sion, occupying half one pleural cavity, has existed three or four weeks, and shows no signs of progressive absorption.

PERFORMANCE OF PARACENTESIS.—Site of puncture. Low down. Reasons. Dr. Bowditch's rule. Find inferior limit of sound lung behind, and tap two inches higher than this on side of effusion, in a line perpendicular from the inferior angle of the scapula. Position of patient, supported by assistants so as to be easily lowered into a horizontal position. Precautions in withdrawing fluid. Not too quickly, nor completely. Warn patient as to deep inspiration. Indications for stopping: if the stream flag, if there be any sucking noise, or much cough.

EMPYEMA.—Frequency in children, *e.g.*, of 44 and 16 consecutive cases of pleurisy, 27 and 14 were empyemata (Dr. Barlow).^{*} Prognosis good in children, save in those of very tender years. Formation occasionally very rapid: *e.g.*, pus present on 4th, 5th, and 7th day. Importance. Pus frequently localised or encysted, *e.g.*, not uncommon in middle third of thorax, limited above by adhesions, and below by fixing of lower lobe of lung to chest-wall; at this spot loud bronchial breathing, resonance, etc. Diaphragm to empyema. Pain intense. Physical signs comparatively slight. Disease often referred to other parts, *e.g.*, stomach and liver. Pus always to be withdrawn. Risks of leaving—*a.* External perforation; usual site, in the 5th space in the inframammary line, according to Mr. Marshall.[†] His explanation that this is a relatively unprotected part of the chest-wall and pleura, the pus here being only covered in by the internal intercostal, the intercostal fascia, and the weakest parts of the pectoralis major, and the external oblique. External perforations may lead to caries, amyloid disease, etc. *b.* Lung-perforation. Gangrene. Sloughing, hectic, etc. *c.* Tuberculosis. An empyema, even if caseating and inspissated, may be infective. View of Niemeyer, degenerating particles taken up from any caseous relic may be distributed by the blood and set up tubercle, by depositing local foci of irritation. *d.* Risk of lardaceous disease. Spontaneous absorption of empyema. Very occasional, and risking tuberculosis.

DIAGNOSIS OF EMPYEMA.—(*Vide supra.*)

TREATMENT OF EMPYEMA.—*A. Simple puncture by needle of hypodermic syringe or aspirator.* May be used, and repeated, under a few conditions. *a.* If patient be very timid. *b.* Where collections are very small or multiple. *c.* Where pus is sweet, the patient healthy, the illness of short duration, and when refilling does not take place quickly. In the above cases, repeated puncture may be successful in empyema, sometimes; but, as a rule, it affords relief, not cure. Patients thus treated should be watched for some time. Puncture may coax pus to surface (Goodhart).[‡] Disadvantages of puncture. Plugging. Loss of time. Risks. Mode of using aspirator. Previous incision in an adult, or where much fat or oedema is present. Puncture through thickened pleura must be quick and certain. Site of puncture. Depends on the amount of pus. 1. If slight or multiple. 2. If large, where subsequent drainage will be easiest, in eighth or ninth interspace behind, in line of scapula. Amount to be drawn off, about eight to sixteen ounces in a child, and twelve to twenty-four in an adult (Marshall).[§] Rules for stopping, constricting pain, urgent dyspnoea or cough, syncope. Aspiration to be gentle and limited, rather than violent and complete; the latter risking fresh effusion and suppuration, hæmorrhage, and injury of lung. Importance of all subsequent avoidance of chills.—*B. Subaqueous drainage.* Mode of using. (Apparatus shown.) *Advantages.* 1. Simple. 2. Tube well tolerated, and (if secured) follows movements of chest. 3. Drainage can be made gradual, and adapted to expansion of lung. 4. Readily converted into a siphon for washing out chest. This last of doubtful advantage. If pus be fetid, make a free opening; if pus remain sweet, washing out is meddlesome (*vide infra*). *Disadvantages.* 1. Tube, necessarily small, is easily blocked. 2. Ulceration usually soon takes place by side of tube, and air enters. Risk. Favourable cases. In children, where the collection is not great, nor of long standing, the lung thus expanding as the fluid runs out.—*C. Incision.* Free drainage. Admits of washing out of pleural cavity, if required. Disadvantages. Severity. Tendency to close. *a.* Single opening. Successful in children. Not so often in adults. Why? Expansion of lung, falling-in of chest, etc., less probable in these

cases. Position in ninth interspace in scapula line. In the ninth space, at the angle of rib, or just in front of it (Goodhart). *b.* Double opening. Required often in adults, in long-standing cases, or with very fetid pus. Site of openings, lowest in ninth interspace, upper one in sixth axillary line. Question of anæsthetic. Chloroform usually well borne by children. Not required in adults with a single opening, and not needed in either case if opening be made quickly either by incision down to pleura, and then by use of dressing forceps and director, or by one incision with curved bistoury, this latter being quite safe in large collections of pus. Local anæsthesia in very nervous patients. Strict antiseptic precautions advisable; where these are impossible, the use of carbolic oil or lint and iodoform.^{*} Question of washing out the cavity. Risks. 1. Shock. 2. Embolism. 3. Absorption. If used, diluted, and very gently. Closure of openings. Long period of drainage often needed. Metal tubes useful in this stage, not in earlier ones. Use of tents. Resection of one or more ribs. Purpose to facilitate drainage and falling-in of chest. Indications. Obstinate suppuration. Hæctic on withdrawal of tube. Mr. Marshall's belief that an empyema is not drained most effectually by an incision at the lowest point behind, but by one at the point to which the sides of the pleural abscess most naturally tend to collapse. In most cases, the fifth interspace below the nipple is, approximately, this point; and to it the ribs heart, lungs, and diaphragm all tend to move.

PENETRATING GUNSHOT-WOUND OF THE ABDOMEN: EXCISION OF THE BULLET FROM THE ERECTOR SPINÆ MUSCLE: RECOVERY.

By GEORGE BUCHANAN,

Professor of Clinical Surgery in the University of Glasgow.

THE following is one of those rare cases, of which examples have occasionally been recorded, of a man's body having been penetrated by a bullet, with subsequent recovery.

On the afternoon of June 11th, 1882, Mr. M., aged 25, a healthy vigorous young gentleman, volunteer, athlete, cricketer, etc., was visiting a steamship in the harbour, in which he had been engaged in assisting to fit up the engines, that being the business for which he was preparing. The captain of the ship showed his visitor and a companion a revolver, and, while the companion was holding the pistol, it accidentally went off, and the contents of the barrel were lodged in Mr. M.'s body. The companion was standing in front and a little to the right of Mr. M., and the barrels of the pistol were directed towards him. Mr. M. fell down immediately when struck, and at once became faint. He was placed on a sofa, and Dr. Renton was sent for, being a friend of Mr. M. Finding that no hæmorrhage was going on, and that Mr. M. could be moved without causing him much pain, Dr. Renton sent a message for the ambulance wagon, and had the patient removed to a private room in the Western Infirmary under my care, and I was sent for.

I arrived at the hospital about 7 P.M., and found Mr. M. in bed in the following condition. His countenance was pale, almost livid, and anxious; his skin cold and clammy; pulse almost imperceptible, so small that it could not be counted. The patient was inclined to vomit, and had vomited several times the small quantities of brandy and hot water which had been given. He was quite conscious, and could give an intelligent account of what had happened, specially insisting that the accident was most certainly fortuitous, and that no blame was attachable to the young gentleman who held the pistol; but he was not allowed to speak much.

On examining the abdomen, a small ragged wound was seen, three and a half inches above the umbilicus, and an inch to the left of the middle line. It was not so big as a threepenny-piece; its edges were dry and inverted, those of two sides resting against each other, so that it was practically closed by the contraction. On putting my finger-tip into the wound, I found its entrance was resisted; and, on gently insinuating a probe into it in the direction in which the bullet must have entered, it went a little way outwards and downwards, and backwards, and then it was resisted, showing that the opening had become valvular and practically closed. There was no hæmorrhage, and little or no pain in the site of the wound, but a good deal of pain in the back, opposite to it, and in the left thigh in front.

^{*} Dr. F. Taylor and Mr. Howse, *Clin. Soc. Transactions*, vol. xiii, p. 19. Mr. Marshall, *loc. suprà cit.*, p. 38. Feitavy, *Berl. Klin. Woch.*, May 1876, and *London Medical Record*, August 1876.

^{*} From cases treated at Great Ormond Street Hospital (*BRITISH MEDICAL JOURNAL*, 1877, vol. ii, p. 759).

[†] *Lancet*, 1882, vol. i, p. 337.

[‡] *Guy's Hospital Reports*, 1877, p. 200.

[§] In a case in which I opened an empyema lately for my friend Dr. Goodhart, the pus was most intensely fetid, and one or more communications probably existed with the lung. Iodoform was used as suggested above; after the first five hours, the dressings were uniformly sweet, and the patient made an uninterrupted recovery.

The most careful manipulation failed to detect any evidence of the presence of the bullet, or any bits of clothing, in the abdominal wall around the wound; and an equally careful examination of the parietes failed to give any indication that the bullet might have, by some curious torsion or oblique movement, travelled round among the layers of the abdominal walls out of reach at the back.

I, therefore, believed that the bullet had passed through the abdominal cavity, and was lodged somewhere in the back, although I could not find any evidence of its presence there; and that, probably, some internal viscus was wounded, thus giving rise to the collapse which is so frequent a sign of perforation of the bowel. I formed a most unfavourable opinion of the patient's state, and asked one of his friends to telegraph to his father and brother, who resided near Dublin, to come to Glasgow next day, but stated my fear that a fatal result would take place before they arrived.

I ordered hot applications to be continued, and as every attempt to administer small quantities of stimulants had been attended with vomiting, I ordered the subcutaneous injection of a few drops of ether from time to time, which was suggested to me by Dr. W. I. Reid, who was in the hospital at the time, to be followed by a renewal of the drops of brandy towards the morning, if he should survive till that time, and the tendency to vomit should cease. A small enema of beef tea and a little brandy had been given also. The ether, to the extent of ten drops, was given subcutaneously every hour; and, by midnight, some reaction of the circulation had taken place, the pulse having become better, though very feeble; but, along with this, some restlessness and irritability, for which one third of a grain of morphia was given by subcutaneous injection. This, along with a continuation of the ether, seemed to be productive of good results.

June 12th, 9 A.M.; pulse 84; soft and feeble; temperature 98°; vomiting had ceased. There was no abdominal pain, no tympanites. He had pain in the lumbar region of the spine, and a great deal of shooting pain in the anterior part of the left thigh, relieved on flexion. I now felt certain that the bullet was lodged somewhere in the lumbar region of the back, but the most careful examination failed to detect the spot.

June 14th.—The patient had been gradually improving, being nourished on very small quantities of iced beef essence and a few drops of brandy given frequently. Vomiting now ceased, but to-day there was some flatulent distention of the abdomen, and frequent eructations of gas. I ordered the discontinuance of fluid, except a few drops of iced water to moisten the lips, and, instead, requested the patient to chew and swallow at intervals a little dry toast or hard biscuit. This acted, as I have often found in cases of gastric debility, almost like a charm. The irritability, eructations, and flatus disappeared as soon as the digestive function had something to act on. In the evening, a soap and water enema still further relieved the abdomen, by producing a free passage of feces.

The wound, which never gave any trouble, was dressed with simple water dressing. No inflammation or suppuration occurred. From this time, for some days, the improvement was gradual, but continuous, giving rise to a certainty that no internal organ had been injured.

June 23rd. The wound was now completely healed. But, while the patient's state had, in some respects, improved, a change for the worse had taken place in others. For the last few days, there had been a distinctly febrile condition. The patient was fairly well during the day; in the evenings, there was a restless state, followed by slight coldness, even approaching to rigor. This was soon followed by rise in temperature, to even 102°, which lasted for several hours; then the patient usually fell asleep, and awoke in a state of perspiration. By the morning visit, he was more comfortable again. This state reminded me much of the remitting fever of the Mediterranean, and of the fever common in the Crimea after any illness, or the sequela of most of the gunshot-wounds. Its occurrence made me daily search for local complications, and for evidence of the presence of abscess.

Repeated careful examinations of the abdominal parietes failed to detect any mark, or weal, or discoloration, or tenderness, which could indicate the existence of a track made by the bullet. I was daily more satisfied that the missile had penetrated the abdomen, and was lodged in the back, but hitherto I had not been able to localise the spot. At length, on the morning of June 25th, I detected a distinct fulness in the left lumbar region, close to the spine, with an obscure boggy feeling, and some tenderness, which sufficiently indicated where the search should be made.

I put the patient under chloroform, and made a free incision an inch deep, parallel to the spinal column, giving exit to a quantity of

dark-brown, semi-purulent, putrid fluid. I introduced my forefinger, which passed between the transverse processes of the first and second lumbar vertebrae, into a little circumscribed cavity in front, but could not find the bullet. I, however, detected that the top of the second transverse process had been chipped off; and, on groping about, I felt a foreign body lying behind and below the broken tip, in the substance of the posterior muscles. This I removed with a pair of curved sequestrum-forceps; and it proved to be the bullet, which had been crushed and grooved by its striking against the bone. It was an ordinary lead conical bullet, weighing half an ounce. It had evidently come straight through the abdomen, struck against and broken the tip of the transverse process of the second lumbar vertebra, had become deflected from its course, and turned sharp down behind the process, where it remained lodged. After the removal of the bullet, I again explored the little abscess-cavity, and that behind the process, with the view of finding if any bits of clothing or foreign substances had been carried in with the missile. I satisfied myself that there was nothing of the kind, and also that there was no communication between the abscess and the abdominal cavity. I now washed out the wound to its bottom with strong carbolic solution, put in a drainage-tube, and dressed the wound antiseptically.

June 24th. I dressed the wound, and was not surprised to find, by the putridity of the discharge, that I had not succeeded in rendering aseptic the abscess-cavity in front of the transverse process, which had, at the operation, yielded the foetid pus. But to-day I took pains, with bits of lint dipped in strong solution of chloride of zinc, to mop out every part of the cavity, and thereafter to wash it out with a douche of strong carbolic solution, and to dress it with antiseptic precautions, using a large drainage-tube. After this, the discharge, which was never copious, remained quite sweet, and the patient continued to improve daily till June 30th, when I dressed the wound in the surgical theatre, in presence of the members of the West of Scotland Branch of the British Medical Association, of which I was President. I thought the case sufficiently important to relate it shortly, and show the patient, with his own consent.

A week afterwards, as the discharge had practically ceased, I removed the tube; but, a few days after this, the former febrile symptoms recurred, the temperature being as high as 104°. Fearing there might be some retained substance, I reopened the wound with a dressing-forceps, and found the top of the transverse process still bare, and around it a small quantity of pus, which I syringed away, and reintroduced the tube. After this, things went on better for a few days; but again he was seized with a rigor, followed shortly by the febrile symptoms; temperature 104°; and, after that, most profuse perspiration. The remitting febrile state continued all July. Quinine in large doses was tried without effect. In the middle of July, there was distinct rheumatic or other pain, and effusion into the right knee and ankle, giving me the gravest fears as to the existence of pyæmia; but these in the end passed off.

August 8th. While the general state of the patient had been better, there was again a slight bulging at the site of the incision, which was opened up, giving vent to a little offensive pus.

After this, the patient gradually became stronger; and on August 18th he left the hospital for a short residence in the country, before going home to Ireland. Since his going home, he has continued slowly to regain his strength; but for a long time he was subject to occasional attacks of the remitting febrile state, and to more or less rheumatic pain in several of his joints. Now, however, he has become strong and well.

REMARKS.—The principal point of interest in this case, from the very first, was the determining the track of the bullet. That a bullet or other foreign body may penetrate through the abdomen without fatal result is well known, from the record of cases in the annals of military surgery. In a few of the cases, there is no doubt whatever that the abdominal cavity had been traversed; in others, it is a question whether the bullet, entering obliquely where the walls are fleshy, had not passed round between the muscular layers, or, where principally aponeurotic, had not passed along subcutaneously. But that recovery has taken place, in some cases, after perforating wounds of the abdomen is quite established.

That the abdomen can be impaled without injury to any important organ, is demonstrated by an experiment of Mr. E. Maylard, who attended my operations during the summer session, and took great interest in the case here detailed. A note of the experiment is as follows.

"With the kind permission of Dr. Coats (the pathologist), I did the following little *post mortem* operation this morning, the results of which I think may interest you. Having first marked the exact

point of entrance of the bullet on the abdomen of a male body, and the opening behind at which it was extracted, I passed a sharp-pointed weaver's spindle directly through the cavity of the abdomen, causing it to enter and emerge at the points indicated. On opening the abdomen, the following points were observed. The instrument, after passing through the parietes, had entered the cavity of the omentum, just below the curvature of the stomach, and at some little distance above the transverse colon. Passing through the posterior wall of the cavity, it transixed the coats of the bowel just above the junction of the duodenum and the jejunum; but the cavity of the bowel was not opened. The slightest deviation to the right would have perfectly avoided the viscous. It then entered the psoas, escaping the pancreas, which was some little distance above, and the kidney, which was situated to the left. Since the ball struck a transverse process, and lay—I think you said—a little internal to your incision, the duodenum would have completely escaped. This investigation may not go for much; for one cannot assume that the position of the parts as found after death—flexed and non-distended—are in any way a representation of the structures as existing in life. Still, I think the fact interesting, that the spindle should have passed right through the cavity of the abdomen without penetrating the interior of any viscous or injuring any important organ. It at least demonstrates the *practical* possibility of such an event taking place during life, and no doubt supports what you have suggested as the probable course of the bullet.

Almost all writers on gunshot-wounds assert that, in many instances, a projectile perforating the skin of the abdomen has been deflected and has pursued a circuitous route to its place of exit or lodgment; and also that the track can be made out by certain signs, as tenderness, swelling, discoloration, and prolonged discharge, which frequently follows gunshot-wounds, although these may at times be trifling; also that occasionally the distance travelled has been half the circuit of the body. The records of the American and Franco-Prussian wars re-establish the statement; yet I can find few well authenticated examples of it. And I have not found one of a bullet entering near the umbilicus and making the half circuit of the trunk. I believe it to be possible that a bullet may perforate the skin near the umbilicus, and, if very oblique in direction, may be deflected, and pursue a course round the body subcutaneously; I also believe it possible that a bullet coming very obliquely might perforate the sheath of the rectus, enter the substance of the muscle, again perforate the sheath anterior to the plane of the abdominal aponeurosis at the linea semilunaris, and, as before, travel round in the abdominal wall. But, in both of these instances, the superficial track of the bullet must be evidenced by some of the signs indicated by those who have mentioned the subject.

In the case here recorded, I think there can be no doubt that it is an example of a direct penetrating wound of the abdomen, without injury to any of the viscera.

I believe that the bullet, having traversed the abdomen, perforated the psoas muscle, just above the transverse process of the second lumbar vertebra. The immediate and continued pain in the front of the left thigh, causing the patient to draw it up, indicates injury to the anterior lumbar nerves, which are imbedded in the psoas muscle; and the small putrid abscess, which was found just in front of the transverse process, almost certainly proves this.

The whole of the symptoms are very similar to those described by Bell, in his *Discourse on Wounds* (part ii, page 630), in reference to penetrating wounds of the abdomen, when the ball injures the psoas muscles.

Having struck the tip of the transverse process, it was suddenly turned on itself and deflected over, and lodged close behind the transverse process, with its point downwards, its base up. That this was its course was manifest to me, because my finger easily slipped through a hole, above the tip of the transverse process, into a small abscess cavity in the substance of the psoas.

I did not feel, and never noticed, in the discharge, any crumbs of broken bone; but the bare bit of bone at the tip indicated that some minute fragment had been chipped off; and this was sufficient to account for the occasional little suppurations at the bottom of the wound, which, I have no doubt, were the cause of the long-continued and remitting febrile symptoms. Several times, during the first two months, there was some gastric and intestinal disturbance, which gave me some anxiety as to the possibility of peritoneal complications; but I now believe them to be due to the suppurations referred to, which occurred after the removal of the drainage-tube, when all discharge seemed to have ceased.

SEQUEL. February 23rd, 1883.

Mr. M. having returned to Glasgow, this morning, with his cordial

assent, I examined him in presence of my clinical class. He is in robust health, and has all the appearance of a vigorous, active young man. Not a trace remains of the various symptoms which troubled him during his tedious convalescence. I carefully examined him, by questioning, as to all the points previously detailed; and, these being now corroborated by the evidence of the patient, I was confirmed in my opinion as to the course of the ball. The aperture of entrance is now a flat, circular cicatrix, exactly three and a half inches above the umbilicus, and one inch to the right of the middle line. The incision by which I excised the bullet is now a cicatrix, about two and a half inches in length, and about two inches to the left of the spine of the second lumbar vertebra. It is much depressed in the centre, and fixed down by strong cicatricial tissue.

Reverting to the whole of the circumstances, as elicited by narrative and cross-questioning in presence of the students, I have no doubt whatever that the bullet penetrated directly through the abdomen.

CASE OF GUNSHOT-WOUND OF NECK, WITH PERFORATION OF OESOPHAGUS: RECOVERY.*

By D. ALLEN CHARLES, M.D., Bellaghy, co. Londonderry.

JOHN M., aged 18, weaver, became a patient of mine under the following circumstances. On the evening of April 7th, 1881, he was sitting before the fire with a pistol in his hand. The pistol was loaded with two slugs, which he had made by hammering the lead into solid pellets. Thinking something was wrong with the percussion-cap, he attempted to fix it with the point of a scissors, the muzzle happening to be directed towards his face. The weapon suddenly exploded, and, feeling a sharp sting in the neck, he fell on his back. He was able, however, to rise immediately, and, a neighbour having come to his assistance, I was sent for. Not being at home when the messenger arrived, three hours at least elapsed before I saw the patient. I found him calm and collected, and able to give the above history of his case.

He complained much of pain between the scapula, and at the epigastrium, especially if he attempted to swallow. He had no cough or vomiting, but immediately after the accident he spat up a few mouthfuls of blood. His respiration was regular, and his pulse 80. On examination, I found his face and neck much blackened with powder, and there was some slight cedema of the neck, with two wounds at the base antero-inferiorly. One of these wounds was a simple contusion of the skin over the junction of the lower and middle thirds of the left sterno-mastoid, while the other was a perforating one, situated at the apex of the left anterior triangle, about one inch and a half above the sternum—the latter barely admitted the tip of my little finger. There was a little blood trickling from it, but the hæmorrhage seemed to have been small. Having enlarged the opening, I explored the wound with my finger, and found that the slug had entered between the tendon of the sterno-mastoid muscle and the trachea, but without injuring either, and had then taken a direction downwards and backwards. I could trace its course with my finger for about an inch, but, by means of a probe, for upwards of three inches. I explored gently for some time, but without discovering any trace of the bullet; I, therefore, gave over any further attempts; but that the oesophagus was perforated, I was led to believe from the spitting of blood after the accident, and the subsequent difficulty in swallowing. I had no alternative, therefore, but to watch the case, and let nature take its course. Accordingly I dressed the wound with carbolic oil, covered all with a pad of fine oakum, and gave a draught of ammonia and henbane. Next morning I found he had passed a fair night, but he was still complaining of pain in his shoulders, and of difficulty in swallowing. Pulse 104, temperature 101.5°, respiration 28. I made a further and last attempt to trace the bullet, using a silver catheter for a probe, but without success. I determined, therefore, to keep the wound clean, and to put the patient on milk diet.

April 11th.—He felt much easier; pain in the shoulder and difficulty in swallowing were still present. He had some substernal pain. Pulse 116, temperature 102°, respiration 28. The tongue was furred, the bowels were confined.

April 14th.—He felt well until yesterday, when he began to have pain in his jaws and neck. He could swallow better; pulse 100, temperature 104°, respiration 28; tongue moist; the bowels were open yesterday; the motion was black and tarry. The wound was

* Read before the Annual Meeting of the North of Ireland Branch.