ROTARY DISLOCATIONS OF THE ATLAS.

BY EDRED M. CORNER, M.B., F.R.C.S.,

OF LONDON, ENGLAND.

Surgeon to Outpatients, St. Thomas' Hospital; Senior Assistant Surgeon to the Hospital for Sick Children, Great Ormond Street.

In this paper there will be brought to notice a dislocation which with the modern improvements of skiagraphy will be found to be of infinitely more frequent occurrence than it has been in the past. Moreover, being by no means necessarily fatal, it was previously overlooked; so that now more and more recoveries will be recognized. There is a minor degree of this dislocation, a subluxation (which will form the matter of another paper*) which will be found to be still more frequent than the complete displacement.

As anatomists have paid very little attention to the atlanto-axial joints, excluding that between the odontoid process and the atlas, it is desirable that a few words be said about them. For practical purposes the joint surfaces may be described as plane and the atlas be said to glide upon the axis. The articular surfaces are not horizontal but are directed downwards and outwards on either side. They are also directed slightly forwards. Thus the atlas rests upon two oppositely inclined planes of the axis. In order to allow for the gliding movements of these joints the ligaments are lax and loose.† In consequence, our heads have to be held firm by muscular effort and not by any other means. If this tonic muscular action is abolished the ligaments allow the head to rotate 30 degrees either side of the middle line. Any violence acting at such a time has what may be termed a "flying start" before it meets any resistance. These joints are peculiar in the whole spine for their adaptation to give a large extent of rotatory

*Transactions, Clinical Society of London, 1906.

† American Journal of Medical Sciences, 1907.

movement; with the result that when any violence is applied obliquely to the head or the spine, these horizontal atlanto-axial joints will suffer the most severely. In spite of this special liability to injury, no surgical study has been made of these joints. In this communication an attempt has been made to remedy this defect and to direct attention to a dislocation which is a great deal more frequent than is thought and is by no means necessarily fatal, so that it

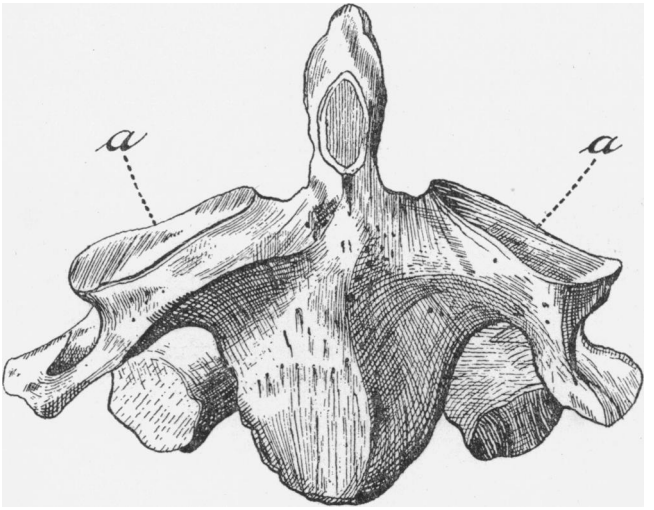

FIG. 1.—Front view of the axis vertebra, to show the outward, downward and forward inclinations of the superior articular facets (*a*, *a*).

is far more commonly overlooked than discovered. The author reports two new cases.

Twenty examples of rotatory dislocation of the atlas have been collected. Two belong to the author, and have not been fully reported as yet, the other eighteen have been gathered from the literature. No museum in the British Isles has a specimen, except that of St. Thomas' Hospital Medical School, London.*

*The same museum is unique in possessing an example of unilateral rotatory dislocation of the axis on the third cervical vertebra. Specimen 192.

It has been decided to report these in two classes—cases in which the injury was confirmed post mortem, and cases which recovered. The author's cases are reported in their proper classes.

Examples of the first class are subdivided into those with the rotatory dislocation alone and those in which the dislocation was complicated by a fracture. There is only

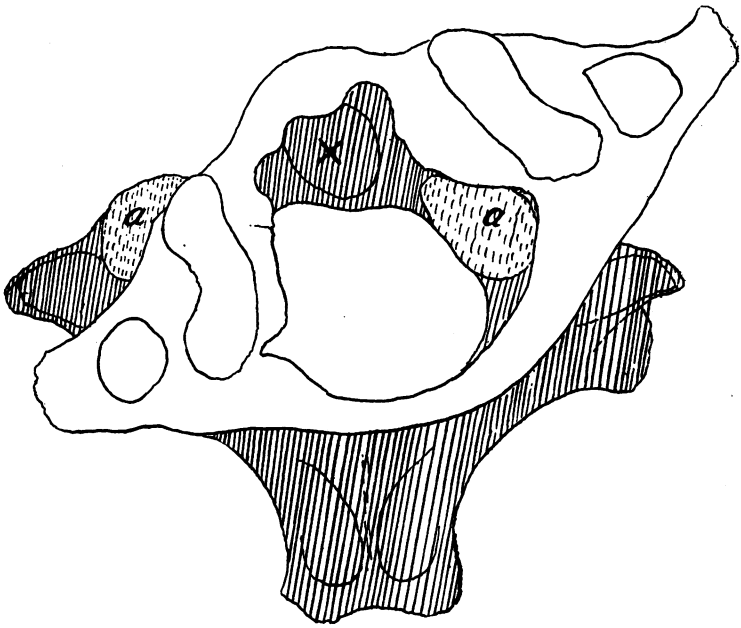

FIG. 2.—Showing anterior displacement of the right side of the atlas (unshaded), on the axis (shaded). The dislocation is only represented as incomplete in the diagram. X indicates the odontoid process and *a*, *a* the superior articular facets of the axis.

one possible case in the first category, rotatory dislocations being almost always complicated by other injuries. This would suggest that cases of uncomplicated unilateral dislocation recover. In this case, Buisson's, it is not quite clear if there really was a dislocation between the atlas and the axis, as well as between the atlas and the occiput. Buisson's case can be doubtfully included in this paper. In this dislocation the vertebral artery of the dislocated

side must run a great risk of being torn. Dupont alone has recorded its rupture.

There is only one possible example of a fatal case of rotatory dislocation of the atlas without other injury, which was recorded by Buisson in 1852. The description is not perfect and it is not clear if the atlas was dislocated from the axis, though such is inferred.

I. Rotatory Dislocation of the Atlas. Buisson. (*Bulletin de l'Academie de Medicine de Paris*, 1852–53, xviii, 102).—A youth, aged 16, was reaching under a cart which was supported by a stake; disturbing the prop, the cart fell on him. Besides the injury to the neck there was a fracture of the right leg. Death was immediate.

Post mortem.—The muscles of the neck were badly bruised, particularly on the right side. The atlas, especially on the right lateral mass, was carried forward, its articular facet being in front of the condyle, which had slipped back; its articular surface was entirely separated from that of the atlas. The ligaments of the condyle which kept it in position, with the articular process of the atlas, were torn from left to right. The occipito-odontoid ligament on the right side was torn off the condyle. The displacement narrowed the spinal canal by half the channel of the foramen magnum.

In eight cases the lesion has been confirmed by an autopsy and was found to be complicated by other injuries; in six the odontoid process of the axis was broken, in one the atlas was broken, in another there was a lateral fracture of the axis as well (Corner's case), and in another the fifth, sixth, and seventh cervical vertebræ were broken. In seven cases the lesion was apparently unilateral, and in one bilateral. As the atlanto-axial joints allow considerable movement without any dislocation, it is often very difficult to decide whether the dislocation is bilateral or unilateral. This difficulty is accentuated by the fact that in some of the unilateral dislocations there is a partial dislocation of the joint of the other side.

Of these fatal cases, in only two did death follow soon after the accident; one in a "few hours" and the other in twenty hours. In the other six, death resulted after periods ranging from twenty-three days to many years,—a very significant fact, as it shows that these injuries need not be

fatal and, when in the living, they are easily overlooked. Gibson's case died on the twenty-third day, Cortes' in the eleventh week, Bernstein's on the one hundred and first day, Lambotte's after fourteen months, whilst Broca's and Corner's were found accidentally after death, many years after the injury.

The absence and onset of paralytic symptoms is also very noteworthy. Neglecting the two rapidly fatal cases, David's and Dupont's, none of the cases presented any paralysis, etc.,—*i.e.* spinal cord symptoms—at first. In Broca's and Corner's cases they never occurred at all. Gibson's case died suddenly on the twenty-third day from a sudden increase of the dislocation, due to injudicious movements, without ever having had any paralytic symptoms. Cortes' case developed spinal symptoms only at the beginning of the tenth week after the accident; Bernstein's on the seventy-first day; Lambotte's after a year.

The absence of spinal symptoms in so many cases points to the ease with which the injury may be overlooked. The sudden death of Gibson's case shows the penalty that may be paid for overlooking it, whilst Cortes', Bernstein's and Lambotte's cases show that a guarded prognosis should be given for some time after the accident, because of the onset of myelitis.

II. Bilateral Rotatory Dislocation of the Atlas, with Fracture of the Odontoid Process.—Broca, in the *Bulletin de la Société de Chirurgie* (1863, 3rd series, 549), reports that on autopsy in an old man who died of an urinary disorder, the occipital foramen was found nearly obliterated. The specimen showed a dislocation of the atlas on the axis, with fracture of the odontoid process. It was a lateral displacement with a certain degree of rotation. During life the man had carried his head a little obliquely and the neck stiffly.

III. Unilateral Rotatory Dislocation of the Atlas, with Fracture of the Odontoid Process. Bernstein. (*Deutsche Zeitschrift fur Chirurgie*, lxx, 174; *Centralblatt fur Chirurgie*, No. 4, iii).—A man, 18 years of age, fell from a step of a carriage, receiving a blow on the left side of his neck. His head had a twist of 40 degrees to the left. Up to the seventy-first day of his illness he had no spinal symptoms. Paralysis then began in the right arm, involving successively the right leg, left arm, left leg, bladder, rectum, and diaphragm. Death on the 101st day after the accident.

Post mortem.—Fracture of the base of the odontoid process with callus formation which led to the compression of the cord. Forward rotatory displacement of the atlas, the right side being displaced forwards on the axis. The left side was in its proper place.

IV. UNILATERAL ROTATORY DISLOCATION OF THE ATLAS, WITH FRACTURE OF THE ATLAS AND AXIS. CORNER. (*St. Thomas' Hospital Museum Catalogue*, 187).—Unfortunately this remarkable case has no clinical history; but, fortunately, the subject of the injury lived and was not paralyzed, as is evidenced by the signs of sound repair about the fracture. As a result, the bones bear marks which have been engraved upon them by the movements of the neck subsequent to the healing of the fracture. These tell their tale, allowing us to ascertain some of the results of the injury. The specimen consists of part of the occipital bone and the atlas, the axis being wanting. Luckily the atlas bears upon it unmistakeable signs of the condition of the axis.

The occipital bone is ankylosed on both sides to the atlas. It is impossible to say whether there has or has not been any fracture of the occipital condyles.

The atlas is much misshapen in consequence of fractures, which have been completely repaired by bone, ankylosis to the occiput accompanying that repair. A fracture has taken place at the apex of the posterior arch and has been united by fibrous tissue, not by bone. In the region of the right lateral mass there has been a further injury. This fracture has apparently been comminuted, accounting for the great deformity of the lateral mass. The damage to the atlas has been confined to the right side, a point which indicates that the head at the moment of the accident was on the right side, so that all the violence was transmitted to the right condyle. The ankylosis of the corresponding occipito-atlantal joint was a direct consequence of the injury; the ankylosis of the joint of the opposite side was secondary and a result of that on the right.

The fractures of the atlas are two in number. The primary one was in all probability the comminuted one of the right lateral mass, owing to the right occipital condyle being impacted on to it. On account of the mechanical disposition of the articular surfaces, the same impact would drive the lateral mass outward and lead to a secondary snapping of the posterior arch, as in the breaking of a bird's "merrythought."

The condition and disposition of the axis can only be inferred by the articular facets on the under surface of the atlas. The left articular facet is markedly smaller than is normal and has been covered with cartilage in the recent state. The facet for the odontoid process presents many peculiarities. Instead of being more or less circular, it is much elongated from above downwards, the process articulating with the left side of the foramen magnum. Its vertical or long axis is oblique and quite out of harmony with the left atlanto-axial facet just described. Therefore, between these two facets there must have been a fracture. Under the large deformed right lateral mass of the atlas, continuous with the facet for the odontoid process just mentioned, is a new facet which must have been a joint between the atlas and the body of the axis. To the right of this

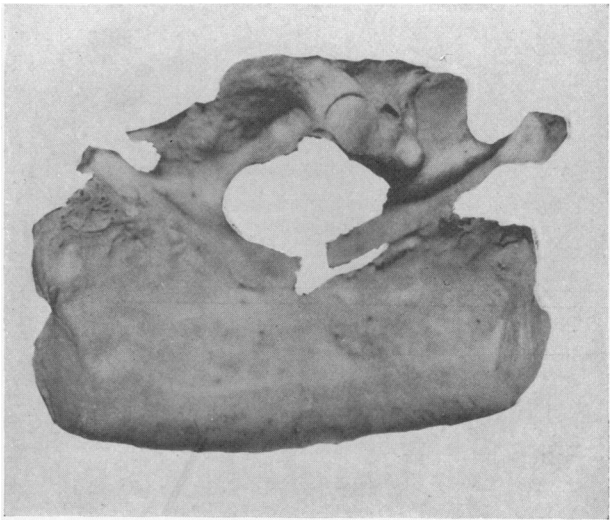

FIG. 3.—Photograph of specimen of Case IV.

impression there is the place where the right articular facet for the axis should be. This can be traced in outline, but the surface has evidently *not* been covered with cartilage. There must have been a dislocation here as there has been ankylosis of the atlanto-axoid joints. To sum up, the articular surfaces on the under part of the atlas indicate that there had been a lateral fracture of the left side of the axis, involving the outer part of the superior articular facet, and a rotatory dislocation of the rest of this joint and also of that of the other side. That is to say, there has been a lateral fracture with rotatory dislocation of the axis without causing death.

The dislocation of the axis has resulted in the displacement of the right fragment of the atlas backwards and slightly inwards; and the left

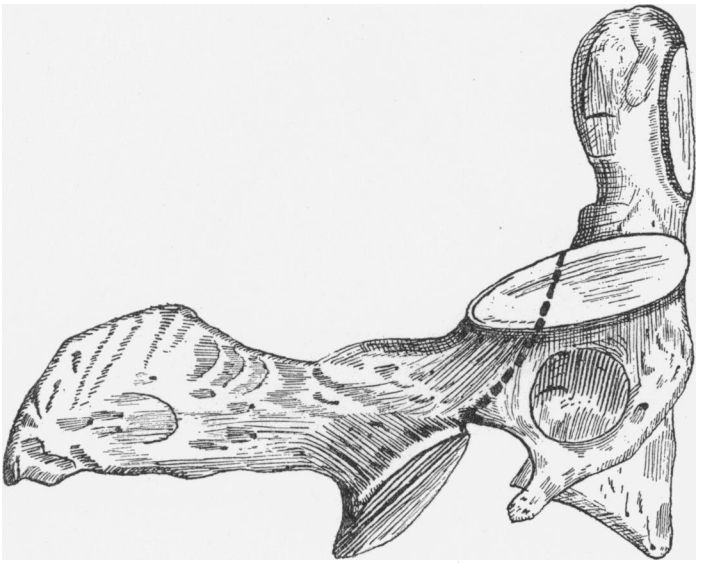

FIG. 4.—Side view of an axis vertebra. The dotted line indicates the site of a *lateral fracture*. See American Journal of Medical Sciences, 1907.

fragment forwards and outwards. There is also some rotation of the vertebræ on their transverse axis.

A few words must be said as to the possibility of a fracture of the base of the odontoid process having occurred.* This seems not an unlikely thing when the presence of the unilateral dislocation of the atlas is taken into account. But there are several reasons to make us think otherwise. In the first place the process has worn for itself a well marked facet, which a broken off process would be hardly expected to do. Such might occur if the fragments united with bone. But fibrous union alone is

*Transactions of the Medical and Chirurgical Society, London, 1907.

known to occur in 97 per cent. when this fracture is required. Also, the articular facet for the odontoid process is continuous with the new facet for the body of the axis, as has been pointed out above, which suggests continuity of bony structure, and therefore no fracture. Apparently. the process has preserved its proper anatomical relationship with the body of the axis, as is shown by the facets. Moreover, the integrity of the process would have a great deal to do with the prevention of instantaneous death, for by locking between the anterior arch of the atlas and the transverse ligament, it will limit the displacement of the axis and prevent damage to the spinal cord and its membranes. In this we may compare Lowson's case*

A similar question of fracture of the odontoid process was raised

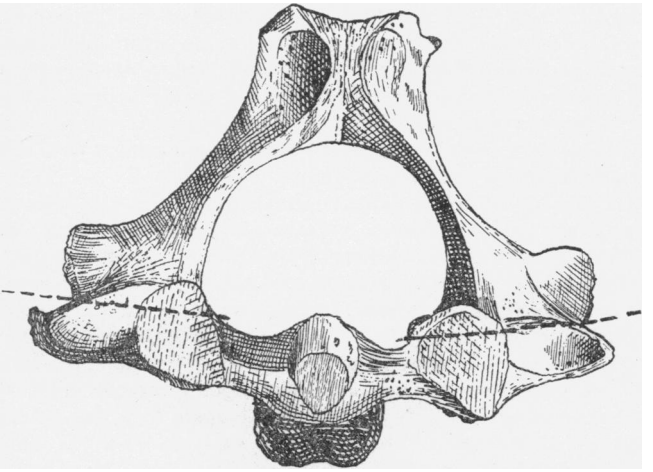

FIG. 5.—View of the atlas vertebra from above. The dotted lines indicate the situations of lateral fractures.

about the author's other case (XIII) and, likewise, it was decided not to be present.

V. UNILATERAL ROTATORY DISLOCATION OF THE ATLAS, WITH FRACTURE OF THE ODONTOID PROCESS. CORTES. (Malgaigne's "Fractures," II, 329).—A youth, aged 15, was thrown to the ground and received several blows on his head and neck. He was quite well for nine weeks; then he lost the use of his limbs, and died in the eleventh week.

Post mortem.—It was found that the atlas was dislocated forwards with the right side more advanced than the left. The odontoid process was fractured across its base and lay almost horizontal.

VI. UNILATERAL ROTATORY DISLOCATION OF THE ATLAS, WITH FRACTURE OF THE 5TH, 6TH, AND 7TH CERVICAL VERTEBRÆ. DAVID. (*Bulletin de la Société Anatomique de Paris*, 1888, lxiii, 910).—A man, aged 26,

* Medico-Chirurgical Transactions, 1875.

was caught by a buffer in the upper part of the neck and thrown some distance. When seen the neck was very painful. There was a suboccipital depression extending as far down as the spinous process of the axis; a corresponding projection could be felt in the pharynx. There was paralysis of all four limbs. Death 20 hours after the accident.

Post mortem.—There was dislocation forwards of the atlas upon the axis, to the left side, with compression of the cord. There was also a vertical fracture of the posterior and middle parts of the body of the fifth cervical vertebra. The sixth and the seventh vertebræ were likewise fractured.

VII. UNILATERAL ROTATORY DISLOCATION OF THE ATLAS, WITH FRACTURE OF THE ODONTOID PROCESS. DUPONT. (*Bulletin de la Société Médicale de la Suisse*, 1876, x, 65).—A man in delirium tremens leapt from the fourth story of a building. Death resulted in a few hours. Upon post-mortem examination there was considerable separation between the atlas and the axis. The latter was luxated backwards and pivoted on its left atlanto-axial joint, which remained in its proper place. The odontoid process was fractured at its base, but owing to the fact that the ligaments remained intact there was no displacement of the process. The vertebral artery was also ruptured.

VIII. UNILATERAL ROTATORY DISLOCATION OF THE ATLAS, WITH FRACTURE OF THE ODONTOID PROCESS. GIBSON. (*Lancet*, 1885. ii. 429).—A man, aged 58, rolled down a bank and lay there all night. Upon rising, he was too unsteady to walk and had to be assisted home. His head was very much set forward, the chin resting on the sternum. It was held rigidly in this position. He said that he was suffering from a pain of a burning character. There was a great prominence at the back of the neck just below the occiput. The highest cervical spine was two inches from the occiput. A diagnosis was made of a displacement between the atlas and axis. There was no paralysis. He was laid on the bed and steady traction applied to the head, when the dislocation suddenly reduced with a snap. Crepitus was also felt, indicating the presence of a fracture. The prominence of the spines disappeared and the head went naturally into line with the body. A week later he was seized with abdominal pain after eating some bread and butter. Whereupon, in spite of efforts to prevent him, he started up and almost immediately fell back dead.

Post mortem.—Considerable separation was found between the atlas and axis. The cord was tightly stretched and pulled against the anterior wall of the canal. There was no damage to the cord. The odontoid process and part of the body of the axis was broken off and remained in its situation against the arch of the atlas, the transverse and other ligaments being intact.

Death after twenty-three days.

IX. UNILATERAL DISLOCATION OF THE ATLAS, WITH FRACTURE OF THE ODONTOID PROCESS. LAMBOTTE. (*Annales et Bulletin de la Société de Medicine d'Anvers*, 189, lvi, 031–133).—The fracture was produced by a simple movement of extension of the head, while the young woman

was sewing. Afterwards, she suffered from pains in the head and a stiff neck. A year later she began to suffer from paralysis in the upper limbs, imperfect anæsthesia, exaggerated reflexes, etc. Death occurred about fourteen months after the injury.

Post mortem.—The odontoid process was found to be fractured across its base transversely, and repaired by some fibrous tissue. The atlas was dislocated forwards on the right side only. The transverse and check ligaments were intact.

Having gleaned what knowledge was possible from the records of fatal cases of rotatory dislocation of the atlas, it now remains to apply that knowledge to reported cases of recovery from that injury. Ten of these have been collected,—the earliest being Bayard's, in 1870, and the latest the author's, in 1905. Of these ten, only one presented any spinal symptoms—the second case of Lannelongue; but the description is insufficient to enable it to be said to what extent. In only one is the odontoid process known to have been broken—Bayard's case—which is striking when compared with the fact that that fracture was found in six out of eight cases in which there was a post-mortem examination.*

In Billot and Picque's case, as in the author's, the patient had considerable difficulty in swallowing. In my case the patient had great difficulty in opening his jaw as well.

In the instance recorded by Uhde, Hagemann and Boettger, the right hypoglossal nerve was permanently paralyzed. It is hardly conceivable that this nerve could have been stretched or ruptured by the dislocated atlas. The probable key to the explanation is to be found in a case of Sir James Paget's which was shown before the Clinical Society.† The hypoglossal nerve was injured in a case of fracture of the posterior fossa of the base of the skull. The violence which produced the dislocation of the atlas in Uhde, Hagemann and Boettger's case would have been prone to fracture the posterior part of the base of the skull. It would appear that this instance is an example with coin-

*Transactions of the Medico-Chirurgical Society, 1907.

†Clinical Society's Transactions, iii, p. 183.

cidence of the injuries. The difficulty in swallowing, noticed by Billot, Picque and the author, was probably due to the dislocation causing some injury to the first or second cervical nerves, so rendering the pharyngeal plexus inefficient. Sir Thomas Barlow has published a case of hemiatrophy of the tongue with paralysis of the soft palate, following injury to the upper cervical spine and (?) to the rim of the foramen magnum, in the Transactions of the Clinical Society of London, 1889, xxii, pp. 322–327. He regards the symptoms to have arisen in consequence of cicatrisation in the healing of the fracture in the occipital bone. The cases of Sir James Paget and Sir Thomas Barlow, in all probability offer the correct explanation of the paralysis of the right hypoglossal nerve observed by Uhde, Hagemann and Boettger in the case which they have recorded (XIX).

X. UNILATERAL ROTATORY DISLOCATION OF THE ATLAS. BACON. (*University Medical Magazine*, 1891, iii, 182).—A man, aged 22, fell down sixteen steps, striking his head. He was conscious and able to walk. His head was slightly flexed and turned to the right. It could not be moved.

On examination, the spinous process of the axis was turned to the left and upwards for a quarter of an inch. In the pharynx, corresponding to the body of the axis, was found a marked projection. There was no paralysis or anæsthesia.

The man got quite well and the movements of his head returned to a limited extent.

XI. FRACTURE OF THE ODONTOID PROCESS AND ROTATORY DISLOCATION OF THE ATLAS. BAYARD. (*Boston Medical and Surgical Journal*, 1870, N. S., v. xliii).—A girl, aged 6, fell, a month previously, from a pile of boards about five feet high, striking her head and neck. Afterwards she could not move her head without pain. She was treated for neuralgic pains in the neck.

The head was inclined forward and to the right; she supported it with her hand under her chin. Any attempt to rotate or move it caused great pain. No irregularity could be found in the vertebræ of the neck. She was ordered to be kept on her back as much as possible. Nine months later she walked well, but still supported her head. The head now rested on the right shoulder and the neck was much altered in shape, the irregularity giving the impression that there was a "partial luxation of the atlas and axis." She wore an apparatus to support her head for a year, at the end of which she could hold her head up and even rotate it consider-

ably. Three years after the accident she had an abscess in the neck from which was discharged the separated odontoid process.

XII. UNILATERAL ROTATORY DISLOCATION OF THE ATLAS. BILLOT and PICQUE. (*Bull. et Mem. de la Soc. de Chir. de Paris*, 1900, xxvi, 23).—A man, aged 21, fell upon his head a distance of three and one-half metres, without losing consciousness, got up and walked a hundred metres. He complained of violent pain at the nape of his neck, great difficulty in swallowing and on movement of his head. There was no paralysis or anæsthesia. The pain in the neck disappeared in about fifteen days; the dysphagia lasting a little longer. At the end of three weeks he was sent back to his regiment with only a stiff neck. The face was turned a little to the right. The upper part of the neck was deformed; a little out of the median line a prominence was visible. The spinous process of the axis was deviated a fingerbreadth to the right. The movements of flexion and extension were very limited and rotation was very incomplete. There was a protuberance in the right side of the pharynx. The case was called one of dislocation to the right of the atlas by rotation of the vertebra upon its body, without fracture of the odontoid process.

Recovery without any serious effects.

XIII. UNILATERAL ROTARY DISLOCATION OF THE ATLAS ON THE AXIS, WITH FRACTURE OF THE ANTERIOR ARCH OF THE ATLAS. NO PARALYTIC SYMPTOMS. RECOVERY. (CORNER.) (*Clinical Society's Transactions*, London, 1905.) Shown at the Clinical Society of London, February 24, 1905.—J. L., aged 21, fell from off a horse, striking his forehead. Beyond making him "see stars," he was not much hurt. He got up and rode his horse home. He came to St. Thomas' Hospital complaining of a stiff and somewhat painful neck, and was treated with liniment and rubbing; but as he was no better at the end of a fortnight he was admitted.

Examination.—The patient carries his head a little flexed and turned to the right. Movements are limited and the neck is stiff. The left transverse process of the atlas is easily palpable between the mastoid process and the angle of the jaw. On the right side it cannot be felt, the examining finger sinking into a groove. Further palpation gives the impression that the transverse process is displaced backwards. There must be a dislocation of the right atlanto-axial joint. On the right side of the neck, below the point just mentioned, there is felt a prominence of the middle of cervical vertebræ, which shows that there has been some accompanying rotation of the vertebræ below the dislocation. After a few minutes' standing the man became fatigued.

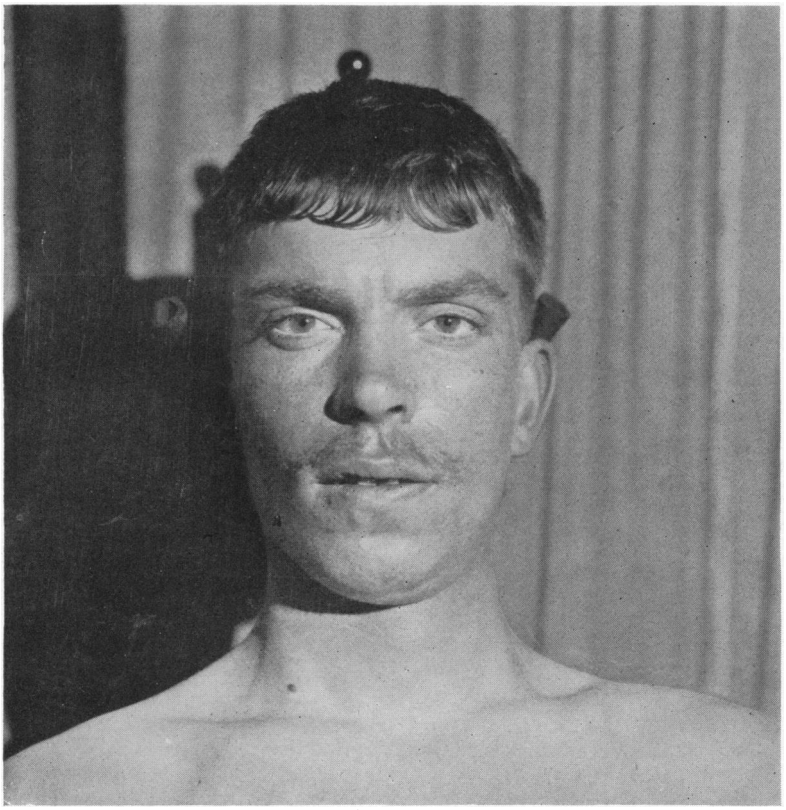

FIG. 6.—Photograph of J. L., showing his chin turned towards his right shoulder.

An examination on a later day confirmed the above observations and it was further remarked that he could rotate his head to the right or injured side, but not to the left or uninjured side. A further observation was that he had difficulty in opening his mouth and his articulation was indistinct. There was no difficulty in swallowing such food as the restricted movements of his jaws allow him to take. He was never able during his stay in hospital to open his mouth sufficiently to allow his pharynx to be examined by a finger. There were never any paralytic or anæsthetic symptoms.

When his pharynx was examined, after his jaws had recovered sufficiently to enable him to open his mouth, the right side of the atlas, which was displaced forward, could be felt as a prominence on the posterior wall.

The skiagraph shows the unilateral dislocation of the atlas from the fracture of the anterior arch of the atlas. It is not clear whether the odontoid process is broken, but it was generally thought at the meeting (Clinical Society*) to be intact.

XIV. Unilateral Rotatory Dislocation of the Atlas. Hesse, (*Beitrage zur klin. Chir.*, 1895, xii[1], 93).—A man fell from a cherry tree. striking on his head. His head was turned to one side and his neck was stiff and immovable. He was never fully unconscious and had a peculiar sensation about his arms and legs. There was no paralysis. The head was replaced when under an anæsthetic. Professor Socin diagnosed a "torsion luxation of the atlas." The recovery presented nothing noteworthy.

Described as an example of the rotation luxation of Uhde, Hagemann and Boettger.

XV. Two Cases of Unilateral Rotatory Dislocation of the Atlas. Lannelongue. (*Compt. Rend. de l'Academie de Science*, Paris, 1904, cxxxix, 495–6.) Case I.—A child, 8 to 9 years of age, hung himself accidentally whilst playing. There was an unilateral dislocation of the atlas on the axis, which was reduced and the child made an uninterrupted recovery.

XVI. Case II.—An officer was thrown from his horse and suffered from a similar dislocation of the atlas on the axis. He had four-limbed paralysis. Reduction was followed by recovery, though it is not stated whether the paralysis passed off completely.

XVII. Unilateral Rotatory Dislocation of the Atlas. Legg. (*Lancet*, 1893, ii, 1382).—A lad (schoolboy) tumbled over another boy in the playground and, turning over, caught the back of his head in an angle formed by the trunk of a tree and the ground.

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* Clinical Society's Transactions (London), xxxviii, p. 228; also in the next volume.

The head remained twisted to the left and he was quite incapable of rotation, all attempts at it causing great pain. The chin was somewhat raised so that he could not see his toes. Pressure over the lower cervical spinous processes caused no pain and disclosed no irregularity, but when applied to transverse process of the atlas, especially on the right side, it caused great pain. The diagnosis was "a probable rotatory dislocation or hyper-rotation of the atlas upon the axis." The dislocation was reduced by exerting traction on the head with counter-extension on the trunk, a click being heard at the moment of reposition. Recovery uneventful.

XVIII. Unilateral Rotatory Dislocation of the Atlas. Panas. (*L'Anjou Médical*, 1898, 41).—A case of luxation of the atlas and axis was described with special reference to the symptoms of amblyopia. The man fell whilst carrying things. There was right torticollis. Not much space is given to the dislocation itself. The sight of the right eye was lost some days after the accident. There is a long account of the possible pathology of the ophthalmic symptoms. Recovery from the injury. There never were any paralytic signs.

Mr. J. B. Lawford, Ophthalmic Surgeon to St. Thomas' Hospital, to whom I showed this paper, thought Panas' explanation insufficient. M. Panas is the only observer to mention eye symptoms in these cases.

XIX. Rotatory Dislocation of the Atlas. Uhde, Hagemann and Boettger. (*Archiv fur klinische, Chirurgie*, 1878, xxii, 217).—A man, aged 34, fell thirty feet. He sustained a comminuted fracture of the right humerus. There was also pain and tenderness with immobility of the neck. The head was carried bent over to the right, the chin being directed to the left. Moreover, the head was flexed, thus being twisted on all three axes. On the right side the transverse process of the atlas could not be felt in its proper position and the finger sunk deeply into the neck in this place. It was ascertained that the right transverse process was displaced forwards. The corresponding process on the left side is asserted to be displaced backwards, but it is not made clear upon what authority the statement is made. There was a permanent paralysis of the right hypoglossal nerve. There were no spinal symptoms. The deformity was restored by extension and the man recovered. The case is called one of luxatio atlantis violenta, with dislocation of the atlanto-axial joints.

It now remains to draw in brief form the features by means of which rotatory dislocations of the atlas may be observed clinically, so that the lesion may be recognized as an important and not infrequent injury amongst instances of sprained necks.

To begin with, there is the history of the accident, in which the violence is commonly applied to the front and top of the head. There are no symptoms of paralysis or anæsthesia, neither has there been recorded a case of spinal concussion.* The neck is painful to touch and to move. It is stiff and capable of little movement. The position of the head is very characteristic. It is flexed and turned a little to one side, usually the right. In more severe examples the head is bent towards one shoulder so that the chin points to the other side. In the latter case, it is probable that the head cannot be moved. In the former and less severe varieties, the head can be rotated more to the side to which it is directed than to the other.

The side to which the chin is directed is that on which the transverse process of the atlas is rotated backwards. The side to which the head cannot be rotated is that which is, or is only partially, dislocated. For the joint of the side to which the head is rotated is fixed, forming the centre of the curve along which the other joint moves. For example, in turning the head to the right, the right atlanto-axial joint is fixed and the left moves, and vice versa. If the left side is dislocated, the head can only rotate a little to the right, as the left joint does not exist. It can be rotated a little to the left, since the right joint can move, but only a little, as the forwardly dislocated left joint is the fixed point and will not permit more. By means of the rotatory movements present it is possible to decide whether the injury is unilateral or bilateral, but care must be taken in making observations.

Normally, the transverse process of the atlas can be felt half way between the tip of the mastoid process and the angle of the jaw. This can be felt plainly on the side from which the head is turned, unless, when the patient looks forward, it is hidden by the angle of the jaws. On the side to which the head is bent it cannot always be felt, the finger sinking deeply inward and forward into the neck;

*Lancet, ii, 1906.

the transverse process of the atlas has been displaced backwards. A similar observation must be made frequently on a sound but rotated neck; otherwise it is not easy to make. From the back, the spine of the axis, when it can be seen or felt, is deviated somewhat to the side from which the head is bent. This is not due to the fracture, but to the lateral curvature of the cervical spine, which is caused by the flexion and rotation of the head. The condition of the spine of the axis is of some interest, as sometimes it is more prominent than usual and at other times less prominent. The prominence of this spine is due to flexion and forward displacement of the head. Great prominence means much forward displacement of the head, and therefore the odontoid process is very likely to be broken.

An examination of the pharynx, preferably under chloroform, reveals two prominences, that on one side being due to the forwardly displaced transverse process, and that on the other, which is bulkier and less distinctly defined, being due to the part of the axis which has been denuded by the backward displacement of the transverse process of the atlas on that side. Attention has never been directed to these *two* points to be ascertained on examination of the pharynx.

A skiagraph of the lateral view of the head shows a forward displacement of one side of the atlas, owing to the transverse axis of that bone being oblique to the rays. It confirms the clinical observations. A most important thing is to ascertain if the odontoid process has been broken or not. If it has not, there is far less danger if a reduction of the dislocation is attempted, a proceeding which is dangerous if it is. This is not easy to make out, as the two lateral masses of the atlas when viewed from the side are normally one behind the other; in a rotatory dislocation they are seen laterally *en échelon*, obscuring the odontoid process. It is possible in most cases, especially in the recent one, to decide whether or not there has been a fracture. Later, the outlines of the bones become obscured from some

callus and inflammatory reparative formations. The integrity or otherwise of this process is extremely important to the life of the patient, as if intact it will lock between the anterior arch of the atlas and the transverse ligament. If it is broken there is little to protect the cord from an injury.

Anterior skiagraphs show nothing, and, owing to the rotation of the head and the patient's inability to open the mouth wide, a skiagraph of the odontoid process cannot be obtained.

The five points upon which to rely for a diagnosis are the *position of the head*, the *positions and fixity of the transverse processes of the atlas*, the *examination of the pharynx*, and the *skiagraph of the lateral view of the neck*. There is usually nothing which will absolutely exclude fracture of the odontoid process. If the process is broken, death may easily result from a sudden increase in the amount of the dislocation. If it is unbroken, it will lock with the anterior arch of the atlas and the transverse ligament, being a safeguard to the spinal cord. Mention has not been made of the differentiation of unilateral rotatory dislocation from an injury, to which I have lately directed the attention of the Clinical Society of London (*Transactions*, 1906 and 1907), namely, rotatory subluxation of the atlas. The distinction is difficult to make in some cases, as the complete dislocation differs from the partial only in the "quantity" of its symptoms, not in their quality. The subluxation is always reduced very easily when muscular relaxation is induced.

Treatment.—When a diagnosis has been arrived at, and the probable condition of the odontoid process ascertained, the question is whether to reduce the dislocation or not. If the accident has already happened for a fortnight to a month, or the odontoid process is thought to be intact, an anæsthetic may be given. In a number of the cases spontaneous reduction occurs when the muscles are relaxed. In others gentle traction on the head and rotation will bring about the desired result. The head can be put up in a plas-

ter of Paris collar or in wood wool and bandages, which will be succeeded in a few days by a poroplastic collar. If, on the other hand, the odontoid process is thought to be broken, keep the patient at rest in bed with the head immobilized with sand bags, and three weeks to a month later give an anæsthetic to examine the pharynx and reduce the dislocation.

Should the surgeon not reduce the dislocation, the neck is put into a poroplastic collar. Movements in the neck will return, but will be limited. Operative treatment, unless to relieve symptoms of pressure on the cord, is not likely to be of much use.

The following case has been published as an instance of rotatory dislocation of the atlas occurring in prehistoric man. It cannot be accepted as an example of this injury and may be regarded a romantic narrative.

XX. Rotatory Dislocation of the Atlas in Prehistoric Man. Baudouin. (*Compt. Rendu Acad. de Science*, Paris, 1904, cxxxix, 494–5).—A skeleton was found in a barrow at Vendée, which had a rotatory luxation of the atlas on the axis. It was a bilateral dislocation. As the skeleton was silicated whilst it lay *in situ*, and therefore before it was disturbed, the dislocation was thought to be the cause of death. The odontoid process was not broken. M. Lannelongue and others who were present at the séance at which the paper was read, thought that the dislocation had been brought about by the head turning with its own weight after decomposition had softened and loosened the muscles and ligaments. Thus the lesion was a post-mortem change and not an ante-mortem cause of death.