at one extremity. He presumed that, by passing such an instrument down to the substance which was suspected by some to be the bullet, and by giving it a rotatory motion, sufficient would be brought away on the teeth of the file to determine its nature, whether bone or lead. At the same time that he was having this instrument made, he reverted to the idea of a chemical reagent, which had been tried before in similar cases of doubt, but without success. Acting on this notion, M. Nélaton applied to M. E. Rousseau, the chemist, to furnish him with some ample means of determining the presence of lead in a wound by chemical analysis. M. Rousseau then suggested the introduction of a body capable of bringing away a metallic impression, should metal be present, such as rough porcelain; thus making the metal capable of being recognised not only by chemical reaction, but by all its ordinary characteristic physical signs. This suggestion led to the construction of the instrument which, since its successful application in Garibaldi's case, has become known as Nélaton's probe.

Nélaton's probe consists of a slender rod of metal, five or six inches in length, terminated at one end by a small knob of white, unglazed, biscuit china. The other extremity of the probe is furnished with a small handle, grooved ridge-and-furrow fashion, in order that the finger and thumb may the more easily roll it between them, while the porcelain knob is being pressed at the bottom of the wound against the suspected foreign body. If it be a leaden bullet against which the porcelain is rubbed, a very distinct mark of lead is impressed on the latter, which is not easily obliterated. The bullet itself is thus caused to give ocular demonstration of its presence and place of lodgment. If the foreign body be iron, having a rusty surface, a stain of rust will be found on the china.

The round ball of china which is fitted to the Nélaton test-probes usually has a diameter of rather more than a quarter of an inch. This is often large enough to cause a difficulty in introducing it through the small fistulous tracks among fibrous tissues which are frequently met with as one of the chronic effects of gun-shot wounds. A sinus of this kind, unless connected with necrosed bone, usually leads to suspicion in the mind of the surgeon that it is prevented from becoming completely closed by the lodgment of some foreign body which passed along it at the time of the original wound. It is, therefore, just one of the cases in which such a test-probe offers itself as a valuable diagnostic aid to the surgeon, but where the size of the round china knob too often prevents the attainment of this object. A probe tipped with a piece of the biscuit china of less diameter, and more oval in form, is required for these narrow fistulous tracks. In a recent wound, the larger round ball is more convenient. It is not so likely to be impeded in its passage along the wound, and the impression made by the lead upon it is more obvious to observation.

The porcelain test-probe was much used during the war of the rebellion in the United States, and many favourable reports of the results of its employment have been published. A very ingenious modification of it, but one of doubtful practical utility, was manufactured during the war by the eminent surgical instrument-makers, Messrs. Tieman, of New York. In this instrument, the porcelain is placed at the extremity of a long flexible gum-elastic tube, which takes the place of the metallic stem in the ordinary probe. The length of the whole instrument is thirteen inches, the flexible part being nine inches long. By turning a screw at the handle in different directions, and by means of a mechanical contrivance concealed within the tube, the lower part of the instrument, at the end of which the porcelain is placed, can be caused to turn slowly round to the right or left, at the pleasure of the operator. It may be moved round so as to assume a considerable curve in either direction.

This instrument has obviously been designed with the purpose of applying the porcelain test in cases where the ordinary Nélaton probe cannot be used; more especially along deep and tortuous bullet tracks, whose ultimate direction is either uncertain or known to be turned from a straight course. The operator is supposed to cause the porcelain to search for the foreign body, as well as to identify it when found by bringing to light the usual evidence of its presence. I have only tried the instrument on the dead body, but the experiments have not been attended with favourable results. The chief sources of failure with it were found to be, firstly, the uncertainty concerning the direction taken by the end of the instrument when turned in search of the bullet among yielding tissues, at distances far removed from the aperture of entrance and from sight; and, secondly, the difficulty of applying sufficient force to get a metallic impression, even when the point of the instrument was directed against the foreign body, owing to the flexibility of the long tube at the end of which the button of china is placed. Another difficulty experienced was the following. If the china knob became entangled in the tissues at the end of a long track, or was prevented from moving freely by any cause, then the screw, not being able to act on

the extremity, caused the middle flexible portion of the instrument to become curved, so as to press on one side the soft tissues of the track of the wound, along which the probe had been passed. It was only through the displacement of the soft tissues being visible externally after it had occurred to some considerable extent, that a knowledge was gained of the fact that the porcelain end was not moving in obedience to the screw, but only that part of the probe lying in the track of the bullet.

It is evident, from the nature of the porcelain test-probes just described, that direct and firm contact between the porcelain and a bullet is essential, in order that the former may furnish the evidence which the surgeon requires. If it be merely a little blood, serum, or soft coagulum, in front of the bullet, pressure by Nélaton's probe will squeeze it away, and the leaden mark can be obtained; but if any resisting medium, however thin—the thinnest membrane, for example—happen to be placed between the surfaces of the metal and the china, no impression will be made on the latter. And there are various substances which are liable to be so interposed—such as muscular or cellular tissue pushed by the knob of porcelain itself before it; pieces of linen, cloth, paper, or other substances which have entered with the bullet; a piece or edge of bone projecting in front of it, and other such matters. The evil in such occurrences may not simply be the impediment to obtaining an impression from the lodged bullet; but possibly a surgeon may be led to an erroneous conclusion that he has obtained proof of no foreign body being lodged, because the usual evidence of its lodgment is absent from the porcelain. This may lead to delay in the healing process and protracted suffering to the patient, which might have been avoided had a more correct diagnosis been arrived at.

[To be continued.]

CASE OF FRACTURE OF THE ATLAS FROM GUNSHOT INJURY.

BY WILLIAM STOKES,
Surgeon to the Richmond Hospital, Dublin.

IN the following brief narrative of the case of the late Constable Talbot, I am indebted to Mr. Agmon Vesey and Mr. J. Walker for a record of many particulars connected with the case, which were noted by these gentlemen, who had the best opportunity of accurately recording them, in consequence of the unremitting attendance they bestowed on the patient, from the time of his admission into hospital up to the period of his death.

Thomas Talbot, aged 44, a large powerfully built muscular man, was admitted into the Richmond Hospital on Wednesday morning, July 12th, 1871, between 12 and 1.0 A.M., suffering from a gunshot-wound of the neck, which he had received about an hour previously to his admission. He was helped into the out-patient room of the hospital by Inspector Gorman and another constable, and immediately afterwards was seen by Mr. Vesey. The patient seemed weak; and, blankets being laid on the table, he was placed on it in the horizontal position. There had been some bleeding from the wound at the station-house in Green Street; but the amount of blood lost was inconsiderable, and at the time of his admission into hospital the hæmorrhage had completely ceased. The patient was perfectly conscious, spoke clearly and distinctly, but was greatly depressed in spirits, and even then despaired of his ultimate recovery. The temperature of the body was normal, with the exception of the feet, and to these a hot jar was applied. Immediately after this, at the patient's request, the surgeon who was on accident duty that day, Mr. Hamilton, was sent for; but as he happened not to be in town, Mr. Walker, who went for him, called for me. I accordingly went, and arrived at the hospital at 2.45 A.M. On my arrival, I found the room where the patient lay filled with people, chiefly police. On the room being to a certain extent cleared from the large and inconvenient crowd that had collected, I proceeded to examine the patient. He spoke slowly, but in a firm and distinct voice, and mentioned that he did not feel at that moment any violent or acute pain. On examining the wound, which I found behind the left ear, a little posterior to the mastoid portion of the temporal bone, I perceived a small round opening about the size of a fourpenny-piece, through which there was not at that time any sign of even an oozing of blood. His respiration was at this time tranquil, and the heart's action regular and strong. Under these circumstances, I considered it advisable to ascertain the position of the foreign body; and, having regard to the situation of the wound, if possible, to remove it. The

patient also expressed an anxious desire than an attempt should at once be made to extract the foreign body. Taking, therefore, a silver probe, I passed it gently into the wound, and found that it took a direction from behind, downwards, forwards, and inwards. After passing in this direction for nearly an inch, the end of the probe struck on something hard; and, on depressing the handle of the probe somewhat more, and striking again, I felt quite satisfied that there was a difference between the body first struck and that on which the probe now rested—the first being, in my opinion, metal, the second bone. As the former was apparently within easy reach, I considered it desirable to make an attempt to remove it, before there was time for any inflammatory action to supervene. Accordingly, I slightly enlarged the opening, cutting horizontally from before backwards; and, through the opening thus enlarged, I passed a fine forceps down, apparently to the bottom of the wound, and endeavoured to lay hold of the ball. This attempt, however, was not attended with success. I then introduced another and still smaller forceps; and, on making a third attempt and not succeeding, I determined to abandon for the time any further proceeding to remove the foreign body, and to wait until I had better light, and also the advice and assistance of my colleagues.

At 11 A.M. on the same day I again saw Talbot, in consultation with Mr. Hamilton, Dr. R. W. Smith, Mr. Tufnell, and some other medical gentlemen unconnected with the hospital. I stated what had already been done; and it was agreed to examine the wound again. This was done in the first instance with an ordinary silver probe; and the existence of a metallic body, apparently in the situation of the lambdoid suture, was determined. Subsequently, a Nélaton's probe was used, but the instrument on this occasion proved neither "reliable" nor "infallible", as some persons have of late inaptly termed it.* It was then determined to make a second attempt to remove the foreign body. Mr. Hamilton stated that he could not quite satisfy himself that the hard body which the probe struck was metallic; but he thought that the operation should be performed for the likelihood of finding the ball, and that the wound should be enlarged in order to relieve the tension of the adjacent soft structures, and to give a free exit to the suppuration which would inevitably follow the gunshot injury. It was accordingly determined that the patient should be brought into the theatre of the hospital, as the light was much better there. During the operation I was assisted by Mr. Hamilton, Dr. R. W. Smith, Mr. Tufnell, Mr. Vesey, Mr. Walker, and Dr. Robert McDonnell. At Talbot's own request, chloroform was not administered; and during the operation he was never heard to utter a murmur. What was done was simply to enlarge the wound, cutting with a small scalpel horizontally from before backwards. In doing this, two arteries were severed: one was a very small vessel, which was at once secured by a ligature; the other was a larger one, and was either the occipital artery, or a large muscular branch which it often gives off in this situation. There was no strong jet of blood from it; but it was obvious that a considerable

vessel had been divided, from the rapid manner in which the wound filled up with blood. After sponging out the wound, Mr. Hamilton made pressure with the index finger of his right hand against the temporal bone, and in this way hæmorrhage was promptly arrested. I then commenced to search for the ball, and in doing so used two or three different kinds of forceps. However, although I was satisfied that there was a metallic body in the wound—an opinion in which Mr. Tufnell and others fully concurred, and which the *post mortem* examination verified—still, at the operation, it soon became obvious to me and to those who were assisting, that it was useless to proceed further in attempting to extract it. Consequently I felt reluctantly obliged, though knowing how very important it is to remove, if possible, foreign bodies when lodged in this situation especially, to desist from all further attempts to extract the ball.† Mr. Hamilton then, at my request, removed his finger, and I then, without difficulty, seized the vessel and secured it with a silken ligature. To prevent the possibility of the ligature slipping off, I left the point of the tenaculum in the vessel on the distal side of the ligature. It is my firm conviction that, during the operation, at the very outside not more than six or seven ounces of blood were lost altogether. I may mention that this belief is also shared by Dr. R. W. Smith, Mr. Hamilton, Mr. Tufnell, Mr. Vesey, and Mr. Walker. To a person of Talbot's great strength and muscular development, such a loss of blood could not by any possibility have been of the slightest moment. On the operation being concluded, water-dressings and a bandage were applied, and the patient was soon afterwards removed to bed. At 4 o'clock P.M. I again saw Talbot, in consultation with my colleague, Dr. R. Adams, who was unavoidably absent from the hospital at the time of the operation. When we went into the ward we found that Talbot's depositions were being taken by the legal authorities. Talbot was not unnaturally somewhat agitated, and he presented three remarkable conditions, which I had not observed at all in the morning: these were an almost complete fixation and retraction of the head, a remarkably tremulous condition of the tongue, and a cold clammy perspiration over his hands.

July 13. At 10 A.M., I saw the patient and found that he had had a restless night, but had got some sleep. He was free from pain, and was quite sensible. There had been no hæmorrhage, and, on the whole, he appeared to be doing well. He was ordered beef-tea, wine, and anodyne draughts containing camphor and solution of muriate of morphia. At 10.15 P.M., his pulse was very quick. He was in some pain, but was inclined to sleep, and was quite sensible. He had pain in the forehead during the day.

July 14, 10 A.M. Pulse 120. He had been very restless. Mr. Walker saw him frequently during the night, and stated that at 3 A.M. he had a severe rigor, followed by profuse sweating. This was also accompanied by great pain in the forehead and neck. By Mr. Vesey's advice, he got a warm stimulating draught, with opium. He had five attacks of rigor between 3 A.M. and 6 A.M. At this latter hour he first got some sleep. After a full consultation of the surgeons of the hospital, it was determined to remove the tenaculum, which I accordingly did without any difficulty. His bowels being confined, he was ordered some opening medicine. The head was still fixed and retracted.

July 15, 10.15 A.M. Pulse 120. The patient had had five or six hours' sleep. There was some discharge from the wound. A linseed-meal-poultice was ordered to be applied over the wound. Towards evening, at about 8 P.M., Talbot got into a very unusual and excited state, said he knew that he would soon die, and insisted on having his brother telegraphed for. Pulse very quick; tongue still tremulous. His whole body was covered with a cold clammy sweat.

July 16. He had a very restless night; no sleep. He did not complain of pain. He was bathed in profuse sweat, and in a very excited state. At about 6 A.M., Talbot's brother observed that there was bleeding from the wound. He pressed a handkerchief against the wound, and immediately afterwards Mr. Walker, and subsequently Mr. Vesey, arrived. They found him pressing on the wound. A large clot of blood was observed on the pillow. Mr. Vesey did not raise the head, but turned it a little to one side, removed part of the dressing, and found a slight oozing of blood. A fresh compress and bandage were applied, which effectually arrested all further hæmorrhage. The patient was observed to be covered with a cold clammy sweat. At about 11 A.M. I saw Talbot. I observed a great change for the worse. His eyes were staring and expressionless. He was in a very agitated and excitable state. His pulse had risen to 140, and he was slightly delirious. Many of the answers he gave were unconnected with the questions that were put. At this time he was seen along with me by Sir William Wilde and Mr. Porter. Shortly after this his symptoms became much more urgent. His pulse rose to 160; his breathing more hurried; then he became violently delirious, requiring several persons to keep him in his bed. He refused all food, medicines, stimulants, etc. His

* In connection with the Nélaton probe, I may mention that Professor Longmore, undoubtedly one of the highest living authorities on military surgery, is of opinion that the instrument is only of value when its evidence is positive. He observes, in a letter recently received: "It settles the question of lead or rusty iron lodging when it brings away the markings; but it settles nothing when it does not bring away any marks. A surgeon would be very unwise if he concluded no foreign body to be present because he got no evidence of its being present on using the Nélaton probe." In a most important letter also on the subject of the Nélaton probe, which recently appeared in the *Times*, which was signed "An Army Surgeon", the following passage occurs: "I have in several instances failed to obtain indications of the presence of bullets and fragments of lead in wounds by Nélaton's probe, when I have determined their presence by other instruments. It would be entering too much into technical matters to describe these instruments, or to discuss the subject of extraction of bullets, in the columns of the *Times*; but a man does not require to be a surgeon to understand the action of Nélaton's probe, and the extent of reliance which may be placed on it. Nélaton's probe essentially consists of a small knob of 'biscuit china' placed at the end of a slender metal stem. Just as we write on a porcelain tablet with a lead pencil, so the china knob takes an impression of a leaden bullet or of a rusty iron projectile when it is pressed fairly and directly against it; but just as we cannot write on a porcelain tablet if a piece of chamois leather, paper, or other substance happen to be between the tablet and the pencil, so the china knob will fail to indicate the presence of a bullet when a piece of skin, wadding, muscle, or other substance, lies between it and the projectile. Again, if the bullet have sunk in bone, or a portion detached from it has sunk in a cleft of bone, and if the probe happen to be pressed only against the edge or edges of the bone, no indication will be conveyed by it. It is evident, therefore, that on many occasions the test by Nélaton's probe is anything but conclusive, and that if a surgeon were to decide that no metallic substance is present in a gun-shot wound, because he could find no indication of it from the use of Nélaton's probe, he might be led into serious error."

† In a communication recently received by my friend Mr. Tufnell from Professor Longmore on the Talbot case, the following passage occurs: "It would have been acting wrongly, had every effort not been made to extract the bullet from the situation in which it was supposed and reasonably inferred to be lodging. It is of immense importance that foreign bodies lodging in the walls of cavities, whether abdomen, chest, cranium, or spine, should be got away, if possible. No one acquainted with such subjects—at least, no one who respects truth more than some other ulterior object—can really believe that the man's death in this case was due to anything else but the direct effects of the gun-shot wound which had been inflicted upon him."

pupils began to dilate, then to contract, and then to dilate enormously again. The respiration became stertorous, then "blowing", and subsequently diaphragmatic. The violence of his struggles surpassed anything I have ever seen even in cases of the most violent delirium; and his screams were very loud. At about 2 P.M. he began to become much worse, and it became obvious that his end was approaching. After each attempt to get off his bed he became weaker. At 3 P.M. he was seen again by me, Mr. Adams, Mr. Hamilton, Sir W. Wilde, and Mr. Porter. Shortly after this he became comatose; and at about 4 o'clock on the evening of that day he died.

July 17th. At about 1 P.M. I proceeded to make a *post mortem* examination. There were present Mr. Tufnell, Dr. Yeo, Dr. Kirkpatrick, Mr. Vesey, Mr. Walker, Mr. Woodhouse, Mr. Smith, Mr. Frazer, Mr. Johnson, Mr. Elliot, Mr. Goode, and two or three others. Mr. Vesey, who acted under my directions, began by removing the scalp and sawing off the calvaria. The brain was then removed and inspected. Its coverings at the posterior and lateral regions (especially at the left side) were found intensely congested. There was a great deal of subarachnoid effusion on the left side also; but there was no evidence of any purulent matter either on or beneath the meninges. On cutting into the substance of the brain, nothing abnormal was observed. An incision was next made down on the original wound, and a portion of the bullet was discovered firmly wedged in the suture between the temporal and occipital bones. Following the incision a little deeper, a collection of matter was discovered in the immediate vicinity of the atlas; and above the left transverse process of the atlas two pieces of lead were found. A third piece of lead was also found lying a little external to the left condyle of the occipital bone. On examining the occipito-atloid articulation, a quantity of purulent matter was found communicating with the spinal canal. The membranes of the cord, from the base of the brain down to the third cervical vertebra, were in a state of inflammation; and it is no exaggeration to say they were bathed in pus. The cord was greatly inflamed and abnormally soft. A fracture of the atlas was next discovered, whereby a small portion of the posterior part of the left superior articular facet was broken off. Several very minute fragments of bone were subsequently found in the adjacent tissues; so that the portion of bone broken from the atlas may be said to have been pulverised. A careful search was then made for the remaining portions of the bullet, but I did not succeed in finding them. Probably, had we continued the search much further, we should have succeeded; but the sole object I had in view in making the examination was, not to discover the whereabouts of some missing fragments of a very minute conical revolver-bullet, such as No. 7 Eley is, but to determine what was the immediate cause of Talbot's death; and, having determined that to my satisfaction and that of all who were assisting, I did not deem it necessary to continue the dissection further, especially as Talbot left distinct and specific directions that nothing but the head and the neck at the situation of the wound were to be examined. A part of the skull, comprising the portions of the temporal and occipital bones in which a portion of the bullet was wedged, was removed; also the atlas and axis. General decomposition of the body had progressed very rapidly.

From the results of the *post mortem* examination, my belief as to the immediate cause of Talbot's death is, that the fracture of the left superior articular process of the atlas necessitated the tearing of the posterior occipito-atloid ligament, and that thus a communication was established between the parts external to the spinal column, where the abscess probably originated, and the spinal canal, through the vertebral canal, or canal for the passage of the vertebral artery; that the fragments of the bullet and the minute particles of bone found in the soft tissues immediately adjoining the fracture, and the tearing of the ligamentous structures between the occiput and the atlas, gave rise to the formation of an abscess, which abscess penetrated the articulation between the atlas and the occiput; that the matter also penetrated into the spinal canal through the vertebral canal; that the existence of that suppuration gave rise to inflammation of the coverings of the spinal cord; that the inflammation extended to the cord itself; and that the inflammation of the coverings of the cord extended up to the base of the brain—these inflammations being the immediate cause of death.

I have, in conclusion, to acknowledge with gratitude the recent publication in the *Times* of the memorandum signed by Sir James Paget and the other justly celebrated English surgeons, who, unsolicited and with characteristic generosity, came forward and stated their opinion not only as to the inevitably fatal nature of the gun-shot injury which Talbot received, but also as regards the treatment that was adopted in his case in the Richmond Hospital.

EXTRACT FROM A LECTURE ON DISLOCATION OF THE HIP-JOINT: DR. BIGELOW'S VIEWS.

By JONATHAN HUTCHINSON, F.R.C.S.,
Senior Surgeon to the London Hospital, and Lecturer on Surgery, etc.

NEXT, gentlemen, let me say that I regard the researches of Dr. Bigelow in respect to our subject as amongst the most valuable of recent additions to the science of surgery. His essay on the *Mechanism of Dislocation and Fracture of the Hip* I recommend to you most strongly, as an excellent example of experimental investigation applied to a subject concerning which but too many had been contented merely to guess and speculate. I will endeavour to state to you briefly some of the chief results of the Boston professor's work—for details, of course, I must refer you to his book.

The main fact to which I must ask your close attention is, that the ilio-femoral ligament is the strongest part of the envelopes of the joint; that it is very rarely torn through; and that it is to it that the peculiar positions of the bone in the several displacements are chiefly due. This ligament must be described as arising from the anterior inferior spine of the ilium, passing downwards and outwards, and being inserted into the whole length of the anterior intertrochanteric line. Thus at its origin it is not more than half an inch broad, and at its insertion more than two inches. It is supplementary to the capsular ligament, over which it passes, and with which it is inseparably connected. You will find in most anatomical works that the term ilio-femoral or "accessory intertrochanteric ligament" is restricted to the lower part of the structure described; but as the whole arises from one part, there can, I think, be no question that it is well to regard it in its entirety. Dr. Bigelow purposes for it the name of the Y-ligament, because its lower fan-shaped expansion has a space between its upper and lower portions like that between the arms of an inverted Y. The accompanying diagram, copied from his work, well illustrates the arrangement referred to (Fig. 1). For

Fig. 1.—The Y-ligament, shewing its inner and outer bands: the former known as the ilio-femoral. (Copied from Bigelow's work, page 18.)

myself, I doubt much whether anything is gained by rechristening it. However, whatever name we give it, the truth remains the same, that it is this ligament—as strong as the ligamentum patellæ or the tendo Achillis—which in dislocations restrains the movements of the great trochanter, and thus regulates the position of the limb. It is this ligament which, when we reduce by manipulation, guides the movements of the bone. We have long known that the ligamentum teres has nothing to do with these matters, being indeed powerless to keep the