would rub on the soft capsular ligament; but if the thigh is drawn down to its natural position, or when the patient is standing on the sound leg with the injured one hanging down, the attempt to rotate the thigh inwards will generally cause the crepitation to be felt, as the broken surfaces of the bone are then made to rub against each other; but even in this position, the sensation of crepitus will not always be distinct, from the great thickness of muscle and other soft parts through which it must be communicated.

The difficulty in distinguishing the nature of the accident will also be increased, when the part has not been examined soon after its occurrence; for so much swelling, distension, and pain may have arisen, that might forbid any attempts to be made to search for the crepitus, or would, if we were so imprudent as to make them, render such attempts unsuccessful, and perhaps very dangerous to the patient.

A derangement of shape may take place in fracture without shortening of the limb, thus in a fracture completely transverse, the lower portion of the bone may be so driven that a small portion of its broken surface near the outer edge of its circumference shall rest, and be supported, on a surface near the inner part of the circumference of the broken portion above, so as to prevent the limb being shortened; in this situation the muscles of rotation, if any such are inserted into the lower portion of the bone, may so alter its position that the front part shall not be in a line with the bone above, but shall be turned inwards or outwards; this may possibly happen when the femur is fractured immediately above the trochanters, and the bone not so displaced as to be drawn upwards; but is not a likely circumstance to occur, as in most accidents at this part, the bone would be drawn upwards. I have seen a femur which had been broken very low down, and in which the fractured surface of the lower portion of the bone had been bent backwards, but whether from the action of the gastrocnemius and plantaris muscles, or the original effect of the violence I could not ascertain: the upper portion of the bone, however, had united to what was formerly the anterior part of the lower portion, but which in this position had become the upper one, here although the use of the knee joint was lost, the limb had not become perceptibly shorter.

The shortening of a fractured limb, in some instances, is produced by the force which broke the bone, thus a fall which breaks the thigh bone will often do more, it will displace the fractured portions, driving them to one side so as to shorten the thigh in the proportion that they are driven from the perpendicular direction.

The weight of the limb below, may from position so act upon the fracture, as to derange the bones after they have been replaced in their proper situation; care should therefore be taken in the treatment of fractures to prevent this; or the weight of the limb at first may displace and keep the fractured bones so displaced, that one portion shall ride over the other; thus when the clavicle is broken the weight of the arm carries the outermost portion downwards; it therefore is found below the other.

The chief cause, however, of the displacement of the bones and the shortening of the limb, arises from the contraction of the muscles attached to the different portions of the fractured bone, generally to that portion furthest from the trunk: so that the derangement of the limb, supposing there should be no counteracting cause, will be in that direction to which the most powerful muscles attached to the lower part of the fractured bone, or to the lower limb connected with it, are disposed to draw it. The extent of the displacement will vary according to the situation of the fracture, thus, generally speaking, the lower portion of a fractured femur, will by the action of the strong muscles on the inside and back part of the thigh, several of these passing from the pelvis to the leg, be drawn to the inside and behind the upper portion of the bone; and when the fracture is immediately below the lesser trochanter, the psoas magnus and iliacus internus muscles inserted into that projection, will carry the upper portion forwards so as to press against the skin, and rotate it at the same time a little outwards. But I do not mean to enter into a description of the particular symptoms in different fractures that depend upon the action of muscles; the anatomical knowledge, which every one now present is supposed to possess of the situation and action of muscles will enable him to form a proper judgement, in any case of fracture, in what direction the displacement is most likely to be found.

Attentive observation to the means which nature employs in repairing those injuries to which our bodies are exposed by common accidents, will always prove the most certain source of that knowledge, which will enable us to assist her best by art. Many of her actions are performed in open view, with the forms and properties of many of her materials we are well acquainted, and the ultimate disposal of them in completing her intention she does not conceal; but the unknown combinations which may be necessary to produce those known forms, and the minuteness and delicacy of her instruments and actions in appropriating them, place some of her processes at an immeasurable distance from human acquirement.

Many circumstances relative to the union of fractured bones unknown to our ancestors, have been ascertained by the observing and inquiring mind of recent Physiologists, and the means used in the completion of this process seem to be well understood. The opinions of the ancient and even of some late authors, respecting the origin and nature of the peculiar fluid which they suppose was secreted to form the callus, or the connecting ~~the~~ medium, have been satisfactorily confuted; but much of the commencement of the process of union is still unknown; and on investigating the opinions of those who have confidently pretended to possess the arcana of nature respecting it, we find that they have left much indeed to conjecture.

In tracing this union, I shall not enter into, for I cannot determine the questions, why the formation of cartilage, or a substance in all known properties resembling it, should be necessary to the union of divided bones? how it is first formed? whether it always preceeds the appearance of osseous matter? or whether some points of this matter are deposited in parts before it appears? Observation by the naked eye, and still more distinctly by the microscope, shews that it always is formed, and that a large proportion of new osseous matter is deposited in it as in the first formation of cylindrical bones; but it is also very probable, that in a process which requires to be quickly completed, bone may be deposited in a part which is not cartilaginous, for in the cranium, bone can, and does form from membrane.

The use of the microscope has shewn much; but we cannot expect it to shew every process of nature, and, however well skilled in the use of this instrument, the most attentive observers have sometimes disagreed.

Experiments on living animals have frequently been had recourse to, for the purpose of discovering the first effects and changes which occur in the re-union of fractured bones; this has been the more necessary, as fractures are not attended with consequences that immediately endanger life, and therefore, in the human body, the first appearance can be very rarely seen. These experiments have generally been made on rabits, guinea pigs, and dogs. From them and cases in human bodies, where an early examination has been obtained, it appears that the process of union in bone, allowing for the difference in the materials of its composition and structure, is very similar to that which takes place in soft parts.

In all the cases now alluded to, the periosteum has been found to be more or less torn, and so generally have some of the other soft neighbouring parts, and nearly in proportion as these have been injured, and the broken ends of the bone further removed from each other, have been the symptoms of irritation and pain. In consequence of the destruction of continuity in the bone and other parts, the lacerated vessels allow some blood to escape into the cavities formed by the division; this immediately coagulates and adheres to the divided surfaces.

The parts surrounding and forming the lacerated surface both of bone and periosteum, now have an increased action in their vessels arising, which forms adhesions in natural cells of both, shutting up the communication with the rest of the cells of the limb; a boundary is thus formed between the injured and sound parts. The absorbent vessels almost immediately begin to remove the sharp edges of the fractured bone, rendering the whole surface smoother, as well as the edges rounder.

The vessels surrounding the portions of coagulated blood, increase in number as well as in action. This increase of vascularity is perceptible to the naked eye, but is seen distinctly when the parts are viewed in the microscope, in the limbs of an animal which have broken, the animal having been killed two or three days afterwards, and the limbs having been injected. Vessels from the periosteum shoot into the coagula nearest to it, and vessels from the internal membrane of the bone shoot into coagula placed between the extremities of the bone; these coagula when rendered vascular unite with each other. It is therefore blood which forms the first bond of union between the divided surfaces, and it is very probable that similar processes take place in the coagula as to the formation and junction of vessels, to those which I have already had the honour of submitting to your consideration last year, when on the adhesion of soft parts.

When vascularity is established, the phosphate of lime begins to be deposited by the arteries, the absorbents removing from the proper surfaces the former materials, and occasionally the phosphate of lime also, and thus working with the arteries in modelling the internal as well as external structure of the connecting medium, a substance similar to the original bone is at last formed. The vessels of the periosteum are engaged as actively in this as the vessels of the bone; the old periosteum assumes the adhesive ossific inflammation, and a new layer of periosteum is formed to cover it when changed into bone, the vessels of the old periosteum shoot into the coagula, so do those of the bone, the general mass of coagulated blood loses the red appearance it possessed from the globules being intermixed with the coagulable lymph, and seems soon to be changed into a substance resembling cartilage; the phosphate of lime is deposited in the cavities of this cartilage; indeed to microscopic observers it seems to be also deposited in parts of the vascular surface even before the cartilage appears. The mass, while nearly in this cartilaginous state, is moulded into a proper shape by the pressure of the surrounding parts, and then gradually, as in the first formation of bone, is converted into that hard substance.

When part of the cranium has been removed, the new bone which is to supply the loss, is always long in forming, and cartilage does not seem here to be necessary to its reproduction; the bones of the cranium formed originally from membrane, and so it would appear the replacing bone does, after part of the original bone has been removed by accident, or intention as by the trephine. A preparation in our museum shows a membranous substance extending across a fracture, in a piece of bone that has been removed with the trephine. I have examined several skulls on the death of the persons, at different periods from days to years after pieces of bone had been removed, and before the vacancies had been completely filled up, but I never could in any of them discover the least appearance of cartilage. Nature thus seems to be guided by the same laws in the reunion and restoration of bone, as in the first formation of it.

The part which was broken, often appears to become firmer and harder than the original bone: sections of bones now before us shew this. In some of these sections of fractured bones which had been placed in tolerably exact contact, and had united, after death the limb having been injected, vessels are seen passing into the united part from above and below, ramifying in it, and anastomosing with each other. The communication of the cells in the cancellated structure, which had been closed in the beginning of union for perfecting the adhesion, is again opened, the absorbents having removed the bony matter between them, and the whole bone is restored nearly to the state it was in before the fracture. Callus while forming is more vascular than the original bone; but after a time its vascularity seems to lessen, and in disease affecting bones, it appears to be acted on more easily, at least to have less powers to resist the disease, than original bone. Instances of this have been recorded, in the effect of scurvy, in Anson's, and other long sea voyages.

In fractures, splinters of bone of different forms and sizes must frequently be broken off. When the fracture is not a compound one, or the bone not shattered into very many pieces, these splinters seldom lose their living principle, but unite to some other part, either of the old or new formed bone. In many instances they may probably retain their life from some vessels, passing into them from the periosteum, not having been torn through: but this I do not consider as absolutely necessary to their continuing to live; for, the bone being in perfect health previous to the accident, these splinters may live and become vascular, on the same principle that both hard and soft parts severed from the body of one animal and inserted into that of another, have lived, received nourishment and grown there. Many preparations demonstrating this, I produced for your inspection during the former season; I now produce preparations which demonstrate the fact, that splinters have been broken off, inverted, or their position otherwise changed, and which have in this altered state formed a firm connexion with some part of the bone from which they were detached.

The time of perfect consolidation in fractured bones will vary from several causes. Soft parts, when divided, will unite completely in a very short space of time; but in bones this rapid union cannot happen, for the divided parts cannot be brought into such exact contact, but that some considerable quantity of the uniting medium must be thrown out between them; this will take a sufficient time, first to become vascular, then cartilaginous, and at last bone. The time of firm union must vary depending upon the age of the patient, the nature and situation of the bone, and state of the persons constitution.

Bones of young children when fractured, from greater vascularity and activity of the vessels still employed in increasing the size of their bodies, will unite sooner than the bones of adults, and these last will unite sooner than the bones of old people, in whom the vascularity of every part of the body is much diminished. And perhaps from nearly the same cause fractured bones in the upper extremity will unite, cœteris paribus, sooner than those in the lower extremity. When the constitution of the patient is strongly tainted with any disease, fractured bones will not unite so soon, or so perfectly as when the constitution is sound. Bones will, of course, unite firmly much sooner when the broken extremities are placed in fair contact, than when they are not corresponding, or the bones riding over each other. The two extremities, not being brought into contact will however not prevent union if the parts are kept at rest, for the cavity between them being filled with extravasated blood, through this medium union shall take place between the surfaces which are nearest to each other; thus a callus of some inches in extent is sometimes formed. The instances of broken and united bones now before us shew the effects of bad surgery, or rather what takes place in union of broken bones when no surgery is used.

It has occurred to some women, who being pregnant, have fractured a bone during the last months of that interesting state, that no attempt at union has taken place until their delivery; of this I have seen two instances; but in other women under similar circumstances perfect re-union has taken place, although in general the process of it has been slower.

In young persons, fractured bones of the extremities, when placed in fair contact, will often be found to have united so as to have no motion on each other, in ten or eleven days. The bones of the extremities of healthy adult persons under similar circumstances, will be found in this state about the third week; but although there is no motion perceptible, the connecting medium is still soft and will bear no exertion of the limb, until the fifth or sixth week, when some exertion may be used with the fore-arm or arm; and about the sixth or seventh week, with the leg or thigh. In attempting this exertion with the bones of the lower extremity, no Surgeon will forget that these bones have the weight of the body to support. No precise time, however, can be fixed, as it must depend, not only on the above mentioned circumstances, but also on the nature of the fracture. A very oblique fracture has its surfaces kept with much more difficulty in contact, than a transverse one, and when united, the callus is less favourably disposed for bearing the weight of the body.

The consolidation of a fracture may also be retarded, or the union be prevented from taking place, by different local circumstances; the last occurrence may happen, from one of the fractured portions of bone not having a sufficient degree of vascularity to allow of union. This is supposed to be one of the principal causes which prevents the fracture of the neck of the femur from uniting when the head is displaced in the cavity of the joint: under these circumstances there being no periosteum to allow of the passage of vessels from it, all the blood which can enter that part of the bone must proceed from the ligamentum teres, and as these fractures happen frequently to old people, even the usual vascularity is, from the period of life, much lessened.

LECTURE IX.

ON THE TREATMENT OF SIMPLE FRACTURES; ON THE NATURE OF THE UNION IN COMPOUND FRACTURES; THE TREATMENT OF COMPOUND FRACTURES; AND ON FRACTURES COMMUNICATING WITH THE CAVITIES OF JOINTS.

THE process which nature adopts in uniting fractured bones, when attentively considered, cannot fail to suggest the means by which this union may be assisted by art. It clearly indicates that the separated portions of bone should be early replaced, so that their re-union should commence without loss of time, and should proceed with the least possible interruption. Should their replacement be delayed until much inflammation and tension have arisen, the irritation and pain attending the attempt would render the success doubtful, and often hazardous; and even should it succeed, no bandage could, with safety, be applied sufficiently firm to retain the bones in their proper position. When these symptoms have arisen, we must therefore be contented with placing the bones in as favourable a situation as circumstance will admit; but as soon as it is possible to adapt the broken surfaces to each other without incurring the risk of bringing on gangrene, this should be done.

The means of allaying irritation and lessening inflammation, in different constitutions, and in different cases of fracture, are not unknown to this audience, it therefore would be idle to enumerate them here. So would it be to discant on the modes of making extension, counter-extension, and coaptation; for without previous anatomical and physiological knowledge, neither general nor particular rules would render the operator confident in his means, nor could he vary those means to suit the exigence of particular cases; but when possessed of such knowledge, a little reflection will enable him to determine on the particular treatment which each variety of fracture might require.

It is scarcely necessary to observe to this audience, that whatever force is used either by the hands of the Surgeon, or his assistants, such force should be applied in a regular and gradually increasing manner, and not by violent and sudden pulling, and should be applied, when the limb is placed in such position that the whole, or greater part of its muscles are either relaxed, or not acting in direct opposition. In setting a fracture, much less difficulty is found in replacing the bones, than in preserving them in their proper situation. In this, it differs much from reducing a luxation, which is attended in general with much difficulty in returning the bone to its socket, but with little or none in retaining it there; it is therefore necessary after the setting of fractures to use rollers, or other bandages, and to apply splints so as to preserve the bones in contact, and with as little motion as is possible upon each other.

When the fractured portions have been removed from riding over each other; and their broken surfaces have been brought into contact, their adaptation requires much nicety, and therefore should be carefully attended to by the Surgeon; for the portions of the bone may unite, and still leave many other inconveniences and deformities, exclusive of those which will arise from the bone being shortened. The knowledge of the exact and relative situation of the natural prominences of the bones will here prove of great use, and it should be distinctly observed that these are in their proper places and positions, before any bandage is applied to the limb. The previous study of the skeleton has informed us what these positions are. The limb of the sound side should not pass unregarded, for it will shew whether any peculiarities existed in the original shape, and it is obvious that the fractured bone should be made as nearly to resemble the original shape as circumstances will admit. From omitting to attend to the shape of the sound limb, I have known a Surgeon, in attempting to make an originally crooked fore-arm, when fractured, straight, fatigue himself and give pain to the patient for many minutes, which would have been prevented had he bestowed a single glance on the arm of the opposite side.

It is very necessary, in the management of fractures of the bones of the lower extremities, to consider what kind of substance and surface is the most convenient and safe for the limb to be placed on until the long period of uniting is passed, and then but little reflection will convince us, that a mattres, regularly and equally filled, is preferable to a feather bed, and that one formed of hair, will be better than one stuffed with wool.

The superiority of the straight or of the bent position of the lower limbs, during the healing of a fracture of the bones belonging to them, is a subject which has been much canvassed, and concerning which Surgeons have not as yet finally agreed. Mr. Pott first suggested the propriety of placing the limb in the half bent position, upon the idea, that weariness would be less felt, when the whole of its muscles were kept nearest to the state between flexion and extension ; and that in consequence, the broken surfaces of the bones would be less likely to be moved or separated ; whereas in the straight position, some of the muscles being on the stretch, while others were perfectly relaxed, the fatigue would be greater, and the chance of motion more considerable. It also has been suggested that placing the patient on his side was preferable to laying him on his back. The old method of placing the patients on their backs, with the fractured limbs extended, has been preferred by others for the following reasons, viz : that in such position they would lay longer without tiring, and would be less liable to have the uniting bones disturbed by those involuntary motions which weakness and pain are likely to produce, and which, in the half bent state of the limb, it would be impossible to prevent ; also that in the bent position the length of the fractured limb could not, during the process of the cure, be compared with that of the opposite side ; and further, that experience proved the flexed position was less easy to be persevered in, than the straight one. Attention being paid to guarding against the twist the lower portion of the bone may receive from the weight of the foot inclining it to one side, either position may be adopted without interfering with the process of union ; but, in fractures happening in the lower extremities, I have always found that the patient bore the straight position of the limb with less inconvenience, and that the union on the whole was more quickly and more perfectly completed when this position was used.

Respecting the state of the muscles, the fact will be found, that with the exception of one muscle, and that the smallest of those which pass from the thigh to the leg, in neither the bent or straight position will they be placed fully on the stretch, and as the leg is supported and at rest, no action beyond their tone is in either case required. The joints of the lower extremities bend in succession contrary ways, and many of their muscles pass over two joints. Thus the semitendinosus, semimembranosus, and long head of the biceps flexor cruris, passing on the back part of the thigh from the tuberosity of the ischium to the leg, bend the leg on the thigh, but also extend the thigh on the trunk of the body, or the trunk on the thigh, and therefore can only be on the stretch when the leg and the thigh are extended on a horizontal surface, and the trunk of the body seated upright and perpendicular to it; but when the person lies upon his back, the tuberosity of the ischium is then placed nearer to the leg, and the muscles consequently cease to be on the stretch. The rectus cruris which extends the leg on the thigh, bends the thigh forwards on the pelvis, or the pelvis forward, on the thigh, this muscle therefore, can only be on the stretch when the leg is fully bent, and the thigh fully extended; for when the person lies upon his back with the leg and thigh in a straight position, this muscle must be nearly in its medium state. The sartorius and gracilis are only fully on the stretch when the thigh and leg, being extended, are separated from those of the other side, and having the toes at the same time turned outwards; when the lower extremities are in a line with the body, and the toes pointed forwards, these muscles cease to be on the full stretch. The two vasti and crureus can only be on the stretch when the knee is much bent: so that the only muscle on the stretch in the straight position of the thigh, when the body it recumbent, is the short head of the bicep flexor cruris. Thus, in the fully bent state of the knee, the two vasti and crureus will be on the stretch, and in the straight state of the knee, only the short head of the biceps flexor. Also in the leg, the gastrocnemius and plantaris bend the knee, but extend the ancle joint, and several of those which extend the ankle joint bend the toes, and those which bend the ankle, extend the toes. From these facts I conclude, that the state of the muscles need not enter into the question, but that the superiority of either the straight or bent position is to be determined, by ascertaining which the patient can endure the longest with the least fatigue, and in which the derangement of the fractured bone is the least likely to take place from the weight or position of the foot; and on these grounds, a preference, I think, should be given to the straight position of the limb.

Whatever position is determined on, it must be agreed, that the less motion is allowed to the fractured surfaces of the bone, the sooner is perfect union between them likely to be effected. For much motion must prevent or interrupt the increase of vascularity and consequent actions of the vessels in the connecting medium; when these are interrupted, the fractured surfaces of the bone become smooth, and continueing to move on each other, an artificial joint is formed without muscles to give it useful motion, and, from its situation and form, not adapted for the support of weight; the use of the limb is therefore lost, so long as such joint is permitted to continue.

The different kinds of bandages and their mode of application, are not subjects for discussion in these lectures, and the audience has elsewhere seen, and considered what relates to them. I shall only observe that whatever bandages are used, they should be applied so as to press equally and to give uniform support to the limb; but not so firmly as to impede the circulation, or to produce swelling and tension; when properly applied, they will assist in keeping the bones together, and being moistened by medicated fluids, they will allow of topical applications to be made to the part, or they may be made to support other topical applications which are not in a fluid form.

Splints, extending over the extremities of the fractured bone, will give great support to the limb; but care should be taken to prevent them from pressing too much and too partially on the projecting portions of the bones, by placing some soft substance, such as linen, lint, cotton, or wool, or even bags filled with chaff, between them and those parts, so that the pressure may be more diffused and equal; they thus applied will not only assist in preventing the whole limb from being disturbed by motion, but will also tend more particularly to prevent the displacement of either portion of the fractured bone, by affording support to each of them for the whole extent of its length. We are not, however, to expect that splints will be sufficient to prevent that derangement of the circumference of the bone, or twist which sometimes arises from the weight of the foot when tired of being supported on the heel, and which inclines it to one side to change the point of support and procure relief from pain often felt in the heel: the pressure of the bed clothes when they are not supported adding to the inconvenience. Every Surgeon here, must have recourse to his own ingenuity, so that by the use of cradles, and the proper application of pillows or other convenient substances, due support may be given to the foot to keep it in its true relative situation; the position of it therefore should be frequently attended to during the progress of the cure.

In particular cases, such as fracture of the neck of the thigh bone, or where the direction of the fracture is very oblique, or other causes, where neither bandages or splints can be applied so as to prevent the two portions of the broken bone from being drawn apart, and if united in that position to occasion shortening or other deformity of the limb, it will be proper to place the patient on his back, and lay the limb on a framework forming a double inclined plane. One of these planes adapted in length to the thigh, should be placed lengthways immediately below the tuberosity of the ischium, and should gradually ascend from the horizontal surface on which the patient is recumbent so far as to regulate the extent of the bending of the joints of the pelvis and knee; the other plane being, something longer than the first, should descend from this to the horizontal surface of the bed. These being covered by thin cushions, or mattresses, the limb should be placed on them, so that the knee should bend over the angle where the two planes are joined. Pegs may be inserted near the edges of these planes, so as to support cushions placed between them and the limb; these will give lateral support to the whole limb and more particularly to the foot, and prevent it from inclining to either side. Mr. Astley Cooper strongly recommends the use of a machine of this kind in fractures of the neck of the thigh bone, and has given a description how easily such could be immediately made, from joining three deal boards. Machines formed on a similar principle, but a little more complicated, being provided with a screw by which the angle between the two planes can very gradually be increased and diminished, and a contrivance by which the foot and lower part of the limb can be raised and depressed, and in which the leg and thigh being placed on cross and moveable straps, which will allow of any part of the limb being examined, or its wounds dressed without being disturbed by much motion, have been long used in cases of compound fracture: I have occasionally employed one of this kind for the last thirty years.

It is known to every Surgeon, that the fractured limb, although thus bound up, should daily be examined to ascertain that no excoriation is produced by the pressure of the splints or other causes; and when excoriation threatens, that the parts should be covered by soap cerate spread upon leather, or other means should be employed calculated for their defence. Also that it is expedient, when there is any doubt of the limb being straight, about the twelfth or fourteenth day after the bone has been set, to remove the bandages and to examine the fracture; for at this period the limb will bear a little motion without displacing the uniting bones, and it is still possible to correct any error in their position, should such be found. The limb is then to be bound up as before. In some instances it may be necessary to employ a degree of passive motion to prevent that stiffness in the joints, which may arise from long rest, or from the parts thickening from inflammation. In the fracture of the radius particularly, it will be useful to move the bone, in the direction of pronation and supination after the inflammation has ceased and union made some progress. During the patient's confinement, attention will be found necessary to prevent the costiveness which usually arises from the loss of accustomed exercise, Food of easy digestion of course is that which should be preferred.

It sometimes happens that the broken extremities of the bone shew no disposition to unite for several weeks after the accident. In these cases allowing the surfaces to rub a little on each other will sometimes excite the vessels, which shoot into the connecting medium, to renew their efforts to produce union; the removal of the splints will sometimes be sufficient to do this, but it has in some cases been found necessary to rub the fractured surfaces of the bones on each other. I have seen an instance, where union refused to take place in the fractured bones of the leg of a person who had lived an intemperate life, and who had drank much spirits, but who after the accident, had been kept low and had been refused strong liquors; upon a moderate quantity of spirits being allowed her, union almost immediately took place. On the breaking of her other leg, which happened within a twelvemonth after the first accident, spirits were not entirely refused her, the bones united, and the patient recovered in the usual time.

When union has been long delayed, after blisters to the skin in the neighbourhood have been tried and failed, it has been proposed and practised to cut down upon the fractured surfaces, and to scrape off the crusts of the new formed cartilage; it has even been thought expedient to saw off a piece of each bone, producing by such operation new surfaces, and allowing or rather exciting these to granulate, and unite as in compound fracture. The difficulty of performing these operations, and the pain and irritation attending them, added to the want of success in the greater number of instances in which they have been performed, have been the causes of their having been very seldom had recourse to. In some cases which would admit of it, a seton has been introduced between the bones, and has excited so much action that they have united after many weeks, or even months of disunion; but it has also in other cases, equally favourable so far as circumstances could be known, failed enitrely.

When emphysema is produced by the end of a fractured rib having been driven into the substance of lungs, and the air passes from the wounded cells through the torn pleura into one of the cavities of the chest, and is not forced into the cellular membrane external to the pleura, it produces similar symptoms to the collection of other fluids, and these take place immediately :---here all bandages should be removed from the chest, and if the wound is a small one, and the rib has been extricated from it and returned to its place, it may soon heal, and the air may be gradually absorbed; but when the air accumulates in that quantity as to press on the mediastinum, and to impede respiration on the opposite side, it may prove necessary to make a small perforation into the distended cavity and to allow the air to be evacuated through it.

In cases where the air is also forced through the wounded pleura costalis into the cellular membrane, it may be pressed further upon every expiration, until a very considerable part of the body shall become inflated; the nature of this tumour will easily be distinguished by the peculiar crackling feel. The operation of puncturing the cavity of the chest used to be performed for its removal. John

Hunter was the first who disapproved of this practice, as it was likely, he observed, to produce suppuration of the internal cavity of the chest, as well as suppuration of the wound in the lungs, and ultimately not answer so perfectly as incisions would, when made through the integuments into the cellular membrane at some distance from the fracture of the rib; for if made near that part, a simple fracture might be changed into a compound one, and the wound inflicted be caused to communicate immediately with the cavity of the thorax; but when incisions were made into the cellular membrane at some distance, the air would find a free passage through them, and the wound in the lungs would generally be found to unite before that of the pleura costalis, so that no more air would pass through it: the air which remained after this in the cavity of the chest would be pressed through the wounded pleura costalis into the cellular membrane, and there would be absorbed or expelled through the wounds in the skin. To explain why the wound in the lungs unites before the wound in the pleura costalis, it may be necessary to remark, that internal wounds do not inflame so quickly as those which are external. In internal wounds the cogulable lymph is generally retained, and by uniting the parts to a certain degree, seems to lessen that immediate necessity of their being so thoroughly healed, as wounds require which happen in parts that are exposed. In external wounds, inflammation and the other processes of union soon take place ; now a wound communicating with the air cells of the lungs approaches nearer to the nature of an external wound, than a wound through the pleura, and therefore in general heals the soonest. The incisions through the skin need not exceed half an inch in extent, but should fairly enter the cellular membrane ; their number must be proportioned to the extent the air occupies that has been diffused into the cells. The chest of the patient should not be bound up, because that would impede respiration by the opposite side, and would prevent the air escaping freely through the openings made in the skin.

In discoursing on surgical subjects before this audience, it is most difficult to draw the line between those general observations which establish principles, and those which apply only to particular cases. To very many who are present, nothing which I have stated on the mode of union and treatment of simple fracture was unknown, and therefore to them I may have been unnecessarily tedious. To the Student I may not have given such particular information of the treatment of the fractures of different bones as he might have wished to receive. I have thought it unnecessary, however, to state more than I have done, for it must be recollected that the Student has to acquire the knowledge of the treatment of particular cases by an assiduous attendance on hospital practice.

ON COMPOUND FRACTURE.

As compound fractures may be of all gradations from the smallest wound of the skin communicating with the broken parts of the bone, to the almost total separation of one part of the limb from another, and may be very complicated, by being connected with injuries happening to various parts, it becomes necessary to confine the observations, intended to be made, to the general principles which regulate the mode of union, and means of cure.

These fractures may arise from the same force, which broke the bone, destroying also the skin; or from the end of the broken portion of the bone being forcibly pushed through the integuments; or from a simple fracture, either from the badness of the patient's constitution, or from improper treatment, becoming a compound one.

In every case of compound fracture, our first consideration, (and a most important one it is,) must be, whether there is or is not a probability or possibility of saving the limb? This is to be determined by careful examination of the situation and nature of the injury, the best information we can obtain of the constitution of the patient, what is his local situation at the time? and what it is likely to be during the cure? For in two cases of compound fracture, of the same nature, and happening to people of similar ages and constitutions, one of these patients may be so situated, that he cannot have rest during the time of union, and the other, so that he may have rest; amputation may give the best chance of life in the first instance, and in the other we should endeavour to save the limb.

This audience well knows that some Surgeons, even of celebrity, have approved of amputation in most cases of bad compound fracture, and that others have been averse to it in any case, recommending that the separation of the dead parts should be left to nature, and that we should only assist her in forwarding her means. A question of such general importance is not to be determined by any particular rule. Cases have occurred in which no probability appeared of saving the limb, yet the patient has lived and kept it; and others, where immediate amputation gave the only chance of saving life.

When the loss of the limb is decidedly unavoidable, and the Surgeon sees the patient immediately after the accident has happened, the sooner amputation is performed the better; but if the operation is deferred until inflammation, tension, and great irritability of the part, or gangrene come on, as in such state of the limb, it cannot be performed with much hope of success, it will be better to defer it still longer, viz: until the inflammation has abated, and the disposition to become gangrenous has ceased. This will be attended with the patient's mind concurring in the necessity of losing the limb, as daily experience will convince him that it cannot be saved, and it is not found that a reduced constitution, (if not reduced too low,) is less likely to recover after amputation of the limb, than one not reduced at all; indeed in many instances the reduction has proved advantageous. When therefore there is any, even the most distant probability of saving the limb, and the local situation of the patient will allow the proper attempts to be made, these should not be omitted ; a chance is thus given to the patient of preserving both life and limb; and amputation, as a last resource, may be performed as safely when this chance has been given and failed.

In compound fractures where the wound communicating with the injured bone does not close at first, the same mode of union cannot take place which occurs in simple fractures ; for from the parts being exposed, the first bond of union, viz. the coagulable lymph of the blood, is removed or destroyed before it can become vascular. Inflammation in consequence of the injury comes on, suppuration takes place, and, when the parts are healthy, granulations arise. These granulations from the broken extremities of the bone, soon assume the ossifying disposition, and when they come in contact with each other unite. The surrounding inflamed parts are often included in this ossifying disposition, and uniting with the granulations, form a bond of bony union.

Where the wound, between the surface of the body and the fracture, heals by the first intention, the bones, if not too much shattered, may unite as in simple fracture.

We meet with instances where bones have united in compound fractures without any evident appearance of granulation, but where a deposition of coagulable lymph seems to have taken place, and to have become vascular. The union of compound fractures often taking place by means of granulations, these cases are more tedious in cure than simple fractures even when they are not very complicated, and more so when they happen in the lower extremities. The time of union will of course vary from a few weeks to several months, depending upon the extent of the injury, the situation of it, and the age and constitution of the patient. In these fractures, it often happens, that parts of the injured and exposed bones are either killed by the accident immediately, or from the effects of disease afterwards, and must therefore exfoliate before the wound can heal.

In the treatment of compound fracture, the same principles are proceeded on, as in the treatment of simple fracture; but, from the wound requiring attention, we must be careful to place the limb in that position which will allow of the sore being uncovered and dressings applied, with the least possible motion to the part. In short, the more a compound fracture is capable of being treated as a simple fracture, the less is the patient's danger, and the sooner is he likely to recover.

When the bone projects through the skin, every Surgeon will, in making the necessary extension, take care to apply the force he uses at first, in the axis of the lower portion of the fractured bone, until the bone passes within the skin. Much difficulty has often occured in replacing the bones, by a long and sharp process protruding through an opening, merely large enough to give it passage, so that much extension has been required to reduce it, and the attempt after all, has sometimes proved unsuccessful. In such case, the removal of the projecting portion may be expedient. But, a considerable portion of bone may project, and this of its whole circumference, so that the removal would be attended with shortening of the limb; it may be necessary here to enlarge the wound; but when so, the enlargement, like amputation, should be made directly; it is not then likely to be attended with bad effects; on the contrary, by removing tension and procuring a convenient outlet for the matter, it may prove materially useful; but if this opening is deferred until the parts are much inflamed and have become very tense, gangrene may arise from cutting through parts in such state; which last circumstance makes it safer to saw off the projecting portion of the bone, even should this practice be attended with exfoliation, and some shortening of the limb. It does not, however, follow that the limb necessarily shall be shortened, for the granulations may shoot out until they have supplied what was thus lost. If an artery continues to bleed it may prove necessary to enlarge the wound and secure the vessel by a ligature. Extraneous substances that may have been introduced at the time of the accident, and loose and detached portions of bone should be moved, for these will increase irritation and retard the cure. We should not, however, be too solicitous to find them, or use much violence in extracting them, for meddling much with the interior of the wound, will do more harm, than their immediate removal would do good. The many tailed bandage is in these cases preferable, for obvious reasons, to a common roller. The limb should be placed in the position easiest to the patient; but this must be regulated by the situation of the wound.

We should, if this possibly can be done, unite the lips of the wound by the first intention; if it succeeds, the case is to be treated like one of simple fracture, where the broken surfaces may have lost their disposition to unite by the first bond of union. If this cannot be affected, we must encourage the formation and union of granulations, and prevent any improper lodgement of matter while they are forming.

Where the bone is shattered into many pieces, and where there is no chance of union until these are discharged, if poultices can be applied and changed without giving much motion to the limb, they may be very useful in promoting suppuration, for during that process the pieces will separate and come away the most easily.

The first danger in compound fracture arises from the inflammation likely to attend it. This inflammation should at first be watched over and kept under ; but when suppuration has taken place, the patient's strength must be supported.

The preparations now before us, shew the effects of such fracture on the bones and the surrounding parts, the changes which the bones undergo previous to their union, and the appearances which they have, after union has been accomplished.

FRACTURE OF THE PATELLA.

The fractures of some bones must necessarily communicate with the cavities of joint: the fracture of the patella is an instance of this. The inner surface of the patella is covered with articular cartilage, and forms part of the internal boundary of the knee joint, any fracture which divides this bone must therefore communicate with the cavity of the knee. This communication must prevent the blood, or its coagulable lymph, which in simple fracture forms the first bond of union, from being retained between the broken extremities of the bone. The patella has some very strong muscles inserted into its upper and anterior surface, and its lower part is fixed by a strong ligament to the tibia when the bone is divided transversely, these muscles having nothing to oppose that constant disposition to contraction, which all healthy muscles possess, now draw the uppermost of the separated portions from the under; while the under part being attached by an uncontractile ligament to the tibia remains in its usual situation. The contraction of the muscles continuing, unless the leg is extended and the body bent forwards, the divided portions are prevented from coming into contact, and therefore cannot unite by bony union. They do, however, in time unite by a long ligament, which must here be formed by granulations that arise without the previous production of pus, or only so much of it as may be necessary to their increase, and merely sufficient to cover the granulating surfaces, without passing into and distending the general cavity of the joint. If the ligament is formed from the coagulable lymph becoming vascular, it cannot be from the lymph thrown out at first with the rest of the blood, that, must have escaped into the cavity of the joint, and have been absorbed; the lymph here must be deposited in consequence of inflammation on the whole of the surface between the broken extremities of the bone; but in either way, the union is very slow in forming, and when it has taken place, the muscles, having contracted to their full extent, have to acquire an additional power of action, before they can produce any motion in the limb below. The preparations now produced, shew the nature and appearance of that ligament, and are good examples of the kind of union which takes place, when no attempt is made to bring the bones nearer together.

Longitudinal fractures of this bone happen very rarely, they are produced in consequence of force being applied, or by a fall on a pointed or sharp substance, and these fractures unite readily by bony union. The fractures of the ~~thigh bone~~ patella are almost always transverse, and occasioned, not by the application of external, but by that of internal force. The patella slides from the under to the fore-part of the trochlea of the femur, in changing the leg from the bent to the extended position. It never is known to break in the full state of flexion or extension ; but when placed on the edge of the femur in the middle state between them, and the body at the time happens to be falling, then the mind, in a kind of confusion, issues its orders to the flexor and extensors muscles of the leg to contract at the same moment ; the immense force of these muscles when in opposition meets in the patella, at this time in the most unfavourable state for resisting either set, and it gives way in consequence, In every patient, whom I have attended or conversed with, who had fractured the patella, the bone has been described to crack and give way before the person reached the ground, or struck it against any hard body. The Parisian Authors, who have treated on this fracture, state that it frequently happens to Dancers, when they begin to spring upwards, the knee being then in the half bent position. The transverse fracture of the bone, like the longitudinal one, has however happened from a fall on a pointed, or sharp and hard ridge.

The symptoms of this fracture are well known, and need not be mentioned here.

The treatment formerly adopted, was by extending the leg and bending the body to bring the two divided surfaces of the bone into as exact contact as possible, and to retain them there by strong bandages. The leg and thigh during the time of cure were kept fixed, and to secure this position, a long splint, extending from the pelvis to the foot, was placed behind them. Under this treatment a bony union sometimes, though very rarely took place; but when it did take place, from a ridge being formed on the cartilaginous inner surface, which prevented the sliding motion of the bone, and from the intire inaction of the muscles for so long a period, the joint became motionless, or in the attempt at motion, the bone was again broken.

Mr. A. Cooper divided the patella transversely in several rabits, and placed them under different treatment; but in all of these experiments he found the divided portions of the patella united by ligament. In one experiment, he made a longitudinal fracture of the patella in a dog, in which bony union took place. In the collection of Dr. Wm. Hunter, there was one well marked instance of bony union, in transverse fracture of the patella, and I have seen in the dead body other instances of its having occurred.

This practice not proving very successful, many Surgeons adopted the opposite, viz : that of not meddling with the bones, but allowing them to unite by a long ligament. This was, however, found to be tedious in forming, and when formed, it was long before the muscles re-acquired the power of moving the limb. John Hunter, in cases which had been so treated, used to advise to the patient to sit on a high stool, and when the legs were hanging down, to kick out the sound leg, and to endeavour to kick out the other; the mind being thus, often directed towards this motion, it in time took place, and gradually increased in power.

The treatment which seems to succeed the best, is to bring the bones near to each other, but not into exact contact, and to keep them from separating too far, by a bandage so applied as not to prevent intirely the motion of the joint. The limb, at first, should be kept at rest; but after the inflammation, tension and pain have subsided, gentle pássive motion should be used to prevent the ligaments from becoming stiff, or the muscles from losing their action. The principle of this treatment is to let the fractured portions unite by ligamentous union, but to prevent a long ligament from being formed. When thus united the portions of bone are less likely to separate, than when joined by osseous matter. The patient may be permitted after a few days to walk upon crutches, with a sling passed over the shoulders so as to support the foot of the affected side.

In the fracture of the olecranon of the ulna, the portions of the bone are to be brought together by extending the arm, and to be secured there by bandages, the arm being kept nearly in the full extended state, but not quite so, until the fracture has united by a bony medium.

LECTURE X.

ON FRACTURES OF THE NECK OF THE FEMUR; MOLLITIES OSSIUM; FRAGILITY OF BONES FROM AGE; EFFECTS OF HYDROCEPHALUS INTERNUS; ABSCESSES IN BONE; SPINÆ VENTOSÆ; AND TUMOURS CONTAINING HYDATIDS.

FRACTURES of the neck of the femur, when within the capsular ligament of the joint, produce symptoms which have been often mistaken for the dislocation of that bone upwards or on the dorsum of the ileum; but fractures of the neck of the bone, either within or without the capsular ligament, may, with a little attention, be distinguished from each other, and from dislocation. In all three the limb is shortened; this shortening takes place immediately in dislocation; but not so immediately when the bone is fractured within the ligament.

In such fractures of the neck of the femur, the trochanter major is drawn upwards and backwards, carrying with it part of the neck of the bone as high as the ligament will permit; the trochanter is therefore felt on the dorsum of the ileum, above but a little behind the acetabulum, and by the action of several muscles attached to it, and to the femur, at its base, the knee and foot are turned outwards, the muscles which produce the rotatory motion in that direction being the most numerous, and also stronger than those which rotate the thigh inwards ; added to which the length of the neck of the bone still attached to the trochanter, and now resting against the outer and upper part of the acetabulum, would prevent the bone from being rotated inwards.

The thigh, in this fracture, will admit of motion in every direction, but more limitedly in some than in others ; the attempt at rotation, particularly at rotation inwards, is limited and painful ; the rough broken extremity of the bone in that action being made to rub against the synovial ligament.

In dislocation, there is very little motion allowed to the limb from the first; the knee is placed rather more forwards ; the thigh cannot be carried outwards ; but sometimes it will admit of being moved a little inwards and before the other ; the trochanter major will be felt between the acetabulum and the anterior superior spinous process of the ileum, of course more forwards than in fracture ; and sometimes the head of the bone will be felt on the dorsum of the ileum above and behind the acetabulum ; the trochanter is also less projecting than before the accident, and the knee and foot are invariably turned inwards, the length of the head of the bone, added to that of the neck, preventing any rotation outwards, while the anterior portions of the gluteus medius and gluteus minor, aided by some other muscles, rotate the thigh inwards.

In fracture, the shortened limb can be drawn downwards, so as to be of the same length with the sound limb; but when the force which drew it to its original position ceases, it very soon is again shortened. In dislocation, the limb cannot without great force be drawn downwards, and when placed in its natural situation it remains there.

In fracture of the neck of the femur, although the thick mass of muscles surrounding the joint prevents the crepitus from being so distinctly felt as in other cases, yet, when the limb is drawn to its proper length, some crepitation will be perceptible; but none will be felt in the shortened state.

Dislocations usually happen to people in the prime, and middle periods of life; while fractures of the neck of the femur within the capsular ligament, are generally confined to people advanced in life, and happen more frequently to females, than to males.

Fractures of the neck of the femur external to the ligament, may take place at any period of life; and the position of the limb is nearly the same as in the fracture within the ligament, but the limb is not so much shortened: the two cases may be distinguished from each other, by the crepitus being felt in the external fracture before extension, in attempting to rotate

More

the limb, while the trochanter is compressed by the hand.

Such fractures also happen to younger patients, are produced by more violent injuries, and attended with more pain, than the fractures within the ligament. The pain arises from the broken extremities of the femur being placed among muscles, and violently rubbing against, or even tearing these soft organic parts upon motion being given to the bone. The degree of rotatory motion is also greater in the external, than in the internal fracture; as the cervix, being detached from the body of the bone, forms no obstacle to this action.

It is now well ascertained that fractures of the neck of the femur, take place much more frequently than dislocations of the head of the bone.

Fractures of the neck of the femur external to the capsular ligament, will unite by callus like any other fracture; but fractures of the neck of the femur within the capsular ligament, so seldom have been found united by callus, that many Surgeons of the greatest experience have doubted whether bony union ever took place between the head and the neck of the bone. In all the cases which have come under my observation, in examining the dead bodies of those to whom this fracture had happened, there have been no appearances of bony union within the capsular ligament; the union has been formed by a ligamentous substance; and in almost every instance, the neck of the bone has been either intirely, or in a very great degree, absorbed. Bands of a ligamentous nature have been found, passing from the head of the bone, which remains in the socket, to the edge of the acetabulum, and to various parts of the internal surface of the capsular and synovial ligament: the membranes have been very much thickened, and much adventitous adhesive substance, now become vascular, has been found filling up a large proportion of the cavity of the joint. A fluid has been found occupying the remaining part, in which flakes of coagulable lymph having become solid were floating, sometimes loose, and sometimes adhering to parts of the inside of the ligament. The cancelli of the broken surfaces have been occasionally found filled up with a deposition of bony matter, and covered with crusts of a substance apparently between the nature of cartilage and ligament, from which processes extend connecting the bones to each other, and to the surrounding ligaments; and adhesive ossific inflammation is often found to have taken place on the outside of the capsular ligament of the joint.

In quadrupeds, where the bone has been broken intentionally, the union has been found of a ligamentous nature.

In cases where this accident has happened, although the patients after a time can walk, they are perceived to droop a little when the weight is thrown on the thigh of that side; and it is long before they can walk without bearing weight on a stick.

M. Boyer, M. Richerand, and other French Surgeons assert, that bony union will take place within the capsular ligament, and some preparations were shewn to Mr. Cross during his visit to Paris in 1815, supposed to demonstrate the fact. Mr. Cross states that none of the preparations were satisfactory, as in all where the fracture was complete, in which union had taken place, part of the fracture had extended without the cavity of the capsular ligament. In one case indeed the fracture was seen extending half way through the neck; but the other half of the neck exhibited no mark of having been fractured, and the bone moreover was rickety. In a recent case, which was examined in his presence, the bone was not united after having been broken six months; and the fractured surfaces were as rough as we might conceive them to be the first hour after the accident. Mr. Clift, our excellent Conservator, when he was in Paris last summer, took a drawing of the only specimen which appeared to have been fractured within the capsular ligament; the place to where one end of the fracture extended shews, that it must have passed beyond the edge of the capsular ligament; he has permitted me to produce to you the drawing, which from his known abilities and high character for accuracy of delineation, we are assured must be correct.

I have seen some specimens of bones, said to have been fractured within the capsular ligament, and which were supposed to have united by the usual process of osseous matter having been deposited between them. There are two preparations of this kind preserved in our museum, one of which was presented by Mr. Liston of Edinburgh, and the other by Mr. Henry Earle. Some slight appearances in favour of the supposition are perceptible in both, but the greatest number by much are adverse to it. I have very attentively examined these two preparations, and cannot perceive one decisive proof, in either, of the bone having been actually fractured.

In the case of a Bricklayer, whom I attended several years ago, every symptom which characterizes the fracture of the neck of the femur within the ligament took place; he quitted his bed at the end of five weeks, and supported himself in walking with the help of a stick; the appearance of lameness gradually went off, and in little more than a year, he was able, without inconvenience, to work at his business. I saw him two years ago, after an interval of nearly twenty years; he told me that he suffered no inconvenience in walking, but he thought the joint of the affected side the weakest. I examined the joint so far as it could be examined during life, and there appeared no mark or symptom, that warranted the supposition of bony union not having taken place. This person when confined to his bed, had his knee thrown over two pillows, and was generally placed with his trunk nearly upright.

The leg although a little shorter was scarcely perceptibly so, and that no more than might have arisen from some absorption of the cervix of the femur; the projection of the trochanter also appeared less than in the sound limb; but as this person is still alive, I do not give the case as a proof of bony union, nor can I be certain, that the fracture was intirely within the joint. All the cases which I have inspected in dead bodies, when the fracture was within the joint, have been united by ligament.

In a lady about thirty two years of age, who was thrown from a chaise at Leatherhead, and concerning whom I was consulted two days after the accident, similar symptoms occurred to those in the preceding case. She was at first carried into a cottage, from which she was obliged to remove at the end of a week. Although she can now support herself in an erect posture, and can walk with the assistance of a stick, and when placed in an horizontal posture, or even in standing, when she bears no weight on the affected side, the limbs appear of an equal length, that side, on which the fracture happened, droops when weight is thrown upon the thigh, and there is every reason to suppose that bony union has not taken place; the accident occured about two years ago. I have mentioned these two cases, as the ages of the patients, and the symptoms, at first, were nearly similar; although the effects have been different. In neither case was a fair chance allowed for bony union; for the bricklayer, from obstinacy attempted to get out of bed in less than a week after the accident, and the lady was obliged to be removed from the cottage within the same period of time.

Several causes may co-operate to prevent bony union in this fracture. The usual advanced age of the patient may be one cause; the want of sufficient vascularity in the head of the bone, as all its blood must reach it through the vessels of the ligamentum teres, may be another; the broken surfaces being kept apart by the muscles drawing up the thigh, may be a third cause; and the quantity of synovia, or other serous fluid, distending the cavity of the joint, and tending to keep the bones apart, may prove an additional cause.

When the accident happens to people not past the middle age of life, we are certainly warranted from our present knowledge of the subject, to place and keep the divided surfaces of the bone so in contact, that a chance, however distant, may be given them, to unite by the deposition of bony matter. This is to be done by the application of splints to the thigh, connected with a bandage passed round the pelvis; the limb should then be placed, with the knee bent, on a frame work forming two inclined planes, the knee being situated above the highest part, where the planes are united and form an angle. When people advanced in life meet with this misfortune, as there are little or no hopes of bony union, pillows or other contrivances may be so placed, as to keep the knee bent, and elevated, until the symptoms denoting inflammatory action have subsided; after this the patient may be allowed to sit with the leg so supported as to prevent pain arising from its weight, and crutches may be allowed her, as soon as she is capable of bearing the motion attending the use of them. By slow degrees she will be able to use the limb, and even after a time to walk, but with a limping gait; and in some favourable instances, she may do this, even when unassisted by a stick.

To Mr. Astley Cooper, we are indebted for some very excellent practical observations on the nature, causes and treatment of this accident, under all the different circumstances which may occur.

MOLLITIES OSSIUM.

The alteration of bone arising from rickets, forms one species of mollities ossium; but there is another species, to which this name is more particularly applied, which arises from some peculiar temperament, and which cannot be accounted for. It is a very uncommon disease, but when it does occur, it more usually attacks people about or advanced beyond the middle period of life. It differs not only in this from rickets; but also very materially from that disease, in the altered state of the bones.

The bones do not appear when dried, as if they had been long steeped in weak acid which had removed the phosphate of lime, and left the animal part of the bone nearly unchanged; but both the animal and saline parts seem to have been absorbed until mere shells are formed, and these shells are also softer than natural bone of the same thickness. Large cavities are met with in the substance of the bones, and which sometimes communicate with the soft parts surrounding them; in some of these are contained quantities of oily matter, almost similar in appearance to boiled marrow; in others, masses of coagulated blood; and in others, a soft organic animal substance.

The degrees of softness of bones in this disease, will vary in different patients. Dr. Bostock, has published, in the fourth volume of the Medico Chirurgical Transactions, some experiments which he made to ascertain the proportion of earthy matter in bones of this kind, when compared with the quantity possessed by those unaffected by disease. They were made on a dorsal vertebra of an adult female, whose bones where discovered after death to be unusually soft and flexible. He found, in one part of the diseased bone, that the contained quantity of earthy matter amounted only to one fifth part of its weight, and in another, only to one eighth part of its weight, whereas the proportion of earthy matter belonging to human bones, in their natural state, amounted to considerably more than half of their whole weight.

A few cases have been published of this rare disease, which have occurred in this country and in France. I have met with three instances of it, and in one of these, it had affected the skeleton to a very great extent, so that even the motion of turning in bed occasionally fractured a bone.

The case was so remarkable, that I may venture to mention here what I could collect of its history. In the spring of 1786, I was requested by Mr. Richard Ogle, then Surgeon to St. Giles's Workhouse, to assist him in the examination of the body of a woman, who at the time of her death had two fractured bones that had not united, and which had long remained in that state. She was about forty years of age, and had been a patient in the Middlesex Hospital, a few months before her death, for a fractured femur, which was supposed to have united. In removing her from the hospital, the people who had her in charge, allowed her to fall while attempting to place her in a coach. In this fall she broke the other femur, she was of course taken back to the hospital, and the bone was properly set. Soon after this she fell out of her bed and fractured the os brachii. These two fractures never shewed the least disposition to unite. About one month before her death she came into the workhouse, and kept her bed until that event happened. While moving in her bed, at different times several of her bones, to her own sensations, seemed to give way.

The body appeared strangely deformed, and we could distinctly feel the edges of all the bones, which have been mentioned as fractured, still disunited.

In the thorax there were incipient tubercles in the lungs. In the abdomen, some of the mesenteric glands were in an enlarged and scrofulous state, and the uterus had pulpy tumours formed in its substance. All the bones were diseased. The ossa brachiorum were so soft, that I very readily divided them with a common scalpel, from their heads, until near the condyles. Immediately at the condyles both bones were hard, and the articulating cartilages had a natural healthy appearance; both bones had been fractured; in one the fracture had not united, and in the other there were several fractures, which had united very imperfectly. The compact substance of the bone, was in some places, not thicker than an egg shell; the cancelli were totally destroyed and the cavities in the middle of the bones were filled up with a substance, which seemed to have been originally extravasated and coagulated blood; but which had become vascular, and had much oil deposited in cells within it. These substances appeared to have produced absorption of part of the bone from their enlargement and internal pressure; for in some places the external surface of the bone was removed, and tumours allowed to extend through the openings.

In the clavicles we found one or two fractures in each; these bones were soft; in parts of them necrosis had taken place, and exfoliations were beginning. The sternum and ribs were in the same soft state;

many of the ribs had been fractured, some had united, others had not.

Mr. Cruikshank attended on the following day to examine with us the rest of the bones. The vertebræ were soft, and the spine incurvated. The ossa ilium were soft and could be cut with a common knife, but these and also the vertebræ were harder than the other bones. The sacrum was bare from the patient having been long confined to the recumbent posture; it was tolerably hard, but was in a carious state.

The bones of the fore-arms had been broken and the fractures had united, they had less of the soft substance in their cavities, but also could be divided with a knife. The carpal and metacarpal bones were soft, and the phalanges of the fingers were beginning to become soft. The bones of the thighs and those of the legs were nearly in the same state with the ossa brachiorum; but in the thigh bones there was more of recently coagulated blood, and in the tibiæ more of the oily matter. From having been frequently fractured the lower limbs were much distorted, for latterly every change of the position of her body seemed to be attended with the fracture of some bone. The bones of the feet although soft were the least diseased.

The skull was so extensively diseased that no one spot the size of a shilling was sound. It appeared evident on examination, that the disease had begun the diploe, for in some places the diploe only was affected, and between the tables spots of newly extravasated and coagulated blood were found ; in other places coagulated blood which had become vascular, and which by pressure was producing an absorption of the surrounding bone; and in other parts the tables were destroyed, and the space occupied by a pulpy substance apparently of a scrofulous nature.

The pia mater was every where sound, and the brain in a healthy state. The dura mater was in some places thicker than natural, so was the pericranium ; the latter was absorbed where the tumours from the diploe pressed out from openings occasioned by the destruction of the outer table of the skull. The senses of this woman remained nearly unimpaired to the last, and she complained more of uneasiness from inability of changing her posture, than of pain. Many of the bones were brought away, and formed part of Mr. Cruickshank's cabinet of preparations, which after his death were disposed of to Russia.

We as yet are totally unacquainted with the original causes of this dreadful disease, and we know of no treatment that will stop its progress. Any medicine that has a chance of being useful may therefore be tried; we should of course, recommend those which will alleviate the most distressing and immediate symptoms, and we should also support the patient's constitution.

FRAGILITY OF BONES.

A state of bones has been mentioned by some nosological Authors, which is said to consist in a deficiency of the gelatinous or animal part in which their flexibility and vitality chiefly reside, and which therefore causes them to break upon very slight force being applied. This is described as the effect of old age; the vascularity of the bone decreasing, and the phosphate of lime remaining, but with less of the mixture of the animal part; the bone thus becomes brittle, and when fractured will not unite.

We certainly do sometimes find in old people, that a very slight force will break a bone, and that union will either not take place at all, or take place slowly and inperfectly; and we cannot doubt but that this arises from the want of powers of action in the affected parts; but bones thus easily fractured, in old people are never found in the state in which some authors have described them to be, viz. so friable and fragile that like a calcined bone they will crumble to pieces. On the contrary, these bones are always found to possess much oil; and after death always ~~dry~~ very greasy, so that they are unfit to be preserved as preparations; their organized vascular part appears to be diminished, but their oily animal matter is in increased quantity.

All that we can do here is to support the patient's strength.

EFFECTS OF HYDROCEPHALUS INTERNUS.

An altered state of the bones of the cranium, occasioning an enlargement and feeling of softness may arise from a disease originating in the contained parts, and producing its effects on the skull by pressure. We have instances of this, in hydrocephalus internus. Water, in this disease, is deposited in large quantities in the ventricles of the brain; from the accumulation the cranium is pressed on internally, and the regular progress of its ossification is interrupted. I have formerly observed that internal pressure produces greater changes on the compressed parts, than a much greater degree of pressure would, if applied externally; external pressure would probably thicken the bone to enable the skull to bear it, while internal pressure produces absorption of its substance; the skull becomes thinner, and points of ossification begin from several places, but a large quantity of membrane is found between them. Thus absorption and deposition go on until the head is increased to an immense size. In Mr. Cruickshank's collection, the head of a child was preserved which measured in circumference fifty-three inches. Mr. Mainwaring presented to me the body of a fœtus, in which this disease had taken place previous to birth, so that he was obliged to evacuate the fluid before the mother could be delivered; the head exceeded in size that of an adult person, as the skeleton which I now produce to you proves.

I do not mean, here, to describe the symptoms of water accumulating in the ventricles of the brain, but it forms part of this series of the lectures to shew its effects on the bones. I may, however, be permitted to observe that when the cause is removed, the bones will cease to enlarge, and in some instances, when the increase has not been carried too far, will recover their natural structure. The late Dr. Clarke, in his publication on some of the most important diseases of children, has mentioned the use of mercurial frictions in this alarming complaint; and I think it right to add, that in one family where two children had died of water in the ventricles of the brain, four others were in succession attacked with the strongest marked symptoms of the disease, attended with much enlargement of the head, who by attention to the state of the gums, and mercurial frictions to the head and back, are now alive, well, and with as much mental intelligence as other children of the same years.

ABSCESSES IN BONE.

In a former lecture I have mentioned, that when bones suppurate, this action is generally attended with ulceration before any granulations arise. Bones not only suppurate when exposed, but also suppurate without exposure, thus forming abscesses, which may be situated on the surface of the bone, between it and the periosteum, in the hard laminated part of the bone, or in its medullary cavities.

Abscesses in the first named situation generally arise from some external injury, but are often very long in making their appearance after the infliction of it. Pain is felt in the part, inflammation arises, and after some weeks, symptoms of suppuration are perceptible. As the matter forms, the periosteum, which had previously become thickened, separates from the bone, the surface of the bone ulcerates, but to no great depth; part of the external surface is absorbed, so that it becomes rougher than where the periosteum continues to adhere; the periosteum also inflames, and some degree of the ossific adhesive inflammation takes place in it, particularly near the edge of the abscess; it is at this part firmly connected with the bone, and a circle of adventitious bone generally remains, and marks the boundary after the contents of the abscess have been evacuated. The pain attending such suppuration is generally considerable from the great resistance at first made to distention, and as the matter accumulates more or less rapidly, will the pain vary in different cases. The periosteum at last ulcerates, when the matter passes through the opening and is brought to the surface of the body by the same processes as in other abscesses.

If the inflammation and suppuration are not of a specific kind, this abscess should in general be early opened, and sufficiently extensively to evacuate its present contents, as well as to allow of a free escape to any matter that may form afterwards. If this is not done, and the surface of the bone remains unhealthy, the orifice through which the matter passed is very likely to become fistulous, and the bone itself to become carious. Should the surface of the bone be much diseased, the incision through the integuments had better extend the whole length of the affected part, so that its state may be discovered; and if exfoliation of the surface is necessary previous to the healing of the part, that action may take place with more ease: no injurious consequences can arise in this state of the bone from a free incision, for the divided edges of the skin will sooner granulate than the surface of the bone, even should it be in a state to form granulations immediately after the discharge of the fluid. In making such incision, no part of the integuments should be removed; for bones, when too much exposed, are very likely to exfoliate, particularly when situated near the skin, as the skull and tibia are; and the cicatrices in these parts will be long in forming, from the granulations not being able to draw in much of the surrounding integuments.

When the parts are healthy, after the evacuation of the matter, granulations will arise on the surface of the bone and will soon ossify; this surface will therefore in general rise higher than the original one, and some adhesive ossific inflammation, having taken place in the neighbouring soft parts, will add to the tumour. Occasionally a thin surface of the bone shall die, and this must exfoliate before granulations begin to form.

But sometimes the surface of the bone shall neither granulate, nor exfoliate, but exist under disease without shewing any disposition towards recovery; the bone is then said to be carious. Soft and vascular bones, such as the vertebræ, bones of the tarsus, the sternum, and also the extremities of the cylindrical bones are more frequently found in this state than hard and compact bones. The bones, while in this carious state, have been compared to the soft parts when affected by an ill conditioned ulcer. From the greater vascularity of bones in young persons than in adults, they are more subject to caries than the bones of those more advanced in years. The term caries, although now applied to bones existing under disease, was formerly applied almost indiscriminately to every kind of diseased as well as to dead bone not yet separated from the surrounding living bone.

A bone affected by caries becomes much softer than when in its natural state, so that a probe pressed on it will enter its substance; and as much vascular animal substance is formed in it, it will readily bleed when touched by the probe or any other hard instrument.

A bone in a carious state, discharges from its surface a very fetid and discoloured ichor or sanies, which generally tarnishes the probe immediately on coming in contact with it, and this renders it easy to distinguish the existence of the disease in a bone to which a probe can be introduced. When we meet with the surface, whereon an abscess had formed, in this state, and cannot alter the disposition; if the caries is not deep, the best practice in general will be to destroy the affected surface by the actual or potential cautery, so that the diseased part may exfoliate, and the remaining sound part shoot out healthy granulations.

It rarely happens that suppuration begins in the hard laminated part of a bone, but it sometimes does; absorption or ulceration take place, increasing the size of the cavity of the abscess, and a deposition of bony matter closes up the communication with the medullary cells; the bone swells externally on the affected side, at last the ulceration proceeds through the outer lamina of the bone, the matter comes in contact with the soft parts, which inflame, suppurate and ulcerate, and this gives us the first information of an abscess having formed. The opening from the cavity in the bone communicating with the soft parts is generally very small, and the cavity of the abscess which forms in the soft parts is often very considerable before the matter reaches the skin, so that a section of the affected parts, would shew a smaller and a larger cavity communicating, by one or more small holes on the surface of the bone, with each other. When the matter reaches the surface, and is discharged, the opening usually becomes fistulous; the fluid discharged through such opening is very rarely good pus; it is not formed on healthy parts, or by parts possessing very active powers of life, and from the hardness of the parts, and their rubbing against each other, or against granulations, should any such have arisen, some discharge of blood takes place, which mixes with the purulent matter: from these causes the matter is fetid, and has a greater disposition to putrefaction, and thus tinges or corrodes a silver probe.

These cases, are in general, very difficult of cure; for it will sometimes be necessary, not only to lay open extensively the cavity of the abscess in the soft parts, but also that of the abscess in the bone, by removing the substance of the bone which bounds the cavity externally, either by the trephine saw, chissel, or actual or potential cautery: it may be necessary, even after this, to produce exfoliation from the whole of the internal surface that remains, by applying such dressings as will kill a thin substance of bone. If the actual cautery is used, care should be taken to destroy all the unsound surface at once, for exfoliation taking place in diseased parts will never be perfect, and the attempt to produce it will render the caries worse than before.

When suppuration takes place in the cancellated part of any of the larger cylindrical bones, it forms a very dangerous and formidable disease, which generally requires the amputation of the limb to save the life of the person afflicted by it.

The cause of the inflammation which terminates in this abscess, can seldom or ever be known, for the cancellated part of the bone can be exposed to no external injury. As the matter accumulates, ulceration of the bone takes place; and the adhesive ossific inflammation, surrounding the ulcerating part, on the inside prevents the matter from being diffused throughout the whole of the cancellæ, and on the outside adds to the bulk of the bone, while the absorbents remove from it within. These actions go on until the bone becomes a mere shell filled with an ill-conditioned ichorish liquor; it at last gives way, but before it does so, a tumour of an immense size is sometimes formed. The antients, finding tumours of this kind in bones which had long been buried, and not knowing what, during life, they contained, called them spinæ ventosæ.

All that can be done here is to support the patient's constitution, and if the diseased part admits of removal, to amputate the limb.

The term spina ventosa is also applied to an enlargement of bone, in which the cavity of the tumour is filled up with a loose fungous substance, covered with a thin plate of bone perforated by a number of holes of different sizes, but which are filled up with membrane; this membrane sometimes gives way, and the fungous extends itself through the openings; but the term osteo-sarcoma has lately been used to designate this formidable disease. When the bone, in which this disease has taken place, can be removed, it should be done early; for the affection is of a malignant nature, and if not absolutely cancerous, so like it, that it requires the same treatment. If the absorbent glands are affected, amputation will not save the patient, as the disease will return elsewhere: here we must palliate the symptoms which will admit of palliation, and keep up the patient's strength.

HYDATIDS IN BONES.

A tumour has formed on the bones of the leg, where from the external appearance it might have been mistaken for the fungous exostosis, but which has been found to contain hydatids. The bone after the hydatids were discharged, has appeared, as in spina ventosa, to have had the cavity enlarged by internal absorption while the arteries deposited the matter of bone on the outside and formed a crust in many places no thicker than an egg shell, but which increased the bulk of the tumour to a very large extent. A case of this kind, if known during life, would lead to the amputation of the limb. The nest of hydatids might indeed be destroyed, but an extensive diseased surface of bone remaining, would soon wear out the patient's strength.

A very interesting case of a bony tumour, which contained a considerable number of hydatids has been related by Mr. Robert Keate. The tumour was situated between the two tables of the frontal bone of a female, who was about eighteen years of age. Two operations were performed to remove the tumour, an interval of two years and nine months having taken place between them; during this time various caustic applications, among which, were arsenical preparations and actual cauteries, had been used, but in vain, to destroy the surface from whence the hydatids seemed to form. On the second operation, in the very hard and compact bony substance, which formed the base of the tumour, were found five or six cells, containing hydatid cysts, and these were carefully removed. Sulphate of copper, and nitrate of silver were occasionally applied to the whole of the denuded surface, and from time to time produced exfoliations of the bone. In eight months after the second operation, the wound healed and the patient enjoyed perfect health.

LECTURE XI.

ON EXOSTOSIS, NECROSIS, AND EXFOLIATION OF BONE.

THE term exostosis has occasionally been applied to every hard swelling firmly connected to bone; but is now used to designate such solid tumours as either arise and proceed from the body of the bone, or are so firmly attached to it, as not to be separable without the division of some osseous or cartilaginous substance.

Exostoses vary very much in their situation and structure; and may be formed either by the bone or the periosteum. They are not always, on their first formation, composed of bone, or even of cartilage; but sometimes of a white membranous substance, in which as the tumour increases, the materials of cartilage and bone are secreted and deposited. Exostoses may be connected with constitutional affections of a specific nature, as scrofulous, venereal, or cancerous; but the following observations are meant to apply to swellings of bone, which are not evidently connected with any of these specific diseases.

When the tumour is seated on the surface of a bone, it has been called by some French Authors Periostosis; and by some in this country periosteal exostosis, from its situation being between the periosteum and the original surface of the bone. When its origin appears to be in the substance of the bone, it has been called medullary exostosis.

The exostoses of each kind sometimes approach very near to healthy bone in their formation and structure; but sometimes resemble, in certain circumstances, the fungous excrescences which arise in the soft parts of the body.

Those which are situated between the bone and periosteum, possess nearly the structure of common bone, and generally project only on one side; their shape varying, as well as the extent to which they enlarge. From their situation being external to the original bone, they may owe their origin to some violence the bone has been exposed to; but they seldom can be distinctly traced to causes of this kind, and as they frequently affect more bones than one, it is likely that the constitution of the patient much influences their formation.

When a section of one of these is made in its recent state, the periosteum which covers it appears to be thicker than that which covers the healthy bone, and a cartilaginous substance of some firmness, strongly adheres to its inner surface; within this there appears to be a compact bony crust covering a cancellated portion of new bone, which is firmly connected to the original surface of the old bone. This is usually the appearance when the exostosis is of large extent, and seems to prove that the deposition of the new bony matter began immediately under the periosteum, and makes it more than probable, that the vessels of this membrane were concerned in the secretion of it. In those cases which have admitted of examination at an early period, the thickened mass has been found in nearly a cartilaginous state, and bone has been discovered forming in its substance. Tumours of this nature are not unfrequent on the tibia, the fibula, the femur, the external surface of the ribs, the os brachii, radius, and ulna, and also on the cranium. When of long standing they have sometimes become nearly solid throughout and very hard.

Tumours, as hard and as firm as ivory, have been found adhering to the bones of the skull of some quadrupeds; an excellent specimen of which we have in our museum in the skull of an ox.

In the sections of other exostoses, the line of separation between the new and the original bone is wanting, and the cancellated structure is continued directly from the old bone into the tumour, which is covered externally with a crust of compact bone; so that, were it not for the projection, the whole might be considered as natural structure. Exostoses of this kind generally project from surfaces to which tendons or ligaments are affixed, and their bases are generally smaller than the bases of those exostoses which are divided by a compact bony lamina from the cancellated part of the original bone. They appear to begin in the substance of the bone, but it is not impossible that the force applied to the surface through the medium of the attachment of tendons, may influence their formation. This kind of exostosis occurs in almost every bone of the body. I have in one patient seen such on the metatarsal bones, on the os calcis, the tibia and fibula of each leg, the femur of one thigh, the ossa ilia, the transverse and spinous processes of some of the vertebræ, on some of the ribs, on the scapula, a large tumour having formed on the spine of the one, and on the acromion of the other, on the sternum, on the ossa brachiorum at the insertion of the deltoid muscles, on the radius of each arm, on the olecranon of the ulna, on one of the metacarpal bones and on one or two of the phalanges of the fingers, also on the parietal and frontal bones. On some of these bones the exostoses were very large, they began to form when the person was fourteen, and increased in number and size until he was twenty-four years of age; after this period they remained stationary until the patient reached his thirty-second year, when he died of pulmonary consumption. John Hunter had frequently seen him, and had desired him to use freely different kinds of acids, both vegetable and mineral, and he was using these at the period the tumours ceased to form, or those which had formed to enlarge. In the latter part of his life he was attended by Mr. Cruikshank.

I have seen similar tumours on the pubes, on the clavicles, and on the mastoid process of the temporal bone.

In young people I have seen instances of this disease occurring in the tibia and femur, in whom after a short time the tumours have become stationary; in one well marked instance in a youth of twelve years of age, two tumours on the tibia and one on the inner condyle of the knee entirely disappeared, while he was using the phosphoric acid internally.

Tumours consisting of firm cartilage are sometimes found under the periosteum, adhering strongly to the surface of the metacarpal bones and those of the phalanges of the fingers; in these there is occasionally a deposition of the phosphate of lime, similar to what is met with when natural bone forms from cartilage. These exostoses on the metacarpal bones will, when they become troublesome from size, bear removal with the knife and saw; but they are very apt to return, unless the surfaces from which they arose are destroyed.

The exostoses which take place on the other bones will also, when very troublesome, bear removal with the saw or chissel: in general however, if they are not rapidly increasing, and are not situated in a very inconvenient part, it is better not to have recourse to this operation. I removed one from the tibia of a young lady; it returned, and in six months was larger than before; she insisted on it being removed a second time, which was complied with; I used the potential cautery to the surface of the tibia after the tumour had been separated, the patient suffered much from the exfoliation produced by it, but the disease did not return. Before her death, which happened about two years after the second operation, the wound had completely cicatrised, and she had the perfect use of her leg.

When exostoses have arisen on several bones of the same patient, an operation, the success of which must always be uncertain, to remove the disease from a single bone, unless under very particular circumstances such as it pressing on parts of importance to life, can only be suggested by folly and cruelty.

Dr. Baillie has related a case in his Morbid Anatomy, of a person who had a very large bony tumour formed round one of his knees; this was removed at St. George's Hospital, by Mr. Walker, by amputation of the limb; very soon after which, a difficulty of breathing began, which was occasioned by part of the lungs being converted into bone, and by a very considerable deposition of bony matter on the inside of several of the ribs. The preparation of the lungs and the ribs, I now produce to you, as they have been preserved in John Hunter's Museum.

Blisters occasionally applied to the skin near the part, and the emplastrum hydrarygri cum opio, spread upon leather and worn over the part, will sometimes assist in preventing the enlargement, if it does not produce a diminution of the tumour. Mercury as an alterative is often given in these cases with sarsaparilla, and mezereon; I cannot say that I have ever seen any sensible advantage produced by these medicines in lessening the exostoses, unless in such as possessed some venereal character. I have often known the use of acids to fail in producing any good effect, but in a few cases I have found the progress of the disease stopped during the time the patient was employing them.

Another structure which is met with in exostosis, is that of the inside of the tumour consisting of a number of large irregular bony cells, communicating with each other, and bounded by a compact plate of bone covered externally by the periosteum of the usual thickness and appearance. This disease seems to begin in the medullary membrane which lines the cancellated part of the affected bone; for the cells of the exostosis are lined by a vascular membrane, and their cavities filled with a soft fatty kind of substance nearly in a fluid state, and some of them with a thin fluid, like serum when tinged by the red globules of the blood.

Exostoses of this character are met with on the bones of the two jaws, more particularly the lower one, on the other bones of the face, on the mastoid process of the temporal bone, also occasionally on the cylindrical bones. On the jaws they have sometimes increased to an immense size and weight. When an exostosis of this kind affects the jaw, it occasionally has been traced to the irritation produced by the fang of a tooth. The increase of this exostosis is generally slow and the pain attending it not great, unless from situation it presses upon some irritable part. The surface of the tumour is at first regular and smooth; as it increases in size it becomes more irregular, and the skin covering the most projecting parts, being constantly on the stretch, inflames and ulcerates; the surface of the diseased bone is then exposed, which also goes into partial ulceration, and fungous excrescences arise from the ulcerated surface; these discharge continually a thin bloody coloured ichor, and often bleed profusely upon being slightly touched with the probe; sloughs and exfoliations also take place, so that from the pain, irritation, and constant discharge, the constitution is worn out, and the patient meets with relief only by death.

Tumours of the Medullary Membrane

We are much indebted to Mr. Astley Cooper for a very valuable and instructive account of this disease, and for a clear statement of many cases which came under his own observation and treatment. He observes that the oxy-muriate of mercury in small doses, given in or, with the compound decoction of sarsaparilla, will sometimes crush in its begining this formidable disease. He also informs us, that Mr. Lucas and he tried the effect of cutting off the supply of blood from these fungous exostoses, by tying the arteries passing to them ; and with the candid and liberal feeling of a man, anxious to improve his profession and benefit mankind, he has detailed the unsuccessful event of two cases in which this attempt was made.

I have seen an exostosis, which arose from the under jaw, removed by the saw and other instruments, before it had ulcerated or that fungi had arisen from it: it returned, and was a second time removed ; it, returned again ; on the third operation, much danger was incurred from hæmorrhage, as an artery which had retracted into a bony canal resisted all means that were employed to stop its bleeding, excepting the application of potential cauteries. An exfoliation of the bone took place, and the patient eventually was freed from the disease. The tumour was of the size of a hen's egg, and had protruded both inwards and outwards through the alveolar plates before the first operation was performed.

There are some exostoses, which arise from the medullary part of a bone, which have a large proportion of cartilage in their structure, and which are covered with a white fibrous substance not unlike elastic ligament; these so far as I have observed them, generally proceed to the same termination that scirrhous affections do in soft parts of the body.

Exostoses are sometimes met with, which consist of large masses of bony matter, disposed in the form of packets of fibres shooting outwards for a considerable extent from the surface of the original bone. This kind of exostosis is not however confined in its origin to the surface of the bone, but will sometimes be found to arise among the cancelli, and to produce by pressure from within the absorption of part of the compact outer lamina of the bone, then to protude through the opening, and to expand itself like other fungous tumours; externally being covered with a thickened periosteum, and in the fresh state having a white animal substance of a consistence and structure between elastic ligament and cartilage passing between the packets of bony fibres.

At first the enlargement is supposed to be effected chiefly by a deposition of that matter which forms cartilage, and after this the bony spiculæ are produced as they were in the original formation of bone. This exostosis in time becomes very solid and heavy. It, like the other bony tumours, sometimes produces ulceration of the skin covering it; its surface bleeds, when exposed, from the slightest touch, and the patient, unless the limb be removed, is worn out by the great and offensive discharge, and sloughs that take place from it. Tumours of this nature form in the diploe of the cranium, and produce the absorption of both tables of the bones of the skull.

In cases which admit of it, these exostoses should be removed by an operation.

NECROSIS.

The active powers of life being much less extensive in bones, than in most of the soft and more vascular parts, this circumstance prevents them from existing equally long under the influence of disease. Thus when a bone becomes diseased it often dies, sometimes throughout the whole of the affected part, and at other times, only in particular portions of it. The term necrosis, although formerly more generally applied, is now used to express the dead state of a portion of bone, not yet separated from the living parts, which previous to its death were connected with it.

Those bones which are soft and possess more animal matter support a state of disease longer than those which are harder and more compact; from their greater vascularity they are enabled for a time to resist death; while the hard bones soon yield to its influence from not being able to carry on diseased actions, and those natural actions which are to support life at the same time. When a portion of a bone dies, the separation of the dead from the living parts is a process, which the hardest and least vascular bones seem equal to, although they cannot continue, or cure a disease. Until the dead bone is completely detached and removed, it will excite much irritation, and no cure can be effected. Exfoliation thus often produces a cure, by performing this separation and removal.

Although the separation of living from dead bone, was well known to the more ancient Surgeons, and modes of treatment recommended by them to produce and hasten it, we are indebted to John Hunter for our knowledge of the particular means, by which this important process is actually accomplished. We no longer talk of a fungus arising and pushing off the dead bone, as we know there is no space in which such fungus could arise, or if there was, we know that a fungus could not possess strength enough to destroy the attraction of cohesion between bony particles; nor do we now account for the separation by the dead part rotting. We are convinced that the separtion of dead from living bone is accomplished by the same kind of actions going on which take place in the sloughing of soft parts, viz: that the dead part acts as any extraneous matter would; it irritates, and from this, the system is stimulated to free itself from it.

In this process the periosteum separates from the dead bone, while the contiguous living portion of the bone inflames, and increases in vascularity; this last effect constantly taking place in parts which have some duties beyond their common healthy actions to perform. After this, the absorbent vessels begin to remove the part of the living bone in immediate contact with the dead, the dead part remaining entirely unaltered.

The action of absorption appears to begin from the circumference of cylindrical bones, and to extend from it to the centre. In flat bones, it begins on the outer and inner surfaces, and extends to the middle. The saline part or phosphate of lime is absorbed first; in proof of this it will be found, that before any mark of separation is seen on the surface, the living bone surrounding the dead for the extent of a mere line, has become as soft as if it had been steeped in acid. The soft or animal part is absorbed the last. Thus a loss of substance always take place between the living and dead parts, the extent of this loss varying in different bones. When the trephine has produced, from its friction, the death of the surface of bone in contact with its outer circumference, the exfoliation, which sometimes come away in the form of a ring, is too small to fit exactly the part it came from, and in the exfoliation of parts of the cylindrical bones which enter into the composition of joints, and where the vascularity is greater than in the skull, the portion absorbed round the dead bone, shall sometimes exceed the eigth of an inch. The numerous preparations from the Museum now on the table, afford very convincing specimens of this absorption of substance.

Although in general the absorption takes place in the living bone, it still appears, that under peculiar circumstances, the absorbing vessels have the power of acting on, and removing the substance of dead bone. This happens after the dead part has been separated from the living, and when, from its shape, and the form of the living surrounding bone, it is prevented from obtaining a passage to the surface of the body ; as in exfoliations of the cranium when the inner table of the exfoliated part is broader, and wider than the outer table ; the absorbents of the living parts, then make an effort to remove it, and this produces the appearance which has been likened to worm-eaten canals, of which also we have many specimens now before us.

The term caries was formerly applied to a dead portion of bone, as well as to a diseased, and this appearance has been distinguished by the name of worm-eaten caries. In cases of this kind the discharge of matter is always considerable, and very fetid. Another proof we have of absorbents beginning to remove dead bone, is in the portions of exfoliated bones of the extremities, when from the deposition of new ossific matter, the dead bone cannot effect its exit. Most of these portions have the groves resembling worm-eaten canals. Formerly when it was the practice to transplant living teeth from the head of one person to the jaws of another, although these teeth fastened, they seldom remained in their alveolar sockets more than three or four years; they then fell out, and I have examined several which have had their fangs removed, apparently by the same process which takes place in the shedding of teeth.

The colour of the dead and exfoliating bone is subject to much variety. In very hard bones it generally is white, in softer bones it is yellow, dark, and sometimes black.

After the dead part has been separated from the living, granulations begin to arise from the new surface of the exfoliating bone; it is by these that the exfoliated part is pushed towards the skin, the soft parts between it and the skin ulcerating, or being absorbed for that purpose. The granulations which arise from bone are at first as soft and as highly vascular as those which arise from any part of the body; but they are afterwards changed into a hard bony substance.

As some bones often exist for a long time under a disease, which they have not the power of healing, it is occasionally necessary, to effect a cure, that the diseased part shall have its living principle destroyed, thus changing it from disease to death, and inducing the healthy living bone to throw off the dead part. This is done either by the actual or potential cautery.

Cauteries were formerly much employed by Surgeons, who entertained an idea that all diseased bones must exfoliate, and therefore that this process was to be hastened in every way. A cure has certainly been often expedited by the practice of killing, and thus producing at once an exfoliation of the whole of the diseased parts, instead of allowing the dead bone to come away in different pieces and at different times: for when the whole is killed there is an end to the disease, as disease can only happen in a living part.

In a hard bone when killed by disease or otherwise, the death of the bone is perfect at once, and the discharge is less fetid: this formerly was termed a dry caries. But in soft bones, some parts remain in a diseased state, while others are dead and exfoliating; but their exfoliations go on imperfectly and slowly, and are attended with an offensive, fetid, and often bloody discharge: this state of disease was formerly named a moist caries.

The older Surgeons, perceiving that the dry caries always exfoliated, and that the moist did not, or if it did, but slowly and imperfectly, applied a hot iron to produce or hasten it. The bone exfoliated, as they imagined, from being drier, and in attempting to make the moist, dry, they, without knowing the principle of the cure, often succeeded in producing it, by destroying the life of the diseased parts.

In the treatment of diseased bones, we are still obliged to use cauteries to produce exfoliation. The actual cauters, or hot iron, should have a surface proportioned to the extent of the disease, and should be thick to retain its heat. More than one may be necessary, and therefore more should be prepared; as it would be desirable, if possible, to remove the whole of the diseased part at once.

The potential cautery, like the actual, should if possible be applied at once to the whole of the diseased surface. When the death of the bone is perfect, mild dressings should be employed; but when not so, the nitric, muriatic, or sulphuric acids diluted, may be applied, and solutions of the argentum nitratum may sometimes be used with advantage.

Cases will sometimes occur, in which instead of using the actual or potential cauteries, the diseased parts will admit of removal by mechanical means, as by a saw, rasp, file, mallet or chissel.

I have already mentioned, that sometimes a large portion of the internal part of a bone shall die and be detached from the living bone it belonged to; but as from being surrounded by the living bone it cannot be brought to the surface of the body, it remains, and irritates the living bone, exciting it to inflammation, which is first attended with an increase of thickness, and then of ulceration and suppuration. As the matter, which is always very offensive, must be evacuated, a number of small holes are formed for this purpose; these holes form fistulous openings, which communicate with extensive abscesses in the soft parts. We have numerous preparations which illustrate this.

In the preparations now produced, several inches of cylindrical bones have become dead throughout their whole diameter, and have been separated from the two living extremities of the bone they belonged to, but have been confined by the new bone, formed by the vessels of the periosteum, and those which remained of the living extremities. This new bone, formed by the periosteum, seems intended by nature for the support of the limb, but is so placed as to counteract the other processes used by her for bringing dead bone to the surface of the body. These cases have been called internal exfoliation.

In our museum there is a most beautiful preparation by John Hunter, shewing the whole of a dead tibia thus surrounded by new bone formed by the periosteum.

We should, in our treatment ef these cases, endeavour, by destroying and removing sufficient of the new surrounding bone to lay hold of and extract the dead. The instruments to effect this whether trephines, saws, chissels, or cauteries must be left to the judgement of the attending Surgeon. If the bone is only diseased in its middle, the diseased part may be sawn out and the two extremities may in time shoot out sufficient granulations which may ossify, and unite without much shortening of the limb. Very few cases however have occurred in which the limb has not been shortened, but still the shortening is to be preferred to the total loss of it. If much bone is inclosed, from the great irritation produced by it, the chance of disease occurring in the surrounding living bone, and the severity of the operation for removing it, the best chance to the patient of saving his life, is submitting to the amputation of the limb.

After the operations of amputation and trepanning, the surface of the bones, acted on by the saws, will sometimes die, and exfoliations of some considerable thickness will take place. The surface of bone which the instruments touch, is I believe generally killed, but not to any considerable depth; instead therefore of coming away as a whole, the dead bone comes away in very thin scales with the dressings: this has been called insensible exfoliation.

In cases where the operation of amputation has been most perfectly performed, and the wound healed by the first intention, a ring of bone has afterwards separated from the extremity of the divided bone, and until it has become completely detached, has greatly irritated the parts which had healed between it and the skin. I witnessed an occurrence of this kind in the person of a very distinguished nobleman, whose thigh had been skilfully amputated immediately after the Battle of Waterloo.* *

* Much of the hour allotted to this lecture, was occupied in demonstrating the circumstances stated to take place in exfoliation from the numerous and beautiful specimens of exfoliating and exfoliated bones produced to the audience. These I earnestly recommend to the attentive inspection of every Surgeon who visits our museum.

* The most noble, the Marquis of Anglesey.

LECTURE XII.

ON DISEASES OF THE JOINTS, ON WOUNDS OF THE CAPSULAR LIGAMENTS, HYDROPS ARTICULI, SPRAINS, AND DISLOCATIONS.

THOSE parts which enter into the composition of joints, with the exception of the synovial membrane, do not require the degrees of vascularity and sensibility, that many other structures in the body must necessarily possess; indeed high degrees of these qualities would prove more detrimental than useful, as they would interfere with the pressure the parts must be subjected to, and the mechanical uses in which they must be employed.

Thus from the small degree of vascularity and sensibility of some of their materials, joints are less able to repair injuries, or to resist going into diseased action in consequence of receiving them; and when this action does take place, it is attended with more severe effects on the constitution than accompany its attack on many of the more vascular and sensible parts of the body.

From the same causes, the injuries of joints are not attended at first, with any alarming symptoms of hæmorrhage and pain. The joints are slow in assuming diseased actions; but when such actions do take place, symptoms of the most dangerous nature frequently attend them. This renders it necessary, that attention should be paid even to the smallest wounds penetrating into the cavities of their capsular ligaments, and that the beginning of inflammation should be carefully watched over; for the patient is not secure because no symptoms of inflammation may have arisen during the four or five days succeeding the injury, as this action seldom occurs so soon in joints as in other parts. Should the wound not unite, and the cavity of the joint in consequence of this suppurate, laudable pus is very rarely produced; when granulations do take place they are always tedious in forming, and their union is attended with the loss of the motion in the joint; while they are forming parts of the joint are very apt to lose their principle of life, and to slough away, or exfoliate, and hectic fever not unusually attacks the constitution while these actions are going on. All these circumstances require that the wound, if possible to accomplish it, should be united by the first intention, and the edges of the wounded capsular ligament prevented from going into suppuration.

After slips of adhesive plaster have been drawn across the wound in the skin, and the limb so placed, that the injured portion of the capsular ligament is not on the stretch, a roller should be applied sufficiently firm, to support the wounded parts, and those with which they are connected, without impeding the free circulation of the blood.

In a very contused and lacerated state of the skin, tendons, and muscles, where there exists an impossibility of bringing the whole of the edges of the wounded parts into contact, compresses of linen, lint, or other materials, may be so applied and secured by bandages, that a considerable portion of the lacerated parts may be brought so nearly together, that some of them may have a chance of uniting. If sutures are found to be necessary, they will of course be confined to the parts external to the capsular ligament; for should they enter its cavity, they will act as setons, and produce suppuration.

In cases where there is reason to suppose that much blood has been effused into the cavity of the joint and coagulated there, or that any extraneous substances have entered, these must be extracted, even should the extraction be attended with some enlargement of the wound, as less risk will attend this, if done immediately, than would be incurred by allowing them to remain. Experience has proved that should much blood be extravasated into the cavity of a joint, it either will lose its living principle and then irritate like any other extraneous substance; or by becoming vascular it will destroy the smoothness of the synovial membrane to which it is united, and thus render the joint less fit for motion.

When inflammation threatens, the joint may be covered with linen, moistened with some cold sedative lotion, and topical bleeding with leeches, or scarifications may be employed; but should any great tension arise, the steam of warm water mixed with vinegar and laudanum may be applied, and other emollient and sedative applications used. Spirituous fomentations are often successful in removing tension and pain.

Purgatives, not only of the lenient kind, may be given, but if the patient's constitution is strong and the inflammation is violent, drastic purges may be had recourse to, as jalap, calomel, colocynth and scammony.

The joint should be kept at perfect rest during the inflammatory state, but when that is removed, passive motion should be carefully used, for the purpose of preventing stiffness in the muscles and ligaments.

HYDROPS ARTICULI.

The joints like other circumscribed cavities, being lined by a vascular membrane, which secretes a fluid to lubricate their inner surfaces, it occasionally happens that a larger quantity of this fluid than is barely necessary for such purpose, is secreted and accumulated, so as to distend the capsular ligament. This accumulation sometimes takes place without having been preceded by symptoms of inflammation, and may arise either from a superabundant action in the secerning vessels of the part, or a deficiency of action in the absorbent vessels. It forms the disease called the hydrops articuli. It is met with more frequently about the age of puberty, and in adults, than in young children.

Like other dropsies, it sometimes occurs after a slight inflammation of the secreting membrane, and is then preceded and accompanied by pain, and when the inflammatory symptoms have subsided, the fluctuation of the fluid may be distinctly felt; but in other cases where the symptoms of inflammation have been more violent, the feeling of fluctuation is less distinct, from the ligaments of the joint having become thicker during the continuance of that action.

In the knee, the distension is attended with some stiffness, and the swelling takes on the form of the cavity of the joint, so that the fluid thrown out may be felt on each side of the patella, and of the ligament connecting that bone to the tibia; it extends wherever the capsular ligament is loose, and will therefore be felt some way above the end of the femur, on the anterior and lower part of the thigh. The other joints have their form, when fluid is contained in their cavities, also regulated by the shape and attachment of their capsular ligaments.

As this disease is not attended at first with any symptoms likely immediately to affect life, it seldom has occurred, that the cavity of the joint could be examined in its recent state, that is, when the effusion first takes place; but in all probability no other appearances would be found, excepting an additional quantity of synovia, and an increased vascularity of the membrane secreting it; which last, after the pain and inflammation had subsided, would disappear, leaving in most instances some thickening of the membrance.

This disease, like pleurisy, may be occasioned by exposure to damp and cold, for those joints liable to such exposure are found to be more subject to it, than those which lie deep and are surrounded with thick muscles; thus it more frequently affects the joints of the ankle, knee, and elbow, than any other. The vessels which supply the synovial membrane are sent off from the same trunks that supply the integuments covering the joints, so that when cold, produces contraction of the external branches, more blood is sent from the common trunk into the internal, and therefore more to the synovial membrane. It may also arise from some strain; or it may be the effect of some constitutional disease; for in some instances it will pass from joint to joint, and even attack several at once. It is not confined in its attacks to joints; but will also take place in bursæ mucosæ and in the sheaths of tendons. When treating this disease in the inflammatory state, we may have recourse to topical and general bleeding, also to the other means known to lessen inflammation, as warm fomentation, and lenient purgatives. When the inflammation is subdued, and in cases where the disease was not preceded by inflammation, stimulating applications to the skin will often prove useful, as rubefacients and blisters; savine ointment, tartar emetic ointment, gum ammoniac dissolved in vinegar of squills, sulphuric acid, and oil of olives made into a liniment, with many others.

ON SPRAINS.

External force may be applied to a joint, so as greatly to strain and injure the ligaments, without producing an absolute dislocation of the bones. Sprains may therefore be of all degrees, from a mere stretching of the ligaments, to a complete rupture of their substance.

The joints which are the most liable to sprains, are those of limited motion; for in joints of extensive motion, the same degree of force which would stretch the ligaments, in all probability would also displace one of the bones; thus mere sprains seldom or ever affect the ball and socket joints, for these are more liable to luxations; while those joints, in which the motion is confined by strong ligaments, are more frequently sprained than luxated. The ankle joints are the most frequently sprained, and the joints of the knees, wrists, and sometimes of the elbows are very liable to be so. The ligaments of the ossa inominata are occasionally exposed to this injury.

The sprain arises from the soft parts surrounding the joint, being overstretched or lacerated, and the symptoms produced will of course be proportioned to the degree of injury, and the number and structure of the parts affected by it. The ligaments may be so torn, that all power of limiting motion in the joint may immediately cease, and the person be prevented from using any force with, or bearing any weight on the limb, and this may be soon succeeded by great pain, swelling and tension. In other instances, although the weakness is immediate, the pain and tension may be much longer in taking place.

The ligaments are not naturally very sensible, but are always painful when overstretched, and when they inflame from injury, often become violently painful. Their sprains are often attended with the rupture of some blood vessel, from which a considerable and extensive ecchymosis is produced; they are also in general accompanied by an increase of the secretion of synovia, which is not always confined to the cavity of the joint, but sometimes passes through the lacerated part of the capsular ligament, and distends the cells of the neighbouring cellular membrane: this is often met with in the joints of the ankle and knee. When inflammation comes on, the tension will be increased from the serous parts of the blood being thrown out, and loading the cellular membrane still more; the joint will now become stiff and nearly motionless, at least every attempt at motion will be productive of much pain. I have had a few opportunities of examining joints which had been sprained at different periods before the patient's death; in one case where the patient died, from the effects of the injury of another part, at the end of five days, I found the capsular ligament of the ankle joint and one of the lateral ligaments binding the tibia to the foot lacerated. In another case I have found the ligaments thickened, and having lost much of their pliability; and in some instances more vascular then usual, and evidently in a state of inflammation. In a knee joint, which had been very weak and occasionly very painful, for years before the patient's death, one of the crucial ligaments had become for half an inch in extent as small in circumference as that of a common probe; this person, when four years of age, had injured the knee by a fall, and had been lame for some time afterwards, the joint having swollen, but no displacement of the bones or alteration of the cartilages had at any time taken place.

When sprains first happen, the unaltered shape of the bones of the limb, and the joint admitting of motion without crepitation, (although the act may be painful,) readily distinguish them from fractures or luxations.

The treatment of sprains must be dependant on the degree of injury done, the time that has intervened since the occurrence of the accident, and the present state of the parts as to inflammation and tension.

When sprains first happen, before inflammation and tension arise, cold astringent and sedative applications continually renewed have very considerable effect in preventing these symptoms from occurring. I have found one ounce of laudanum, two of alkohol, and three or four of water, a very useful mixture for this state of the sprain. The joint should be kept at rest, should have a roller carefully applied so as to give support, and if the joint is important, and the weakness very great, splints may sometimes prove useful. After the chance of inflammation has subsided, although no force should be used by the patient's own exertions, nor weight born on the joint if there was reason to suppose that the ligaments had been lacerated; gentle friction should be occasionally applied to the limb, and passive motion used to the joint.

But when inflammation and tension have arisen, those means which are known to remove such a state of parts must be had recourse to, as bleeding with leeches, or cupping and scarifying. I need not state that sedative and emollient fomentations, and solutions of opium will be found very serviceable in lessening the irritation and pain.

Sprains are often attended with future inconvenience, however proper the treatment may have been on their first occurrence, but when improperly treated, very great inconvenience may be felt which may continue during life. When the sprain has been violent, and the joint intirely recovers, it is probable that the injury was confined to the ligaments; for when the cartilages are included in the injury, as they possess no powers of restoration in themselves, very serious consequences often take place, and diseases are produced, which will be noticed afterwards and the effects shewn in the specimens preserved in our museum.

In all cases of injury done to or near the joints of the extremities, it will be proper for the Surgeon to examine carefully whether the tendons of some strong muscles passing over the lower part of the bones, may not have been displaced. The tendons of the two peronei extensores muscles, where they pass behind and below the fibula over a smooth lubricated surface of that bone, are bound to it by a strong ligament, but should this ligament give way, one or both of these tendons may escape from the groove or pulley on which they usually play, and being thrown forwards over the edge of the bone, in this new situation, their action on the foot will be to bend it on the leg, when in their natural position it was to extend it. The peronei having been habituated to act with the extensor muscles, continue to contract at the same time with them; but now they oppose the effect, which formerly in conjunction with the extensor muscles, they produced on the foot, and by so doing excite much pain and irritation in addition to the lameness.

When this situation of the tendon is discovered early, the tendon can readily be returned to its proper place ; but if this is not done, it forms a new groove on the forepart of the bone, and the old one is filled up, or otherwise so altered that it cannot receive the tendon, and thus pain and lameness may continue for life. I have seen this occurrence sometimes in the living body early enough to return the tendon, and have been consulted in cases where it could not be returned ; in one, where the pain was so violent, that I recommended the division and removal of part of the tendon ; the muscle then contracted to its full extent, and afterwards shrunk and no inconvenience was felt after the operation. I have met with two or three instances of this kind of displacement of tendons in bodies brought into the dissecting room; but of the previous history of the case I could know nothing. These remarks will apply to the tendons passing below the inner as well as the outer ankle, and allowing for difference of situation to all tendons passing through grooves in bones. When the tendons are returned, it is necessary to keep the part at rest for some time, and by the application of compresses and bandages to prevent them from again slipping from their proper pulleys or grooves.

ON DISLOCATIONS.

A bone is said to be luxated, when its articular extremity is displaced from the surface of the bone which received it, or on which it had motion. The luxation is called complete, when the articular surface of the dislodged bone is driven into some other part; and incomplete, when part of it remains in contact with a portion of the articular surface of the other bones, but with which it does not correspond, and on which it cannot possess its natural motions.

Complete luxations take place the most frequently in ball and socket joints, as in them the capsular ligament is thinner and more loose in all directions, so that it cannot resist the force that displaces the bone; and should that force place the head of the bone on the edge of the socket, from the smoothness of the surfaces in contact with each other, and their being lubricated with synovia, the muscles attached to the bone, on their first attempt at motion, will in most instances draw it back into its cavity, or do, what however is seldom done by them, displace it intirely. I have more than once found in incomplete luxations of the os brachii, that the attempt made by the patient to take off his coat, produced the return of the bone into the glenoid cavity, with a noise perceptible to every bystander.

Joints of more limited motion, as the ankle, elbow and knee, are more liable to incomplete than complete luxation; for their form is such, that when the bones are once displaced from their natural corresponding surfaces, it will require more than the action of their own muscles to draw them back again.

Luxations very seldom occur in children, as in them the force applied rather tends to produce a fracture of the bone or a separation of the epiphysis.

Bones may have their corresponding articular surfaces removed from each other, by disease taking place in the cavity of the joint, and this happens in the thigh joint when the acetabulum and the head of the femur ulcerate, so that the muscles draw the bone from the socket and place it elsewhere. This kind of luxation, being a symptom or effect of another disease, will be noticed with the disease producing it. The present observations are intended to apply to those luxations which are produced by external force, such as falls or blows, or to those which have been occasioned by the sudden and violent action of some particular musles.

I have already stated, that those joints which have the greatest motion are the most frequently luxated, and that great strength and great latitude of motion are incompatible in the same joint, so far as these properties depend upon bony and ligamentous structure. Ball and socket joints possess more motion than any other, they are therefore, when deprived of the action of the muscles which surround them, weaker than any other, and consequently more subject to dislocation; their principal strength being dependant on the muscles and tendons surrounding them, and not on the firmness of their ligaments or the form of their articular surfaces of bone. A reference to the shoulder joint will prove this. The largeness of the head of the os brachii, and the shallowness and small size of the glenoid cavity receiving only a part of the head at any one time, although well calculated for motion, are not adapted to impart strength; for the capsular ligament is loose and thin, and cannot give that strength to the joint which the efforts of the arm often require. So weak is the bony and ligamentous structure of this joint, that in the dead body, if the muscles and tendons are dissected off and the ligaments only left, the weight of the arm, when hanging down, will often subluxate the os brachii; and in the living body, if the muscles become paralytic, a very slight force applied will throw the arm from its socket. This joint has its capsular ligament strengthened by the attachment of the tendons of very strong muscles, which occupy a very large proportion of its outer surface, so that it is nearly surrounded by the tendons of the supra and infra-spinatus, the teres minor and subscapularis muscles. These muscles contract during life whenever, the mind is conscious that the arm is to be moved, and by their tendons pressing on the capsular ligament, form the boundary of a cavity of much temporary strength surrounding the head of the bone. When the arm is at rest, these muscles produce no more pressure on the capsular ligament than is derived from their tone. The same effect, but on a less surface of capsular ligament, is produced on the joint of the thigh; but as this joint has to assist in supporting the weight of the body, its strength is more dependant on the form of its bones and ligaments, than the shoulder joint, and it is therefore proportionably less subject to luxation.

In other joints, in which less motion is required, the strength is also proportionably greater: the strength depending and the quantity of motion being in a very great degree regulated by the shape of the articular surfaces of the bones, and the firmness and disposition of the ligaments; the muscles and tendons being only useful in producing the motions which the form of these structures will allow of, as in the joints of the vertebræ, hands, and feet. As we cannot have joints in many parts of the body, whose strength shall depend upon such mechanical structure; in some parts the strength is made to be dependant on the action of surrounding muscles; and this mode, although unmechanical, precludes the necessity of many joints.

Joints of this nature are sometimes disposed to luxate with the application of but little force; when so, the weakness is not in the bony or ligamentous structure; for these are as usual, but is dependant on the want of proper contraction in those muscles, whose tendons surround the capsular ligament, this arising either from the muscles being weak, or the will having lost its power over them. It is in the ginglymoid, and other joints where motion is more limited, that the want of strength depends upon the ligaments.

From the above described structure of the joints, which possess much motion, it is readily accounted, why a small degree of force suddenly and unexpectedly applied should produce luxation, and why a much greater degree of force will fail in effecting this, when we are prepared for resistance by knowing at what time its application is to be made. In the one case, the muscles which surround the joint, and on which its strength depends, are taken by surprise; in the other, they are prepared to resist the force, and therefore contract the moment it is applied. From this it happens, that more luxations arise from falls than jumps; and from sudden and unexpected falls, although slight, than when a person resisting is thrown down by violence.

It is unnecessary in this place to state, that an accurate knowledge of the relative situation and form, not only of the bones and ligaments of the joint, but that also a correct knowledge of the muscles connected with its ligaments, as well as of those which move the limb, are requisite to the understanding the real nature of luxation, and to guide us in the choice and direction of the means to remedy it; and unless the Surgeon is acquainted with the vessels, nerves and other parts which may be pressed on by the head of the dislocated bone, symptoms may not only be mistaken, but irreparable injury may be done to the patient in attempting the reduction, by force applied in an improper direction.

Luxations are productive of some symptoms which are peculiar to the nature of the accident, but common to every joint affected by it; and of others which must belong to the particular joint.

Some of the attending symptoms are not of a distinguishing nature, but are common to luxations, fractures, and even violent contusions; among the last are the deformity or altered shape of the limb, the pain felt, and which is increased by every attempt at motion.

It is evident, that no luxation can take place without some change in the form of the joint. In most cases, part of the dislocated bone will be felt forming a prominence in a new situation, while a vacancy will be perceived in the part from whence it was driven. But these alterations cannot always be detected from the quantity of blood that may be immediately diffused in, and around the joint, or from the swelling and tension that may have subsequently taken place. If a cylindrical bone is luxated, the extremity furthest from the accident, not partaking of the swelling, will, from its position and the general direction of the bone, inform us of the position and situation of the dislocated part; and this will be known more accurately from the natural perceptible projections of the bone either, not being found in their usual places, or from their being felt in other parts.

A change will in general be produced in the length as well as in the direction of the limb, and the usual motions of the joint will not take place even when attempted by the hands of the Surgeon; and should the joint have possessed rotatory motion this will be completely lost. It is not so in a fracture of the bone; for motion may at first be produced by the Surgeon in every direction, although crepitus, and a considerable degree of pain will attend the attempt. Indeed immediately on luxation happening, if it is complete, the bone will admit of some motion, although this in a very short time is prevented by the contraction of the muscles which keeps the bone rigidly fixed in its new situation; but all rotatory motion is generally lost from the first. I have, however, in a dislocation of the shoulder joint, some hours after the accident, found so much motion, that had not the head of the os brachii been felt in the axilla, and a vacancy been perceptible under the acromion scapulæ, the nature of the accident might have readily been mistaken.

A sensation not very dissimilar to crepitus, will sometimes be perceived in attempting to bend the joints of a dislocated limb before much inflammation has come on, and after it has subsided, which has led to the supposition of the accident being a fracture. A similar sensation has sometimes been felt where tendons are placed on bursæ muscosæ. What this arises from, I have never been able to ascertain in a manner satisfactorily to myself; but

I have met with it frequently in a knee joint, where neither fracture nor luxation had occurred, and where no other symptoms of disease existed but a fulness of the cavity of the capsular ligament from a morbid increased secretion of synovia, and occasionally some little elongation in particular places of the packets of fibres belonging to the articular cartilages.

The pain produced in luxation, depends upon the structure of the parts upon which the head of the displaced bone presses, and on the degree of its pressure. When the head of the os brachii presses on the axillary nerves the pain is sometimes excruciating, and occasionally such pressure produces numbness and paralysis of the parts below. When the luxated bone presses upon muscles, it excites a dull heavy pain, but this after some little time subsides, or is but little felt, unless an attempt is made to move the limb.

When the extremity of a bone has been completely thrust from its socket by violence, the joint having been previously to this free from disease, the capsular ligament must always be torn. No healthy joint which will admit of complete luxation without a breach of the capsular ligament occurring. I have examined some cases of recent dislocations, and many preparations of luxations in all of which the capsular ligament has invariably been ruptured. The interarticular ligaments, such as the ligamentum teres in the joint of the thigh, and crucial ligaments in the joint of the knee, are torn asunder when the femur is completely luxated, or the tibia dislocated from the femur. Cases however of incomplete luxation may happen, in which both sets of ligaments, although stretched, shall remain free from laceration.

In joints, which have had their cavities for a long time distended by the accumulation of fluid, and the ligaments in consequence kept long on the stretch; upon the subsiding of the tumour, slight efforts have produced a luxation of one of the bones. I have known the patella, in one gentleman, to have been luxated very frequently from this cause, and it would still become so on any exertion of the muscles, did he not ~~to~~ wear constantly a bandage of support: and in another person, in whom an accumulation of synovia had long remained in the shoulder joint, I have frequently known the sudden action of the latissimus dorsi and teres major muscles, dislocate the os brachii. In such cases the reduction of the bone is seldom attended with much difficulty.

Dislocations usually happen when the joint is bent, so that the bones form an angle; for to effect the luxation of a healthy joint, the force which is used, must not only press in the direction of the shaft or length of the bone to be displaced; but also in a lateral direction, to thrust it from its socket. In the reduction of a luxation, the removed bone must first be brought to a level with the edge of its socket, and then by lateral pressure, or rotatory motion, returned to its cavity.

The first of these processes is the most difficult, as the contraction of muscles must be overcome; but when this is effected, and the bone brought to a level with the edge of its socket, the contraction of the muscles will tend more to return the bone into its proper cavity, than into the new one to which it had been driven.

It is seldom that much obstruction to the reduction arises, either from the projecting brim of the socket, or from the head of the dislocated bone being larger in circumference than its neck; but when such obstruction does arise, it is easily distinguished, and soon remedied, by the application of pressure in that direction which will clear the bones of each other.

The difficulties that attend the reduction of a luxation will be much increased by the delay which may have taken place between the time of the accident happening, and the attempt made to remedy it. When a bone is thrown into a new situation, some of the muscles connected with it will be shortened, for they will immediately contract so as to form the straightest line between their extremities; and some others will necessarily be thrown on the stretch. If the reduction is attempted immediately, or very soon after the accident, the contraction from tone is soon overcome; but if much time is allowed to elapse, the injury produces, from its irritation, a strong and permanent contraction of the muscles, requiring a very great additional force to be overcome; and this contraction is increased by the natural, but involuntary resistance, which the patient makes to extension, when he finds the attempt so much increases his pain; added to which the laceration in the capsular ligament, through which the bone passed, soon begins to close, and the ligament to thicken, so that the aperture refuses to allow of the bone returning through it, or may require much force to be used and some new laceration, to permit it to pass to its natural cavity. Luxations should therefore be reduced as soon as is possible, for all the parts of the joint, viz. bone, ligaments and tendons, are apt very soon to begin to adapt themselves to their new situations. When from the inflamed and tumefied state of the parts, it is found impossible to apply the required force to return the bone immediately, this state should be remedied by the use of the means known to every Surgeon, and upon the first probability of success the reduction should be attempted.

In reducing a luxation, whatever is the degree of force necessary to be used, it should be applied gradually, and the strength of the contraction of the muscles should be tired out by constant opposition, rather than by sudden and violent efforts; for muscles will resist such violent efforts, although the force may be much greater, than that which will overcome their contraction if gradually but constantly applied.

As it is chiefly from muscular action that the difficulty of reducing a recent dislocation arises, means should be taken to lessen that action. Bleeding as one of those means, and the warm bath as another, should be had recourse to when muscular contraction is violent. It is unnecessary to mention here, that as temporary, not permanent weakness is required, the blood should be withdrawn quickly, and through a large orifice. It is also unnecessary to state to this audience, that when the extension is attempted, the limb should be placed, as far as circumstances will permit, in that form in which all the larger muscles would be a little relaxed, that is, in a state between flexion and extension.

In the excellent treatise of Mr. Astley Cooper on dislocations, among many other very judicious practical observations, he states, that he has found tartarised antimony, given in repeated doses so as to produce constant nausea without vomiting, of very considerable use in lessening the resistance of the muscles, and thereby enabling the reduction to be effected at a more distant time from the accident happening, and with comparatively less effort than could be effected in any other way. A case which occured to me last summer confirmed the justness of his observations. A strong muscular person, resident in the north of England, had dislocated the os brachii, and unsuccessful attempts had been made with pullies to reduce it at different times during seven days that he remained in the country; he then came to London and consulted me; hearing what had been done, I gave him tartarised antimony until much nausea was produced; then, on making the attempt at reduction without pullies and having only two persons to assist, the reduction was, I may say, easily effected, although the bone had been out of its place ten days. We are indebted to Mr. A. Cooper, also for the history of a case in which the reduction of the os brachii was effected, by the patient's attention being directed to an action to be performed by the contraction of other muscles than those of the arm; an effort, unexpected by the patient, was made at this period to replace the bone, and which, not being resisted so strongly by the muscles of the arm, was attended with immediate success, although before this it had baffled every attempt.

M. Boyer and M. Richerand, recommend, first upon the authority of Fabre and Dupouy, as a great improvement, confirmed by their own experience, that the extending force should not be applied immediately to the dislocated bone, but to those articulated to its lower extremity, and they assert, that by this practice the muscles surrounding the luxation are not compressed, and not stimulated to that spasmodic contraction which would oppose the reduction; they also state, that the extending force is greater than could be obtained by applying it to the luxated bone, as by elongating the lever they acquire a greater degree of power. There may possibly be some advantage gained by not compressing the muscles; but there must be much loss of power in applying the force through the medium of another joint, and some risk incurred of greatly weakening, if not of luxating, such joint; and as the force is to be applied in the direction of the shaft of the bone, the additional length of the lever can be of no use. In the luxation of the joint of the shoulder, in some instances, it is allowable to pull at the wrist, as it gives the operator, the advantage of placing his heel in the axilla of the patient, to assist him in thrusting the bone into the cavity when the extension has been made; but when no advantage, similar to this, attends it, the extending force is likely to be more successful in effecting the reduction, with less injury to any other part, when applied to the lower end of the dislocated bone.

It is well known that the force used to the dislocated bone will be uselessly exerted, unless the bone forming the socket is so firmly fixed, as not to yeild to it.

The quantity of force cannot be ascertained at first, it must be applied and increased gradually so as to be proportioned to the resistance. It should not be persevered in beyond a certain degree and time, when the luxation is not recent, as the cavity from which the bone was expelled may have filled up, and a new socket began to be formed.

A variety of machines have been invented for applying the force necessary to reduce luxations, and if the reduction depended only on force, many of these are capable of exerting more than would be sufficient; but something more than force is wanting, and unless the operator is well acquainted with the nature, structure, and relative situation of the bones, ligaments, muscles, and tendons forming the joint, the force is not likely to be well applied. No machine has as yet been invented that would prove useful in every case of luxation of the same joint, and I know of none which are adapted to steady the bone near to the trunk, while force is applied to the dislocated bone. With the advantage of anatomical knowledge and the use of straps and towels, we can apply force enough (so far as force is necessary) to reduce any dislocation; but still the use of the compound pulley in dislocations of the shoulder not recent, and in dislocations of the hip joint, may be had recourse to with great advantage.

When the reduction of a luxation has been long delayed, there is very little chance of the attempt succeeding, for although force enough may be used to return the bone to its original situation, from the change which may have taken place in both bones, they will no longer correspond to each other, and the replaced bone will in general soon return to the situation it occupied after the luxation. The muscles from not being called into their usual actions also undergo a change. In unreduced luxations of long standing, those which are shortened, diminish also in thickness, they shrink and become almost ligamentous; and not unfrequently the adhesive ossific inflammation spreading to them from one or both bones, a part of them becomes converted into a similar substance.

If the head of a dislocated bone rests merely on muscles,it undergoes but little change, and the articular cartilage shall remain unabsorbed for many months or even years ; but if it is placed so as to press upon another bone, the articular cartilage is not only removed, but the bone is absorbed, so that the shape becomes much flatter where the two hard surfaces meet. The part compressed is also absorbed so as to form a kind of imperfect socket for the bone pressing on it, the lacerated part of the old capsular ligament closes, a deposition of osseous matter takes place round the part where the new socket is attempting to be formed, and the cellular membrane becomes condensed so as to answer the purpose of a new capsular ligament. The articular cartilage of the old socket is removed, and the cavity of it is filled up by a ligamentous substance in which bony matter is often deposited. Much bony matter is often deposited to form the edge of the new socket, so that it would be found impossible to remove the luxated bone from its artifical situation without fracturing a part of this edge. In the new socket the luxated bone sometimes regains so much motion that the new joint becomes useful. The preparations which are here produced will shew you these effects of unreduced luxations on several joints, but more particularly on those of the shoulder and the pelvis.

In an elementary course of Surgical Lectures it might be expected that symptoms should be given, marking the luxations of the principal bones, but here, and to this audience, such description is unnecessary.

LECTURE XIII.

ON INFLAMMATION OF THE SYNOVIAL MEMBRANE, ULCERATION AND SUPPURATION OF JOINTS, LOOSE CARTILAGES IN THE CAVITIES OF JOINTS, AND ON ANCHYLOSIS.

THE inflammation of the inner membrane of the cavities of joints, although it sometimes terminates in the increased secretion and accumulation of synovia, will often proceed much further, and assume the character of a very formidable disease; in the beginning the inflammation is seldom very rapid in its progress; but it sometimes continues slowly to advance so as to impair, and then distroy the natural structure and function of every part of the joint.

There is much variety in the degrees of pain by which this affection is accompanied. Pain is sometimes felt before the swelling begins, and when so, is usually confined to one particular spot; from this it gradually extends over the whole joint, but continues to be the most acutely felt near the part where it originated. The joint swells and a fluid may be felt in its cavity, at first very distinctly, but less so as the ligaments become thicker from inflammation; a stiffness then takes place in the joint, and every attempt at motion increases the pain. It sometimes happens that enlargement of the joint, attended with an accumulation of fluid, and with stiffness shall take place with so limited a degree of pain as to cause but little annoyance to the patient, and after these symptoms have continued some days the inflammation and tumour will subside, although some stiffness shall continue; in a short time another attack of a similar nature shall be made, and the patient shall be subject to such attacks for months or even years, upon exposure to cold or to any unusual violence.

In other cases, the inflammation shall begin with more violent symptoms, and proceed more rapidly; tension and great pain shall attend the disease from the beginning, and the system shall also be affected soon with symptomatic fever; the pain though constantly severe, shall be increased so much at every attempt at motion, that the patient will endeavour to keep the joint motionless in the state between flexion and extension; these cases sometimes rapidly subside; but they more usually fall into the slower chronic form.

When the inflammation is very violent at first or has continued long, the vessels of the synovial membrane pour out coagulable lymph, the whole of which does not always adhere to the inflamed surface, but some of it, when coagulated, forms flakes which float in the fluid in the cavity of the joint, sometimes in masses large enough to be felt through the capsular ligament. In other instances, the whole of the lymph poured out, in becoming solid, adheres to the inside of the synovial ligament and becomes vascular from it. The surface of this adventitious coating is sometimes tolerably smooth, but occasionally it is otherwise, the lymph in particular places forming thick projecting masses. In the museum in Windmill Street, there is a preparation of a knee joint, where processes of very different degrees of thicknesses and length, (the length varying from a quarter of an inch, to a full inch or even more,) project from the synovial membrane, in such numbers as to completely conceal every part of its original smooth surface. These were probably produced by much coagulable lymph being thrown out on inflamed spots, strongly adhering to the surface, and then becoming vascular. The history of this case during the person's life is not known, as the knee was found in a subject brought in for dissection. There is no preparation shewing this affection of the synovial membrane in the museum of our College; but Sir Wm. Blizard informs me, that he has met with a similar appearance in a knee joint.

Sometimes a layer of coagulable lymph is found to extend between the surfaces of the articular cartilages; several specimens of this nature are preserved and are now on the table, shewing the appearances, from the lymph having first coagulated until it has become highly vascular, and thus proving that it is thrown out as in the inflammation of other membranes, and undergoes afterwards the same kind of changes. It is, however, difficult to account for the lymph passing so completely between the articular cartilages, as to cover the whole of their surfaces; for there is no appearance of vessels either in their substance or on their surfaces; and if the lymph is thrown out, which it most probably is, by the vessels of the synovial membrane, it must have remained fluid sufficiently long to have been effused over every part of the surfaces of the articular cartilages which were not at that time in contact with each other; and afterwards on those, which from change of position in the bone, it was enabled to reach; or the vessels of the synovial membrane must have continued to secrete it, until, from change of surfaces produced by the usual motions, every part of the cartilage had been exposed to its contact. It must, under either circumstance, have coagulated and adhered to those surfaces, and become organized from the vessels and nerves of the synovial membrane. In this state it has been sometimes considered and described as thickened perichondrium.

When the inflammation subsides, and the fluid is absorbed, the deposition of solid matter remaining, occasions the natural mobility of the joint to be lessened, and the shape to become a little different from the sound joint of the opposite side: this altered state renders it very liable to be frequently acted on by similar causes to those which produced the first disease.

The joints which are covered with a thick mass of muscle, are less liable to this disease, than those which are nearer to the skin. It does not occur very often in the shoulder; but when it does, the form of the distended capsular ligament can be felt under the muscles, although the fluctuation of fluid contained in its cavity will be indistinct. When it occurs in the hip joint, the quantity of muscle and adipose membrane is so great, that the discovery of fluid by its undulation cannot be expected: the buttock, however, appears at first to be fuller than on the other side, and usually some swelling will be perceptible towards the groin. The pain is dull and heavy, but the parts will in this state of the joint bear the pressure of weight; motion, however, always aggravates the pain; and the patient will sometimes, as in cases of suppuration, refer the pain to the knee. In the ankle, elbow, and knee joints the fluctuation of fluid is very readily perceived.

It rarely happens that the inflammation of the synovial membrane of joints proceeds to suppuration or ulceration, without having produced previously much disease of the capsular ligaments, or of the articular cartilages. I have however known this happen in the shoulder of a child, where matter formed, and an abscess pointed twelve or thirteen days after an accident had befallen the joint; on the evacuation of the pus through a small but depending opening, a probe readily passed into the cavity of the joint, notwithstanding which the abscess closed, and the use of the joint, some months afterwards, did not appear to have been much, if at all, impaired. Mr. Brodie has narrated the dissection of two cases of ulceration of the synovial ligament terminating in death, where the extent of the ulceration, in one of the cases, did not exceed the surface of a shilling, and in the other, was not larger than the surface of a sixpence; about half an ounce of thin dark-coloured pus was found in each.

In the treatment of the inflammation of the synovial membrane, topical applications are chiefly to be depended on for its removal. When the inflammation is active, means must be had recourse to, which being known to all present, need no repetition from me. Perfect quietude of the joint is, of course, necessary. After the inflammation has been subdued, stimulating applications to the skin near the part, will often be found productive of much advantage in diminishing the swelling. Blisters repeatedly applied, have very marked effects in doing this. The stimulating liniments employed are composed of various materials; those that produce very small ulcerations of the skin which are not disposed to spread, or become deep, will often have a good effect. I have seen a liniment composed of gum ammoniac dissolved in vinegar of squills, occasionally, very useful; but the application of it to some skins, I have known in several instances to produce very violent erysipelatous inflammation. Liniments composed of the oil of olives and sulphuric acid, or ointments of the tartar emetic and spermaceti, may be used, of strength proportioned to the state of the patient's skin; the strength of course must be varied to different people. I need not name to you the effect of other stimulating applications, as the linimentum camphoræ compositum, the linimentum ammoniæ fortius and carbonatis, the linimentum saponis, or the tinctura lyttæ when diluted, all of which may occasionally be useful.

MORBID THICKENING OF THE SYNOVIAL MEMBRANE.

A morbid alteration of structure, sometimes takes place in the synovial membranes of joints, which previous to Mr. Brodie's publication on the subject, has never been sufficiently distinguished from other diseases: it appears to begin in one part of the synovial membrane, then gradually to occupy the whole, and eventually to produce so much disease in the joint, as to be remedied only by the removal of the affected limb.

This disease has rarely been met with in the synovial membrane of any other joint than that of the knee. It is marked by the membrane losing its natural organization, and becoming much thicker, even sometimes to the extent of nearly an inch; then being converted into a pulpy substance of a light brown, or sometimes of a reddish brown colour, intersected by white membranous lines, and sometimes studded with red spots, formed by vessels injected with their own blood. The progress of the disease is generally slow; as it proceeds, ulcerations take place in the ligaments and bones; the cartilages are destroyed and removed, and purulent matter in small quantities collected in the cavity of the joint.

This disease generally takes place in persons about, or not much beyond the period of puberty; it can seldom be traced to any evident cause, but is found occasionally to make its appearance after repeated attacks of inflammation.

The first symptoms of its occurrence are some stiffness and tumefaction of the joint, taking place without pain, and being productive early in the disease of but little inconvenience; but the quantity of motion gradually diminishes, and in most instances in the advanced state of the disease, becomes totally lost. The form of the swelling is less regular, than that which takes place in inflammation of the synovial membrane; it is soft and elastic, and gives to a superficial examination a sensation as if it contained fluid; but when carefully felt by a hand on each side, the absence of fluid is distinguished by the want of fluctuation.

When abscesses begin to be formed, and the articular cartilages to be destroyed, the pain becomes more severe, but seldom so excessive as in other cases of ulceration in the cavity of the joint. Hectic fever comes on, the patient loses flesh, and gradually sinks, unless amputation is performed. In general the disease indures one or two years before it reaches the last stage, sometimes even longer. It occasionally becomes indolent, and remains in that state without alteratiou for many months.

Many Surgeons have blended this disease with white swelling; and it not unfrequently has been confounded with chronic inflammation of the synovial membrane; it does not, however, yield to the treatment which would subdue simple inflammation. Occasional symptoms of a distressing nature may be palliated; but it forms one of those dreadful diseases which justifies the operation of removing a limb. It approaches near to cancer, particularly in the thickening and appearance of white lines intersecting it. I have seen something like this alteration of structure in the peritoneum covering scirrhous portions of the stomach, and of the great intestines, also in the pleura lining the inner surface of a cancerous tumour which had spread from an affected breast.

DISEASES OF CARTILAGE.

The active powers of life are possessed by articular cartilages in a very limited degree, so much so, that the ocular demonstration is wanting of their being capable of inflammation. This affection is in other parts marked by a state of vessels easily distinguished by the eye and by the touch; but as vessels are not to be seen, or felt in these cartilages, we have not sufficiently decisive proofs of inflammation ever taking place in them. I have never seen in articular cartilages, which were completely formed, any vessel either filled with its own blood, or having its cavity distended by injection. In cases of scrofulous joints, where portions of the articular cartilages are in a state of absorption, and other portions separating from the bone, and where a very increased degree of vascularity exists in the bone and ligaments, I have seen vessels filled with blood, and in the dead body, I have by injecting the limb, seen vessels running some way on the separating surface of the cartilage; but when I have carefully examined these vessels, I have always found them to belong to some portion of bony matter, often very thin and small, which was separating from the original bone, although not quite detached from it; but adhering firmly to the cartilage. I have also seen hollow surfaces of the cartilage receiving and being filled up with soft vascular matter, arising from the surface of the bone which it covered; but I have not been able to trace, in a way satisfactorily to myself, any vessel, however small, passing into the cartilage so as to ramify in its substance. I have formerly stated, when on the structure of articular cartilages, that I had never been able in their natural state, to demonstrate any membrane, passing over the whole of their surfaces opposed to and moving on other cartilages.

The synovial membrane which lines the capsular ligament and is reflected from it over part of the bone to the edge of the articular cartilage, will indeed sometimes pass a little way on the surface, it there becomes inseparably connected with the cartilage and its appearance is then lost: I have frequently tried, by maceration and other means, to ascertain whether as perichondrium, it spread over the surface, and althongh I have kept the cartilage in water until its fibrous structure, shooting outwards from the bone,was unravelled and very apparent, I have not seen any membrane covering the extremities of the packets of fibres; nor have I seen any membrane on the inner surface of the patella, in those cases where some of these packets of fibres separate from the rest, and elongate so as to project beyond the natural surface. In a diseased state of the joint, I certainly have seen the surfaces of the articular cartilages covered by a membrane, but this membrane, I have no reason to believe to have been, originally, more than a coating of coagulable lymph; it is of different degrees of thickness, and at first easily peels from the surface it covers, but it soon becomes organized and very vascular.

In a preparation belonging to the Windmill Street Museum, vessels seem to pass from this new-formed membrane into little inequalities on the surface of the cartilage, and it is far from improbable but that absorbent vessels may be among these and which are employed, along with the absorbents from the bone in removing the articular cartilage; for in many diseased joints we find the whole cartilage has been absorbed; and in others, that the process of the absorption of it has been partial.

We have on the table many proofs of articular cartilages being wholly or partially removed from the surfaces of bones, and it is not doubted, but that their removal is by the action of the absorbent vessels; nor do I mean to deny the possibility of this removal being attempted partially by vessels belonging to their own substance, so as to produce some of the appearances called ulceration of cartilages; but we are deficient in proofs of this, and from what I have observed of the state and appearance of diseased joints, I am induced to abide by the opinion entertained by John Hunter, that the removal of articular cartilages is generally effected by the vessels of the neighbouring more vascular parts, viz. of the bones and synovial ligaments, and occasionally by the vessels of coagulated and organized lymph.

None of that ragged irregular appearance, which ulceration assumes in bones, is perceived in the removal of cartilage, and excepting where soft and vascular parts are in contact with it, its removal seems rather to be effected by constant friction, than by ulceration.

In joints, where pain had been felt on motion sometime before any manifest swelling arose, we do meet (when opportunities allow of their examination,) with an appearance of destruction of cartilage, which has been described as ulceration. I am, however, inclined to think that this state of the cartilage is produced by abrasion from friction. I have met with it in joints, where previous to the person's death a grating noise has been heard, and the sensation of grating been felt; and in several of the preparations now before us, it appears evident that the cartilage has been by friction worn from the bone near the edges of the articular surface, and in other places it seems to be worn mechanically into groves, by some hard substance moving on it.

I submit to your observation and consideration a specimen in which, after the removal of the cartilage, the bone itself has been worn into similar grooves, which, were it not from their polished surfaces, seem almost as if formed by a chissell. In two patellæ from the museum in Windmill Street, these appearances are also most distinctly marked, and I have seen the same appearances in patellæ in the Museum of Mr. Brooks.

In other instances, we find that where the cartilage has been removed, the surface of the bone, exposed in consequence to friction, has become smooth, polished, shining, and as hard as enamel. I met with this appearance several years ago in some of the bones of the wrist, and thinking that it had not been observed before, I shewed it to John Hunter; he told me that it had been long known to him, and produced from his museum, the preparation which I now place before you.*

In cases where the surface of the articular cartilage is less regular the alteration from natural structure may arise from the action of the absorbent vessels of the neighbouring parts. In diseased joints where matter is found, these appearances called ulceration of cartilage are usually met with; but they are also found in joints in which no purulent matter has been deposited.

The exfoliation, as it has been termed, of cartilage appears to be produced by the vessels of the bone, for a thin lamina of bone is generally found adhering to the exfoliated cartilage and which has been separated with it; when cartilages become black before they exfoliate, they are seldom without this lamina of bone. In other instances, the cartilage is previously changed into bone, and by the change gains sufficient vascularity to separate the dead portion from the living; this happens most frequently in the cartilages of the larynx, and in those of the ribs, which are naturally more vascular than articular cartilages; in these last, viz. articular carti-

* A beautiful specimen of the above-named appearance on the head of the femur.

lages, I have met with no instance of such change ever taking place.

I have before alluded to an alteration of structure, which occasionally is met with, more particularly on the articular cartilage of the patella: in the joints of female servants who have been accustomed to work much on their knees in scouring the floors of rooms, a crepitus, or a sensation very similar to it, frequently is felt when the patella moves on the femur; this crepitus has alarmed them more than the pain, and has been the usual reason for their applying to the Surgeon. In dissecting the knee joint in this class of females in hospitals and elsewhere, I have very often found packets of fibres belonging to the cartilaginous crust occupying a space of some extent and projecting beyond the natural surface, also separating from each other.

These projecting packets are of various lengths and very often adhere but slightly even at their bases to each other. This was the only alteration of structure I perceived in the knee of a person who died of a typhous fever, but who for many months before her death had complained of the sensation of grating in the knee. This state of the cartilage is not however peculiar to females, I have seen it in both sexes, but generally in the knees of hard-working people; it has been supposed to precede the removal of cartilage by absorption.

From the want of vascularity, articular cartilages cannot throw out granulations; nor will granulations from other surfaces adhere to them. I removed the fore finger of a woman at the joint with the metacarpal bone, the integuments were brought over the cartilaginous extremity of the last named bone, and the edges united by the first intention; no union took place with the cartilage, but the skin remained loose and had very perceptible motion on it; this however lessened by degrees, but was apparent in some degree at the end of two years: the person, about that period from the operation, died of apoplexy, and I embraced the opportunity, when I examined the head, of also seeing what had taken place in the finger. A very small surface of cartilage still remained, to which the integuments had not united, but they had firmly united to the surface of the bone from which the cartilage had been absorbed. I mention this case in proof that union with cartilage does not take place, by adhesion in cases of wounds; but when coagulable lymph is thrown out in diseased joints, we have, in the preparations already shewn, seen it united to articular cartilage.

SUPPURATION OF JOINTS.

When suppuration takes place in the cavity of a large joint, it must then be considered as a most formidable disease. It may take place in any constitution from accident; but occurs more frequently in scrofulous habits than in any other. I mean in a future lecture to shew you the effects of this action in some of the larger joints.

I shall now only observe that the matter which is secreted by parts so indolent in their actions, and possessed of so little vascularity, is, very rarely indeed, healthy or well formed pus. That which is first evacuated, where the disease arises from accident, sometimes appears to be tolerably healthy and without a putrid offensive odour; but after the abscess has burst, or has been intentionally opened, whatever was the state of the joint before, in most instances, ulceration now makes a more rapid progress; the articular cartilages become absorbed or are thrown off; the surfaces of the bones become carious and ulcerated; ulcerations take place also in the ligaments; from the friction of the hard parts, small blood vessels give way on the inner surface, and the bloody fluid discharged mixing with the purulent matter, the whole acquires a most offensive and putrid fetor, and when accumulated in large quantities, the absorption of it not unfrequently produces symptoms very similar to those of typhous fever; a constant irritation from all these circumstances is kept up, and hectic fever comes on; indeed this fever arises sooner in diseases of the joints, than in those of bone, where the joints are not affected. The joint, from absorption on the inside and deposition of bony matter on the outside, soon loses its shape and motion, and if the limb is not removed, the patient gradually and painfully sinks under the disease.

But sometimes we find, particularly in young people, that suppuration of the cavity of a joint shall terminate more favourably. I have already mentioned one instance of an abscess forming in the shoulder joint, and healing without loss of motion; an occurrence of this kind is, however, very rarely met with; but the chance of a favourable termination is always greater when the disease happens from accident, than when it arises from a slight cause, or without any known cause, in a scrofulous constitution. In the former case when the matter is evacuated, the disease is then brought nearer to the state of a compound fracture; but is more dangerous as to its result, and generally more tedious in its cure.

The opening for the evacuation of the matter, if we are obliged to make an artificial one, should be small; and in that part from which the matter will meet with the least obstruction to its constant exit; for the cavities of the joints never bear with impunity extensive exposure; and if the matter is retained, from its imperfect and fetid nature, injurious consequences to the patient's health will arise from the absorption of it. Should the first opening close and the matter again collect, the re-opening of it should not be delayed, but it should be opened so as to expose the cavity as little as possible.

No abscess of a joint should be opened until the part has been for some time kept in a state of rest, so that any additional inflammatory symptoms, that might arise from the recent motion of the part, might subside. After the evacuation of the matter it should still be kept in perfect quietude, for the purpose of encouraging the growth of granulations, or forwarding any other process by which anchylosis might take place. For it does sometimes happen, in cases where the person is young, and the powers of the constitution are vigorous, that after the cartilages have been absorbed, granulations from the exposed bony surfaces shall arise, and when they come in contact, shall firmly unite, and afterwards shall be changed into bone, so that the limb shall be saved at the expence of the loss of motion in the joint.

In a large joint we are not warranted, by using passive motion, to attempt the prevention of its mobility being ultimately lost; as by doing this the efforts of nature to cure the disease by anchylosis, being interfered with, might be discontinued. In lesser joints, where the existence of disease is not likely to be attended with the loss of life, after the inflammatory symptoms have abated, passive motion may be used, and will often succeed in preventing the loss of the mobility of the part.

In diseases originating in the joints, it rarely happens that the extremities of the bones are actually enlarged in their substance, although from a thickening of the soft parts, the first impression on applying the hand is that the bones have partaken of the enlargement so as to form part of the swelling. In cases where inflammation and abscess have first occurred in the bone, and where the matter has worked its way into the cavity of the joint, the extremity of the bone will of course be enlarged, will continue hard, and will be usually of a dark colour.

A considerable enlargement will sometimes take place around the extremities of the bones from deposition of ossific matter; the soft parts in the neighbourhood having taken on the adhesive ossific inflammation; but the determined hardness and irregularity of the surface, will, in general, enable us easily to discriminate such enlargements from a general swelling in the bone itself.

LOOSE SUBSTANCES FOUND IN JOINTS.

It is well known that hard substances are occasionally found loose and detached in the cavity of a joint, although but very rarely in any other than that of the knee; these substances being lubricated with synovia move about in the cavity containing them, but sometimes, by becoming suddenly jammed between the moving bones, are productive of immediate lameness, attended with most excrutiating pain in the joint, and tenderness in the parts surrounding it, and also being often accompanied by much constitutional disturbance.

When joints possessing them are examined in the dead body, the inside of the capsular ligament, and surfaces of the articular cartilages have in some instances been found tolerably free from disease; more frequently, however, the ligament near its attachment to the bone is thicker, appearing as if it had been formerly inflamed, and the articular cartilages have some appearances of abrasion on their surface.

These substances have been found to vary in number, and in size, In general there is only one, but I have met with nine or ten in the same joint, and these, of sizes, varying from that of a small seed, to one measuring more than three quarters of an inch in its long, and half of that space in its short diameter, and being nearly half of an inch in thickness. They have been found in greater numbers, and larger in size. Morgagni describes a case in which twenty-five were found. Sir Everard Home mentions his having found one in a soldier nearly as large as the patella, but which occasioned little uneasiness, its size preventing it from passing between the moving parts of the bones.

They are usually of an oval shape; and although called cartilages, they are generally bony in the middle; and by analysis, like other osseous substances, are found to consist chiefly of phosphate of lime.

The hard or bony portion is sometimes nearly covered with a cartilaginous crust, and in some few instances the substance has been cartilaginous throughout; when so, they are usually of a small size.

In other instances, and most frequently so, the cartilaginous crust, which they all seem originally to have possessed, appears to have been partially worn off by constant friction, leaving the surface of the bony portion smooth.

From their perfectly detached state, it proved at first very difficult to account for their formation, so that various conjectures, and some of these very improbable, have been formed concerning it; but nothing satisfactory was known until John Hunter's observations, not only threw light on the subject, but left their mode of formation, on some occasions at least, unattended with doubt. He observed that he had never met with these substances excepting in joints which had formerly, or recently, met with an accident; that, therefore, blood might at the time have been extravasated, coagulated, and have adhered to some part of the internal surface of the joint near to the edge of one of the bones; this might have become vascular, and the vessels of the surface to which it adhered shooting into it, and assuming the action they do in the formation of bone, might first change into cartilage, and then deposit bony matter in its centre, converting it gradually into bone. John Hunter supposed therefore, that these substances at one time, viz. while forming, adhered to the inner surface of the joint, near, if not immediately, to the edge of the bone; and this last seems probable, from the remains of a fine membrane being sometimes found on part of their surface and which appears to have formerly covered the largest portion of it: he further supposed, that projecting from the part which supplied them with vessels, they were broken off by some accidental force, and fell into the general cavity of the joint, and there, were gradually worn into the smooth and regular shape by the friction to which they were subjected. The preparations which are here produced admirably illustrate the truth of this doctrine. One preparation from our museum has pieces of bone of several different sizes placed round the edges of the three bones forming the joint; some of these firmly adhere, others slightly, and thus are liable to be broken off by a small degree of force; one large substance has become detached and afterwards has been worn into a regular shape and surface, by the friction of the bones of the joint; and by its pressure on some of their articular cartilages, has produced an abrasion of their surfaces.

In every case which has fallen under my own observation, where the previous history could be known, the joint, before these substances were found, had been affected by inflammation. I removed one of these substances from the knee of an officer nearly thirty years of age, and who had discovered the hard mass, which he then thought was of a larger size, several years before it gave him any great uneasiness, moving about in the joint: having had a fall, his knee had been weakened, and after this accident he had often suffered much inconvenience and pain from the substance getting fixed between the moving parts of the joint. His relations informed him, that his knee had been injured when he was two or three years old, which had produced then some lameness; but he had no recollection of the circumstance, and had not discovered the substance until several years after that period.

It is not impossible, but that similar pendulous tumours to those which we have seen growing on the inside of the synovial ligament, may ossify, then break off, and become loose, without the patient recollecting that he had ever experienced any former local injury.

These substances can be removed only by an operation; but as that operation consists in cutting into a very important cavity, which does not bear exposure with impunity, if the substance can be secured in a convenient part of the joint by bandages and compresses, this should be preferred to the risk which must be incurred by opening the capsular ligament. They often, however, prove so troublesome, inconvenient, and even dangerous, by insinuating themselves between the articular cartilages, that we are justified, when we find them lodged in a proper part for the operation, to remove them. I have known several instances of the operation succeeding, and none where such injurious consequences as some Surgeons apprehend have followed. The mode of performing the operation has been frequently described by authors, and is so well known, that it is unnecessary for me to say more of it here.

A case has been published by Sir Everard Home, in the first volume of the Transactions of a Society for improving Medical and Chirurgical Knowledge, where, in an artificial joint formed in the os brachii, a number of projecting parts covered with cartilage grew out from the exposed surfaces of the bone, some of these were small and some large, and others grew from the edges of the bones and newly formed capsular ligament, these last were larger, more irregular in shape, broader in their attachments, softer in their texture, and serrated upon the external edge. Thirty or forty small substances were found loose in the cavity, varying in size from a millet seed to that of a barley corn, they were of a roundish form and smooth on their surface. He infers, and the inference no one looking at the preparation which I now produce can doubt, that these bodies were originally attached, and afterwards broken off by the friction of the parts on one another.

When joints become stiff and immoveable they are then said to be anchylosed, although from the literal meaning of the term, the limb should at the same time be crooked. This effect may be produced by various causes, and these acting on different structures; anchyloses has therefore been divided into different kinds; but with those which depend on a thickening, or adhesion of the ligaments or some permanent contraction of the muscles, our present enquiries have nothing to do.

The anchyloses, which I produce specimens of, are dependant on bones which should have motion, directly or indirectly on each other, being deprived of this by being either immediately connected by the bony union of part of their surfaces, or by being joined immoveably to each other by some solid connecting medium, such as deposition of bony matter, or from their ligaments, or muscles being converted into bone.

In cases of gunshot wounds where the articular cartilages and other parts of a joint are destroyed, or when an abscess takes place in the cavity of a joint and the articular cartilages are absorbed, anchylosis is often a very desirable termination. In such cases, the vascular surfaces of the bones have shot out granulations which have united as in compound fracture, and by so doing the life of the patient has been saved although the motion in the joint has been lost. This process is however slow, and is not to be expected to take place but in constitutions of some vigour.

In other instances, union has taken place between the surfaces of bones which formerly moved upon each other, through the medium of an adventitous membrane, apparently formed of coagulable lymph, which being thrown out between, having adhered to and united the surfaces, and having become vascular, has been ultimately changed into bone. Union here having taken place without the formation of granulations. We now produce some specimens showing this process going on.

I have preserved in the Museum in Windmill Street, a wet and a dry section of a hip joint which had anchylosed so that the motion was entirely lost, without much alteration having taken place either in the os innominatum or in the femur, and where, apparently a single cartilaginous crust remains between the socket and head of the bone, adhering to both; nor has this anchylosis been tended with much adhesive ossific inflammation on the outside: I have seen no similar instance to this. The disease had taken place about eight years before the patient's death, but what symptoms then attended it I could not learn. The patient had, however, acquired the power of walking by throwing back the pelvis, although the anchylosis had formed in the complete bent state of the joint. This last circumstance I learned from Mr. Daw, formerly the House-Surgeon to St. George's Hospital, by whose kindness the preparation was presented to me.

Anchylosis sometimes has taken place, by the ligaments and other soft parts having been changed into bone by the adhesive ossific inflammation, and by a deposition of new osseous matter on the edges of the bones, altering their natural shape.

It sometimes has arisen from parts of muscles being converted into solid bone, so that the usual instruments of motion by this change have become the cause of its loss. One of the most remarkable instances of this kind is seen in the skeleton now produced, the person was only thirty-five years of age, and the bones of the trunk and most of the extremities have anchylosed: among many other bony connexions, there appears to have been a conversion of part of the latissimus dorsi muscle into bone which has united the pelvis, trunk, shoulder, and arm. The instances of bony anchylosis are so numerous that I know of no joint in which I have not met with their occurrence.

The anchylosis of the bones of diseased joints is in general an object to be desired rather than prevented: and I need hardly say that entire rest of the joint will contribute greatly to produce its accomplishment. Anchylosis threatening to take place from other causes, and where the articular surfaces of the joints are not diseased, we should prevent, if we had any certain means of doing so, and as we have not these certain means, we should have recourse to any which are likely to be of use. Passive motion, frequently employed, is among the best of those means, gentle frictions with the hand, and with the addition of the mild mercurial ointment and camphor, applied to the skin in the neighbourhood of the joint may be tried; pumping or pouring warm water on the joint and in the direction of its principle muscles, has been by some people thought useful, and when there is a great disposition to the deposition of osseous matter in muscles and other soft parts, a plentiful use of acids may be tried; the phosphoric acid in one instance, where I had an opportunity of watching its affects, appeared to have been of some utility.

LECTURE XIV.

ON SCROFULA GENERALLY, AND ON SCROFULOUS AFFECTION OF JOINTS.

IN a disease so common in its occurrence as scrofula is known to be in this climate, it might be expected that the boundaries between it, and other diseases originating in the same parts, should be so defined as to admit of a clear discrimination in practise; but the many different parts and structures of the body affected by it, produce such variety of symptoms, and some of these so similar to symptoms, which occur where there is no scrofulous taint, that the distinction between them is often of a very equivocal nature; thus many diseases of the joints may have been considered as scrofulous, and treated according to some received theory of the nature of that affection, although there may have been no scrofulous tendency either in the patient's constitution or in the diseased parts, merely because joints are very often the parts where scrofula exhibits its greatest ravages.

I propose to shew its effects on the joints, and to point out, where I can do so, the difference between these, and effects produced by other diseases; this I trust will apologise for a few preliminary observations on scrofula generally.

Scrofula most frequently takes place in glandular structures, but every part of the body may be affected with some symptom of this disease.

As it often attacks persons of the same family and in successive generations, it has generally been called an heriditary disease; but in what manner diseases are heriditary, has not yet been clearly ascertained. The process of conception, will not bear us out in the supposition, that diseased particles of matter can be transmitted from the parents to their offspring: for although scrofula appears to be continued in several generations of the same family, these shall not always be successive, for an intermediate one may escape its influence. Thus in three generations, the grandfather and grandson shall be affected with this disease, and the father shall have no symptoms of a scrofulous taint. In other families, children shall become scrofulous whose parents were not so; and in others, parents shall be scrofulous whose children are perfectly healthy. These facts are strong against the supposition of particles of matter being transmitted; for it must require abundance of faith to suppose that such matter should be transmitted from the grandfather, through the father, to the grandson, without having produced any effect on the father's constitution.

Also in those persons whose families are affected by it, the disease shall not shew itself for two, three or even a greater number of years, and when it does appear, and has remained long and produced very marked effects, it shall disappear soon after puberty; perhaps return again at the end of twenty or thirty years, or often not return at all. Another fact which should be noticed is, that scrofulous parents, who have left the climate of their birth, and resided long in one where the disease is rare, have produced children who have not been affected by it, nor has the disease appeared in any of their succeeding generations, while they remained in that climate. Also another, which likewise should be noticed is, that parents, whose ancestors and themselves have never been effected with scrofula, coming to reside in this or any other climate where the disease is frequent, have produced children who have been much affected by the disease.

Were the disease propagated by the actual transmission of matter, we should not, from analogy, expect, that change of climate would produce this great alteration; for the children of Africans born in this country have neither the colour of their skin nor their features altered from those of their parents. It is probable that no matter, but that on which the natural and essential structure of the animal depends, can actually be transmitted to the embryo: and the mules afford instances that such matter can be transmitted, as in them parts of both the parents are blended.

It is by no means certain that a father can transmit any disease at the time of generation to his offspring; for men whose constitutions have been strongly affected, and who have shewn every mark of the secondary symptoms of the venereal disease on their skin, throat, and bones, (not having any chancre or gonorrhea at the time,) have begotten children, who have lived, and had no symptom of that disease; nor have the mothers been infected from the intercourse. An infant, however, may be affected with this disease from its mother; children have been born with venereal spots on the skin, when the mother's constitution has been affected; and in other infants, these spots have appeared in a few days after birth; but these infections had taken place subsequent to, and not at the time of conception, the matter having been transmitted long after the generation of the infant.

Children are said to inherit similar passions of the mind to those which have been the most predominent in the parent; this, merely is asserting that they heriditarily possess the susceptibility, or disposition of the mind to produce these particular passions more than others; but still it must require some cause, more or less strong, absolutely to produce them. It is therefore reasonable to suppose that the pre-disposition, or susceptibility to be affected by scrofula is heriditary; but that the actual production of this disease arises from some accidental influence, as climate, or mode of life.

Scrofula is generally considered as a disease of weakness, but it is obvious that weakness alone will not produce it; for the constitution may suffer the greatest extremes of weakness without scrofula taking place, and scrofula will arise in different parts of the bodies of persons whose general constitutions are remarkably strong, It may be said that the parts attacked by it are weaker than in other people, notwithstanding the system generally is strong. Of this, however, we have no decided proofs, and if our practice in the treatment of scrofulous affections was always to be biassed by the supposition that in every state of the disease the patient was too weak to bear the application of any lowering means, we should often lose the opportunity of checking this disease in its earliest stages, for an inflammation of an active kind is often blended with the scrofulous affection. It is true, however, that scrofula usually makes it appearance at that period of life when the constitution is not the strongest, and often affects parts which have been weakened by some accidental cause.

It is well known, that those people who are said to be of scrofulous habits, have, in general, fair hair, also fair and thin skins, with delicate and florid complexions, and they usually have thick lips. In these the disease generally takes place between two years of age and seven or eight; about puberty it usually disappears, and sometimes returns between forty-five and fifty. It is not, however, confined to these periods, for in the joints, it will sometimes make its first attack at, or long after puberty, and is then not so much confined to complexion as when it attacks more early; for people of a dark, dusky complexion are often affected by it, but even in these people, it has been remarked, that the skin is usually thinner than in others who are equally dark. It is well known that in this climate it affects negroes, and that often to a great degree.

Cold, joined to moisture, and irregularity of climate appear to prove predisposing causes of this disease; for it is not found in those countries where the climate is warm and the weather constant. Children of scrofulous parents going early to reside in such climates shall in general escape its malignity; while the children of parents who never had a symptom of scrofula, coming to reside in a moist cold and changeable climate shall be severely affected by it.

This disease rarely attacks Africans in their own country, but in this it often destroys them. In this most changeable climate, it is certainly a very frequent disease. It is not confined to the human species, for monkeys, parrots, turkeys, Canary birds and even turtles, when kept long on their passage and preserved alive in this country, often have the joints of their fins much affected by it. In the coldest inhabited countries it is not so common as in the more temperate latitudes, the weather in them not being so changeable; cold therefore has less effect in producing it, than constant changes attended with much moisture.

Among the occasional causes producing scrofula, under circumstances of predisposition, may be enumerated almost every thing which will excite a diseased or unnatural action; thus scrofulous affections often happen after fevers, small pox, measles, chicken pox, or the venereal disease when affecting absorbent glands; common colds often produce it; so do strains of all kinds. The disease also often springs up without any apparent cause.

The structures most liable to be affected by scrofula, are the superficial absorbent glands, particularly those of the neck, the mucous membranes, the ligaments and bones of joints, more especially those which are formed by the softest bones and are the furthest removed from the centre of the circulation, as those of the foot, ankle, knee, hand and elbow; but those of the shoulder, pelvis, and lumbar vertebræ, are also often affected by it. The tubercles formed in the lungs have strong characteristic marks of being allied to this disease; it effects many of the abdominal viscera primarily, and all collaterally; so does it the brain and the membranes which contain that organ; in fact every part of the body may be immediately seized on by this disease, excepting perhaps the skin, in which it does not seem ever to originate; but to which its effects from other parts very frequently extend.

In true scrofulous inflammation the enlargement of the tumour and the inflammatory symptoms proceed very slowly, and it is attended with little or no pain; when the progress is quick and the pain great, a proportionate quantity of phlegmonous inflammation is blended with the scrofulous.

In some places the scrofulous inflammation, before suppuration, seems to be attended with a change of the substance of the part, which change appears like a deposition of new matter, of a white pulpy nature. The parts often remain in this altered state for years without suppurating, or perhaps do not suppurate at all: after this they seem to lose much of their active powers and are often converted into a curdly kind of substance peculiar to this disease, but which does not give the irritation of an extraneous body.

The suppuration of a part affected by scrofula, when it does take place, is seldom so perfect as to form true pus, although that secreted by scrofulous mucous membranes approaches very near to it; the matter is generally a compound of coagulable lymph and pus; sometimes it is glary, viscid, slimy and colourless with no true pus mixed with it.

Scrofulous ulceration is also a slow process, and when the matter reaches the skin, the sore will often remain for a long time stationary, it is seldom very painful; but sometimes it is exquisitely so, and its edges are, in general, much raised. Different parts of the same scrofulous tumour frequently suppurate at different times, so that the pus cannot be evacuated at once, as in other abscesses; but an ulcer is often formed, and even healed while another part of the tumour remains in an inflamed state.

Scrofulous sores must lose their specific quality before they can granulate. They often put on a shining smooth appearance and will remain in that state for years.

The cicatrizations of sores that have been long scrofulous, is also backward, the skin from having been long in a tumified state probably loses much of its elasticity.

Notwithstanding the frequent occurrence of this disease, it must be owned that we are very deficient in our powers to cure it; many pretended specifics have at different times been promulgated, and have been recommended by regular practitioners, empirics, and by well-meaning but credulous people. Some of these have been found useful in lessening the effects of the disease, when exhibited under particular circumstances, and have had more credit given to them than subsequent experience has justified, for no single remedy or mode of treatment has yet been found that could, in a few successive cases, effect a cure.

The disease very often disappears at puberty, which circumstance has given the credit of specifics to many medicines, and character of utility to some particular treatment used in or near that period; but we as yet are acquainted with none, either of the one or the other, that will eradicate the disease. Nothing proves more strongly that this disease has long baffled medical skill, than the absurd and ridiculous ideas which have been entertained, that the touch of particular men, some times of kings, sometimes of recently-executed criminals, should charm it away

While the pre-disposing causes, such as climate and particular period of life continue, medicine cannot be expected to have much effect in the cure; for we know so little of the true nature of the disease, that we can judge of no medicine, a priore, whether it will prove efficacious or not.

Change of climate would perhaps be the most certain means of cure; but as this can seldom be accomplished by the patient, the next best plan will be, to enable the body to resist the power of the climate, by using those means which will tend to increase the general health, such as attention to wholesome food, breathing in pure dry air, and using moderate exercise.

As regular temperature appears to lessen the effects of the disease, persons affected with it should wear warm, and sufficient cloathing to defend them as much as possible from cold and sudden changes. Sea air, and in some instances sea bathing will be found to contribute towards the cure, I cannot reason why this should be so, but from the experience I have had of cases sent to the neighbourhood of the sea, I am justified in saying that the result although often disappointing, has upon the whole been favourable.

A marked degree of indolence in the part is one of the usual symptoms of a scrofulous affection, and those Surgeons who have formed their practice on the theory of the want of action, have used local applications of a very stimulating nature, and have shunned even the temporary use of those means, which by weakening the part or system are known to prove successful in lessening common inflammation. I shall here only remark that phlegmonous inflammation, in very different degrees, not unusually accompanies at some period the progress of scrofulous enlargement; and therefore that the Surgeon, instead of flying to the extremes of practice, should carefully consider the particular state of each scrofulous case, as to the prevalence of phlegmonic or strumous symptoms, and regulate his treatment accordingly. Thus in some cases, from the prevalence of active inflammation, it may be necessary to bleed; in others, to increase the action of the part and system.

When scrofula attacks the bones, it usually begins in those parts which possess the greatest quantity of animal matter, and which are consequently the softest and most vascular. The extremities of the bones concerned in the formation of joints are therefore the most frequently affected by scrofula, and from the bones it spreads to the other structures entering also into the composition of joints, and the soft parts surrounding them; but it sometimes begins in the synovial membranes, and even in the capsular and other ligaments, and spreads from them to the extremities of the bones. The articular and inter-articular cartilages, so far as I have been able to ascertain by the dissection of scrofulous joints, suffer not from the disease originating in themselves, but from it extending to them from other and more vascular structures.

In a true scrofulous affection of a joint the disease begins almost imperceptibly, and insidiously steals on without alarming the patient, it not being accompanied with much pain. The change of structure in the part takes place by very slow degrees, no active inflammation attends it, and therefore no redness or discoloration of the skin is produced by a determination of blood to the surface; on the contrary, from the indolence and pressure of the tumour, less blood than usual appears to be circulating in the cutaneous vessels, giving a more pallid hue to the integuments, from which the term white swelling has been applied to the disease.

In other instances, diseases of joints, which eventually are found to have the same morbid appearances that are met with in the last stages of white swellings, begin with pain, more or less severe, according to the quickness of their progress and the quantity of action which may accompany them. These cases are never purely scrofulous, they have much common inflammation mixed with the scrofulous disposition. From this variety we find authors, who have written on this disease, often using the terms of acute and chronic white swellings, and in the treatment of these swellings it is always necessary to consider how much of common inflammation does actually attend, that our remedies may be better adapted to the cure of the disease.

A scrofulous affection of the joints will often originate without any known cause, although the patient generally attributes it to some slight injury; and in a scrofulous habit, it certainly does often happen, that any irritation or injury, occurring in a part of the body liable to be the seat of this disease, and sufficiently strong to produce common inflammation, shall excite the latent disposition into action; for after the common inflammation has subsided, a scrofulous affection shall be found to have taken place and shall remain in the part. Exposure of the joints to cold and moisture is often the only cause to which the production of the disease can be traced.

When its origin can be traced to some accidental injury, the disease is often confined to a single joint; but when it arises from constitutional causes several joints may be affected at the same time, although one of these will in general take the lead and advance more rapidly to its last stage.

In young people this disease occurs very frequently; it very rarely takes place in the middle of life; but will sometimes appear at its decline. When it attacks early in life, it is usually accompanied by scrofulous affections of other parts of the body, particularly of the absorbent glands of the neck and mesentery; but when it begins after puberty, it often goes on without any marked appearance of scrofula in any other part of the body.

Before any swelling is perceptible, a dull but slight pain is often felt deep-seated in the joint; not sufficient however, if in the lower extremity, to prevent the person from walking, or if in the upper from using the arm for common purposes. Sometimes a swelling attended with a sensation of weakness but without pain is first perceived in the joint. The disease is therefore seldom noticed at its first occurrence, for the progress of it is so slow, and the action so indolent, that the ligaments often become very much thickened and diseased, and the bones carious, without much pain having been previously felt, or the general health of the patient visibly impaired.

When it begins in young children, the swelling is often firm to the touch, but sometimes in them, and more markedly so when it commences later in life, there is a feel of puffiness which might lead to the supposition that some fluid had been extravasated or secreted immediately below the integuments, did not repeated experience prove that the sensation was fallacious.

Soon after its first formation the tumour possesses a peculiar feel of elasticity when pressed on, certainly different from that which is met with in other tumours, but still not very dissimilar to the sensation which is perceived when the fluid matter of a very deep seated abscess is felt through a thick mass of diseased soft parts; but should a small opening be made to evacuate the supposed fluid, none will pass through it, and a probe if inserted into the opening will, in general, reach a naked and diseased surface of one of the bones. In this state, no change takes place in the colour of the skin, although serum and a large proportion of the coagulable lymph appear to be poured out in considerable quantities in the interstices of the cellular membrane. From the tension, hardness, and thickening of the ligaments and other parts external to the cavity of the joint in addition to this effusion, and also from the wasting of the limb from the want of its being properly used, the extremities of the bones, to external feeling, will often seem to be enlarged, although on dissection they are not found to be so.

Much stiffness in time takes place, and as it increases, so also does the pain at every attempt at motion; this causes the patient to keep the limb in a half bent position, which is generally the one most free from pain, Even now the pain is not constant, but is felt chiefly in the attempt at motion, nor is it so depressing as that which takes place when very active ulceration, succeeding common inflammation, is going on in the joint: indeed in some patients, the pain is far from being the most troublesome symptom of the complaint. The limb below the joint now becomes, from the shrinking of the muscles, much less than the opposite sound limb, and this gives an additional appearance of largeness to the swelling.

As the skin becomes more distended, the superficial veins having the return of blood from them obstructed, as in other instances of indolent tumours, become enlarged and sometimes varicose, sometimes indolent ulcerations take place on the surface of the skin.

In other instances, symptoms of more active inflammation shall arise, abscesses shall form under the skin, and a fluctuation of matter shall be perceived in some parts of the tumour. I have known several abcesses take place in the neighbourhood of a scrofulous joint, which did not communicate with its cavity, but were situated in the space between the capsular ligament aud skin: some of these have burst or been opened, and afterwards have healed; others have terminated in fistulous cavities, and occasionally formed communications with the disease in the internal surface of the joint.

Sometimes a fluctuation of matter is perceived evidently in the cavity of the joint, it works its way slowly to the surface, the skin now becomes red and inflamed, and at last ulcerates or is burst, and a thin purulent matter is discharged; at other times a glairy viscid matter, and rarely, although I have in a few instances seen it, matter much resembling tolerably well-formed pus. The opening sometimes closes, but soon bursts open again; it then remains in a fistulous state, through which a fluid is discharged generally having some flakes of a curdly substance mixed with it. The matter discharged, is sometimes intirely of a thick and chalky nature, resembling that found in scrofulous glands, but more generally it is thinner, and often very fetid and tinged with blood. A probe being inserted into the fistulous opening, will pass on to a portion of denuded and carious bone, and in general it will be discoloured when withdrawn from the sore.

Before the abscess in the joint bursts externally, it generally will be found that the matter, instead of coming directly and by the shortest rout to the surface, shall have worked its way in several directions among the cellular membrane connecting the ligaments, muscles, and skin, thus many sinuses are formed, some of which become fistulous, and much coagulable lymph and serum, is frequently effused in the cells bounding their course.

Fungous excrescencies will occasionally arise from the diseased internal parts and push outwards, and when the limb is moved the surfaces of the carious bone will be felt to grate against each other; and loose pieces of bone and cartilage will sometimes be discharged through the opening.

In many instances, should the diseased parts not be removed by an operation, from the constant irritation and drain, the patient's constitution gives way, hectic fever takes place, violent purgings come on, and death closes the scene.

This is not however the invariable result, for it sometimes happens, that the parts assume a more healthy action, anchylosis takes place, and the patient recovers, suffering only the penalty of a stiff joint. This is occasionally effected by bony union, but occasionally by a mass of organized matter deposited between, but adhering to the surfaces of the bones which formerly were covered with articular cartilage. Indeed in some instances, under favourable circumstances of age and constitution, a limited motion in the joint has been preserved, or regained.

Various appearances present themselves on the examination of white swellings of the joints, after the amputation of the limb or the death of the patient.

When opportunities have occurred to me of examining the joints at an early period of the disease; I have found in the tarsus and carpus, the substance of the bones much softer than usual, so that they could be divided readily with a common scalpel; and in the extremities of the cylindrical bones forming joints, I have met with the same degree of softness; in this state they seem to be highly vascular, so much so, as, when recent, to appear of a very red colour, and when injected, to possess as many vessels as most of the soft parts; I have seen them thus, and still covered with their articular cartilages, these substances not having been as yet injured by ulceration or absorption.

The synovial membrane has also appeared to be thicker and more vascular; sometimes the capsular and other ligaments have also been in a thickened state, and a larger quantity than usual of synovia has been found in the cavity of the joint.

As the disease proceeds, coagulable lymph is thrown out, and adheres to the inner surface of the synovial ligament, it also extends between the articular cartilages, and in joints which possess inter-articular cartilages or ligaments it likewise covers them; but the extent of this covering is different in different cases, so is the thickness of the deposited lymph; this lymph becomes vascular, and absorption of the cartilages now takes place. In some cases the cartilages are entirely removed, and in others partially so; in some an absorption takes place on both surfaces, the external surface appearing to be acted on by the vessels which have shot into the new membrane formed of the coagulable lymph, and the absorbents of the bone acting on the other surface in contact with them. I have found large masses of the cartilage detached with the outer surface unaltered, but with a thin lamina of bone adhering to that which was separated.

Ulcerations are also met with in the synovial ligament; an imperfectly formed purulent fluid is found in the cavity of the joint, with shreds of coagulable lymph floating in it, detached, and in some places adhering to the surface of the cavity. The curdly matter, peculiar to scrofula, is also occasionally found.

After the articular cartilage is absorbed, the surfaces of the bones become carious, ulceration extends into their cancelli, and scrofulous matter is often deposited in their cells; fungi arise from some parts of the surface, and exfoliation takes place from other parts. The process of exfoliation appears to go on very slowly, and when the dead bone is detached from the living, becoming loose in the joint, it tends of course to increase the general irritation.

The bones although very soft and in this carious state, I have already observed, are not found to have their extremities enlarged, although most authors, who have treated on white swellings, have described them as being so. Our late professor of comparative anatomy, Mr. Lawrence, who had long been in the habit of paying great attention to all morbid alterations of structure which occurred in the public and private dissections at St. Bartholomew's Hospital, having remarked that he had not met with a single specimen of bones being actually enlarged in white swellings, took every opportunity of examining joints affected by this disease, and being convinced that the opinion entertained of their enlargement was unfounded, he communicated this to Mr. Crowther, who published the observation, in the second edition of his work on white swellings. Mr. Samuel Cooper had also, it appears, made the same remark. I may be permitted to add, that every examination I have made since then, and these have been numerous, confirm the justice and accuracy of Mr. Lawrence's and Mr. Cooper's observations.

The soft parts covering the joint, viz. ligament, cellular membrane and muscle become thickened, indurated, and changed in places into a greyish curd-like substance ; all distinction of parts is in many places lost, and sinuses, some filled with scrofulous matter, and others with illconditioned purulent matter are found, as I have before stated, running in various directions. The opportunities of examining the appearances of scrofulous joints in their progress towards recovery, have, for obvious reasons, been less frequent, than when the joints were in a state of progressive disease, or after their recovery. In those which I have examined, in which the curative process had begun, in some, I have found the ligaments thicker than usual, with a soft substance, which seemed to have been when first thrown out coagulable lymph, but now forming a solid and organised mass, adhering to a greater or lesser portion of their internal surface; and in cases where the articular cartilages had been absorbed, this substance was found to pass between the surfaces, which when covered with cartilage moved on each other, and now to unite them by adhering to, and receiving vessels from each.

In other instances, the bony surfaces from which the cartilages had been removed, had become hard and polished, and although the ligaments were thickened, some limited motion of the joint had been preserved. These cases were generally attended with some external deposition of bony matter from the ossific adhesive inflammation having taken place in the ligaments and cellular membrane. In cases where the matter had a free escape from the cavity of the joint by a direct and depending opening I have met with the appearance of granulations arising from the surfaces of the bones from which the articular cartilages had been removed.

In one instance I found the cavity of the joint filled up with a solid substance which adhered to the bones wherever the cartilage had been absorbed, but where it had not been removed, it adhered slightly to the surface of the cartilage, I could trace vessels from the bone passing into it, but could not trace them passing into it from the cartilage.

I have never met with an instance of articular cartilage having been regenerated; in those cases where motion has been preserved after the bones had been found to grate on each other, the surfaces have either been covered with a ligamentous substance, or have become hard and polished like enamel.

The mode of union by anchylosis has already been described and shewn.

In the treatment of scrofulous affections of the joints, no plan likely to be successful in all can be pointed out, for the treatment demands to be varied according to existing circumstances which might accompany the scrofulous character, and the particular joint affected by it, also according to the nature and quantity of the soft parts which are implicated in the disease.

The joint being kept at rest, and as free from internal irritation as the nature of the case will permit, must under every circumstance be right, so long as the disease is going on. When the disease is likely to terminate by an anchylosis, it cannot be kept too quiet, as every motion given to it must tend to prevent the accomplishment of that desirable event; but great care at this time should be taken in placing and retaining the joint in such form, that the loss of motion shall be productive of the least inconvenience; thus when the knee, hip, wrist or toes are likely to anchylose, the position should be extended or straight; when the elbow, the arm should be a little bent and pronated; when the fingers, these should be also a little bent; and when the ankle, the best position is the foot forming nearly right angles to the leg.

In cases where phlegmonous inflammation is joined to scrofulous action, the abstraction of blood from the skin and cellular membrane, by the application of leeches, or by cupping and scarifying, has sometimes been found useful, and has been strongly recommended by some practitioners in every case of the commencement of scrofulous affections of the joints, founded, as they assert, on the strong ground of experience having proved it to be advantageous. It certainly is so under the above-mentioned circumstances; but as far as my own experience allows me to form an opinion, and in this opinion I am confirmed by the experience of many others, where no inflammation of the common kind is apparent, but where the sluggish indolent scrofulous character exists unmixt, the disease seems rather to gain ground than to be diminished when the practice of local bleeding has been resorted to. Still the practice under certain states of scrofula is proper, and often the best that can be used; but it is useful in checking an action accompanying the specific one, and not the specific action itself; it therefore should only be used when the adventitious action is present, and the extent of its use should be dependant on the degree of that action.

Experience has proved that those applications which produce cold by evaporation are useful, not only when the skin and contiguous parts are affected by inflammation, but also in cases of deep-seated scrofulous occurrence, even at their commencement when little pain is felt, and more indolence than action is perceptible. It is not easy, upon the first consideration, to reconcile these applications being useful in such different states of the diseased parts; as in the first, they are used to lessen, and are evidently successful in lessening the flow of blood to the part, and diminishing its increased action; but in the second, the disease does not seem to be attended either with too much blood, or too much action, on the contrary, there appears to be a deficiency of both. I can only account for cold evaporating applications being useful in the last instance, by their contracting the vessels belonging the external parts, and thereby preventing the usual quantity of blood from entering them; and as the trunk from which these branches proceed must receive the same quantity of blood, that it did before their application, from each contraction of the heart, more blood must be sent to the diseased internal part, and if the action of the vessels was before too indolent, a more healthy action may be excited. As cold applied to the surface of the chest will sometimes excite the pleura to inflame by determining too much blood to that membrane; when applied to the skin of the ankle wrist, or knee, it may, by determining more blood inwards, remedy an indolent affection in the more internal parts of the joints.

When cold evaporating lotions are used, all preparations of lead should be excluded from their composition, for this mineral is found to weaken the powers, as well as the actions of the parts; and although it may at first appear to lessen that pain which arises from inflammation affecting the skin, it will ultimately tend to make the parts on which it acts more susceptible of the indolent scrofulous disposition.

When the pain attending these affections of the joints is very considerable, and seems to arise from, or to be increased by, the tension of the skin and parts immediately within it, fomentations with some tinctura opii, a : poultices with a solution of opium blended with them, used of a warmth very little exceeding the natural temperature of the body, will be found serviceable in removing the tension and pain of the external parts, and thus of lessening the more immediate distressing symptoms; but after having effected this, they are not be persevered in as applications likely to cure the deep-seated original disease. They are to be used as in cases of common inflammation, when from the presence of a degree of that action in scrofulous affections, where the continuance of it may not be wanted, we wish for its removal.

When abscesses form in this disease, experience has shewn that no advantage is derived from their being early or extensively opened; many parts of the body when in a scrofulous state, will neither bear much cutting or exposure; when the one is used, or the other produced, extensive sloughing, or the formation of fungi are the usual consequences. The propriety of opening these abscesses or allowing them to burst, must be determined by their situation and the symptoms attending them; but the opening when made should never be large.

When a curative process seems to have began, and when the joint seems disposed to anchylose, but some fistulous sinuses which we wished closed refuse to heal; having ascertained their direction and extent, a seton can be passed through each; it may be continued for a few days, when withdrawn it will often occasion the healing of the fistulous cavity, and that very rapidly. In some cases of fistulous sinuses, pressure by stripes of adhesive plaster spread upon linen, or compresses of linen, lint, or other materials, may be applied to keep the sides of such sinuses in contact; but care should be taken in doing this not to obstruct the circulation of blood in the surrounding soft parts, and also to apply the compressure, so that it may act on the whole length of the sinus at once. Dilatation of the fistulous opening is seldom attended with any advantage, and frequently when used, is productive of an extension of the disease.

Two cases have been published by Mr. Charles Bell, in which complete success, so far as the production of anchylosis can be so considered, attended the introduction of a seton across the knee joint. Both cases had been condemned to amputation, and the patients had come into the hospital, wishing that operation to be performed; but both left it with the limb retained, and the joint anchylosed. I have seen this practice succeed in a case where suppuration had been going on in the cavity of the knee joint for three months; a seton was then drawn across it; for four or five days the irritation was very great; on the seventh day the purulent discharge had lost its formed fetor, and in seven weeks the seton was withdrawn; a few days after this the opening cicatrized, some tenderness in the joint still remained, but anchylosis appeared to have formed; the person was nineteen years of age.

When fungi arise from the diseased surfaces, it is not often necessary to remove them by violent means; indeed when this is attempted it rarely succeeds; for they almost immediately return; when not meddled with, they will generally subside as the disease advances towards a cure. Still when from their situation fungi ~~they~~ have proved very troublesome, I have not found that destroying them with lunar caustic, when the neighbouring parts were defended from its action, has produced any inconvenience, but on the contrary, often a temporary, and some times a permanent advantage.

In cases of white swellings, before any active inflammation has taken place in the skin, but where the joint appears to be much enlarged, blisters applied to the nearest integuments, then healed and frequently renewed, will sometimes assist in lessening the swelling. I have found this practice as useful upon the whole, as keeping up a discharge from the surface by the savine cerate, for the last sometimes occasions an almost insupportable irritation. In cases where the above named applications have been tried, and in which we have reason to think the disease in the bone is increasing and matter forming, a constant discharge being kept up from the external parts, as near as possible to the affected part of the bone, by caustic issues, or setons should be had recourse to; and it will often be found productive of much advantage in arresting the progress of the disease, and occasionally in effecting cure.

I was consulted respecting the probable event of a case, where the lapis septicus was applied so freely on the skin on each side of the patella of a child about seven years of age, that two most extensive and apparently very deep sloughs had formed; the parts fortunately were very much thickened by the scrofulous disease so that the cavity of the joint was not exposed, but the ligament bounding it was laid bare to a very great extent, and fluid perceptible within it. Although the first appearances were alarming, the child being kept at rest, and the strength supported, healthy granulations arose from the ligament, the wounds filled up, the skin, which had been previously much stretched contracted, and the joint recovered so as to have a very considerable degree of motion preserved: it is now four years since the wound cicatrized, and the knee has continued free from disease.

The use of mercurial frictions has often been tried in scrofulous affections of the knee; in a true scrofulous case it seldom has been productive of any effect in stopping the progress of the disease; but in cases of a mixed nature, where active inflammation had formerly been present, but had terminated in an indolent swelling, with the feeling of fluid contained in the cavity of the joint, it has often been found useful in resolving it. In the inflammatory stage, friction is injurious.

In one instance indeed in an enlarged knee joint, which appeared to be of a scrofulous nature and had taken place in a person formerly much affected with glandular swellings in the neck, and had remained nearly indolent for three or four years, upon its beginning to give pain, one drachm of the mild mercurial ointment, mixed with some camphore, was ordered to be applied to its surface and to remain there during the night; next day a soreness of the mouth was felt, which was soon succeeded by a most violent salivation, the extent of which threatened to destroy the patient, as she had recently lain in; the swelling, however, from that single application began to lessen, and in three months had completely disappeared: she recovered slowly of the ptyalism, and so far as I know has remained well ever since. Sir Everard Home saw this case with me about fifteen years ago.

When extensive ulceration of the ligaments and absorption of the articular and inter-articular cartilages of the knee joint have taken place, and more particularly after the soft parts have suffered much distention, a dislocation has sometimes occurred of the knee. The tibia in such cases has been drawn backwards, and lodged in the ham by the gradual action of the flexor muscles; in this position it has anchylosed with the back part of the femur, and the patient has recovered. This state of the part is readily distinguished by the alteration of the joint both to the eye and to the hand.

When it is wished that anchylosis of the knee joint should take place, a splint of tin properly adapted to the leg and thigh, will be found very useful in keeping the limb free from motion, and preserving the bones in the most favourable situtION for the union to be effected in.

From the success which has followed the introduction of a seton into the joint of the knee where amputation must otherwise have been performed, in cases which will admit of this practice being tried without endangering the patient's life by delay, no one, I trust, will now hesitate to make the experiment; enough has been already done to shew that no additional danger has arisen from it in any case, in several that some advantage has been derived from it, and in a few, that it has preserved the limb, with the loss only of the motion of the joint.

LECTURE XV.

ON ABSCESSES OF THE HIP JOINT, AND ON INCURVATIONS OF THE SPINE FROM CARIOUS VERTEBRÆ.

THE suppuration and ulceration of the hip joint form a disease which is so frequent in its occurrence, is attended with so much derangement of the natural motions of the body, is so painful in its duration, and dangerous in its consequences, that I feel justified in calling your attention to its particular effects on the form and motion of the skeleton.

Diseases of the hip joint, not arising from some obvious accidental cause, are generally considered to be of a scrofulous nature. Ulcerations of the parts composing it, certainly occur more frequently in people whose habits are scrofulous than in any other; but they may arise and be carried on, without producing any marked symptom of being scrofulous, or the person in whom they occur having been predisposed to that disease. More generally, however, the disease has a scrofulous character in the constitutional symptoms it produces, as well as in its local effects.

A slight accident in a habit pre-disposed to this disease, may excite it to action, when it otherwise might have remained dormant, and may do this at periods of life when scrofulous action does not usually appear.

Disease in the hip joint has generally made some progress before the aid of the Surgeon is required; and even then from the thick mass of muscle surrounding the cavity, the extent of its progress cannot be ascertained by the touch, and therefore it can be judged of only by careful attention to its peculiar symptoms.

It is not confined to those periods of life when scrofula usually makes its attacks; it will occur at all periods, but much more frequently before than after that of puberty.

It often forms a very complicated disease; for the soft parts suffer much from the length of the course that the matter must take to reach the surface of the body; so that fistulous passages are not unusually found, forming communications with various other structures, and leading to various different parts of the surface of the body from the remains of this important joint, the cavity of which is freqently obliterated, or filled up with a diseased mass of organized matter.

On dissection the appearances met with, will be found to vary more in circumstances marking the extent of the disease, than any difference in its nature.

In an early state the articular cartilages appear abraded in some parts, and absorbed in others;

the ligaments appear to be more vascular in some places and thickened in others; the synovial membrane is lined with coagulable lymph adhering to it in different degrees of thickness; this substance also lines the acetabulum, and is often spread over the head and neck of the femur. As the disease proceeds, the articular cartilages are completely destroyed, both on the head of the bone and in the socket; the bare surfaces of the bones now become carious and ulcerate; the socket is widened and rendered more shallow by this process, and the head and neck of the femur is lessened, so that the parts composing the joint no longer are fitted to each other in shape. The ligamentum teres ulcerates, and is in time completely absorbed; the remaining part of the head of the bone is soon displaced, and by the action of the muscles is drawn upwards and lodged on the dorsum of the ileum, thus producing a dislocation from an internal cause: this effect was known to the antient medical practitioners, but the cause of the displacement of the bone, they seem to have been unacquainted with. Cases are said to have occurred where the upper extremity of the femur, when dislodged from the acetabulum, has been drawn downwards and inwards on the foramen ovale, and has remained there. I have seen no instance of this kind, nor have I met with any preparation showing that it had ever happened.

The edge of the acetabulum formed by the ligamentous cartilage is absorbed; the purulent matter, thrown out in the joint, passes through ulcerations of the thickened and diseased capsular ligament, forming often long sinuses; or large abscesses before it reaches the surface, sometimes these open on the nates, sometimes in the groin, and not unfrequently on the upper part of the thigh. Ulceration will sometimes extend through the bottom of the acetabulum, and the matter pass into the pelvis, where it descends and forms fistulous openings by the side of the anus; and it has been occasionally found to work its way by ulceration into the rectum. Pieces of exfoliated bone have sometimes been discharged through the openings of the abscesses; but this is far from being so usual as in ulcerations of the joint of the knee.

In the latter stages the acetabulum is sometimes filled up by a whitish organized substance of different degrees of hardness in different cases, and in different parts in the same case; all distinction between the synovial membrane, the capsular ligament the cellular membrane and this new substance seems to be ~~the~~ lost, the whole being converted into a similar mass. The muscles become much wasted and loose their distinctness; the hip therefore of Symptoms the affected side is much less prominent, or rather much flatter than the other, and is often intersected by sinuses discharging very fetid purulent matter.

In cases where a curative process appears to have began, organized coagulable lymph is found between the bony surfaces which have lost their articular cartilages, thus forming the connecting medium through which anchylosis takes place; the upper part of the femur becomes in this manner united to the surface of the innominatum on which it happens to have been placed, and the acetabulum is filled up, partly by newly formed soft matter, and partly by the adhesive ossific inflammation, occasioning the deposition of some osseous matter in particular places.

In some instances, after the cartilaginous crusts have been removed from the acetabulum and the head of the femur, these parts of the bones have anchylosed, without the femur having been dislodged from the joint. In one instance I have already shewn an anchylosis taking place between the pelvis and femur without ulceration, the articular cartilages even remaining, but appearing to be much compressed.

The great extent to which the disease is carried, and the long and painful sufferings of the patient when it goes on, form strong inducements for every Surgeon to become as well acquainted as the nature of the disease will allow of, with the symptoms produced by it at its commencement, so as to attack, and endeavour to arrest its progress before it extends beyond the powers of our art.

Some diseases affect the constitution, so as to produce much alteration in many of the general actions of the body previously to their appearance in some local form; as in the small pox and measles, a fever exists before the eruption takes place. This is not so in scrofula, for a local effect takes place first, and the constitution suffers apparently from its occurrence, and does this in proportion to the importance of the part, and the number of stuctures affected.

Thus the first symptoms of a scrofulous affection of part of the body, not being attended with much pain, is often disregarded, and the disease allowed to make a certain progress before attempts are made to check it; or the attempts made, are only those which might effect its cure by strengthening the constitution, The disease in the hip joint is in this way often overlooked at first, and no local treatment had recourse to for its cure until it has made considerable advances.

Although it often begins without much pain, as it proceeds this symptom gradually comes on and increases to a great degree of violence. The constitution of the patient is seldom much affected at first but frequent fits of languor take place, relieved occasionally by those of cheerfulness; the languor increases and become more constant, and the countenance becomes pale, the desire for exercise becomes less, a kind of listlessness comes on, and when the attempt is made to walk, a degree of lameness, (that usually called limping,) is perceptible, which in children is often mistaken for an acquired awkward gait. The pain is not always referred at first to the hip joint, it is often referred to the loins and groin; and as the disease advances to the upper part of the thigh, the inside of the leg, or to the heel; but by much the most frequently to the knee. Occasionally the pain is referred to both the hip and knee; but that felt in the knee is usually described as the most severe. Sometimes it is referred to the knee only, and is felt there so violently, that the patient and the relatives are with difficulty persuaded that the knee is not the situation of the disease. Many instances have occurred even of medical practitioners mistaking its seat, and without even suspecting that the disease was in the hip, all their remedies have been directed to the knee. The limb is subject to occasional startings during sleep, and the sufferer often expresses the intense degree of pain these occasion, by sudden and involuntary screams, referring the agony chiefly to the knee: notwithstanding this, when the knee is examined, the only appearance of alteration is, sometimes, but that not often, a little puffiness of the skin, which may arise from the patient constantly applying his hands to the part. The thigh and leg when compared with those of the opposite side, will now be found less in circumference in their muscular parts.

The limb, to the feelings of the patient, and to the eyes of a casual observer, will seem to be elongated, so that the patellæ, when viewed in the standing position of the body shall not be in a line, the one belonging to the affected side being the lowest; it will also appear so at first, when the patient is placed horizontally on his back, unless the straight position of the pelvis is particularly attended to. The supposed elongation of the limb has been attempted to be accounted for, by the head of the femur being pushed downwards by the substance which in this disease sometimes fills up the socket; but if pressure took place from this cause, it would be outwards not downwards. The limb in point of fact is not lengthened; but only appears to be so, from that side of the pelvis being depressed. This appearance of depression is produced by the positions of the sound and affected limbs when the person is standing; the principal weight of the body, to avoid pain, is then thrown upon the sound limb and born by it when extended, while the diseased thigh is carried forwards, and the knee bent: in this position to permit the foot to touch the ground, the pelvis of that side must be lowered in proportion to the bending of the two joints of the thigh and leg; the spine is concerned in allowing this, and is, of course, a little bent, and, when anchylosis of the hip joint takes place, it retains this bend; but previous to anchylosis this curve of the spine may be remedied in a few days, if the patient is confined during that time to the horizontal posture.

Mr. Crowther, in the last edition of his work on white swellings, has very clearly stated the obliquity of the pelvis to be the cause of the apparent elongation of the limb. His first idea of its being so arose from some observations of Dr. Falconer; on his mentioning which to Mr. Lawrence, he was informed by that gentleman that John Hunter had attributed the appearance of lengthening of the limb to the situation of the pelvis, and that the observations of Mr. Long had confirmed this. Mr. Crowther and Mr. Lawrence then made a very accurate examination and measurement of the spine, pelvis, and limbs, in two well-marked cases of diseased hips in children, and found the fact to be so.

The thigh early in this disease is usually bent forwards, and the knee is also kept in the bent state, the ease being the greatest in that position; and after some time, the weight seems rather to be supported on the toes, than on the flat sole of the foot. It is therefore the trunk, by bending towards the affected side in walking, that produces the limping which so constantly attends this disease.

When weight is born on the limb, the pain is greatly increased; so is it, when, in the horizontal posture, the femur is pressed, without bending, against any part of the acetabulum, particularly when pressed upwards; for the articular cartilages, or the surfaces which they originally covered, are then made to press on each other, and when ulceration has taken place, this pressure always produces much pain. The pain is not found to be so great, on pressure being used, before ulceration has began.

As the disease goes on, any attempt to extend the thigh is always attended with violent pain.

A great degree of tenderness takes place in the groin, and the absorbent glands in general enlarge. The symptoms, having proceeded thus far, will sometimes remain stationary for weeks or even months, indeed will sometimes appear to subside, when, suddenly and without any apparent cause, they shall be reproduced, and shall be carried on with greater violence than before.

From the ulceration of the head of the femur and of its socket, the bones cannot remain in their natural situation; for from the action of the muscles, what remains of the head and neck of the femur, no longer being retained by the acetabulum, is drawn upwards, and rests on the os ilium above that cavity. The toes will in general in this state incline outwards, if much absorption of the bones has taken place; but if the thigh has been much bent, and the neck of the bone but little shortened, as in other dislocations the toes will be inclined inwards. When the os innominatum has been much diseased, it has happened that a portion of the edge of the acetabulum has been broken off, and carried upwards with the femur.

Suppuration of the cavity of the joint sometimes precedes the shortening of the limb; but this shortening frequently takes place before the matter is felt under the skin. In some instances the limb has become shortened and anchylosed, without any apparent suppuration. After the shortening, however, matter usually forms, and, in the manner formerly mentioned, works its way to different parts of the surface of the body, but most frequently to the skin covering the outside of the upper portion of the vastus externus muscle. Pus tolerably well-formed is sometimes discharged at first, but afterwards the discharge becomes thin, bloody, and fetid. Sometimes a thin fluid issues out with solid matter floating in it, and as Mr. Ford has expressed, not dissimilar in appearance to curds and whey. The fluid is sometimes, but not often in this joint, viscid and glairy.

Many dissections of these diseased joints, with histories of their respective cases, have been published, and can be referred to in the valuable works of Russell, Crowther, Ford and Brodie, and which render it unnecessary for me to give the history of any particular dissection, although many, from the length of time I have been engaged in teaching anatomy, must have come under my own observation.

The management of the disease, under its different forms, has also been so fully and judiciously commented on, that any enlargement on the subject in this place, might be supposed to arise from an idea that the works of the authors alluded to were not sufficiently known; but to the persons who compose this audience, these works are well known, and their merits properly appreciated.

Several of the observations, which I have already made on the ulceration and suppuration of the joints generally, will apply to the treatment of those actions when occurring in the the hip; others will not so well apply, for example, from the great thickness of muscular flesh between the cavity of the hip joint and the surface of the body, the cold evaporating lotions are not likely to prove so useful in checking the disease, as they are found to prove in joints which are more thinly covered.

When inflammation of an active kind takes place in the joint, or in the parts contiguous to it, and is attended with painful throbbing, quick pulse, and much preternatural excitement of the whole system, bleeding by leeches, or cupping from the vessels near the joint, or even bleeding from the arm when the patient's constitution is tolerably strong, will often be productive of temporary relief; but bleeding alone will not be sufficient to cure the ulceration which has began in the joint. Among other means, particularly in the early stage of the disease, the occasional use of the warm bath will sometimes be attended with alleviation of the pain.

In this disease, under any circumstances, the most perfect quietude that can be obtained should be given to the joint; for all motion must necessarily tend to increase the disease when ulceration is going on, and to prevent anchylosis from being completed when the curative process has began. Every Surgeon will consult his own judgement how that quietude can be procured, and recommend the means to his patient. The horizontal posture will, of course, be the position chosen for the patient to remain in; and all sudden motion from contraction of the muscles should be carefully guarded against.

It must be recollected that the limb will prove more useful, if the thigh is not too much bent; it will be impossible indeed to keep it constantly and perfectly extended, nor is it necessary to attempt this; but attention should be paid to prevent it from being much bent, for an anchylosis in that position of the limb would not only produce deformity; but the difficulty and inconvenience in progressive motion would be much increased.

Blisters repeatedly applied, or kept open by some stimulating cerate, will often be attended with much good effect in stopping the progress of, and even in curing the disease. They can be applied to every part of the surface of the skin surrounding the joint, but the nearer they are placed to the cavity, the more useful are they generally found to be. I have also found that blisters applied to the loins, the inside of the thigh and to the knee, have sometimes procured sudden relief to pain, which before was excessive.

Next to keeping the joint perfectly at rest, our greatest dependance for a cure, is on the effect of setons, or issues produced by caustic applications to the skin, as near as possible to the cavity of the joint. My own observation agrees with that of Mr. Ford, that the nearer they can be applied the more certain is their effect. These setons may be inserted, or the issues by caustic made, either in the hollow behind the trochanter major in the hip, or in the groin, or in both. Setons in the groin are preferable to caustic issues. Mr Brodie has extracted from the notes which he took of cases in St. George's Hospital four instances of setons being inserted in the groin, that were all attended with immediate relief, and two of them with permanent advantage; for both patients left the hospital with the disease cured; in the two others the setons were withdrawn before the cure was effected, but not before much benefit had been received from their insertion.

I shall not here discuss the question, whether the advantage derived from setons and issues, proceeds from the counter irritation, or from the drain which is established. They certainly on many occasions have been found to give relief before suppuration had taken place in the part. It is possible, however, that they may be persevered in beyond the period of their doing good; and therefore in those cases where manifest advantage arose from them at first, when, although the joint has been kept in a state of perfect rest, the symptoms of the disease re-occur, it is often necessary to discontinue their application. In several instances, I have known that the disease has been again arrested by their removal.

A gentleman, about twenty-four years of age, had complained for nearly two years of a pain, sometimes in the joint of the hip, and sometimes in that of the knee, and which latterly had increased in the hip to that degree of violence that he could not suffer his foot to touch the ground. I recommended perfect rest in the horizontal position, and introduced a seton into the groin, I also applied a caustic behind the trochanter major. In seven weeks all pain had left him, and he gradually recovered the motion of the joint. On a slight occurrence of the pain, arising from having used too much exercise, a blister was applied to the nates, but the pain soon became so excessive in the joint that the blister could not be continued; the pain was lessened upon its removal, but did not intirely cease. The seton was then withdrawn, and the issue healed up a few days afterwards; the pain not only ceased, but the patient has remained well ever since, and can attend to his farming concerns, on horseback for hours without inconvenience.

In a lady, about forty-five years of age, who was the mother of several children, so much pain and inability of motion occurred in the hip joint, that she had not, when I was consulted by letter, been able to leave the horizontal position for some months. I recommended a seton to be inserted behind the trochanter major; this was done. In a few days the pain became much less. The seton after some weeks was removed, and the pain soon after this returned. A second seton was inserted near the groin, which on its first introduction was attended with success equal to the former. It was continued for two months, and for seven weeks of that period, the patient appeared to be recovering; the seton then became violently painful, the pain also in the hip again came on, and increased to intolerable anguish; I therefore recommended the removal of the seton; and within twelve hours after its removal, the pain, both in the groin and hip, subsided. This happened about a year ago. The lady can now walk with the help of crutches without feeling pain; but the thigh is bent forwards, and anchylosed in that position. No fluid was felt in this case, nor did any appearance of suppuration of the cavity of the joint occur; although the symptoms strongly marked an absorption of the articular cartilages.

I have stated that it was not my intention in these discourses to dwell on the treatment of particular cases, I have therefore no further observations to make on abscesses arising in the hip joint, beyond what I already have made, last summer when on the subject of suppuration generally, and in the recent lectures when on the formation of matter in the cavities of joints.

ON CURVATURES OF THE SPINE FROM CARIOUS VERTEBRÆ.

When on the subject of rickets, many specimens were produced exhibiting the effect of that disease on the vertebral column in occcasioning lateral deviations from its natural shape. Curvatures of the spine may also arise from the bodies of the vertebræ becoming carious and being absorbed, and from the disease and destruction of the inter-vertebral substances. When this happens, the effects are usually found to extend to the ligaments, spinal marrow and nerves contained within the vertebral canal, and thus to produce symptoms very different and distinct from those which arise from caries of other bones.

Many very excellent observations on the caries of the spine and on its consecutive symptoms are before the public ; and to the late Mr. Percival Pott, we are greatly indebted, for the very clear and comprehensive view he has taken of it, in its origin and progress, and also for the means of arresting its dreadful course, with which, in his peculiarly interesting treatise, he has made the world acquainted. It is therefore unnecessary for me to enter further into a description of its symptoms and treatment, than the production of the preparations from our museum, illustrative of the altered structure of the the spine and its contained parts, will naturally suggest.

As caries of the bodies of the vertebræ may take place in every period of life, incurvations of the column formed by them occur in old as well as in young people, but from the greater degree of firmness in the joints of the articulating processes, and the stiffness of the muscles and ligaments, the bend in the spines of people advanced in life is more rare, and when it does occur is less extensive, than when caries affects the vertebræ of those who have more lately commenced their career in life.

Unlike to the curvature of the spine from rickets, in this disease there is but one bend, this is almost constantly forwards, the projection of the curvature or hump is therefore backwards, and is made immediately by the spinous processes of the vertebræ. The bend is sometimes so great that the margin of the chest is brought down to that of the pelvis. It does now and then happen, that from the same side of the bodies of one or two contiguous vertebræ being more extensively destroyed than the other, the bend has some lateral inclination.

From the repeated dissections which have been made of the parts affected by this disease, it appears that it is much connected with scrofula, and that it arises more frequently from a constitutional taint of that character, than from any local injury done to the spine.

Patients are generally willing to attribute it to some accident or injury, not unfrequently to some sprain; but it will often arise without any discoverable reason. A sprain is not, however, unlikely to call a scrofulous disposition into action, which might otherwise have lain dormant. In some cases where it has seemed probable that the caries arose from a local injury, certain symptoms of its being present, such as loss of power in the lower extremities, have not occured until four or five years after the accident.

The disease is supposed to begin generally in the bodies of the bones, and sometimes to originate in the intervertebral substances, for as it proceeds, both of these are affected; but it may begin in some of the structures situated within the theca vertebralis, and spread from thence to the bones, and to the soft parts connecting them.

When the disease begins within the theca vertebralis, the loss of power in the parts below its seat may take place, without any curvature of the spine. From the difficulty of bringing the spinal marrow into view, particularly when bodies are opened privately, it must often happen that the appearances of disease beginging in the theca vertebralis are not sought after, or are perhaps overlooked. In several instances I have met with scrofulous tumours in the spinal marrow, some of which have been confined to its substance, and others have affected the ligaments also. The two specimens, which I now place before you, are very well marked instances of these scrofulous tumours, and would, from the destruction of the spinal marrow, produce those symptoms of paralysis, which are usually attributed to the diseased and bent state of the bones of the spine. As this disease may take place in various parts of the vertebral column, some of the symptoms attending it will depend upon its situation being higher, or lower. I have seen these tumours in every part of the spine from the middle cervical, to the lowest lumbar vertebra.

If the parts are examined on the death of a person, in whom previously the disease was going on, a thick and confused mass of organized soft substance will be found before and on the sides of the bodies of the vertebræ; when this is cut into, it usually contains a quantity of thick curdy scrofulous matter, mixed in some places with common pus; the inner surface of the cavity containing this matter is generally irregular, and the ligaments of the vertebræ seem to have been concerned in its original formation; but all accurate distinction of parts is lost in the thickened mass. In some cases the bodies of several vertebræ will be found to have become softer and more spongy, also more red and vascular than usual; but not enlarged. Early in the disease, ulceration will be seen beginning in their bodies, either on the fore part or on the sides, and occasionally, at some little distance from the inter-vertebral substance, as in the preparation now before us. In other instances, the inter-vertebral substances will be seen separating from the carious surfaces of the bodies of the vertebræ, and sometimes these substances will appear to be thickened and projecting; but this may in part arise from the diminished size of the bodies of the bones. Occasionally the whole of the bodies of some of the vertebræ are removed, their articulating, transverse and spinous processes being left remaining; the spine under these circumstances bends forwards, and forms a greater or lesser angle according to the number of the bodies of the vertebræ which have been destroyed. In elderly people I have seen instances of a large proportion of the bodies of several vertebræ having been destroyed without much, if any, curvature having taken place; a deposition of ossific matter had adhered to the outside of the remaining parts of the bones, sufficiently large and firm to prevent the bend; the inter-vertebral substances had also been destroyed, and the spaces formerly occupied by them were filled up with curdy matter.

Mr. Brodie thinks, that he has in some instances traced the origin of the disease to the inter-vertebral substances, particularly in one case, where the articular cartilages of several of the larger joints were much diseased; the inter-vertebral substances connecting some of the dorsal vertebræ, instead of having in their centres the usual white semi-fluid materials, had a mass of a brown colour, of a solid but somewhat brittle texture and composed of several portions having a very slight adhesion to each other; and he supposes this change to be very frequent, although not constant, before ulceration. I have frequently seen the intervertebral substances thickened, and with such marks of vascularity, that I cannot doubt of ulceration occasionally taking place in them. There are instances before us, where several of these substances and the contiguous bones, have been destroyed and removed. These intervertebral substances have at all times much more vascularity than inter-articular, or articular cartilages.

In the latter stages of the disease, no trace remains of what structure it began in; bones, ligaments and intervertebral substances having been removed, and a mass of scrofulous matter substituted in their places.

Caries of the bodies of the vertebræ will take place in persons who have no scrofulous taint, when such vertebræ have been long exposed to an unnatural pressure; thus tumours of various kinds, but more particularly aneurismal swellings of the aorta, by pressure on the spine, have frequently produced this disease. In the preparation now exhibited, the bodies of several of the dorsal vertebræ have been destroyed from this last mentioned cause.

Caries of the vertebræ may also exist for months, or even for years, without producing incurvation of the spine; and when incurvation, does take place, if it proceeds slowly, a very considerable degree of it may occur without affecting the spinal marrow so as to produce a loss of power or of sensation in those parts of the body, which receive their nerves from below the seat of the disease. I have seen instances, where from the bend, the anterior and inferior margin of the thorax has been brought nearly in contact with the anterior and superior margin of the pelvis, and where, notwithstanding, neither sensation nor voluntary motion in the lower limbs have been much impaired, certainly not more so than would have arisen from the body being long retained in an unnatural position. It is not unusual to meet with persons, who, though much deformed by incurvations of the spine forwards, not only enjoy good health, but are also capable of using very considerable exertion in standing or walking without experiencing any great inconvenience, or suffering much from fatigue.

We have before us several specimens of two, three four, or even more vertebræ, the bodies of which have been completely destroyed, whose processes have anchylosed with each other and with the bodies of those vertebræ that were situated above and below them; which bodies, although originally placed far apart, from the destruction of those intermediate, and from the bend, have arrived in contact with, and become firmly connected to each other by bony union, as well as to the processes of those, the bodies of which were destroyed.

When disease originates in the spinal marrow, or spreads to it from the surrounding bones and ligaments, or when so much morbid matter is formed as to produce partial or permanent pressure on it, then symptoms either of derangement, or of complete loss of sensation and voluntary motion will take place in all those parts whose nerves come off from below, or are connected with the affected part of the spinal marrow.

Symptoms of this nature generally take place gradually; but sometimes from the bones giving way at once, either a portion of detached bone or cartilage, or some of the accumulated scrofulous matter, may suddenly be driven on the spinal marrow, and so compress or injure it as to bring on these symptoms immediately. If the incurvation takes place slowly, the spinal marrow will always adapt itself to the bent state, and none of its functions will be injured, or lost. In every case of which I have known the history, that I have examined after death, where the nerves have been affected, such affection has been found, not to arise from the curvature of the spinal marrow in consequence of the bend of the bones, but either from some morbid alteration of structure in its substance, or from some of the accumulated matter, or from a portion of some dead and detached bone, pressing on it.

Caries of the vertebræ may exist for months without matter being necessarily formed, or without producing incurvation of the spine, the only symptoms being great lassitude of motion, and a heavy dull pain felt near the seat of the disease.

When suppuration does take place from caries on the anterior part or the sides of the bodies belonging to the lower dorsal or to the lumbar vertebræ, the adhesive inflammation, which takes place on the surfaces nearest to the cavity of the abdomen, thickens and stengthens the boundary between the abscess and the peritoneum, so as to prevent the matter from bursting into the cavity. The matter as it accumulates generally works its way downwards in the direction of the psoas muscle, and appears first in the groin; or sometimes in the upper part of the thigh, forming the psoas abscess. On some occasions the matter has taken the course of the spermatic vessels and has passed through the ring, so as to be mistaken by careless observers for inguinal herniæ. In other instances the matter has extended round to the loins, and the tumour opened behind, forming the lumbar abscess.

When disease affects the spinal marrow, characteristic symptoms of the paralytic kind will often take place before any curvature of the vertebræ is perceptible, and the pain in the beginning of the disease cannot always be referred to any decided part of the spine; indeed even when well marked symptoms of the existence of the disease have taken place, the part cannot always be discovered either by the sight or touch. In general, however, although there may be no perceptible projection of the spinous processes, the affected part will feel more tender to the touch; and it has been observed by Mr. Copeland to be more susceptible to the stimulus of heat, so that a sponge wetted with warm water and drawn over the skin in the direction of the spine, will be felt so much, as to give pain when it passes over the diseased part. Should there be any projection, this will be more easily discovered when the patient bends the body forwards, than when the spine is examined in the erect attitude.

The symptoms of incurvated spine have been very often and very accurately described; and to Mr. Pott we are indebted for a masterly delineation of those circumstances which mark the difference between symptoms produced by the effects of the disease on the spinal marrow, and those which arise in a true paralysis. I shall here only observe that in a true paralysis, the muscles are soft, they have a flabby feel, and scarcely seem to have a disposition to contract; the joints, upon external force being applied, are easily moved in every direction; there is no rigidity or stiffness in the limbs, nor any disposition for them to be drawn in one direction more than in another. But when the disease arises in the bones, and affects the spinal marrow, although from want of exercise the muscles are shrunk, they are much firmer to the touch, and appear to be more in that state of contraction into which their tone would throw them. In consequence of this the knees and ankles are stiff, and the legs and thighs are often rigidly retained in a particular position: this may be either straight or bent. The foot is generally extended, so that the heel is drawn up and the toes pointed downwards; this indeed forms a very characteristic symptom of the disease.

Its first attack is often attended by the patient (either child or adult,) becoming languid and very soon tired if obliged to stand or walk. He is observed also frequently to stumble or trip. The legs are often involuntarily drawn across each other, so that the patient is thrown down; the knees totter and bend under the weight of the body, and he finds that he cannot, with any precision or certainty, give his feet a determined direction; he feels also a want of power in bending the body backwards; when in bed, he finds a difficulty in turning, and when seated, the legs are almost constantly drawn across each other. When the pressure is in the neck the head cannot be supported, therefore is generally leaned on a table or chair; the arms are also affected, so that numbness and loss of voluntary motion, to a greater or lesser degree take place in them, and there is much difficulty of breathing.

When the disease affects the dorsal vertebræ, the abdominal muscles become paralysed, so that laborious respiration comes on, with a hard dry cough; a tightness is felt about the, stomach and the patient usually describes a feeling as if a band was tied tight round the belly, this is attended with loss of appetite, a quick pulse, and hectic fever. There is great coldness of the limbs, with a constant heavy dull pain in the part, and the power becomes lost of retaining or discharging the urine or fæces according to the will; and sometimes all sensation and voluntary motion in the lower limbs will be lost, and continue to be so for some time before the patient is relieved by death. But as death is not the inevitable consequence of the disease, we are encouraged in almost every case, to try those means of cure which have often proved successful.

The medical treatment must be regulated by the symptoms which mark some derangement in those actions on which life is found to depend, as those of the heart, lungs, stomach, intestines, or bladder, so as to assist the local remedies, which are those to be chiefly depended on, in the cure of the disease.

It is obvious that the horizontal posture, is ~~less~~ favourable than any other to the progress of the disease, and therefore such posture should be strictly enjoined.

Although instruments, which would act by extending the spine, would prove highly injurious if applied when anchylosis was likely to take place, yet if any can be applied, while the disease is advancing, so as merely to assist in supporting weight, they may certainly prove useful, in so far, that they will prevent diseased surfaces pressing so much on each other as when no instruments were used. Much judgment however will be required in the choice, and in the application of them. When anchylosis is likely to happen, they should be discontinued, and the horizontal posture should be constantly persevered in; for although, a deposition of bony matter will take place round the anchylosed surfaces of bone, the bodies of the destroyed vertebræ are never renewed.

In almost every stage of this disease I have witnessed very favourable effects from caustics applied, or setons introduced, on each side of the projection of the spine. It must be owned however, that sometimes we are disappointed in the benefit, we have had reason, from the result in other cases, to expect from them; but we have no other means of cure so certain, and that they are not specifics in the cure, should not be urged against a fair trial being given to them. In one of the most unpromising cases for which I was ever consulted, where a child of five years old was bent nearly double, where the limbs had become useless, and the power of retaining the urine and fæces had been lost, and in fact where death was daily expected, by the suggestion of Doctor Baillie I applied extensive caustics on each side of a projection made by the middle dorsal vertebræ, and in six weeks after that period the child was able to walk round the room with the help of two sticks; in two months to walk half a mile on crutches, and in less than six months, no disease nor any inconvenience more than what arose from the curve, remained. The person is now alive, although seventeen years have elapsed since the use of the caustics, and has had during that time uninterupted good health. I mention this as a case remarkable for the degree of health the person has enjoyed. I could relate several others, where the caustics or setons have proved successful, but many of such cases have already been published in various works.

When matter forms, and works its way to the groin, to the upper part of the thigh, or to the loins, and then bursts through the skin, all that we can do is to let the orifice heal as soon as possible after the pus has been discharged, and to open the abscess by a puncture with a lancet when it again points, or to evacuate the matter through the canula of a small trocar: no good can arise in such case from any extensive opening, nor will the abscess heal permanently until the disease in the bone is cured.

It was my intention when I began this Series of Lectures upon the natural and diseased structure of bones and joints, after the foregoing observations on Scrofula, to have concluded with some remarks on the effects produced by two other specific morbid actions, viz. Cancer and Syphilis; and on the treatment which such affections required; but although I am not conscious of having introduced irrelative matter, or gone into an unnecessary minute detail of the symptoms or treatment of those diseases or accidents which I have had the honour to submit to your consideration, and am very conscious of having omitted much that might have been advantageously introduced, I have not been able in the allotted time to fulfil what I had proposed. Observations or these diseases must therefore be reserved to some future occasion, or may be more ably delivered by some future Professor.

The attentive inspection of the valuable materials preserved and arranged in our museum, will, to those who compose such an audience as this, convey silently, but forcibly, the most important information on all subjects connected with our profession, and render the office of the oral Lecturer almost superfluous. I have therefore not dwelt on the description of any particular preparation, although I have placed many before you. When your time permits, allow me to recommend an attentive examination of these preparations in the museum, and then comment on them yourselves. Truth and utility to mankind are the objects of our professional researches, and we are deficient in our duties to each other, if we leave any means in our power untried to obtain those desirable ends.

I cannot conclude the present Series of Lectures, without acknowledging my great obligation to you, Sir,* for the kindness with which, as Chairman to

* Sir Wm. Blizard, who officiated for our respected Master, Sir David Dundas, on the day when this Lecture was delivered.

the board of Curators of our Museum, you have honoured my endeavours to render our sources of information generally useful; nor without expressing to this Audience, that I must ever gratefully remember the attention with which I have been heard, by the Students, the Visitors, and Members of our College.

Much applause followed

CONCLUSION OF THE LECTURES.

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APPENDIX.

(See Note, Lecture the Fourth, Page 91.)

ON THE FORM, AND PARTICULAR SITUATION OF THE DIFFERENT CLASSES OF THE ADULT TEETH OF THE HUMAN BODY.

THE incisores, are so named from cutting or dividing our food. They are situated in the fore part of each jaw, and are eight in number; four of them being placed in each jaw.

The body of an incisor is broad, and rather flat; its anterior surface is a little convex, and its posterior concave; these surfaces meet in the cutting edge where the tooth is broadest, from which they gradually become narrower towards the neck, and continue to do so to the extremity of the fang, they thus form the narrowest sides or edges of the fang.

In a side view, the body of an incisor becomes thicker or broader from the cutting edge to the neck of the tooth; the flat side of the fang is continued from the neck to the apex, and gradually becomes narrower.

An incisor is therefore of a wedgelike form; the greatest width of the body is from side to side, and of the fang from before to the back part.

The enamel is thicker, and is continued further towards the fang on the fore-part, than on the sides of the tooth.

The fangs of the incisores are shorter than those of the cuspidati; but are of the same length with those of the other teeth.

They stand almost perpendicularly; their bodies, however, are inclined a little forwards.

The incisores of the upper jaw, especially the two middle, are broader and larger than those of the under jaw.

Each outer incisor of the upper jaw covers half of the outer incisor of the under jaw, and more than half of the under cuspidatus.

In some people the edges of the incisores are worn so as to become blunt and thick; in others they sharpen each other, becoming thinner.

THE CUSPIDATI OR CANINI.

The first name is given from each tooth of this class terminating in a point; the second, from their resembling the teeth of a dog or other carnivorous animal.

They are four in number, two being placed in each jaw.

The cuspidati are situated at the angles, where the jaws begin to pass backwards, between the incisores and bicuspides.

They stand, particularly those in the under jaw, nearly in a line with the incisores; but project further out in the circle than the other teeth; the projection is greatest on the side next the incisores.

They are placed nearly perpendicular, but those in the upper jaw have their bodies inclined a little forwards and outwards.

The cuspidati are broader, longer, and stronger than the incisores. They are the longest of all the teeth.

The body of a cuspidatus is more convex anteriorly than that of an incisor, and its base, instead of possessing a cutting edge, forms a point; but in the adult the point often disappears from the tooth being worn down.

The fang is shaped like that of an incisor, but is larger.

The enamel covers more of the lateral part of the tooth than it does of an incisor.

When the jaws are closed, the cuspidati of the upper jaw fall between, and project a little over the cuspidati and first bicuspides of the lower jaw.

The use of these teeth seems to be the holding and tearing of substances, for they are not formed for dividing like the incisores; nor are they fit for grinding.

BICUSPIDES.

The bicuspides are so called from having their bases divided into two parts; this name was first given to them by John Hunter. They have also been called the first and second molares; the other teeth named molares being then called the third, fourth, and fifth.

They are situated immediately beyond the angles formed by the cuspidati, on the anterior part of the sides of the jaws.

They are eight in number, four in each jaw, two being on each side.

They stand almost perpendicularly, but are inclined a very little inwards, especially the back teeth of this class.

The first and second of each side resemble one another so much that a description of one will serve for both.

The first is generally the smallest, but has the longest fang, resembling more the neighbouring cuspidatus.

The base of the body has two points, viz. an external and an internal. The external point is the most projecting, and in the shut state of the jaws is the only one seen; so that in this state these teeth resemble much the appearance of cuspidati. The groove dividing these points passes from side to side.

The body of a bicuspis is also flattened on the sides, answering to the flat sides of the fang.

The first bicuspis has generally but one fang, which is often crooked at its point ; its fang is however sometimes forked.

The second often appears to have two fangs, sometimes distinctly separated, but more frequently appearing compressed together, one on the outside, and the other on the inside.

The enamel passes a little further towards the neck externally and internally, than on the sides ; but in some bicuspides it terminates equally all round.

In the upper jaw the bodies of the bicuspides are rather thicker than in the lower, the fangs in general are more decidedly double, and they are inclined a little forwards and outwards.

The first bicuspides in the upper jaw, in the shut state of the mouth, fall between the bicuspides of the lower jaw.

The second bicuspides fall between the second bicuspides of the lower jaw and the first molares.

The bicuspides are of a middle nature between the incisores and the molares, and in most animals the space which they occupy in the human mouth, is left vacant between the incisores and molares.

THE MOLARES.

The molares or grinders are situated in the sides of the jaws behind the bicuspides.

They are twelve in number, six in each jaw, and three in each side.

Those which are situated the most backwards, and which are called the dentes sapientiæ, will be described separately, the present description will apply only to the first and second.

The body of a molaris approaches something to a square form with rounded angles.

The base of it, or grinding surface has commonly five points, three of these are on the outer part, and two on the inner : these protuberances form an irregular cavity in the middle of this surface. The body is more convex on the outer than on the inner side, and towards the neck becomes rather smaller.

At the neck the grinders of the under jaw divide into two flat fangs, which have their edges turned outwards and inwards, and their sides forwards and backwards. These fangs are broad, but are a little narrowed towards their ends, which are sometimes forked.

There are two cavities in each fang, one towards each edge, leading to the general cavity in the body of the tooth ; these seem to be formed by the meeting of the sides of an originally flat and broad cavity in the middle, and thus dividing it into two.

The first molaris of each side is larger and stronger than the second, and each of them have shorter fangs than the bicuspides.

In the upper jaw, each of the molares have three fangs, and these are of a rounder form than the fangs of the teeth in the lower jaw. Two of these are on the outermost side of the tooth and are placed nearly perpendicularly: The third is on the inside, and is generally the largest, it stands at some distance from the others, and slants inwards.

The second molaris in the upper jaw is the smallest. Both molares in this jaw are placed immediately under the great maxillary sinus.

Their bodies are inclined a little outwards.

The enamel covers the bodies of the grinders nearly equally all round.

DENTES SAPIENTIÆ.

The dentes sapientiæ, or third or last grinder are more irregularly shaped than the others, their bodies are rounder, shorter, and smaller; they are also inclined a little more inwards and forwards, and have generally only four points on their base.

The fangs are not so regular and distinct, they are generally shorter and appear as if squeezed together, so much so that they often appear as having but one fang. In the upper jaw the dentes sapientiæ are subject to greater variety than in the lower.

The first molaris of each side of the upper jaw covers, in the shut state of the mouth, the largest proportion of the first molaris of the under and part of the second.

The second molaris of the upper jaw covers the remaining part of the second of the under, and a very small part of the third.

The third or dens sapientiæ being smaller is opposed to that surface of the third of the under jaw which is not covered by the second molaris of the upper.

The numerous fangs of the molares prevent them from loosening by the lateral pressure they suffer in grinding. The molares of the upper jaw have three fangs on account of the antrum maxillare preventing them from having so deep a socket, as the molares of the under possess; their situation also inclining them more to fall out renders this additional fang necessary.

The temporary teeth require no particular description as they are similar, allowing for difference of size, to the same classes of teeth in the adult.

Varieties are occasionally met with in the appearances of the bodies of the teeth belonging to the same class, also in the number of the fangs, and in their size and direction.

In the above account of the form and relative situation of the adult human teeth, the writer has nearly followed the description which is to be found in the works of John Hunter; the many opportunities he has had of comparing that description with the natural appearances, having convinced him, that none more accurate could be given.

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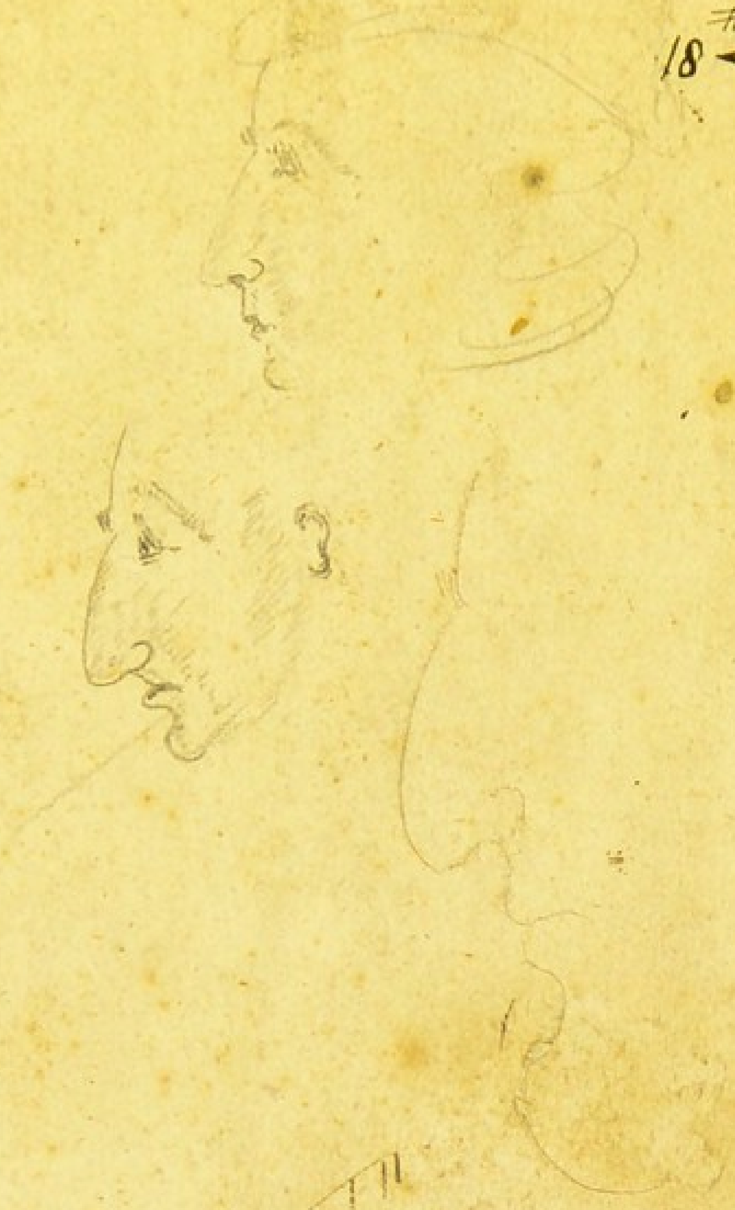

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