by pressure on the arteries of the neck. Strange to say, this result has seemed to me more common when the tinnitus is a continuous sound than when it is pulsating.⁴

I cannot now pursue the possible suggestiveness of this fact, but it leads up to another. I feel compelled to mention to you one case, which has been described in Germany,⁵ on account of the importance of the lesson it conveys. An elderly man had gradually become completely deaf in the right ear, with most troublesome tinnitus. The left ear was becoming deaf in the same way. The tinnitus was so loud, so persistent, and so distressing that the man had several times declared that he could endure it no longer and must end his life. This proceeding on his part was made unnecessary by the treatment which was adopted. It was found that pressure on the carotid artery diminished the sound. The right internal carotid was therefore tied. It is very difficult to understand the grounds for the operation. The blood supply to the labyrinth comes partly from the external carotid and partly from the basilar. The path by the auditory nerve to the opposite hemisphere is entirely within the blood supply of the basilar. The opposite auditory centre is supplied by the opposite middle cerebral artery. It is thus easy to understand that the operation was found to have no effect whatever on the tinnitus. It produced left hemiplegia and left hemianopia, and death resulted on the fifth day. I draw attention to this case because I think it should for ever prevent any repetition of this operation for the relief of labyrinthine tinnitus.

I wish that I could have made this lecture less unworthy, alike of this College and of the memory of him to whose request it is due. But when we find our work, our efforts to secure practical results, beset by conditions alike rugged and unyielding, one consolation is at least available—that that which is unsatisfactory now may be less so in the future. It does not do to pass such subjects by for those of greater promise. We have to till the fields to which our path may lead us, however barren they may seem, and hope that some of the seed sown, even upon stony ground, may germinate and bring forth fruit, at least in time to come.

TWO LECTURES

ON THE

STUDY OF ANATOMY AND ITS APPLICATION TO THE PRACTICE OF MEDICINE AND SURGERY.

Delivered at Guy's Hospital

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LECTURE II.

Look, now, at a vertical antero-posterior section of a vertebra and observe the cancellated structure of the body through which is transmitted in varying directions the weight of the trunk, together with what additional weight it may be bearing at the time. The cancellous tissues of the bodies are arranged to transmit weight to best advantage along the directions in which pressure is usually greatest. These vary considerably in the bodies of the different portions of the column. All, however, are exposed to a tendency to the forward displacement of the vertebra above from that below when the spine is flexed. The cancellous tissue is therefore universally arranged to oppose this tendency, and this is most marked in the parts of the spine most exposed to force of this kind. Perhaps the vertebrae about the lumbo-dorsal curve show it best. The normal bodies are only capable of simple displacement from one another without fracture under rare conditions and in certain positions, since their surfaces are united together most firmly by the powerful intervertebral discs. If the vertebrae are exposed abruptly to a degree of flexion greater than they can bear the upper and anterior angle of the lower vertebra yields, partly in consequence of the pressure it sustains and partly

because of the traction exerted upon it through the fibres of the superjacent disc. As the result of this displacement and fracture, the cord is more or less completely crushed between the posterior superior angle of the fractured body and the lamina of the displaced vertebra immediately above it. Comparing the structure of the body with that of the arch, the latter is seen to be composed chiefly of compact tissue. This results from the exercise of strain upon or the transmission of pressure through this part of the bone exerted almost always in the same direction.

I have described these fractures and their mode of production in detail to impress on your mind that you should examine carefully and consider the functions of the compact and cancellous tissue in the long bones of the parts you dissect, and that you may understand that bones vary largely in the detail of their structure during the several periods of life. This variation depends solely on changes in the characters of the mechanical influences which determine their structure, and without the constant influence of which they cease to retain their type.

Again, you observe the use of cancellous tissue in the bodies of the vertebrae in order to obtain a mass of considerable bulk, of as little weight as possible, and composed of a material which serves to transmit force in varying directions at the greatest mechanical advantage. It breaks or deadens shocks transmitted through it, so securing the very sensitive structure of the brain and spinal cord as much as possible against sudden injury. I would point out to you that when the spine ceases to perform its normal function, as in old standing lateral and angular curvatures and in the various curves due to occupation or disease, the superjacent weight is no longer transmitted through the bodies of the several vertebrae in very variable directions, but along a single fixed plane, then the construction of the bone is changed to meet the altered mechanical conditions, cancellous tissue being replaced very largely by compact tissue, new material being superadded also upon the surface so that the bones are altered in shape. This I will illustrate more fully later, but these specimens show very well many of the coarser changes. A very good instance of the application of the use of cancellous tissue to deaden the abruptness of the shock resulting from the sudden application of force is seen in such bones of the vault of the skull as are uncovered by muscle. The more readily vulnerable parts of the skull—namely, the vault—consists of two layers of compact bone separated by a thick layer of cancellous tissue, while the base of the skull, which is relatively free from direct injury, is composed almost entirely of compact tissue; this is most marked along such directions as force is transmitted to the condyles of the occipital bone, and through them to the spinal column. The directions of the lines of force along which the weight of the skull and its contents are transmitted are the same as those along which the added weight of a load born on the head is also transmitted, and as you must remember also the direction is the same as that along which a sudden and abrupt massive impact is also transmitted. This last point is, as you will readily understand, one of vital importance in the protection of the brain, and in this manner. If the top of the skull be struck a heavy blow insufficient to produce a fracture, a large surface of the brain is driven forcibly against the base of the skull, and the portion that sustains the impact is damaged in proportion to the force of its impact on the base of the skull. Owing to the convex outline of the surface of bone struck, the force is distributed largely over the surrounding area and is transmitted directly and indirectly to the occipito-atloid articulation. Much is transmitted through the layer of cancellous tissue which serves to deaden the force transmitted through it and to limit the vibrations of the outer layer of compact tissue. The area of distribution of the impact to the smaller are formed by the inner layer of compact tissue is greater still. By this means the impact upon the surface of the brain by the vibration of the vault is diffused as widely as possible and its force reduced very considerably. The area of the brain immediately beneath the surface struck sustains but trifling injury as compared with that borne by the surface which impinges on the base of the skull. If the force applied is sufficient to produce a fracture, a fissure extends from the point of impact to one side along the whole breadth of the base of the skull, unless stopped by extending into the fora-

⁴ The fact that reduction of pulsating tinnitus by pressure on the vertebrae has been described by Dr. Dundas Grant, and this leads me to express a hope that those whose observation are not mentioned will note the statement in an early part of the lecture. Its scope is limited to some of the facts which have come under my personal observations, and the suggestions they seem to me to present.

⁵ Linsmayer, *Wien. Med. Blätter*, 1893, Nos. 8 and 9.

men magnum. The line taken by the fissure is that along which force is usually transmitted—namely, through the middle fossa. The double arrangement of compact tissue offers such a considerable resistance to fracture, so that the fissure rarely extends to the opposite side of the vault. It seems to me that this fracture is of the greatest advantage to the individual, since it diminishes enormously the elastic impact exerted by the skull upon the brain and so saves the brain from an amount of bruising which would be more certainly fatal if the skull remained intact. This suggestion I would commend to you for thoughtful consideration and criticism. I may tell you that in more than five-sixths of all cases of fracture of the base the fissure passes through the middle fossa. When the blow is struck by a small object, a small fissure may result, the force not being sufficient to cause it to extend into the base; or the outer table alone may be driven in; or the inner may be driven in without there being any fracture of the outer; or, again, both may be forced in, in which case, owing to the inner table being an arc of a smaller circle than the outer table the transmission of force through the cancellous tissue produces a more extensive area of depression of the inner than of the outer table. Where there is a soft muscular covering the use of cancellous tissue is avoided, in order to keep the size of the head within as small limits as possible consistent with safety. The soft pad of muscular tissue covering the bones in the temporal fossa compensates more or less for the absence of the mechanical arrangement which exists in the bones forming the rest of the vault. Any portion of the osseous case, which in the ordinary course of events is protected by other bones from violence, as for instance the roof of the nose and orbit, is constructed of a thin layer of compact tissue which serves to support the brain and bind together adjacent bones. You will observe that in proportion as the part is exposed to violence so its bony wall is thicker. For instance, the roof of the orbit is very much more exposed to violence than the roof of the nose, which is sheltered by the frontal, nasal, and upper maxillary bones, consequently it is much stronger than that of the nose. In much of its extent it is double and is provided with an intervening air space. It is well to bear in mind the remarkable thinness and fragility of the roof of the nose. There is a very troublesome disease of the nasal cavities with which you will become very familiar later, in which they are more or less completely occluded by the formation of tumours of myxomatous and glandular structure upon the mucous membrane covering the roof, upper and middle turbinated bones, and adjacent spaces, and it is often very difficult and sometimes impossible to relieve the sufferer for any long period effectually of this trouble. An eminent surgeon, being dissatisfied with the somewhat tedious methods in common use, advocated an operation, which consists in introducing the blade of a pair of dressing forceps into the nose and in tearing away the polypi together with the turbinated bones from which they grow. Now, Nature, or the centre in the brain which looks after its integrity and the security of its bony surroundings, has made no preparations for such a mode of treatment, and though the removal of the turbinated bones exposes the individual to no risk except from septic infection, a very small amount of force exerted on the roof of the nose by the point of the forceps causes its perforation, together with that of the dura mater covering and intimately united to it, and an acute septic meningitis soon terminates the patient's existence. How far this method of operating is effectual in curing the patient is somewhat doubtful, but if you undertake it you must remember that it is an operation accompanied by considerable risk if not effected with great dexterity, since death has resulted from it in quite a considerable number of cases, although the operation has been performed by very experienced and skilful surgeons. Perhaps I can best make you understand the manner in which the transmission of pressure determines the form of the several bones by showing you:

1. The manner in which adult bones react to a pressure in excess of what is normal—these represent the fixation of positions of activity.

2. The changes which the skeleton undergoes in feeble old age—these represent the fixation of the positions of rest by the fully developed skeleton.

3. The mode in which bones placed under abnormal mechanical conditions react to normal pressure.

4. The laws which influence the growth of the child—their consideration involves the study of the positions of rest fixed by the growing skeleton.

Now, the skeleton only remains normal as long as the individual bears to his surroundings an average or normal relationship. In other words, the so called normal anatomy of a race is dependent for its existence and continuance upon a certain fixed mechanical relationship between the organism and its surroundings. If that normal mechanical relationship of the individual to his surroundings, or to express it differently, if the physiology of the organism be altered, a corresponding change is produced in its anatomy in order that it may be able to accommodate itself to its surroundings and to perform its novel functions.

Of this principle surgeons are often very forgetful. Let me give you an example. A hernial sac possesses as one of its most important constituents a peritoneal lining. This peritoneal pouch has been formed by pressure and it depends for its continued existence upon the persistence of that pressure. In other words, if the mechanical factors which developed it are in abeyance it undergoes rapid degenerative changes. In performing a radical cure upon a hernia, it is not an uncommon thing for a surgeon to twist or fold the sac up and use it as a plug to occupy the canal, under the impression that it will retain its bulk and afford an obstacle to the descent of bowel. I need hardly tell you that the assumption is a false one.

We understand that each portion of the skeleton, its muscular coverings and appendages, performs a definite physiological function, the character of that function varying not uncommonly at different periods of the lifetime of the individual, in correspondence with changes in its relationship to its surroundings.

Take for example the brain of the foetus which can be subjected to very considerable local or general pressure without suffering any injury. See how the structure of the skull is adapted to retain the integrity of this organ in its first most important mechanical relationship, namely, to the true pelvis of the mother, as it makes its transit into the outer world. Later, as the brain develops and acquires a more sensitive structure, the skull cap is rendered just sufficiently strong and firm to shield the most sensitive organ in the body from such local and general pressure as it is exposed to under average circumstances. Compare the skull of the human infant with that of the gorilla and you are at once impressed by the very close similarity which exists between them. But if the skull of the adult male gorilla be placed beside that of a man's skull the differences are most striking. Yet this variation is due almost entirely to the different lives led by the average human being and by the gorilla, much of the variation resulting from the respective attitudes, since the erect posture of the human subject is responsible for very many of the differences which exist between its skull and that of all other animals. In the human subject, which bears to its surroundings the ordinary mechanical relationship of adult life, we obtain by these means a skull of a thickness and texture which we are accustomed to regard as normal. As the mechanical relationship which this portion of the organism bears to its surroundings differs very considerably in the different races of men and of their near relations the quadrumana, we find that in each case the thickness and density of the vault of the normal skull varies in direct proportion as the necessity for such protection exists. The influence exerted by attitude, which is considerable, will be described later.

If the physiological relationship of the normal organism to its surroundings be altered in such manner that the brain and its bony case are exposed habitually to the influence of forces other than those that affect and determine its normal structure we see that the form, texture and thickness of the skull is altered in order that it may perform satisfactorily its new functions or physiology. Such experiments are being continually performed for us owing to the necessity which exists in large communities for the subdivision or specialisation of labour. If we examine the skulls of those who have been engaged for many years in carrying loads upon the head or upon the back of the head and neck, and compare them with the normal or average skull of the same race, we find that the abnormal forces to which the skull has been ex-

posed have produced changes in its several characters which vary in type and locality with the direction and degree of the forces which have exerted their influence upon it, and also with the age and vigour of the individual.

I do not think that any one would regard a skull influenced in such a manner as diseased, or would assert that the abnormal characters it presents are the result of chronic inflammation. The influence of the same heavy load that produces the alterations in the skull determines in the other portions of the skeleton through which weight is transmitted changes whose character and causation are identical with those present in the skull, yet pathologists, with very few exceptions indeed, insist on describing the more obvious and local changes in the former as inflammatory and not physiological. Up to a very recent date the mechanical changes which ensued in the opposing surfaces of bone were regarded as evidence of the presence of a disease which was called rheumatoid or osteo-arthritis. The changes to which I refer are a general increase in the density of the structure of the bones exaggerated along the lines of greatest pressure; a compression and induration, or a partial or complete removal of the soft structures intervening between adjacent bones; the formation of large bosses or margins of dense bone in the situations of greatest pressure where they perform a necessary and definite physiological function; a frequent partial or complete ankylosis of adjacent bones; the occasional conversion of an amphiarthrodial joint into one of an arthrodial type, the formation of an entirely new joint, etc. It seems to me absurd to argue that, because the bones and the bosses or margins that project from them have acquired a density of structure and a power of resisting pressure which is necessary to them in order that the organism may continue to perform its abnormal or special functions, which are enormously in excess of the average or normal, the condition is inflammatory and not physiological.

The skeleton of such a labourer is brought into a remarkable and abnormal relationship to its surroundings, which entails its habitually and constantly performing certain special functions, which are somewhat similar to those performed by the normal subject, but which demand the expenditure of an enormous amount of muscular energy in the support of an immensely heavy load.

Similar changes ensue in animals other than man if they have habitually to draw or carry very heavy loads. Practically, it is impossible to pursue any occupation entailing the habitual performance of any sequence of movements or the carrying of any considerable weight without the several portions of the skeleton influenced by it undergoing distinct and characteristic changes.

That pressure habitually exerted upon a normal bone can cause it to alter in form, although its several portions have ankylosed together and its epiphyseal lines have disappeared, I will readily demonstrate to you. Take the normal skull and increase the tension in its interior by the presence of a tumour in the brain, or by other morbid condition. You may get as the result of this, the rapid absorption of the inner table as in this specimen where you see the eroded and excavated interior of the vault is marked by the convolutions of the brain, or the process may go more rapidly still and a thin membranous or bony shell result. If the increase of pressure be more gradual the skull may enlarge without any alteration in the structure of the bone from the normal. It would seem that the gradual removal of bone from the inner plate of the vault is associated simultaneously with a deposit of compact bone on the exterior of the inner and outer plates and with the cancellation of the interior of the outer plate. This is probably the sequence of events in the growth of the normal skull and is shown in an exaggerated form in this specimen of chronic hydrocephalus.

It would appear probable that the reverse is also true—namely, that the absence of accustomed pressure, as in the case of the wasting brain of old age, results in the deposition or bone on the inner aspect of the skull.

Another very good instance of the effect of pressure on bone, which you will have many opportunities of observing in the living subject, is the remarkable deformity of the sternum, which results from the constant pressure exerted by the mode in which the boot is fixed between the chest and thigh. The depression which is formed in front of the chest

by this alteration in the form of the sternum is very considerably and striking, and I will refer to it more fully when I describe to you the anatomy of the shoemaker.

The body of the same labourer illustrates in a wonderful manner a function which the organism possesses, and which is perhaps even more curious than the selfish control which is exerted upon the bone-forming department in favour of the brain. I refer to its capacity to form a perfectly new mechanical arrangement or to produce a modification in an already existing one where it is obviously of great advantage to it to possess it. The sweated shoemaker, as he sits daily for twelve—and probably a larger number of hours—sewing, holds his head in a sloping position, so that it is tilted obliquely to one side. It would obviously be of the greatest service to him in that it would relieve him very considerably of muscular strain in fixing his skull during the abrupt and powerful movements he is constantly performing if he had projecting up from the upper surface of the lateral mass of the atlas, on the side to which his skull is tilted, a pillar of bone which articulated with the jugular process of the occipital bone, and formed with it a secure joint through which much of the superjacent weight is transmitted. This is exactly what takes place, and these diagrams illustrate the condition of the atlas and of the occipital bone. (Figs. 1 and 2.)

Fig. 1 represents the anterior aspect of the atlas, showing the prolongation upwards of the anterior arch from the margin of the odontoid facets which develop in consequence of habitual and excessive pressure—B; also the large quadrilateral mass of bone projecting from the upper part of the lateral mass referred to in the text—A.

Fig. 2 shows the foramen magnum and condyles of the occipital bone. B indicates the groove which received the sharp free edge of the articular facet on the atlas. A, a transverse ligament which lay behind this upward prolongation, and C the facet on the under surface of the jugular process which articulated with the column on the lateral mass of the atlas.

This represents a new formation quite independent of any pre-existing joint, and therefore serves my purpose in demonstrating this function very clearly to you. Yet though this exists independently of any joint, if you examine the various changes that take place in the several joints in the labourer and in the subject whose mechanics have been altered by disease of bone or joints, or by fracture of a bone or bones, you will find the same law in evidence everywhere.

We take advantage of this law very largely in surgery. Occasionally the temporo-maxillary articulation becomes ankylosed in consequence of some septic infection, either from its becoming involved in some adjacent inflammatory process or because of its infection through the circulation as part of a pyæmic process. In such cases the articular and interarticular cartilages are destroyed, and the condyle of the jaw becomes united by bone to, and is practically continuous with, the temporal bone. The jaws are fixed on one another

in the position in which they are normally closed, so that the molars and bicusps come into accurate apposition, while the incisors of the lower jaw project into the roof of the mouth considerably behind those of the upper jaw. The patient is therefore only able to swallow food of a fluid consistence. If ankylosis takes place early in life the portion of the jaw represented by the condyle and neck becomes very broad and thick, and also shorter than its fellow. The jaw not performing its normal function does not develop in the same proportion as the rest of the bones of the face, so that the chin loses altogether its normal prominence. The lower incisor teeth, missing the habitual pressure exerted by the upper incisors in biting the food, become abnormally long, and project into the mucous membrane of the roof of the mouth, so interfering still further with the introduction of food. This difficulty is even more exaggerated by the overgrowth of the upper incisors from the same causes.

The treatment of such a condition consists in cutting down upon the temporal bone and upon that portion of the jaw which is continuous with it, and in cutting away a piece of bone from the junction sufficiently large to enable the mouth to be opened. Within a few days of the operation the child is encouraged to bite and chew, and by the mutual friction of the bones upon one another they alter in form, become covered by articular cartilage, and a synovial membrane is developed. In this manner a perfectly new joint is evolved, and it performs the function of the normal temporo-maxillary articulation more or less perfectly. Perhaps I will interest you more in the manner in which such a joint is formed if I illustrate it by the report of a case, its treatment, and the result obtained.

E. H., aged 13, was admitted under my care into Guy's Hospital in September, 1893. When 18 months old she was stung on the left upper eyelid. Much inflammation of adjacent parts followed, with free suppuration, some of the skin of the lid with the subjacent orbicularis muscle coming away in the slough. Shortly after this it was noticed that the child could not open her mouth, and much difficulty was experienced in feeding her. On admission the face was much deformed by the fact of the lower jaw being very ill-developed. It was immovable on the upper jaw, and the incisor teeth of the lower jaw were very long, and projected into the roof of the mouth, pressing on the mucous membrane. (Fig 3 represents her condition at this time.)

Fig 3.

Chloroform was administered on September 19th, when it was found necessary to open the trachea at once, as the tongue fell back and occluded the upper aperture of the larynx. After considerable difficulty the upper part of the ramus of the jaw and the portion of the temporal bone continuous with it were removed. There was no indication of the presence of the original joint. Owing to the angle of the ill-developed jaw coming into contact with the front of the

spine it was impossible to obtain a greater interval than $\frac{1}{2}$ inch between the teeth. This afterwards increased to an inch. Associated with the more perfect development of the new joint, the lower jaw increased in size so that the present condition, as shown in Fig. 4, though still very deforming, is

Fig. 4.

not nearly as striking as it was originally. Here you have developed during a fraction of the lifetime of the individual a perfectly new mechanical arrangement having all the structure and functions of a moveable joint, the only foreign factors which determined its development being movement and pressure of bony surfaces on one another, the organism itself providing the necessary structures under their influence.

I will now show you how a bone will vary in form in a normal subject when its functions change at different periods of life, and the lower jaw again affords as good an illustration as any. This bone in the infant performs no function other than that of moving forwards and backwards upon the temporal bone during the process of sucking. If you examine the temporo-maxillary joint of the infant you find it possesses a fibro-cartilage and two synovial cavities, the condition differing from that of the adult in that the head of the bone is less developed and is flatter on its upper surface, the eminentia articularis is less prominent, and the fibro-cartilage does not present the same variations in thickness. These are just such differences as you would expect to find between the joint of the infant which is arthrodial or gliding and that of the vigorous adult which is ginglymoid or hinged in character.

The jaw of the adult is very large and strong, and the angle has quite lost the obtuseness of the infant and approaches a right angle in size. This is the result of traction exerted upon this part of the bone by the very powerful masseter muscles in forcibly approximating the teeth in biting, this movement being absent in the edentulous infant, while the general density and strength of the bone is consequent upon and varies directly with the amount of pressure it sustains in mastication.

The head of the bone is large and convex from before backwards, the eminentia articularis is very prominent, and the fibro-cartilage is dense and strong, and varies in thickness,

so that when the jaws are separated, it forms a suction socket for the head on the eminentia articularis, while in the lateral gliding movement of chewing it forms a smooth elastic surface on which the head of the bone moves. It also serves another very important function during chewing or scrunching of hard food, in that it acts as a buffer, breaking the abruptness of force transmitted suddenly through the jaws. You observe that the condyles of the jaw bear a very important relationship to the brain, any constant succession of jars upon which might result in damage to this very sensitive organ. The pugilist is thoroughly cognisant of this fact, and finds that he can most effectually knock out his opponent by striking him under the jaw. The amount of force required to do this is comparatively small as compared with the strength of blows usually delivered, but the whole of the force is transmitted through the condyles of the jaw to the skull and brain within a very limited area.

Let us pass on to the examination of the jaw of the edentulous subject. The angle again becomes obtuse since the factor which diminished its size, namely, the severe and habitual strain exerted by the masseter muscles has ceased to exist. The alveolar process has disappeared since the mechanical conditions that determined its development and continued existence, namely, the presence of the teeth, no longer exert influence upon it. What are the functions performed by the edentulous lower jaw? They consist in gripping the material between the gums and in breaking it up as much as possible in this manner. Every one of you must have seen such a subject eating, and must be familiar with the great freedom of movements of the lower jaw upon the upper in a horizontal plane. The anesthetist is fully aware of this. The jaw of the vigorous adult as a lever of the third order differs altogether mechanically from that in infancy and edentulous old age.

This movement results in a complete alteration in the anatomy of the temporo-maxillary articulation as it exists in the vigorous adult. The head of the bone becomes flattened on its upper surface, the fibro-cartilage is first perforated and then removed; and the eminentia articularis is flattened. If the nutrition of the old subject becomes very much impaired, the head of the bone and the flattened glenoid cavity become deprived of articular cartilage and then the opposing surfaces of bone by their mutual friction are gradually rubbed down and altered still further in form apparently by a process of decalcification and fibrillation.

Each condition of joint is perfectly normal to the subject at a certain period of life. What variations exist result simply and solely from changes in the physiology or function of the part. You can readily understand that, if such a considerable change takes place in the normal subject during a portion of a lifetime in obedience to mechanical factors only, enforced alteration in diet will readily produce such differences as exist in the jaws and dentition of animals which are closely allied, as, for instance, man and the higher apes. In other words this helps to substantiate the truth of the view I would place before you and which I hope to strengthen by subsequent evidence, namely, that the sole factor in evolution is a mechanical one.

REMARKS ON WOUNDS OF THE HEART,

WITH NOTES OF A CASE IN WHICH DEATH TOOK PLACE FOUR MONTHS AND A HALF SUBSEQUENTLY, AND CICATRISATION WAS SHOWN POST MORTEM.¹

By WILLIAM TURNER, M.A., M.D.,
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THERE unquestionably exists in the popular mind a firmly implanted belief that the heart of the animal organism is its most vital structure, that in order to attain the destruction of a life with the utmost certainty and with the utmost rapidity attention should be directed towards the destruction or disablement of this portion of the circulatory system. The deerstalker, for example, recognises that his best chance of promptly securing his stag is to aim well on the shoulder as being the best landmark for reaching the heart; and so

with big-game sportsmen generally. The bull-fighter maps out in his mind's eye a little area on the surface behind the shoulder-blade through which his sword must penetrate *en route* to the heart, if he is to succeed in quickly despatching his adversary. Military regulations direct that when an offender has to be executed by shooting, the firing party must point their weapons at the heart of the culprit, obviously with the idea that the extent of his suffering will thus be minimised. Indeed it has even been supposed that if the substance of the heart be touched in any way by a foreign body its action must necessarily and immediately cease.

Most surgeons, however, can of their own experience abundantly disprove such notions. I recently saw a child, aged 2 years, with a sewing needle driven into its heart. The whole needle had disappeared into the chest, but I could feel its head underneath the skin tapping against my finger with each beat of the heart, and I was thus enabled to cut down upon it and extract it, no evident harm resulting to the heart or to the child.

A case which much impressed me at the time in regard to the degree of laceration which the heart is capable of undergoing before it is brought to a standstill occurred some years ago in my practice as police surgeon. The dead body of a young man was discovered by the police lying in a secluded spot with a series of some ten or twelve wounds over the region of the heart. A large butcher's knife lay buried in one of these wounds to the depth of 4 inches, and the right hand, covered with blood, grasped the handle of the knife. No doubt could be entertained that these wounds had been self-inflicted. At the necropsy it was found that no fewer than three of the wounds had penetrated the cavities of the heart, and had caused considerable laceration of its walls. It follows, therefore, that after the heart had in this case been at least twice run into by a large butcher's knife, and much damaged, the subject of the suicidal attack had retained the physical strength and mental determination necessary to inflict a third wound in the same organ.

Although the records of such cases are not numerous, they mostly point to the fact that wounds of the heart are seldom if ever immediately fatal. Out of 29 collected cases of injury to the heart, only 2 were fatal within forty-eight hours.²

Of gunshot wounds of the heart some interesting examples are recorded. A stag ran 60 yards after being shot through the heart, examination of the heart showing that the left auricle had been practically annihilated, and the left ventricle completely torn through by the bullet.³ There is a well authenticated case in which a bullet was found embedded in the substance of a soldier's heart six years after he had been wounded, he having died from quite another cause.⁴

The following examples of penetrating wounds of the heart in which life was not immediately extinguished, may be interesting:

A soldier fell on his bayonet, which passed into his left side between the fifth and sixth ribs. Death took place on the fourth day. At the necropsy the wound was found to have penetrated the pleura costalis, passed over the thin edge of the lung, apparently without injuring it, perforated the pericardium, entered the left ventricle of the heart about $1\frac{1}{2}$ inch from its apex, and passed out through the mediastinum into the vertebral column.⁵

Muhlig⁶ relates the case of a mason who was stabbed with a stiletto on the left side of the sternum. His life was despaired of for a while, but he recovered sufficiently to return to his employment. Ten years later he was admitted to hospital suffering from excessive dyspnoea and anasarca, and with a loud double *bruit* accompanying the systole and diastole. After death the lung was found intimately connected with the pericardium by old adhesions, and the pericardium was intimately adherent to the heart throughout its whole extent. A rounded opening was found on the inner surface of the right ventricle admitting the little finger, and a corresponding hole in the interventricular septum leading into the left ventricle.

The heart in the case which I am about to describe shows a

² *Lancet*, October 8th, 1881.

³ *Ibid.*

⁴ *Ibid.*

⁵ *Med. Times and Gaz.*, November 7th, 1863.

⁶ *Med. Times and Gaz.*, August 3rd, 1861.

¹ Read at a meeting of the Gibraltar Branch of the British Medical Association.