REMARKS
ON
DISLOCATIONS
OF THE
FIRST AND SECOND PIECES OF THE
STERNUM.

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(Received November 11th, 1873—Read January 13th, 1874.)

THE object of this paper is to offer an explanation of the mode of occurrence of displacement of the first and second pieces of the sternum, illustrated by cases coming under observation at the London Hospital, and to show that their peculiar features are dependent on the anatomy of the articulation existing between them.

It is generally admitted by surgical writers that both displacements and fractures of the sternum may result either from direct or indirect violence, and that these injuries frequently complicate fractures and dislocations of the spine. But very different, sometimes conflicting, and often indefinite explanations have been put forward in reference to their mode of occurrence. In the article on "Injuries to the Chest," in the 'System of Surgery,' edited by Mr. Holmes,

Mr. Poland has collected 14 examples of dislocation of the first and second pieces of the sternum, and of these cases the displacement was due or was attributed in 4 to force applied immediately to the sternum, in 1 to violent lateral compression of the chest, in 1 to muscular action, in 1 to flexion of the body forward as the result of a fall, in 3 to falls from a height on to the back, in 2 to falls from a height, the part struck not being mentioned, whilst in 1 the cause is not stated. Precisely similar causes have been assigned to fractures of the sternum, cases having been recorded as resulting from falls on to the back, falls on to the nates, falls on to the head, muscular action, and direct blows. In fact, the two classes of injury have so much in common that some writers include the displacements under the head of fractures of the sternum. Indeed, whether the one or the other injury occurs in any particular case would appear to depend partly on the mode of application and direction of the force, and partly on the relative strength of the articulation and of the weakest part of the bone.

The resemblance between the two classes of injury is increased by the well-established circumstance that, in the large majority of cases of both, the upper fragment lies behind the lower. In displacements, for instance, the manubrium is almost invariably found with its lower extremity concealed by the upper extremity of the gladiolus, the second pair of ribs remaining attached to the manubrium, and the strong posterior layer of periosteum untorn but stripped up from the bone holding the two segments together. The only recorded exception, so far as I know, to this disposition of the segments is related by Sabatier. A man, of about 60 years of age, was thrown from a height of thirty feet into a ditch, falling on to his back and coming in contact with a large stone. A displacement of the sternum resulted, the gladiolus being buried to the extent of 20 millimetres behind the manubrium. The patient died on the eighth day. On opening the body a large quantity of blood was found extravasated beneath the ligaments and in the substance of the lungs. In commenting on this case, M. Maisonneuve re-

marks that it would prove the possibility of a dislocation of the second piece of the sternum behind the first, from indirect violence, or, as he terms it, by *contre-coup*, if the extreme conciseness of the details did not leave some doubt about the mechanism of the lesion, and he avows his belief that the nature of the displacement, with the accompanying contusion of the lung, and extravasation of blood, points rather to a direct than to an indirect cause. This criticism appears to me to be reasonable and just, but until we are in possession of other instances of the lesion related more completely than the case seen by Sabatier, we should not be justified in drawing a positive conclusion on the mode in which the unusual position of the segments is produced.

At first sight it might appear that there could not be any room for controversy as to the mechanism of fractures and displacements occurring from *direct* violence, and accordingly the position of the upper segment behind the lower has been generally attributed to the direct force of the blow pushing it backwards. But M. Maisonneuve has suggested that the same effect may be produced by force applied to the body of the sternum, the elasticity of the ribs and costal cartilages attached to it causing it to rebound after it has been depressed. This suggestion appears to me to furnish a more probable explanation, because the lower and more prominent position of the gladiolus, and the greater extent of surface presented by it, render it more exposed to violence. The same effect would also be produced by pressure applied towards the lower end of the gladiolus, whereby the upper end would be tilted forward, and separation of the two segments effected. In other cases, again, the question may arise whether the lesion is to be regarded as due to direct or indirect force. Sabatier's case, which has been related above, is a case in point. The instances of fracture and displacement, which complicate fractures and dislocations of the spine, furnish other examples. Some surgeons attribute the injuries to the sternum occurring under these circumstances to a violent descent of the chin on to the manubrium, whilst others explain them either indefinitely by calling them the

effect of counterstroke, or by a doubling forward of the sternum caused by forcible flexion of the spine. It is evident that the first explanation, the descent of the chin on to the manubrium, would bring the lesions under the head of lesions caused by direct violence, and that the two latter would assign them to the category of lesions caused by indirect violence. Strict attention to the circumstances under which the accident occurs in each particular case can alone furnish the correct interpretation.

That violent descent of the chin on to the sternum is sufficient to occasion a fracture of the bone, not only seems, *à priori*, probable, but is supported by the record of cases. The following case, which occurred at the London Hospital, in June, 1871, in the practice of my colleague, Mr. Couper, who has kindly permitted me to quote it, appears to corroborate this view.

The notes of the case were supplied to me by my late house surgeon, Mr. John Cooke, who took them at the time.

Henry B—, æt. 30, carver and acrobat, a strong, muscular, and healthy man, was turning a double summersault forwards, when he fell about ten feet on to the back of his head. He came down on some tan, and his head was violently flexed on to his chest. On admission into the hospital he exhibited all the symptoms of a fracture of the spine in the cervical region, and a fracture of the sternum near the junction of the manubrium with the gladiolus. He lived thirty-six hours. At the post-mortem examination the following injuries were found: Rupture of the intervertebral substance, between the sixth and seventh cervical vertebræ; of the anterior common ligament in part; of the posterior common, the interspinous, supraspinous, capsular and yellow ligaments. The sternum was fractured obliquely from a point between the first and second costal cartilages on the right side, to the third costal cartilage on the left, the line of fracture traversing the articulation between the manubrium and the gladiolus. The obliquity of the fracture accords with the effect likely to be produced by the chin inclined to one side, and pressing down upon the sternum, and it is

obvious that disruption of the ligaments joining two of the cervical vertebræ would allow much freer motion of the head than in the normal state, or than would have been possible if the injury to the spine had been situated in the dorsal region. I call special attention to these circumstances, because I am inclined to think that the chin is much more likely to occasion a fracture than a displacement, and that it is mostly if not entirely in cases of injury to the cervical portion of the spine that such a cause may come into operation.

It is remarkable that neither Mr. Poland nor Dr. Hamilton makes any allusion to contact of the chin with the sternum as a cause of fracture or displacement. Are we to conclude from their silence that they have rejected it as an efficient cause of these lesions, or that it did not come under their notice or consideration? Possibly they may have rejected it on the ground that there were more satisfactory means of explaining the injuries attributed to it. And certainly in some of the cases thus explained, other causes, such as forcible flexion and extension of the dorsal portion of the spinal column, have been the efficient agents. In illustration of this, I may adduce a case which came under my care at the London Hospital, in January, 1871. The patient, a man thirty-seven years of age, was walking in the street when some scaffolding fell upon his head. The hat which he was wearing was completely crushed, and his scalp was torn away from his skull. The spinous processes of the third and fourth dorsal vertebræ were fractured, and the body of the third was broken and compressed. The manubrium was displaced backwards from the gladiolus. It is evident that the force applied vertically to the head produced violent flexion of the dorsal vertebræ, mainly expending itself in crushing the body of the third vertebra. At the time it was believed that the separation of the manubrium and the gladiolus was due to the chin having been driven down on to the sternum; but there was not the slightest evidence of the fact. Subsequent consideration convinced me that the displacement was the result of flexion of the

dorsal vertebræ. The body of the third dorsal vertebra being crushed, the first and second vertebræ were driven further forwards than otherwise they could have been, and the force thus transmitted to the manubrium was far more considerable than any which it could have received if the vertebra had remained entire. This force would cause the upper end of the manubrium to be tilted forwards, and the body of the sternum being acted upon at the same time through the ribs attached to it, the strain would fall on the joint uniting the two pieces together. The lever-like action of the ribs on the two pieces of the sternum being quite sufficient to cause disruption of the joint, it would be unphilosophical to assume another cause, such as violent contact of the chin with the manubrium, which was not proved and could not be proved to have been in action.

A remarkable exemplification of the view that in cases of displacement of the manubrium from the gladiolus, occurring in connection with fractures and displacements of the spine, and from *indirect* violence generally, the lever-like action of the ribs is the efficient cause of the lesion, is afforded by the following case, which was recently under my care at the London Hospital. A man, æt. 55, was standing on the floor of a warehouse, when a bag of seed falling from a height of forty feet through a trap in the floor above, alighted on his back, striking him between the shoulders. The spinous processes of the six upper dorsal vertebræ were broken off, the body of the sixth dorsal vertebra was fractured, and the first six ribs on the left side were broken near their angles. The manubrium was displaced backwards from the gladiolus and considerably depressed. As the scapulæ were uninjured, the bag must have struck the patient's back nearly in the centre, but with more force on the left than on the right side of the spine, to occasion fracture of the six highest left ribs. The patient was quite certain that his head had not been driven downwards, so as to cause his chin to strike against the sternum, nor had he fallen either forwards or sideways against any projecting body. All his injuries were due to the fall of the bag of

seed directly on to his back. On admission into the hospital, there was a marked projection of the upper end of the gladiolus, and both it and the manubrium could be felt to rise and fall with each act of inspiration and expiration. The existence of rather extensive emphysema in the neighbourhood of the injury showed that the lung had been wounded. There were none of the symptoms of fractured spine, but towards the close of life interruption to the functions of the spinal cord began to manifest itself. Death took place in less than two days after the accident, and post-mortem examination displayed the injuries described. The explanation of the displacement of the manubrium and the gladiolus in this case appears to be this. The shock of a violent blow received by the six or seven upper dorsal vertebræ was transmitted by the true ribs to the sternum, driving that bone forwards. Owing to the greater mobility and leverage of the five lower true ribs, the gladiolus was acted upon more powerfully than the manubrium, and the result was that the strain fell on the structures uniting the two segments, and that the gladiolus was pressed forwards in front of the manubrium. This driving forwards of the gladiolus either separately or more powerfully and rapidly than the manubrium, which is held firmly by the first and second pair of ribs, seems to me the correct explanation of some recorded cases, such as that mentioned by Professor Humphry, in his work on the Human Skeleton, in which a woman who fell on her back on the pavement was found to have broken her sternum; and that of David, in which the separation of the two segments of the sternum was caused by a fall from a height, the back striking in the fall against some prominent object. Such cases have been explained hitherto either erroneously, as I believe, by a supposed stretching of the sternum between the sterno-mastoid and abdominal muscles, or vaguely by the violent shock or *contre-coup*. The explanation here offered will account also for several cases of displacement occurring as the result of falls, in which the body having alighted on the feet or nates has fallen over on to the back. The lever-like action of the

ribs is likewise brought into play, in cases of compression of the chest, as well as in cases in which the force is unilateral. In the latter class, the ribs will act on the sternum with the addition of a twisting or rotatory motion, well suited to rupture the ligaments and periosteum uniting the segments. Overarching of the back by violent contraction of the muscles would occasion a corresponding overarching of the sternum, and thus give rise to a fracture or displacement. The fractures recorded by Chaussier, as occurring during the expulsive efforts of labour, were evidently due to this cause, for the patients threw back their heads, bending their bodies, and resting occasionally on their heads and their heels. In all these cases of displacement or fracture the sternum is influenced through the medium of the ribs.

The frequency with which displacement of the manubrium and gladiolus occurs, and the pathological peculiarities of the lesion, are explained with remarkable clearness by the anatomy of the articulation by which they are united. Our English anatomical text books afford us no help in the matter, for they merely state that the first two segments of the sternum are connected by a single piece of symphysial cartilage, whereas there are really two distinct descriptions of joint to be found between them. There is the amphiarthrodial joint, which is the only one mentioned in the English manuals; and there is the diarthrodial or that form of diarthrodial joint which is known as the arthrodia or gliding joint. This fact was brought under my observation whilst examining fresh specimens in the post-mortem theatre, with a view to determine the anatomical conditions which predisposed to the displacement, and as I could find no mention of it in the English works, I began to entertain a hope that the observation might possibly be original; but on referring to a French 'Treatise on Anatomy,' by M. Jamain, I found a brief epitome of some observations made more than thirty years ago by M. Maisonneuve. A subsequent perusal of the original memoir on 'Luxations of the Sternum,' published in July, 1842, in the 'Archives Générales de Médecine' (iii série, tome xiv), both convinced me that there was very little new

material to be collected on the subject, and occasioned some surprise that such scanty justice had been done in works on anatomy and surgery to M. Maisonneuve's careful and accurate observations. M. Maisonneuve, however, has himself remarked in his article, that the articulation which is the seat of the lesion under consideration expressly pointed out by the ancient anatomists had not even found a place in the most justly esteemed works on anatomy of his own day.¹

According to M. Maisonneuve's observations, with which my own in great measure agree, the superior sternal articulation presents the two following forms :—" In a certain number of cases, the tissue between the manubrium and the gladiolus is a true fibro-cartilage, more dense and tenacious at the periphery where the fibrous tissue predominates, more thin and friable in the centre where it is reduced to a purely cartilaginous state. The articulation is thus a true amphiarthrosis, which has no movement but such as is permitted by the elasticity of the intermediate lamina. But in the other cases, in place of a uniform layer of substance adherent to both surfaces, each of the latter is clothed with a distinct lamina, adherent on one side, free on the other, having, in short, the aspect of diarthrodial cartilages. When this disposition exists the layer belonging to the second sternal piece is continued on each side without interruption on to the little facet destined for the cartilage of the second rib, whilst the layer belonging to the first piece adheres on the outside to the spur of the second costal cartilage. It results from this arrangement that the condro-sternal articulation of the superior piece is isolated from the proper sternal articulation, also that the cartilage of the second rib is much more strongly

¹ "There is a kind of articular motion between the handle and the body of the breast-bone which has been observed, not merely in very narrow-chested children, but sometimes even in adults."—"South's Otto," 1831, p. 210. Reference is made to Beauchène, "Observation sur une sorte d'articulation contre-nature entre les deux premières pièces du Sternum," in Sedillot, 'Rec. period. de la Société de Médecine de Paris,' vol. xxxiii, p. 287; and to Heusinger, in 'Meckel's Archiv für die Physiologie,' vol. vi, p. 541, tab. 5, figs. 4 and 5. Otto adds, "In diseases of respiration I have also once found it in a man who died of asthma."

attached to the manubrium than to the gladiolus. This explains how it is that in the luxation of the first two pieces of the sternum the body always abandons the cartilage of the second rib, whilst the manubrium remains constantly united to its point." It also explains the presence, in pathological specimens, of a separate layer of cartilage covering each piece of the sternum. This condition is observable in a specimen in the London Hospital Museum (marked Gb e 5), which shows a displacement of the manubrium behind the gladiolus, the periosteum remaining entire. It was taken from the body of a man, thirty-six years of age, who fell into a dry pit forty-five feet deep, and fractured the first and second lumbar vertebræ, as well as some ribs and the sternum. About half an inch below the displacement of the manubrium there is a fracture through the gladiolus.

Union of the articular surfaces in the diarthrodial form of joint is maintained by some short and deep anterior and posterior fibres, passing between the edges of the manubrium and the gladiolus, and underlying the fibrous laminæ, which "clothe the anterior and posterior aspects of the sternum, and which serve as a periosteum at the same time that they constitute a true ligamentous coat." M. Maisonneuve has thus described the periosteal layers:—"Meckel has compared them, not without reason, to the anterior and posterior ligamentous coverings of the bodies of the vertebræ. The *anterior ligamentous coat* is formed of white fibres, which cross each other in every direction. The longitudinal fibres appear to proceed from the internal tendon of the sterno-mastoid muscles. These are the thinnest; the others, transverse, are especially marked at the level of the costal cartilages, upon which they are prolonged and inserted: in short, the aponeurotic expansions of the great pectoral muscles here throw themselves into it. From these different fibrous planes there results a sort of felt, possessing an enormous power of resistance in the transverse direction, but less in the longitudinal direction. It strongly adheres to the anterior face of the bones, and would break rather than permit their detachment by violence. The *posterior ligamentous coat* is less thick than the preceding;

its fibres are more distinct and less felted; they possess for the most part a longitudinal direction, and have but little connection with the chondro-sternal articulations."

Although the posterior coat is less thick than the anterior, yet it is commonly observed that the posterior coat remains entire, or nearly entire, in displacement of the sternum. This is due to the direction in which the force generally acts, namely, from behind forwards through the ribs and to the shape of the bone. The sternum, as M. Maisonneuve has pointed out, forms an arch with the convexity forwards, and with its highest point at or near the articulation between the manubrium and the gladiolus, and the strain falls necessarily on the anterior ligament. Moreover, the longitudinal direction of the fibres of the posterior ligament resists the force better than the transverse disposition of the anterior, and favours its simple stripping up from the bone as the gladiolus is carried forwards and upwards in front of the manubrium, and the end of the latter becomes inserted like a wedge between the periosteum and the body of the bone. This view is confirmed by the fact that when the violence is direct and proceeds from the front, the posterior layer may be torn, whilst the anterior remains entire. An interesting specimen was recently removed by my colleague, Mr. Waren Tay, from a patient at the hospital, who had fallen from a height on to the sternum. The bone was broken across, near the middle, and the ends of the fragments were bent inwards, the posterior layer of ligament being ruptured, and the anterior retaining its continuity.

The posterior layer of periosteum adheres but slightly to the bone above the level of the third pair of ribs, but below that point its connections are more intimate, and hence, as pointed out by M. Maisonneuve, it will generally be found stripped from the bone as far as, and no farther than, the third ribs.

The general anatomical conditions of the displacement which have been enumerated are exemplified in the specimen which I removed from the body of the patient, whose sternum was dislocated by the fall of a bag of seed on to the

upper part of his back. It will be seen that the second pair of ribs adheres to the manubrium, that the two segments are held together merely by a strip of the periosteum covering their posterior surfaces, and that the periosteum has not been separated farther than the level of the third pair of ribs.

The articular end, both of the manubrium and the gladiolus, had doubtless been covered each by a distinct layer of cartilage at an earlier period of life, but it would appear that these layers had been in process either of absorption or of ossification, for the ends of the bones show only traces of cartilage here and there.

There are one or two points on which my observations differ from those of M. Maisonneuve. In respect to the relative frequency of the two kinds of joint, M. Maisonneuve states that the majority of sterna exhibit the diarthrodial form. And he places the proportion as high as three out of five specimens. My own observations would give a slight preponderance to the amphiarthrodial description, reckoning adults only, for if children be included the preponderance would be much more considerable. Again, M. Maisonneuve remarked the occurrence of the diarthrodial form more often in the female than in the male, whereas I have found it more frequently in males than females. It is to be regretted that M. Maisonneuve does not state the number of the specimens which he examined anatomically. Up to the present time I have examined 100 specimens, with the following results.

Out of 100 specimens, 51 exhibited the amphiarthrodial, 32 the diarthrodial, and 11 an intermediate variety of joint, and 6 had undergone ossification. The several series were thus composed :

Amphiarthrodial.—Adult males, 26 ; adult females, 17 ; boys, 4 ; girls, 4=51.

Diarthrodial.—Adult males, 22 ; adult females, 9 ; boy, 1=32.

Ossified.—Adult males 4, of the respective ages of 30, 36,

53, and 65; adult females 2, of the respective ages of 73 and 76=6.

Intermediate.—Adult males, 9; adult females, 2=11.

Under the head of the intermediate variety of joint I include all the specimens in which the separation between the two pieces is incomplete. Either a small—in some cases a very small—cavity exists in the centre of the uniting tissue, or a separation is found on one side and not on the other, or a few fibres pass across the interspace, and connect the layers of cartilage. On the whole, the affinity of these specimens seems greater to the diarthrodial than to the amphiarthrodial form of joint. On the other hand, I regard the ossified specimens as belonging exclusively to the amphiarthrodial series, as it appears extremely improbable that ossific deposit would invade and destroy the interspace which exists in the diarthrodial variety.

M. Maisonneuve found the diarthrodial joint at all ages and even in very old people without a trace of ossification, and I have found it in the child as well as in old people of seventy and eighty years of age. He has made the curious observation that the diarthrodial form is found more frequently in the adult and old person than in the child, and my own observations bear this out. I am therefore inclined to believe that the diarthrodial joint is formed by absorption occurring during the period of youth, but I have not sufficient data for the settlement of the question.

Another point on which I differ from M. Maisonneuve is in respect to the part played by the clavicle in producing displacements of the sternum. M. Maisonneuve attaches great importance to the action of the clavicle. It forms, he says, a solid buttress, and in falls on to the neck and shoulders transmits the shock to the sternum from above, whilst the middle and lower ribs convey it from below. Thus pressed between two forces the sternum yields at its weakest point. He adduces the fact of the frequent fracture of the scapula and clavicle, to show that the force was transmitted along that line. I do not deny that the clavicles

may have some influence, and in some cases considerable influence, over the manubrium, but that their action is not necessary to the production of the dislocation is, I think, conclusively shown by the case which has been related, in which the luxation was caused by force applied solely to the dorsal vertebræ and the ribs. A bag of seed fell on to the six upperdorsal vertebræ without touching the scapulæ, and the shock was therefore conveyed to the manubrium by the first and second pairs of ribs. These ribs are united to the manubrium by far less movable joints than the sterno-clavicular joint, and must have a correspondingly greater power over it, not only in forcible flexion and extension of the dorsal portion of the spine, but also in cases in which the violence is applied unilaterally. If a recent specimen be examined, in which the diarthrodial joint exists, or in which there is a tolerably thick symphysial cartilage, it will be found that in addition to slight forward and backward movements (differing much in degree in different specimens), some amount of rotatory motion can be obtained. The occurrence of dislocation from unilateral violence is greatly favoured by this mobility, and I think it will be obvious that the first and second ribs must be chiefly concerned in giving the necessary twist to the manubrium.

The influence exerted by the first and second pairs of ribs over the manubrium receives illustration from the following cases, which have recently come under my observation at the London Hospital.

CASE I.—Wm. C—, æt. 41, fell off a plank on to the ground. The height of the plank above the ground was about fifteen feet. He alighted on his back, and the two upper dorsal vertebræ came in contact with a piece of timber a foot square. Immediately after the accident he experienced great pain not only at the seat of injury, but also over the sternum, at the point of junction of the manubrium and the gladiolus, between the cartilages of the second ribs. On examination I could not detect any fracture of the vertebræ, or fracture or dislocation of the sternum, but there was

marked tenderness on pressure over the sternum at the point indicated, and this remained evident for several days. In this case there had been a severe strain of the joint, the force conveyed by the second ribs not having been sufficient to occasion a dislocation.

CASE 2.—A man, æt. 36, admitted under my colleague, Mr. Couper, fell off a gate on to the back of his head and neck, the latter coming into contact with a large stone. The accident caused a separation of the fifth and sixth cervical vertebræ, with fracture of some of the spinous processes. The sternum was sound, but the first rib on the left side was separated from the manubrium. On examination the sternum was found to be unusually thick and strong, and the joint between the manubrium and gladiolus was seen to be obliterated by ossification, owing to these peculiar conditions of the sternum, the shock conveyed by the first rib occasioned its separation from the manubrium instead of causing injury to the sternum itself.

In conclusion, I will state the views embodied in this paper in the following propositions.

1. The frequent presence of an arthrodial joint between the manubrium and the gladiolus favours the occurrence of displacement in preference to fracture. In other words, the ligamentous fibres keeping the ends of the manubrium and gladiolus in contact are generally weaker than the weakest part of the bone. Whenever the contrary is the case fracture will occur in preference to dislocation.

2. Separation of the manubrium and the gladiolus may occur from forcible flexion of the dorsal portion of the spine, and is most likely to occur when one or more of the dorsal vertebræ is crushed or fractured. Fracture may result from the same cause,

3. Separation of the manubrium and the gladiolus may occur from forcible extension of the dorsal spine, as, for instance, from falls or blows on the back or muscular action. Fracture may also occur from this cause.

4. Both in flexion and extension of the spine the sternum is acted on through the ribs, and the greater length and leverage of the lower ribs causes the gladiolus to be thrust forwards in front of the manubrium.

5. Many cases of fracture or dislocation attributed to direct muscular action or to counterstroke were due to the leverage of the ribs brought into action by violence applied to the back.

6. Fracture of the sternum, but scarcely dislocation, might be occasioned by violent descent of the chin on to the sternum, and this might occur in injuries to the *cervical* portion of the spine.

7. The anatomy of the joint between the manubrium and the gladiolus explains several circumstances noted in pathological specimens, such as the presence of a distinct layer of cartilage covering the ends of each segment, the adhesion of the second costal cartilages to the manubrium, the rupture of the anterior layer of periosteum, and the stripping up of the posterior layer of periosteum as far as the third pair of ribs.

8. The diarthrodial form of joint has been more frequently met with by myself in males than in females, and this concurs with the greater exposure of males to violence of all kinds in favouring dislocation in preference to fracture.

In illustration of the remarks made in the paper, two sterna have been prepared to show the two different forms of joint. The specimen showing the amphiarthrodial joint was taken from the body of a male ; that showing the diarthrodial form, from a female. The latter specimen is interesting also from the fact that eight ribs on each side articulate separately with the sternum. The London Hospital Museum contains another specimen in which eight ribs join the sternum, and Professor Humphry mentions one in the Anatomical Museum at Cambridge. Besides these two specimens, there are some others of the upper part of the sternum, cut vertically to show the joints. One of the diarthrodial specimens was taken from an old man, seventy-seven years of age. Another

showing the amphiarthrodial form with scarcely any cartilage, no motion, and apparently commencing ossific union, from a young man of twenty-two.

The usual condition in young subjects is illustrated by a sternum with the costal cartilages and part of the ribs attached, removed from the body of a boy, eleven years of age. The specimen shows fracture of five ribs on the right side—the second, third, fourth, fifth, sixth, and seventh. He had been run over, and I may, perhaps, incidentally mention that the accident also caused laceration of the right lung, and a slight laceration of the left lobe of the liver close to the longitudinal fissure, with rupture of a branch of the left hepatic duct, causing extensive effusion of bile into the peritoneal cavity and peritonitis. At the post-mortem examination the coils of intestine were coated with a thick layer of lymph stained with bile. The stools passed after the accident were at first quite white, rendering the nature of the injury apparent during life.

In this specimen an indication of commencing division of the symphysial cartilage seems to exist in the form of a slight central depression.

The other specimens on the tables are the dislocated sternum of the man who was struck by a bag of seed on the back, and the specimen (marked Gb e 5) from the London Hospital Museum.