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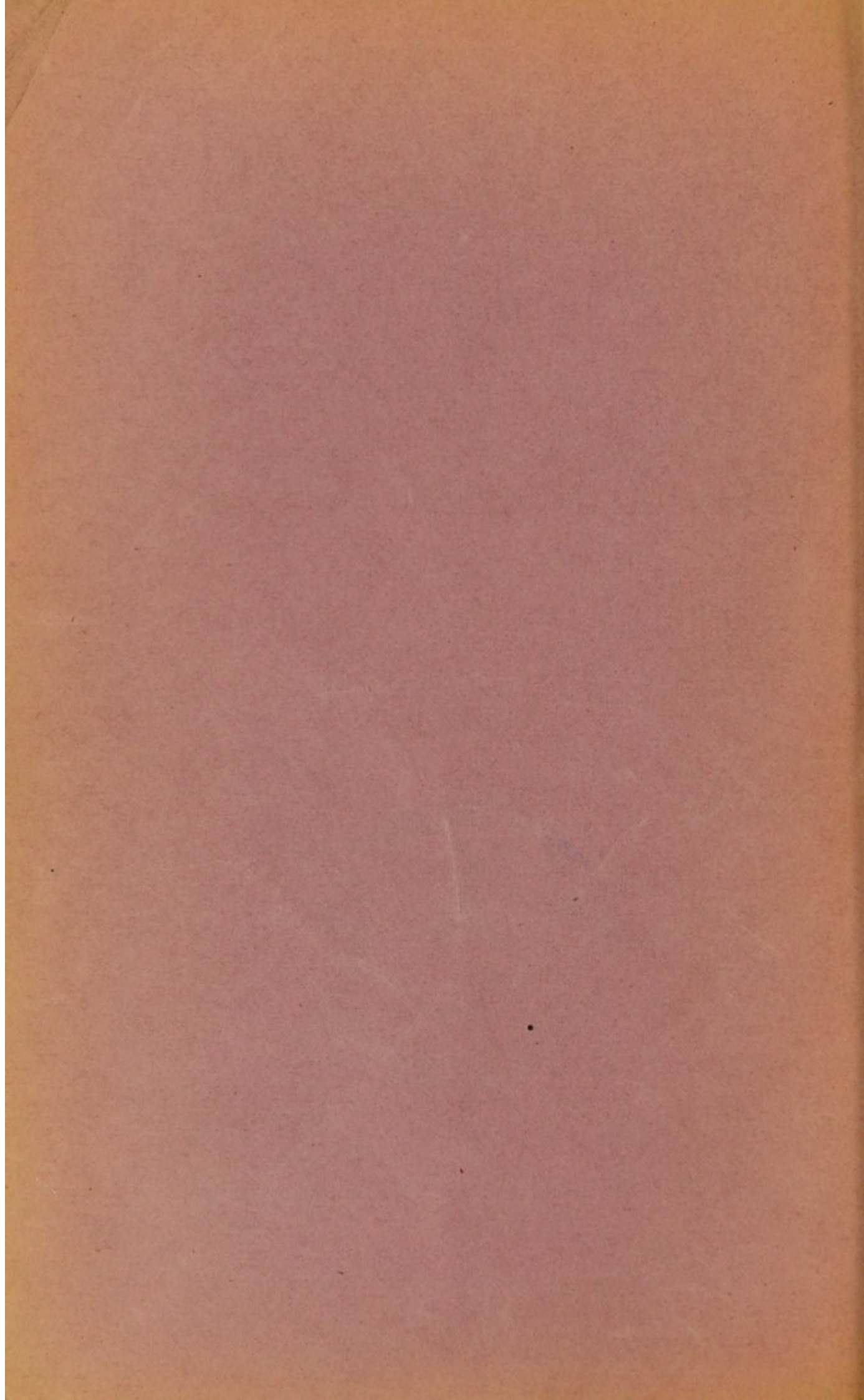
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Wounds of the Heart

by

J. F. West.







ON

WOUNDS OF THE HEART.

BY JAMES F. WEST, F.R.C.S.

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NUMEROUS remarkable cases of wound of the heart have been recorded by English surgeons, but no complete essay has yet been written on this subject in our language, such as will compare with the valuable memoirs of Sanson, Jamain, or Raynaud. Having the opportunity afforded me of bringing under the notice of the profession some cases of this rare form of injury, I thought it right to examine the various authors who had written on wounds of the heart, and in so doing I collected a series of recent observations, which seemed to me of considerable value.

The various difficult questions which arise as to the diagnosis, pathology and treatment of wounds of the heart must tend to be elucidated by the publication of all cases that are met with in practice, whether successful or the reverse in their result. That cases of wound of the heart, though generally fatal, are sometimes followed by recovery, seems now to be admitted on all hands. Patients have lived for years after the receipt of such injuries; and yet, as in the first case which I shall relate, post-mortem examination has clearly shown the existence of the lesion. The exact site of the wound has been revealed, the pathological processes resulting therefrom, as sanguineous, serous, or purulent effusion have been demonstrated, and the means by which a successful issue to the case has been attained, have been clearly traced.

The hæmorrhage even in penetrating wounds of the heart, though at first profuse, does not appear to come subsequently, except in cases of very extensive laceration from the interior of the cavities, but rather from the muscular walls of the heart or from the parietes of the chest. No case, therefore, however unpromising at first sight, need be looked upon as hopeless.

Before reporting or discussing at length the cases I have met with, it may be well to refer to the authors who have devoted attention to this subject, and for this purpose I think I cannot do better than give a brief abstract of the literature of wounds of the heart, such as is given in M. Raynaud's essay.¹

These injuries seem to have attracted attention early, for we find Hippocrates stating that they are always fatal.

Celsus describes them as accompanied by profuse external hæmorrhage.

Galen first distinguished between penetrating and non-penetrating wounds, considering the latter only were not followed by instant death, and that of all injuries a wound of the left ventricle was most serious.

Lanfranc believed a flow of black blood indicated a wound of the heart, while bright frothy blood proceeded from the lungs.

Fallopious, from the same symptoms, arrived at the conclusion that black blood came from the right and red from the left ventricle.

Ambrose Paré was the first who recorded an authentic case of wound of the heart. It is that of a gentleman killed by a sword thrust, who moved a distance of 200 feet after being wounded. "In him was found a wound in the substance of the heart big enough to admit the finger, and with a large quantity of blood fallen on the diaphragm."

Just after that time Muler reported a case in which a man survived sixteen days after a wound of the right ventricle.

From this period examples multiplied in the works of various surgeons, and cases were brought to light in which foreign bodies were found in the hearts of animals who had been wounded a long time before.

Job à Meeckren first recorded a case of pericarditis following injury.

¹ 'Nouv. Dict. de Méd. et Chir. Prat.,' vol. viii, Art. "Cœur."

Senac attributed greater danger to functional disturbance of the heart than to hæmorrhage in cases of injury. The heart, according to him, became highly excited in its action, and this excitement it was almost impossible to allay. He believed that the opening of the cardiac vessels was never followed by sufficient hæmorrhage to cause death; an erroneous opinion, as several cases are on record in which death has proceeded from injury of the coronary vessels.

Morgagni was the first to show the real cause of death in the majority of cases. He established the fact that it was owing to great extravasation of blood in the pericardium that the heart could not perform its functions properly, and this opinion continues to obtain in the present day.

Having thus briefly enumerated the surgeons to whom we are indebted for the gradual extension of our knowledge respecting wounds of the heart, I proceed to relate the cases which I have had under my personal observation, and also a case which occurred some years ago at the General Hospital in this town, the notes of which have been kindly given me for publication by Dr. Russell, who is one of the present physicians of that institution, and witnessed the case.

I shall then discuss the various features of interest which each presents, and review in succession the history, pathology, and treatment of these and other instances of wound of the heart which have been placed on record by British, American, or Continental surgeons, since the appearance of M. Jamain's comprehensive treatise on the subject.¹

Lastly, I shall give, in the form of an appendix, a table of the cases to which special reference is made in this paper, detailing the site of the injury, the name of the surgeon or reporter, the period during which the patient survived, and the nature of the wound or the instrument with which it was inflicted.

*Non-Penetrating incised wound of the heart followed by recovery.
The patient living four and a half years.*

CASE 1.—William Checkley, æt. 44, shoemaker, was admitted into the Accident Ward of the Queen's Hospital, Birmingham, about 1 a.m., on October 26th, 1858.

¹ 'Thèse de concours pour l'agregation sur "les Plaies du Cœur,"' 1857.

About a quarter to 10 the same night he was engaged in a quarrel with another shoemaker, when he received a stab with an ordinary shoemaker's cutting knife in the left side of the chest. The blade of the knife was nearly triangular, about an inch and a half long and very sharp on the cutting edge. The whole of the blade as well as the haft of the knife was stained with blood, so that probably the knife had penetrated as far as the length of the blade would permit.

Blood was lost in vast quantity, and he almost immediately fainted.

In company with Mr. Scofield, of Highgate, I arrived at the scene of the casualty shortly after 10, and found the man sustained in a sitting posture in the garden of the house at which he had been stabbed, and cold and pulseless from loss of blood and exposure to the chilly night air; very feeble respirations were distinguishable about every half minute, but no other sign of life was appreciable.

The man was at once laid on his back, his feet warmed, and brandy administered on a rag. In the course of an hour the pulse began to be perceptible, respirations were more frequent, the skin became slightly warm, and inarticulate sounds began, for the first time since the accident, to escape from him. About half-past eleven he was able to give his name and residence, the syncope had gone off and given place to great restlessness and frequent jactitations. The pulse was about 50.

The wound from which the hæmorrhage had taken place was of an incised character, one inch in length, extending vertically from above downwards, at about 2 inches to the left of the sternum, and had completely and cleanly divided the cartilage of the fifth rib, and opened the pericardium, into which the finger could be passed, and the movements of the heart clearly perceived. A probe introduced was moved to and fro with each contraction of the heart in a remarkable manner, being thrown forward and swayed from side to side with each systole, and drawn backwards with each diastole into the cavity of the pericardium. The pericardium was full of blood, and when the man made any exertion blood welled up from the distended pericardium. There was apparently no injury of superficial vessels, and the intercostal artery was not divided. It was almost impossible to say whether the heart itself was intact; however, Mr. Scofield affirmed that he felt a wound on its anterior surface near the ventricular septum.

At 12 the man was placed in a covered cart on a shutter, and slowly removed to the hospital, Mr. Scofield on one side applying a rag steeped in brandy to the lips, and I on the other holding ammonia to the nostrils, while a policeman kept a hot bottle to his feet. Several times during the journey (a distance of 3 miles) it was feared that the man had ceased to breathe, however stimulants brought him round, and he arrived at the hospital alive, but in a complete state of syncope, and perfectly unconscious of all that was passing around. The warmth of the bed with some more brandy soon restored him from the syncope, though he remained during the night very faint and restless, and continued to throw his arms about wildly.

The edges of the wound, from which very little blood had oozed during the journey, were accurately approximated with straps, and a pad of lint and a broad body bandage applied. Very slight bleeding took place during the night, and in the morning the man, though extremely feeble, was sensible, and able to give some account of himself.

Pulse 96, small and weak. Heart's action regular, but sounds muffled and indistinct; large extent of præcordial dulness; no absolute bruit, but marked prolongation of the first sound. Skin dry and hot. Tongue brown and farred. Great tenderness experienced on pressure in all parts of the chest.

Ordered perfect rest in the recumbent position. Beef tea and milk iced, and to take two grains of calomel with half a grain of opium in a pill every three hours, and a draught of effervescing citrate of ammonia every four hours.

27th.—He passed a good night; continues pale, anæmic, and faint. Perspiration has occurred during the night. Pulse 100, small, and compressible; heart's action rather more distinct; impulse greater, but prolongation of first sound diminished; very little pain or tenderness in the chest except around the wound, which was dressed with fresh straps of adhesive plaster. The lips were found to be approximated by healthy deposit of fibrine, and there was no inordinate inflammation about them. Thirst is less complained of, but headache persists.

28th.—He seems very comfortable this morning. Pulse has gone down to 80 and is soft and natural; heart's action impulsive, and felt over a large space; all indistinctness has vanished, and there now only remains slight prolongation of the first sound; no pain in chest; bowels costive; skin moist and perspiring; gums rather spongy. To take the calomel pill every six hours. To continue the effervescing draught and to have half an ounce of castor oil immediately.

29th.—Going on well. Pulse 75, natural; skin acting; tongue clean; bowels have been relieved; gums very sore; no pain complained of; wound has united by the first intention. To take the pill at night only and to continue the draught.

31st.—Feels quite easy, and begins to be anxious to get up; heart's action normal, but heard over a very large surface; wound looks healthy; tongue rather swollen from the effects of the calomel, and gums still spongy. Ordered to omit the pill, and to use a gargle of dilute sulphuric acid and infusion of roses.

November 2nd.—Going on well; no pain, heat of skin, or other sign of febrile excitement. Pulse normal.

4th.—He sat up and was dressed for the first time since the accident; felt very faint at first. The wound has skinned over, and there is no tenderness about it. There is slight bulging of the chest in that situation, and a large area of præcordial dulness; heart's action impulsive, but unattended by bruits.

6th.—Seems well in himself, but there is for the first time slight purulent discharge from the wound, about which there is no pain or tenderness. Ordered to keep his bed.

8th.—Discharge still continues, and has, in fact, increased in quantity during the last two days. There are no bad constitutional symptoms, and he seems in very fair health, though he remains very anæmic. Ordered to take three grains of quinine three times a day in infusion of roses.

9th.—Discharge is less. He complains of frontal headache; bowels are open; allowed to get up.

11th.—Discharge much less. Headache still continues, being worse when he lies down; bowels open. Pulse natural.

13th.—Very little discharge; headache not so bad as it has been. On stethoscopic examination a slight friction sound is noticed at the base of the heart. It

is *only* found in that situation, and is heard for the first time this morning, although diligent examination of the heart has been made daily. No febrile symptoms. Pulse and respiration perfectly natural.

15th.—This morning a loud rasping bruit is heard over the whole præcordial region. There is no pain, but he sometimes suffers from palpitation. Headache entirely disappeared; bowels regular; urine healthy; appetite good. Ordered a chop.

17th.—Wound nearly closed; bruit still as loud as before; health good.

21st.—The wound is healed with the exception of a small sinuous track, scarcely large enough to admit a probe, at the mouth of which is a minute vascular tubercle of granulation. The friction sound is much louder than before. Feels no pain; sometimes has slight palpitation. Pulse regular, small, and easily compressed.

23rd.—The friction sound continues, being quite as loud at the seat of the wound, but clearer and less marked at the apex of the heart.

26th.—The discharge has stopped, except that occasionally a drop of matter oozes out; a slight friction sound is appreciable towards the base of the heart, but the apex is perfectly free from bruit. His general health being excellent, he was at his own request discharged from the hospital.

December 3rd.—He came to the hospital as an out-patient, stating that he had been able to get about pretty well since he left us, suffering but little inconvenience except from palpitation when he exerted himself actively, and occasionally from a sharp stinging pain in the region of the heart, which, to use his own expression, "almost took his breath away." The heart's action was vehement and unequal, being heard over a very extended space (one inch to the right of the sternum, and two inches to the left of the left nipple). The friction sound had completely gone off.

He was seen at intervals of two or three months during 1859 and 1860. He continued pale and weak, and was unable to work at his trade more than a day or two occasionally.

In January, 1860, he stated that he had been unable to work at all for the last nine months, exertion bringing on palpitation and giddiness, and once or twice causing him to fall off his chair in a state of syncope. His breathing is stated to be at times very difficult, especially when he first gets up in the morning. He sleeps but little, and dreams very much. He perspires greatly, and is very weak. He has lived very poorly of late. He feels comfort from a bandage bound tightly round his chest. His pulse intermits once in every ten or twelve beats. A systolic bruit (probably of an anæmic character) is heard, and the heart's action is tumultuous and irregular. No perceptible change in his symptoms or appearance took place during the rest of 1860; but in January, 1861, he again came under notice, suffering from a cough and cold. His appearance was but little changed. He still looked pale and bloodless, and complained of weakness and consequent inability to work. His breath is very short, particularly when he ascends a hill. The systolic bruit is no longer heard. The heart's action is quieter and more natural; the impulse is most marked at the site of the cicatrix, which is depressed, so as to admit the tip of the little finger; the surface of the integument and the heart appears to have but little

tissue intervening between them; pressure, however slight, in this situation is resisted by the patient as causing pain.

There is no friction sound, but the præcordial dulness is heard over a very considerable extent of the chest wall.

He complains of being very liable to take cold, of having unpleasant dreams at night, which arouse him with a start, and of being suddenly seized with a temporary giddiness and tendency to fall down, more especially if he attempts to subject himself to any fatigue, or even to active bodily exercise.

In August, 1861, he informed me that he had not been able to work for several months; that exertion of any kind brought on palpitation and faintness, and that several times he had fallen off his chair; that distressing dreams trouble him at night, and that he has a frequent hacking cough. During the next twelve months he lingered on in a miserable state, hardly ever able to work, and depending entirely on parish relief, which was scantily doled out to him.

General tuberculosis of the lungs set in, accompanied by hectic and the usual symptoms of phthisis, from which he sank exhausted on March 6th, 1863.

At the autopsy the thorax only was examined, in consequence of the patient's friends objecting to a complete examination of the body. Mr. Yarwood, of Aston, kindly assisted me.

We found the body greatly attenuated. A depressed cicatrix, one inch in length, was observed to the left of the sternum about opposite the cartilage of the fifth rib. Both lungs were adherent to the thoracic walls by old and firm adhesions, so that they could hardly be detached from them. They contained cavities in their upper part, and were also extensively infiltrated with soft cheesy tubercle. The left lung was more extensively disorganized than the right. There was no purulent collection in the pleural sac, but fibrinous cicatricial tissue united the two layers of the pleura together.

The pericardium, which was more than twice its ordinary thickness, was almost universally adherent to the heart, and at many points it was impossible to separate the visceral from the parietal layer. The heart was flabby and soft, and appeared more capacious than natural, though the walls of the various cavities seemed comparatively thinner than in a healthy heart. A linear cicatrix, vertical in direction, half an inch in length, and extending nearly a line and a half in depth, was seen on the anterior wall of the right ventricle, running parallel with the ventricular septum.

The incision had probably not penetrated the ventricle, as there was no evidence of a cicatrix on the endocardium.

There was no abscess, bulging, or aneurismal dilatation of the ventricle at the site of the injury.

The muscular fibres of the heart were pale and anæmic, but were not obviously affected by fatty degeneration. All the chambers and the various valves were free from abnormal appearances.

Penetrating wound of both ventricles; death immediate.

CASE 2.—A young man, æt. 20, was "larking" with some companions at Walsall, when he either fell accidentally or was pushed down the shaft of a coal-

pit. When picked up he was quite dead. A coroner's inquest was held, and I was called upon to assist Mr. David Moore, of that town, in making a post-mortem examination.

There was no wound on the surface of the skin, but the whole of the left side of the chest seemed greatly contused. The sternum was broken into two fragments, and the third, fourth, fifth, sixth, and seventh ribs of the left side were fractured. The pericardium was full of black fluid blood, as were also the pleural cavities. Both the right and left ventricles were extensively lacerated, the opening on the anterior surface of the former cavity admitting three fingers.

There could be no doubt as to the wounds of the heart having been caused by the broken ends of the sternum and ribs. In his recent lectures at the Royal College of Surgeons, Mr. Le Gros Clark mentions a case somewhat similar, where a patient with fractured ribs sustained a penetrating wound of the left ventricle, from one of the broken ribs which had transfixed the pericardium, but, strange to say, in this instance the patient survived several hours.

Penetrating wound of the right ventricle; death on the twenty-fourth day.

CASE 3.—John Meeking, æt. 14, a healthy looking lad, of medium stature, was admitted into the General Hospital, Birmingham, on Saturday, November 7th, 1836, at 7 a.m., under Mr. Wood, in consequence of a wound in the chest, inflicted by a sharp piece of iron. Wishing to unload a small cannon, which he was unable to discharge, he heated a pointed piece of iron, and having introduced it into the cannon, he pressed the iron against his side, with the intention of burning through the touch-paper; however, the powder ignited, and blew the iron into his chest.

Examination at 8 a.m.—Wound in the chest on left side of the lower third of the sternum, about opposite the junction of the cartilage of the seventh rib. Blood was flowing from the wound, and those who brought him to the hospital said he had lost about two pounds; at any rate, his shirt was completely saturated with blood. A probe being passed into the wound, it was found to be directed downwards and inwards for about half an inch, when it was stopped by the cartilage of the rib. This circumstance led Mr. Hodgson, one of Mr. Wood's colleagues, to suppose that the instrument had not penetrated the parietes of the chest through the whole extent, but perhaps the natural elasticity of the cartilage might have closed the opening made by the instrument. There was considerable pain in the cardiac region upon inspiring. Respiration 47, effected chiefly by the diaphragm. Pulse 156. Slight headache, but no feverish symptoms. Wound to be poulticed.

Evening.—More pain in the region about the heart; respiration more difficult and hurried. Eight leeches to the cardiac region.

November 8th.—Respiration 56; not so difficult. Pulse small and irregular. The stethoscope showed respiration to be more impaired on the left than on the right side. Sounds of heart irregular and dull. On examining his back on the left side, respiration conveyed an undulatory sound. Pain on pressing about the

wound, which had put on a sloughing appearance. Tongue moist, but white with red edges. Increased pain on lying flat on his back. No feverish symptoms except slight thirst. Pain in head not so great.

Evening.—Leeches to be repeated, followed by a hot bath and James's powder. Appetite bad.

9th.—No better; passed a restless night. Face swelled. Pain on breathing not so great. Respiration 60. Pulse feeble and irregular. Bowels well opened. Nurse says that in one of the stools there were clots of blood; but as the vessel containing it had been broken subsequently, the truth of this cannot be ascertained. Tongue drier, of a dark colour. The wound looks unhealthy, having extended itself to the size of a shilling; discharges nothing but serum.

Evening.—During the day one or two hæmorrhages from the wound, altogether amounting to two ounces.

10th.—Has passed a bad night. Face more swollen. Pulse irregular and feeble. Respiration 60, attended with less pain, and accompanied with a mucous râle. His tongue presents a blackish-brown appearance, and is more dry and furred. Complains of a slight cough, which gives him great pain. Pain in the head increased, and he is very restless. Extremities cold; skin natural. In the early part of the morning he vomited a nauseating white liquid. Appetite bad.

11th.—Passed a better night, and looks much more himself. Face not so swollen, neither is there so much anxiety expressed in his countenance. Lividity of the lips disappeared. Less pain in the head. Respiration 64, attended with much less pain, performed still by the diaphragm. Mr. Bindley, the house-surgeon, examined him at 7 a.m., and found respiration 44. He accounts for this difference by the excitement he was put in from his examination. Tongue quite moist, and more its natural colour. Bowels not opened since yesterday. Lower extremities cold. Pulse 160, not so irregular or weak. Appetite bad. Cough easier, breathing clearer. Wound looks about the same; if anything, more serous discharge from it, which is increased by pressure on the cardiac region. Stethoscope indicates the existence of frottement in the left side of the chest.

12th.—Passed a better night. Very little pain in either head or chest. Respiration easier, not more than 44. Pulse 120, more natural. A hectic flush on right cheek. The wound has put on rather a singular appearance, presenting three semilunar lines across its surface; upon pressure not so much discharge forced out, but nurse says there has been a great deal running from it. Appetite a little improved. Cough easier. Bowels moderately opened. Tongue more natural.

13th.—Seems much better this morning. Pain in the head a little more violent. Breathing about the same as to frequency, but the mucous râle much more distinct. More pain on pressure round the cardiac region. Discharge from the wound continues. Feet remain cold. Tongue moist, but of a dark red colour. Six leeches round the wound.

14th.—Passed a rather worse night, cough having been troublesome. Respiration 60. Pulse 160, and small. More pain in the chest. Upon removing the poultice there was a great deal of discharge, owing to his body being raised up; the discharge had assumed a purulent character. At each inspiration a portion of this fluid was forced up, with bubbles of air. Feverish symptoms much

more apparent. Skin hot. Tongue dry, but no thirst. Bowels moderately opened.

15th.—Very feverish. Flushed cheeks, and a dry and white tongue. Skin hot and dry. Respiration about the same, but accompanied with more râles. Cough much worse, and of a dry hacking nature; sleep much disturbed by it. Moaned a great deal during sleep. Feet quite warm.

16th.—Seems much better. Cough not so troublesome. Did not pass so restless a night. Fever much abated. Tongue more healthy. Extremities warm. Wound still extending its edges; is now about the size of a half-crown piece, with a great deal of sero-purulent discharge. Upon pressing in the intercostal spaces a very curious sound was heard, perhaps the term *frottement* will best convey the idea. Respiration and pulse about the same.

17th.—Was found sleeping, and respiration was observed much easier. Pulse about 156, and full. He says his "chest gives him a violent pain when he draws in his breath." Wound remains the same, both in appearance and as to quantity of discharge. Appetite improved. Bowels moderately opened. Tongue almost natural.

20th.—This morning seems much worse, and, indeed, says "that he feels very ill." Pulse quick and rather full. Respiration not more than 40. Cough the same, worse at night. Tongue moist, and of a brick-red colour. Breath very offensive. Bowels moderately opened. Skin cold, and no thirst. The wound still discharges freely, but the discharge is of a more serous nature. Opening in the chest larger, allowing of a very free admission of air, which is forced out at each expiration. The before-mentioned sound (*frottement*) may be heard over the whole chest. Not so much râle when he breathes.

24th.—Since the last report he has continued about the same, none of the symptoms alleviated and none sensibly worse, but during the preceding night he has had two rigors, the first of which lasted about a quarter of an hour. Pulse quick and small. Tongue moist and bowels regularly opened. Lassitude has increased; the least exertion is wearisome to him. Nurse thinks his appetite a little improved. Cough still troublesome.

From the 25th to the 29th no fresh symptom.

30th.—Lassitude evidently increased. Countenance more cadaverous. Bowels have continued open, sometimes being much relaxed. His tongue presents red edges, coated with a white fur in the middle. Pulse small and quick, accompanied by an undulating motion. Respiration 40. About 8 o'clock he had a rigor, which lasted for about twenty minutes, and he has been restless ever since.

The wound in the pericardium seems to be growing over, so that much of the opening into the chest cannot be seen without looking from below upwards. On looking at the heart it appears to present an ulcerated surface, but this is perhaps only lymph deposited on its surface. The wound still discharges a great deal of sero-purulent fluid, rather offensive. The skin round it presents an appearance of granulation. Sore throat is complained of.

December 1st.—This morning he appears rapidly sinking. Face pale and cadaverous. Talks incoherently. No report could be obtained from him, but the nurse said he passed a very bad night, getting out of bed two or three times, and

moaning all night. Pulse feeble and irregular. Bowels confined. Skin cold and dry.

Evening.—No apparent alteration.

2nd.—Quite insensible, and lies apparently motionless, with his eyes fixed. Cornea slightly opaque. Respirations very frequent. Pulse very small and weak. Discharge from the wound remains the same. He died a few minutes after this report had been taken, without evincing any increased suffering.

Sectio cadaveris, forty-eight hours after death.—Having sawn off the ribs, leaving a square portion of the parietes of the chest round the wound, there were found to be firm adhesions of the pleura pulmonalis to the pleura costalis, more particularly on the right side. The portion of the parietes left were then divided, and the abdominal viscera removed, when it was found that the iron had entered between the sixth and seventh ribs, running over the upper surface of the diaphragm. The cartilage of the seventh rib had sloughed away. The pericardium was enormously thickened, and of a dark colour. A sero-purulent fluid was found in its cavity, and several points of ulceration. The heart, covered with fat, presented a number of fissures. On its upper surface, about half an inch to the left and three quarters of an inch above the wound, was an opening which admitted a probe half an inch. This was supposed to have been made with the iron. In the interior of the right ventricle an opening, large enough to admit the point of the little finger, was found to communicate with the one observed externally. This opening ran in a direction from without downwards and inwards, and seemed to divide the carneæ columnæ supporting the tricuspid valve. A little lymph was removed from its surface. The lining membrane of this cavity was of a darker colour than usual, but otherwise healthy. Upon removing from the outer wall of the right auricle a large piece of lymph, which was unattached except at the lower end, there was found perforating the walls of this cavity a large opening, communicating directly with the pericardium. This opening was partly covered by several bands of fibres; if these had not existed the clot of lymph must have passed into the bag of the pericardium. The left side of the heart was quite natural.

Lungs.—The right lung rather œdematous, and consolidated on its under surface. Traces of inflammation in the bronchi, and upon pressing the consolidated portion of the lung a dark coloured fluid, mixed with a little pus, flowed out. Left lung consolidated on its under surface, and upon cutting into it there were found on its outer surface two or three ossified points. Bronchi of this lung perhaps more inflamed than those of the opposite one.

Contents of the abdomen.—The liver was attached on its upper surface to the diaphragm, and also presented two fissures, as though there had been some time ago a laceration of its surface. The structure was healthy. Bowels tympanitic, but perfectly empty. The lower portions of the large intestines filled with hardened fæces. Spleen, kidneys, and bladder healthy.

Head.—Dura mater healthy. Effusion in the subarachnoid cellular tissue. Pia mater healthy. Structure of the brain firm and natural. A little effusion in the ventricles.

P.S.—The above was selected from a full report of this case made by Mr. Arnold, who attended the boy. Dr. Russell only saw him once or twice, and therefore

could make but few observations. The heart could be plainly distinguished on looking into the chest in a direction from before backwards and below upwards, alternately advancing against and retiring from the opening in the pericardium, and a loud noise resembling an infant sucking, but if anything rather louder, was heard. This occurred during the latter part of the time he was in the hospital. Other noticeable points in this case are, that hæmorrhage came on on the second day; that there was marked swelling of the face and coldness of the extremities continuing for a week; that pericardiac frottement showed itself on the 4th day; that persistent serous discharge existed for seven days, and then gave place to purulent discharge, which flowed more freely when the patient was raised up; that, owing to the sloughing of the wound, air found its way freely into the pericardium; that rigors occurred on the 17th day, followed by hectic and colliquative diarrhœa; and that rigors occurred again on the 23rd day, and heralded the approach of death.

The division of wounds into *penetrating and non-penetrating* is the most useful; all distinctions derived either from the direction of the wound or from the nature of the instrument with which it is inflicted are of little practical consequence.

The crossed disposition of the muscular planes of the heart renders a wound which is perpendicular to the superficial fibres oblique to the deeper ones.

All sorts of foreign substances and weapons have produced wounds of the heart, swords, knives, and daggers being the most common; but fish-bones, needles, and thorns have even been found in the substance of the heart. Probably of late years gunshot wounds have been more frequent than incised or punctured wounds. In considering the relative frequency with which the various parts of the heart are injured, we are struck with the preponderance of cases in which the right ventricle is wounded. Out of Jamain's 121 cases the right ventricle was involved forty-three times, and in Ollivier's sixty-one cases, twenty-three times.

The right ventricle, occupying as it does the front of the heart, is nearer the surface, is less covered by the lungs, and has less protection from the sternum and ribs, than either of the other cavities—hence the greater frequency with which it is injured. The left ventricle, being most at the back of the heart, is found to be injured when foreign bodies have made their way from the stomach, or in cases of very severe injury, either from gunshot or from splinters of bone, where probably more than one of the cavities is implicated. The auricles lie deeply under cover of

the sternum for the most part, and therefore are but little exposed to injury, the left being less frequently involved than the right. When either the auricles or the left ventricle are injured, there is generally concomitant wound of the lung.

The pericardium may be punctured without the heart being touched, but the result seems to be almost as fatal as when the heart is injured. Of this lesion there are several well-marked instances on record. One which occurred in the practice of Sir Astley Cooper terminated unfavorably. A man was wounded by a reaping-hook deeply through the cartilages of the ribs. The wound was small. In two or three days he had much pain about the heart, and a quick small pulse. He shortly began to swell, and could not lie down. He lived two or three weeks. On post-mortem examination an effusion of bloody pus was found in the pericardium. Another, which is recorded by Hennen, survived the effect of the injury. It was a bayonet-wound of the pericardium and diaphragm, where the patient recovered from the immediate effects of the injury, but died from pneumonia three months after. His heart was found adherent by long fibrinous bands to the pericardium.¹

A third, which came under the notice of Dr. Parkes,² at University College Hospital, was followed by death. It took place as follows :

“A juggler, æt. 19, was exhibiting the trick of swallowing a sword two feet long, three inches broad, and round and blunt at the extremity. It passed down the œsophagus, and, meeting some obstacle, he pushed the sword violently past it, and immediately gave a sudden leap in the air, and then fell and fainted.

“Five and a half inches from the lower border of the pharynx was a wound one inch long and several lines broad on the anterior wall of the gullet, which went direct into the pericardium at the angle formed by the reflection of the pericardium from the right auricle. Probably air entered. Great pericarditis ensued, and a large amount of lymph was thrown out. None of the important vessels or organs were injured.

“Thirty minutes after the accident he was pale, perspiring, and nauseated. Pulse 47. He had acute pain in the cardiac region, increased by full inspiration. A sharp but distinct pericardial friction sound was heard with the systole, at the apex of the heart. This sound increased, owing to rapid effusion of lymph, and on the following day was both diastolic and systolic, and audible all over the cardiac region. The sounds of the heart were unaltered ; there was an abnormally clear

¹ ‘Chelius,’ vol. i, p. 454.

² ‘Pathological Transactions,’ vol. iii, p. 41.

sound on percussion, probably from the presence of air in the pericardium. Respirations 30; pulse 100, intermittent. The following day the friction sound was more marked, and the clear note on percussion had disappeared. Respirations 40, pulse intermittent. He died the same evening."

Two other cases have recently been brought before the profession which bear upon this point. They occur in Mr. Le Gros Clark's '*Lectures on the Principles of Surgical Diagnosis.*' One was followed by death and one by recovery.

"The first case is that of a boy, *æt.* 7, who met with a fall three hours before he was brought to St. Thomas's Hospital. He looked pale, and his respiration was somewhat embarrassed, but he did not complain of pain. The dresser on duty, fancying he detected a fractured rib, applied a flannel bandage. He was taken home, and for twelve hours his condition did not seem to excite alarm. He then complained of uneasiness in the chest. Fifteen hours after the infliction of the injury he rose up to pass urine, but fell back fainting and almost immediately expired. A needle had passed through the cartilage of the fifth rib. About an inch of the pointed end had been broken off, and was found free in the pericardium, where it had rested and lacerated the apex of the heart, and from the wound thus caused hæmorrhage had taken place into the pericardium to the extent of six or seven ounces. A second part of the needle was imbedded in the cartilage of the rib, not projecting on the pericardial aspect, but slightly on the cutaneous. The aperture by which the needle entered could not be found."

"The other case, which occurred in the practice of Mr. Morton, of Guildford, was that of a schoolboy, *æt.* 17, who received a punctured wound three eighths of an inch wide, made by an ordinary penknife, one inch and three quarters long from point to handle, between the third and fourth ribs, an inch and a half from the centre of the sternum, and two inches to the right and an inch and a half above the left nipple. There was no hæmorrhage and no faintness for an hour after the injury was inflicted. Vomiting and faintness continued, with feeble and irregular pulse, for fourteen hours. The heart's action continued feeble for a fortnight, but without abnormal sounds, and then a loud bruit was heard over a limited area, having the seat of the puncture as its loudest point. He had no further serious symptoms, and after the lapse of seven months all traces of the accident had disappeared."

Mr. Clark adds with propriety, "There can be little doubt that the pericardium was penetrated in this case, and probably the heart itself punctured."

It is almost impossible to conceive a non-penetrating wound of the auricles, in consequence of the thinness and almost membranous character of their parietes; they are also well protected by the sternum, and almost completely covered by the lungs.

Non-penetrating wounds may be complicated with injury of either the coronary arteries or veins.

Jamain quotes two cases which he believes to be the only instances on record; one is from Lamotte's 'Surgery.' It occurred thus:—An officer received a sword thrust and expired two hours after. The sword had pierced the pericardium in two places, making a wound in the heart, the course of which was oblique, and had opened the coronary artery without entering the ventricles; the opening in this vessel afforded so large a quantity of blood that the chest on that side was altogether filled with it. The second case is reported by Larrey. The wounded man lived sixty-three days.

To these cases may be added that of Dr. J. Ferguson, in which the wound was inflicted by a cobbler's awl on a boy aged twelve, and also that of a woman who died at University College Hospital, from an opening made by a fish-bone into the left coronary vein. In the former case the boy lived eight days, and the post-mortem examination showed a wound of the left coronary artery without injury of the muscular tissue. The latter case is recorded in the 'Lancet' of August 25th, 1860, and is as follows:

A fish-bone lodged in the œsophagus and thence perforating the diaphragm and opening the left coronary vein.

"A woman, by trade a hawker, with no fixed dwelling, was admitted into University College Hospital, warm, but with life extinct. No history could be obtained as to her age, name, or habits, except that she felt pain in the chest, which compelled her to rest on a door-step, when she became faint and was removed to the hospital.

"The pericardium contained a pint and a half of fluid blood. A jagged wound was found on the posterior surface of the heart, just over the descending coronary artery and vein, the latter being punctured.

"The blunt end of the fish-bone projected into the cardiac end of the stomach close to the œsophagus; it had then passed through the pericardium and œsophagus, causing some extravasation between them. The cavities, which were empty, had not been opened by the external wound. There were débris of fish-bones in the intestines. Death took place by syncope, blood being poured out slowly, as shown by consolidation of fibrine in the form of threads around the heart."

Non-penetrating wounds are either simple or complicated with impaction of a foreign body or with a wound of the

coronary vessels. Though less perilous than penetrating wounds, still they are from their commencement full of danger. In the first place, shock or syncope may bring about immediate death, as in the case of Latour d'Auvergne, which proved fatal after a wound extending only two lines into the substance of the wall of the left ventricle.

The patient may survive some hours, as in the case related by M. Nélaton, of a young sub-officer who died twenty-four hours after receiving a contused wound from a pocket pistol, in whom superficial erosion of the muscular fibres of the right ventricle was found. Another instance, recorded by Hortius, is that of a prisoner who lived eight days after having plunged a knife into the substance of the ventricular septum, though without opening any of the cavities of the heart. Or the patient may recover from the effects of the injury and live for years. Such cases are rarely published, from the difficulty of following them to an issue, and consequently of recognising the exact lesion which existed. In this way I was about to publish Checkley's case, soon after he first left the hospital, as one of a wound of the pericardium with probable implication of the heart, not feeling positive whether the heart itself was injured, and in the event of its being injured being unable to determine the exact site of the wound, and whether it was of the penetrating or non-penetrating variety. Dupuytren relates a case of a non-penetrating wound of the heart produced by a fragment of the sternum, which terminated favorably. The case of William Checkley may also be cited, where undoubtedly the surface of the heart was incised, though none of the cavities were invaded, and where life was prolonged for upwards of four years.

In those instances of non-penetrating wounds where life is preserved it was suggested by Senac that probably the deeper fibres of the heart would subsequently rupture or form aneurismal pouches. Two cases, narrated by Boyer and Dr. Mühlig respectively, give colour to this opinion; but in Dr. Mühlig's case there had been probably a division of the whole of the right ventricle, and a communication formed between the right and left ventricles. How much of this lesion was due to the original injury, and how much to subsequent dilatation of the cicatrix, it is difficult to determine. No such result seems to have been met with in other cases of non-penetrating wound;

the firm fibrous adhesions between the pericardium and heart, caused by pericarditis, would tend to prevent the occurrence of any aneurismal dilatation of the cicatrix. Dr. Mühlig's case is so full of interest that I quote it at length :

"CASE.—A mason, ten years before he came under Dr. Mühlig's notice, was wounded on left side of sternum with a stiletto; the cicatrix was visible; he was for awhile in danger, but was able to resume business, a 'bellows-murmur remaining' until a few weeks of his death. Excessive dyspnœa, anasarca, and an intense double bellows-murmur set in, the man got worse and gangrene supervened. At the post-mortem the left lung was connected over its entire surface to the thorax and pericardium by means of old adhesions. Pericardium was intimately adherent to heart; over the right ventricle it could not be removed without cutting, and there was felt a hard prominent body covered by the sternum, and which at first was believed to be indurated fibrine; heart increased in size, particularly left ventricle; right ventricle seemed to form only an appendix, and on the inner surface of its wall a rounded aperture lined with cicatricial tissue was observed, through which the little finger could be passed into a sac about the size of a small walnut. At the bottom of this was felt a hard body covered with asperities, giving very much the sensation imparted by a carious bone; this was the same indurated body that had been felt through the pericardium. On opening the sac it was found to be a partial aneurism of the heart, containing an encrusted fibrinous concretion, and having its wall solely constituted of the two layers of the pericardium fused into one, no trace of muscular fibres being present. The aneurism was situated at the union of the upper two thirds with the lower one third of the wall of the right ventricle; and exactly opposite the aneurism there was a hole in the interventricular septum leading into the left ventricle, which scarcely admitted the point of the little finger; but on the side of the left ventricle this hole was twice as wide, and it was completely lined with cicatricial tissue, which extended several lines into the left ventricle, forming above a semilunar fold which partially closed the orifice, a similar fold below floating freely in the cavity of the ventricle. Close to the free edge of each semilunar valve of the aorta was a cauliflower excrescence, larger than a pea, and viewed from the cavity of the aorta the valves exhibited a solution of continuity near their free edges, a probe passing through this into the middle of the fungosities. The substance of the heart was of a pale red, with yellowish streaks, and it was flaccid and friable. The auricles were much dilated, and their walls were thinned.¹"

Penetrating wounds seem to be much less fatal in the lower animals than in man. Repeatedly acupuncture needles have been introduced into the hearts of animals for experiment without causing death, and bullets have been found imbedded in the hearts of animals of the chase, which had probably lain there for years. Recent experience shows that the pericardium

¹ 'Presse Médicale Belge,' 1860, No. 43.

may be tapped without risk, and even with advantage, when a considerable collection of fluid has taken place in it.¹

The appearance and form of wounds of the heart, as a rule, correspond with the weapons with they have been inflicted. In a case of Letenneur, where the puncture had been made with the leg of a compass, the wound was said to be triangular in shape. They rarely gape, unless inflicted by firearms or when accompanied by extensive laceration or destruction of the parietes. Profuse hæmorrhage is common at the time of the accident, but soon ceases from the patient falling into a state of syncope. While in that condition a clot forms, which is not very easily dislodged, and which may, in course of time, become organized and lead to union of the lips of the wound.

In Checkley's case bleeding never appeared to come per saltum, although blood continued to flow for many hours in small quantity. In one case at St. Mary's Hospital, under the care of Mr. Spencer Smith, arterial bleeding continued for two days, and came both from the wound and from the mouth, although the lungs had not been punctured.

"CASE.—J. W—, æt. 21, was admitted into St. Mary's Hospital, under Mr. Spencer Smith, December 25th, 1866, with a wound three quarters of an inch below and to the right of the left nipple, running under the integument, from left to right, about an inch and a half. Arterial blood was flowing from the wound and from the mouth. Ice was applied both externally and internally.

Bleeding continued at intervals, but in small amount, up to the 27th of December. On the 28th of December great pain was experienced and a sense of suffocation came on. The heart's action was roughened, and a friction sound was heard at the apex. On the 29th the symptoms were increased. He died five days after the accident. Opium was given throughout, and leeches were applied when the inflammatory symptoms showed themselves.

At the post-mortem examination a wound was found running one inch under the skin from left to right. It had entered the chest between the fifth and sixth cartilages, and had opened the pericardium, which contained a clot of discoloured blood weighing three ounces, and two ounces also of fluid serum. There was recent lymph on both surfaces of the pericardium. The heart, which was rather large and flabby, was wounded about two inches from the apex of the right ventricle; the edges of the wound, which was half an inch in length and slightly curved, were covered with lymph. The lungs were congested, and there were signs of pleurisy at the base of the left."

¹ See Dr. Sibson's paper on "Paracentesis Pericardii," in the 'Med.-Chir. Review,' July, 1854; and also Dr. C. Allbutt's cases in 'Braithwaite's Retrospect,' vol. liv, p. 309.

In another case, which was under the notice of Mr. Thompson, at the Nottingham General Hospital, arterial hæmorrhage, very difficult to restrain, persisted till the following day, and then blood accumulated in large quantity in the chest, and on two different occasions required to be drawn off by a catheter.

"CASE.—J. H. N—, æt. 17, a volunteer, while running fell on his own bayonet, which entered the left side of his chest. He drew it out and walked a short distance, when he fainted. An hour after, when admitted, he was faint but conscious; had a triangular wound between the fifth and sixth ribs, an inch and a half below and external to nipple, extending inwards, backwards, and a little downwards, and admitting the tip of the little finger; air passed in and out, and arterial blood issued in jerks from the upper edge of the wound. Artery could not be seized, so the wound was plugged.

October 6th.—Slight hæmorrhage had taken place; increased dulness below wound, and resonance above it; emphysema, but no cough or bloody expectoration; respiration 80.

7th.—Pleuritic and pericardiac friction sounds; great increase of dulness; No. 10 catheter introduced, and a pint of brownish fluid blood, which on standing feebly coagulated, was drawn off, with relief to the dyspnœa. In the evening a quarter of a pint more blood was drawn off.

8th.—Good deal more blood came away from the wound. He began to sink, and, in spite of counter-irritation and stimulants, he died on the 9th inst.

Autopsy.—The wound had penetrated the pleura costalis, passed over the thin edge of the lung without manifest injury to it, perforated the pericardium, and thus entered the left ventricle, about an inch and a half from its apex, traversing the left lateral and posterior wall obliquely, and coming out close to the septum ventriculorum. It then traversed the pericardium again, and passed into the posterior mediastinum, then behind the aorta, and finally, after touching the vertebræ, entered the right pleural sac. There was lymph in the pericardium and two small clots of blood. There was also blood and recent lymph in each pleural cavity."

The situation of the wound is generally to the left of the sternum, and most commonly, as in Checkley's case, in the neighbourhood of the fifth rib and its cartilage. Sometimes the wound enters at a more distant spot, and takes an oblique course in its progress towards the heart. In Mr. Wood's case it was opposite the junction of the cartilage of the seventh rib. Occasionally the foreign body enters from the œsophagus or stomach. Thus, in the Museum of Pathological Anatomy of Erlangen is shown a heart, into the right ventricle of which a thorn of *Prunus spinosa* (Linn.), half an inch long, is projecting. It had gone through the œsophagus and penetrated the

posterior surface of the heart, an inch above the apex cordis and just above the septum, leaving a contracted cicatrix, and had lodged behind the anterior papillary muscle of the tricuspid valve. The patient had swallowed the thorn the summer before he died, and had for some months previous to his death complained of a difficulty in the cardiac region. In the cases before quoted, of the juggler and the woman who died in consequence of swallowing a fish-bone, the foreign body came from the œsophagus and stomach respectively.

At other times the wound is inflicted, as in the second case I have related, by a fragment of a rib or of the sternum, and is unaccompanied by an external wound. Occasionally death results from the accidental or suicidal introduction of needles into the heart, and then, probably, no external wound is noticeable; such cases are not uncommon, and the persistence of peculiar symptoms which are not referable to any known disease or ascertained injury should lead us to question as to the possibility or probability of their being due to such a cause.

Hennen mentions a case in which a pin was found in the heart after death from carditis, though it was impossible to say how it got there. The patient had complained of pain in the chest three months.

The following cases, bearing upon this point, indicate the remarkable course which needles may take in their way to the heart, and the special symptoms to which they may give rise:

Case of lodgment of a needle in right bronchus, with perforation of heart.

CASE.—A child, aged 11 months, was brought to the Hospital for Sick Children on account of vomiting after food and diarrhœa. A month before, the child was feverish, and there was swelling of the joints; child was rickety, and had suffered from improper food. Cardiac sounds were healthy.

Three days after, the child "had a fit," could not get its breath, face and hands became blue, and it died.

Post-mortem examination showed a small abscess in the cellular tissue over the sternum; universal adhesions of pericardium. On endeavouring to cut through the right bronchus the knife was arrested by a needle, $2\frac{3}{8}$ inches long, which projected for about half an inch into the right ventricle, through the posterior wall. There was a little pus round the needle where it perforated the ventricle.

There was thickening of the edges of the mitral valve, and the walls of both ventricles were thicker than natural; no disease elsewhere.

The mother recognised the needle as one she had lost a month before, when she had left the child in the room where she had been darning.

Dr. Neill dissected a negro who had suffered for some time, but not urgently, from palpitation, dyspnœa, and severe cough; he had never received an injury or showed any tendency to suicide. A broken worsted needle two inches long was found imbedded in the external wall of the left ventricle, with its point directed to the apex of the heart. It was much oxidized, and could not be moved from its situation until the cyst containing it was slit up. The broken end was contained in one of the *carneæ columnæ*.

Dr. Leaming relates the case of a seamstress who thrust a needle through her chest by falling against a table, and who died after suffering from pleurisy, pericarditis, and pneumonia, for nine months. The needle was found imbedded partly in the wall of the right ventricle and partly in the septum, while the point projected a quarter of an inch into the left ventricle.

In the '*Archives Générales*' of 1842 there is the case of a soldier who ran two needles into his heart and died in nineteen days. They had passed through the heart and lodged in the lower part of the left lung, therein inducing an abscess.

Dr. Graves reports a case where a needle, which had been run into the heart for suicidal purposes, was cut down on and removed; the patient died on the eighth day, and on opening the left ventricle, where the needle had entered, a small membranous sac of the size of a pea, containing pus, was found.

In connection with wounds of the heart, wounds of the lung are very common; they may be recognised by the expectoration of frothy red blood, by the entrance and exit of air from the wound, and by the presence of emphysema; they form a very grave complication, in consequence of the probability of blood accumulating in large quantities in the pleural cavities as well as in the pericardium, and so compressing one or both lungs as to interfere with the process of respiration. Large hæmorrhage may come from wounds of the intercostal or internal mammary arteries; the presence of the bright arterial fluid coming in jerks will enable us to diagnose injury of those vessels.

Again, the wound may come through the diaphragm, and may in its course have injured one or other of the abdominal viscera. Dr. Babington ('Medical Records and Researches,' p. 59) gives the case of a marine who fell on his bayonet, which entered the abdomen, passed through the sigmoid flexure of the colon, through the stomach, left lobe of liver, diaphragm and pericardium, and traversed the heart near the tricuspid valve. It then penetrated the lung, and made its exit at the anterior part of the chest, between the second and third ribs on the right side. The man lived twenty-four hours.

Or lastly, the wound may involve the heart first, and then the diaphragm and abdominal viscera, as in the following case reported by Dr. J. T. Fraser of a Madras artilleryman, who survived three and a half hours after a gunshot wound of the heart. The bullet had passed through the sternum into the pericardium, causing a great effusion of blood which was found coagulated, then into the right ventricle, then through the diaphragm, bruising the small intestines but not perforating them, and ending its course in the recto-vesical pouch of peritoneum where it lay loose. No blood was found in the abdominal cavity. Dr. Fraser supposes that the heart was *bruised*, but that contraction of the muscular fibres had torn open the wound, and that blood had gradually blocked up the pericardium and so arrested the heart's action. Dr. J. H. Grant reports ('Charleston Med. Journal,' May, 1857) a remarkable case of this kind; the subject of it, a constable, received a ball from a revolver, which entered "a little to the right of the sternum, between the cartilages of the fifth and sixth ribs," "perforated the pericardium," entered the right ventricle about an inch from the apex, and emerged from the same on the under side of the heart, before going far enough to enter any other cavity; "passed through the diaphragm and through the cardiac extremity of the stomach, and lodged on the left kidney. This man was in a state of collapse for fifteen hours, and continued to live for twenty-six days without taking any nourishment. When the post-mortem was made the wounds in the organs had healed, but the cicatrices were evident."

The *diagnosis* in all cases of wound of the heart is extremely difficult. The form and length of the instrument with which

the wound was inflicted, and the direction, size, and situation of the wound itself, are important points to be looked at in every case. The greater the proximity to the cartilage of the fifth or sixth ribs, the greater the probability of the heart being wounded. The difficulty is no less great in determining whether the wound be of the penetrating or non-penetrating variety; if the wound be ever so slight, it is well to avoid much probing, and if it be large, it is positively interdicted in consequence of the probability that the clot might be thereby disturbed, and fatal hæmorrhage induced. A peculiar whirring sound is heard in some cases over the region of the heart, similar to that of a varicose aneurism, and its importance as a diagnostic sign of penetrating wounds is insisted on by Jobert. Its presence is not, however, invariable. It is most likely to be met with in cases like Dr. Mühlig's, where a communication has been established between the two ventricles.

Profuse bleeding cannot be looked upon as pathognomonic, inasmuch as these injuries are often unattended by great hæmorrhage, and in those cases where the intercostal arteries are wounded the loss may be very considerable. Great nervous excitement and intense fear have been looked upon as constant accompaniments of wounds of the heart, but they are not always present. Very much will depend in each case on the peculiar temperament of the patient; but, as a rule, a marked nervous depression and a tendency to syncope are evident, and the patient remains for a long time pale, exsanguine, with cold extremities, with a low feeble voice, and with a strong disposition to fainting on the least exertion.

The *prognosis* must always be exceedingly unfavorable, whether the wound be penetrating or non-penetrating; in the latter case wound of the coronary vessels may have taken place, and this is quite as formidable an injury as puncture of a ventricle.

At the onset the danger is chiefly from shock and syncope; farther on there is the risk of separation of the clot, and sudden death from hæmorrhage; while if the patient survive these risks there is still the danger of the heart being stopped by the compression of blood effused around it; an inevitable attack of pericarditis and probably of endocarditis follows, which may either cause death at once or may lead to such permanent mischief about the

heart that the circulation will remain embarrassed, and the functions of the heart will be carried on with difficulty. In penetrating wounds clots will form in the heart, and these being carried into the arterial system will give rise to the various morbid conditions with which we are familiar as the result of embolism.

We can never be sure of the exact situation of the wound; but we may say with tolerable certainty that if it be the right ventricle that is wounded the patient's chance of recovery is greater than if it be the left, and that a wound of the auricles must almost necessarily be fatal.

Pathology.—Strange though it seems, the heart may be wounded, and yet the pericardium be intact. In four cases recorded respectively by Borellus (*a*); Professor Holmes, of Montreal (*b*); Dr. Ward, of Manchester (*c*); and Dr. Fraser, of the London Hospital (*d*), the pericardium appears to have been pushed into the cardiac wound, and to have escaped laceration.

(*a*) Latour describes this case. A person of mark received a ball in the chest, and died three or four hours after. The foreign body was found to have made a wound in the lower part of the heart through the pericardium; that membrane was entirely filled with blood, though no solution of continuity could be found in it.

(*b*) The second case, related by Professor Holmes, of Montreal, occurred to a young man who was struck by a ball, and only lived a short time after receiving the injury.

(*c*) The third case is recorded by Dr. Ward, of Manchester. A man, æt. 26, shot himself with a pistol, and died in ten minutes. His shirt was on fire, but there was no mark of violence beyond a bruise under the left nipple.

Post-mortem.—The intercostal muscles between the fifth and sixth ribs were perforated, so that they would admit the finger. The pericardium was *intact*, but greatly distended. The left ventricle was discovered to be ruptured longitudinally to the extent of an inch on its anterior surface; in size, texture, and condition, the heart was perfectly healthy. The pistol was held close to the chest, and the mark was inflicted by the ring of the key used for taking the barrel to pieces.

(*d*) Dr. Fraser reports the following case, which was com-

municated to him by Dr. Aitken, author of the 'Practice of Physic.' A boy, æt. 14, accidentally shot in the chest, was taken to the Glasgow Infirmary, and survived three days. On post-mortem examination the pericardium was *entire*; but on opening its cavity the serous surface corresponding in position to the injured part of the lung was somewhat red from blood-vessels ramifying over its surface. A lacerated wound extended for about half an inch in length upon the anterior and lateral surface of the left ventricle, near to and parallel with the septum.¹

In most cases, however, the pericardium is injured, though generally to a less extent than the heart, its firm fibrous nature enabling it to resist injury better than the soft muscular tissue of the heart.

Great effusion of blood is generally found in penetrating wounds of the heart; sometimes it is fluid and sometimes coagulated. After a time the effusion forms false membrane, by which the sides of the sac become agglutinated, and where the patient has survived a long time this union becomes so intimate that the two layers can with difficulty be separated. This pericardial inflammation usually comes on from the second to the fourth day, and may proceed beyond the adhesive stage, and lead, as in Mr. Wood's case and my own, to the formation of pus, or even to softening and ulceration of the substance of the heart. The pleural cavities are also frequently the seat of great effusion of blood, even though the lungs be not injured. Pleuritis, with its usual train of pathological phenomena, ensues.

Jamain has tabulated 121 cases, which he has examined, and finds the cavities affected by injury in the following order of frequency:

Right ventricle	43	The two auricles	1
Left "	28	Left auricle and left ventricle	
Right auricle	8	destroyed	1
Left "	2	The whole heart	1
Point and base of heart	7	Coronary artery	2
Interventricular septum	2	Without precise information	5
The two ventricles	9	With no information whatever	12

¹ Fraser on 'Penetrating Wounds of the Chest,' p. 89.

It is thus seen that the right ventricle is far more commonly injured than any of the other cavities. Experience fully confirms this statement.

Thirty-one cases have been collected by me, which have appeared with four exceptions in various British and American medical journals since the publication of M. Jamain's essay, and they exhibit the following results in respect of the relative frequency with which the different cavities are implicated:

Right ventricle	14	Right auricle and right ventricle	1
Left „	8	Point of heart	1
Coronary vessels	2	With no precise data	2
Both ventricles	3		

The experience derived from the cases collected by Ollivier still further confirms these statistics; out of sixty-one cases the right ventricle being wounded twenty-three times, while the left was only affected twelve times.

In most of these cases the wound was probably either punctured or incised; but in gunshot wounds the whole heart may be completely destroyed, as in the cases reported by Tardieu and Rigal; or the apex may be torn off without any of the cavities being opened, as in the following instance mentioned by Chassaignac:—A man received a pistol-shot in the cardiac region. There was no hæmorrhage from the wound or hæmoptysis. Death occurred on the fifth day. The ball had entered the pericardium, had torn off the point of the heart without penetrating any of the cavities, then had glided over the vault of the diaphragm, between the lung and the pleura, as far as the eleventh intercostal space, where it had lodged itself, opening the pleural cavity. This inoffensive gliding of the ball between parts so delicate is remarkable. Traces of pericarditis, from which the wounded man had died, were found.¹

Gunshot wounds are not, however, always fatal; bullets have been known to lay encysted for years in the substance of the heart. Dr. Balch, of North Lawrence, New York, relates a very interesting case of this sort, where a bullet was lodged in the heart for twenty years. In 1840 a boy, æt. 14, was shot in the right shoulder, the bullet entering through the upper

¹ 'Gaz. des Hôp.,' Sept. 4th, 1858.

border of the trapezius, about two inches from the acromion. The ball, by those who examined him, was supposed to lie four or five inches from where it entered in a direction towards the cavity of the chest, near the sternal end of the clavicle. In about six weeks he resumed his work, and gradually quite regained his health. In 1845 he was attacked with severe pneumonia on the right side, and then was first noticed a tumultuous action of the heart, which continued to increase after his recovery, its pulsation being seen and heard at a distance of ten or twelve feet. Another attack of pneumonia carried him off in 1860. At the autopsy the right internal jugular was found enlarged, and the external was entirely closed about a quarter of an inch from where it entered the internal jugular. In the right subclavian artery, at the thyroid axis, was a large ossific deposit. The heart, two or three times its natural size, was very soft and flabby; and although on the outside no scar was discernible (the pericardium was, however, adherent on the right side), on opening the right ventricle a leaden bullet was found imbedded in its walls.¹

Professor Hamilton, of New York, records a still more wonderful case, where a musket-bullet lay imbedded in the apex of the heart for thirty years, and was found surrounded by atheromatous deposit.²

Of shorter periods during which bullets have been retained in the heart, I present the following examples:

Dr. Hopkins, of Ohio, reports a case in which a patient survived fifteen days with a pistol-ball encysted in the wall of the left ventricle.

Carnochan's patient, the notorious Poole, lived eleven days with a pistol-ball encysted in the wall of the heart.

In a case reported by Dr. Randall, of Ohio, the patient died on the sixty-seventh day, and three shots were found in the right auricle and left ventricle, the wounds having cicatrized.

In the '*Indian Annals of Medical Science*' a man is said to have survived ten weeks with a musket-ball in the cavity of the left ventricle.

Fournier gives the case of a man wounded by a ball, who fell

¹ '*Amer. Med. Journ. of Med. Science*,' July, 1861.

² '*Med. Times*,' Jan. 26th, 1867.

as if dead. Three months after, he suffered from severe palpitations, which nearly disappeared after three years. He died six years after the receipt of the injury from some malady unconnected with his injury, and the ball was found lodged in the right ventricle, near the tip, and resting on the septum medium.¹

Mr. Le Gros Clark relates the case of a soldier who was struck by a ball at the battle of Corunna, the wound being to the left of the sternum, between the second and third ribs. He remained insensible for half an hour, but did not lose much blood. He was carried on board a crowded ship, and sent to England. On his arrival the external wound was healthy and suppurating. A probe was introduced nearly its length without meeting any resistance. His countenance was pale; respiration frequent and laboured; pulse 120, feeble but regular. He had inability to sleep and distressing restlessness, obtuse pain in the chest, and colliquative diarrhœa. Three days after landing, and fourteen after the receipt of the wound, he died.

Post-mortem examination.—The left pleura contained two quarts of sero-sanguineous fluid, and the lung, shrunk to a small size, was adherent to the spine. The thickened and distended pericardium contained half a pint of the same fluid, and the surface of the heart was covered with a thin layer of adhering lymph, a small clot of blood being attached to its apex. The right ventricle presented a transverse opening about an inch in length, which penetrated to its interior, near the origin of the pulmonary artery. The tricuspid valve had a circular lacerated opening in it, near the attachment of the ventricle. The ball, though found loose in the pericardium, must have lodged in the right auricle.

Different kinds of foreign bodies have been found in the heart, and in some cases have lain there for years without their presence being suspected.

Raynaud mentions, among other curious things found there, the point of a sword; a hair-pin (Laugier); an ivory toothpick (Barbier, of Amiens); a wooden peg, three inches in length (David); three deer-shot, lying loose in the right ventricle, and two in the right auricle; and an iron wire nearly six inches long

¹ 'Brit. Med. Journ.,' March 23rd, 1867.

and three sixteenths of an inch broad, which had been plunged into the heart for the purpose of suicide by a madman (Tillaux).

I have already related cases where needles have mysteriously found their way into the heart, probably having first been swallowed. One of the most striking I have met with is that mentioned by Piorry, in which a needle was found implanted in the interventricular septum, but free at each end, where it had given rise to fibrinous deposits on the walls of each ventricle.

As the result of wounds, death may occur in three stages :

1. Death may be instant.
2. Death may come after a few hours or days from the proximate effects of the wound.
3. Death may result after a variable period from the secondary results of the injury.

1. Instant death is most common when the auricles or the left ventricle are involved. It then generally results from the hæmorrhage and consequent syncope; but when the right ventricle is affected, and the wound of the heart is not very extensive, hæmorrhage is seldom very profuse, partly owing to contraction of the muscular fibres of the heart, partly to the formation of a coagulum between the lips of the wound, and partly to the accumulation of blood in the pericardium preventing the further exit of blood.

2. Death may come on after a few hours or days from the proximate effects of the wound. The mechanism of death in most of these cases is compression of the heart. The pericardium being not very distensible, blood can only accumulate in it to a certain extent. The blood then begins to coagulate, and forms around the heart a firm mass of fibrinous concretion, which gradually compresses the heart until it is no longer able to act.

Occasionally, but rarely, death is due to the sudden dislodgment of a clot from the wound in consequence of violent emotion or slight muscular exertion a few days after the accident.

3. Death may result after a variable period from the secondary results of the injury. The principal of these are pericarditis, endocarditis, pleuritis, embolism and as a result of it, gangrene or paralysis. As an instance of fatal result coming on during

this stage I shall quote the following remarkable case of partial recovery from a punctured wound of the heart:—F. W. F—, æt. 14, was wounded in the left breast with a penknife; the wound healed and the boy was discharged from the Middlesex Hospital cured; three months after that he was taken suddenly ill and died in a few hours. Dr. O'Flaherty found that the right ventricle had been penetrated in a slanting direction. To this circumstance he attributes the fact of the boy living so long. "The cause of death was apoplexy, produced," he believed, "by the weakening of the heart's action from the thinning of the walls, the effect of the wound."

Although undoubtedly cures are possible after wounds of the heart, still pericardial adhesions or endocardial mischief are sure to remain, and from these causes sooner or later a fatal issue is generally brought about.

In reference to the length of time patients survive the receipt of a wound of the heart, Jamain gives the following interesting table of eighty-four cases collected by him where the length of time is noticed.

Right ventricle.

4½ hours, 1 case.	3 days, 4 cases.	9½ days, 1 case.
5 " 1 "	3½ " 2 "	11 " 1 "
12 " 1 "	4 " 4 "	12 " 1 "
13 " 1 "	5 " 4 "	15 " 1 "
15 " 1 "	6 " 1 case	16 " 1 "
24 " 1 "	7 " 1 "	18 " 1 "
36 " 1 "	8 " 1 "	20 " 1 "
2 days, 2 cases.	9 " 1 "	23 " 1 "

Left ventricle.

½ hour, 2 cases.	4 days, 1 case.	16 days, 1 case.
6 hours, 1 case.	5 " 3 cases.	17 " 1 "
12 " 1 "	8 " 1 case.	20 " 2 cases.
2 days, 1 "	9 " 1 "	65 " 1 case.
3 " 1 "	10 " 1 "	6 months, 1 "

Right auricle.

Some hours, 1 case.	9½ days, 1 case.
9 " 1 "	11 " 1 "
22 " 1 "	20 " 1 "
5 days 1 "	

Left auricle.—1 day, 1 case; 2 days, 1 case.

The two ventricles.—1 hour, 1 case; 1½ hour, 1 case; 4 days, 1 case; 25 days, 1 case; 9½ months, 1 case.

Apex or base of the heart.—3 days, 1 case; 7 days, 1 case; 11 days, 1 case; 14 days, 1 case; 20 days, 1 case.

Interventricular septum.—8 days, 1 case; 12 days, 1 case.

Coronary arteries.—63 days, 1 case.

In the other cases the account was incomplete.

Without doubt there are cases in which wounds have been cured, the patients having survived for years and finally succumbed to a different malady. Thus, Velpeau found a fibrous cicatrix on the anterior wall of the right ventricle of a man, aged fifty, who died from another disease nine years after a wound from a table-knife in the region of the heart. Bougon, Dupuytren, Begin, Latour, and Durande, have brought forward undoubted cases of cure. In this category must be included the case of Checkley which I have myself recorded; that of Dr. Tillaux before alluded to, where the patient was living a year after the receipt of the injury; those of Dr. Mühlig, Dr. Balch, and Fournier, before quoted at length; and to these I may add the following interesting case of Brugnoli which came under his notice at the Bologna Hospital, where the patient lived upwards of nineteen years after a wound of both ventricles.

“Pierre de Lucca, of Bologna, was stabbed with a knife on Aug. 23rd, 1835, two inches above the left nipple, a short distance from the sternum; at the end of seventy-eight days he was discharged cured from the hospital. During this period the symptoms observed had been violent palpitation and purring tremor; a very audible souffle under the left clavicle and in the axilla, masking both sounds of the heart and extending to the right side of the neck. At the end of some months the man resumed his occupation of a shoemaker. A tumour then formed under the left clavicle, but disappeared after an attack of pulmonary hæmorrhage, and was completely cured after a course of diet on Valsalva's plan. A long time after, the man had signs of hypertrophy of the heart, with a murmur masking the first sound, heard chiefly at the base. He was seized with œdema of the lower limbs, enlargement of the liver, colic, bilious vomiting and enteralgia, and died in the hospital at Bologna on April 12th, 1855, nineteen years and seven months after the receipt of the wound.

“At the post-mortem the heart was found excentrically hypertrophied; the pericardium was thickened, and adhered to the heart by numerous bands, some of which were encrusted with calcareous matter. At the anterior part of the right ventricle, near the semilunar valve, was a quadrilateral spot, rather more than an inch in extent, of a white opaque colour, and evidently consisting of a cicatrix.

"A similar spot was found in the interventricular septum directly opposite the other, and also at the posterior angle of the mitral valve, which was cleft and its two borders converted into two large tendinous cords."¹

Symptoms, course, and progress.—On the receipt of the injury the wounded man either makes a sudden jump in the air and then falls, or else staggers for a few moments and then is obliged to seek support. Intense pallor overspreads the countenance; the circulation, and even the respiration, are at first temporarily and then may be finally suspended.

Sometimes death is very rapid, even when but a slight puncture of the heart has been sustained, as in the case of Latour d'Auvergne, and in that of Professor R. Smith, where the wound was only a quarter of an inch in length.

Professor R. W. Smith brought before the Dublin Pathological Society the case of a soldier who was stabbed in the chest by one of his comrades with a clasp knife. He was dead when brought to the hospital. The blade had penetrated the apex of the right ventricle, passing into its cavity, but not wounding its opposite wall. Both pericardium and pleura contained a large quantity of partly coagulated blood. The wound of the ventricle was not more than a quarter of an inch in length. The blood had likewise dissected, as it were, the costal pleura from the side of the chest.

In other cases faintness continues for some time, the patient lying on his back and complaining of intense pain at the heart, with a fluttering feeble pulse, a nervous and pallid expression of face, sighing respiration, cold surface and extremities, a weak voice, and great sense of thirst. Nausea and vomiting sometimes come on when the patient begins to rally. Bichat speaks of a cyanosis of the lips and face as a symptom, and undoubtedly there is generally extreme pallor with a tendency to lividity around the eyes and lips. The syncope may be long continued; in Checkley's case it continued many hours, and probably helped to favour the formation of a clot in the wound.

In a case mentioned by Jamain a soldier was left in the sacked quarter of a city with a sword-thrust in the chest, and lived for five days in a sort of death-like trance; he was then removed to the hospital, where he lived ten days. In the five

¹ 'Bul. del. Scienz. Med.,' et 'Presse Méd. Belge,' July 20th, 1862.

days he lay in a state of syncope, the wound in the heart had cicatrized.

On applying the hand to the præcordial region a tumultuous but extremely feeble pulsation is noticed. When the ear is applied, the heart's sounds appear more distant and less distinct, and with them is heard a purring bruit. There is either increased resonance on percussion from the introduction of air into the pericardium, or else a greater extent of præcordial dullness from accumulation of blood in the pericardium. Cough is not common unless the lung is also wounded, and then there is great dyspnœa and expectoration of frothy, bright-coloured blood. As a rule, there is also dullness on percussion at the side of the chest from the collection of blood in the pleural cavities. As before stated, hæmorrhage at the time of the injury is generally for the instant profuse and alarming, and may prove immediately fatal; more often it comes in a gentle stream from the wound for a short time, and then during the state of syncope ceases altogether, recurring either when that condition goes off or when the patient coughs or makes the slightest exertion. It may continue for several days, in spite of the patient lying recumbent in the most complete state of repose, and, as in the case recorded at the Nottingham Hospital, it may lead to a fatal issue. More frequently, however, the flow ceases externally, although extravasation may take place gradually within the pericardium. With each systole a fresh quantity of blood is forced into that cavity until it can contain no more, and then the heart is gradually compressed until its action is altogether paralysed. During all this time the mind is quite clear, and, as a rule, the patient retains his consciousness to the last.

Dr. Hicks, of Simpsonville, Kentucky, mentions the case of a man shot through the left ventricle, who was moved four miles, lived forty-eight hours, and was perfectly rational.¹

If the patient lives two or three days a period of reaction commences, symptoms of pericarditis arise, and that disease is recognised by the ordinary physical signs. This pericarditis may either terminate in prolonged discharge of serous fluid, in fibrous adhesion of the walls of the sac, or, lastly, in the formation of pus. Endocarditis may also come on, and lead to thickening of the valves and parietes of the heart, as in the child whose

¹ 'Brit. Med. Journ.,' Aug. 6th, 1864.

heart was punctured by a needle ; to softening and ulceration of the substance of the heart, as in Dr. O'Flaherty's case ; or, as in Dr. Mühlig's case, to the formation of a false aneurism.

Under the most favorable circumstances the respiration and circulation continue for a long time in a very troubled state ; violent palpitations and urgent dyspnœa come on from the least excitement, and it is months before the health is re-established.

Emaciation and great debility mark the progress of the case throughout.

The phenomena connected with embolism sometimes show themselves in the course of the case. In a case of Dupuytren, where hemiplegia attacked the patient on the third day, several clots in a state of softening were found in the right hemisphere of the brain. Gangrene of the lower extremities may show itself from obstruction of the iliac arteries, as in Langier's case, or sudden death with symptoms of suffocation may be produced by dislodgment of a clot from the heart, and its subsequent impaction in the pulmonary artery. In a case of Letenneur clots were found in the branches of the pulmonary artery, extending as low as the fifth or sixth division of the bronchial tubes. The patient may, however, survive the obstruction of important vessels, for we find that in Dr. Balch's case, where there was a large ossific deposit in the right subclavian artery, and where also the right external jugular vein was entirely closed, the patient lived for twenty years.

Rigors, hectic, and colliquative diarrhœa often herald the approach of death in fatal cases. Rigors occurred on the seventeenth and again on the twenty-fifth day in Mr. Wood's case, and after each attack the patient's condition became worse and his chance of life more desperate.

Treatment.—The treatment to be pursued should fulfil three indications :

1. To favour the formation of a coagulum in the wound.
2. To prevent the separation of it when formed.
3. To moderate the force of the circulation and to prevent the mischief which would occur from severe pericardial and endocardial inflammation.

The first indication will be best carried out by enjoining the strictest silence and rest ; by retaining the patient in the recum-

bent posture ; by freely exposing the chest to the air ; or, if there be great tendency to hæmorrhage, by applying bags of ice or refrigerating lotions to the præcordial region.

The wound should be closed at once, and should not be opened unless the collection of blood in the pericardium becomes so vast as to cause intense dyspnœa and to interfere materially with the action of the heart.

The advantage to be gained by reopening the wound is seldom great ; it should, therefore, be avoided as far as possible, more particularly soon after the reception of the injury.

In the case I have related as occurring at the Nottingham Hospital no good result followed its adoption ; and in that of the Duc de Berri, although that plan of treatment was carried out under the sanction of such eminent surgeons as Roux, Dubois, and Dupuytren, the patient only lived eight hours.

Foreign bodies should be removed, if their removal can be effected without difficulty ; but no violence should be used in attempting to withdraw them, lest a fatal hæmorrhage should ensue. They may become encysted, as we have already seen in many cases.

The second indication, that of preventing the separation of the clot, requires persistent rest of the body and removal of all sources of irritation, either local or general. For a considerable period the patient must maintain the recumbent posture, avoid talking and excitement of all kinds, only take the lightest and most digestible food, and have very little of that at a time.

It was formerly the practice to bleed the patient from the arm until he was in a state of syncope, and to repeat the venesection as often as the pulse began to rise and reaction to set in. Experience shows that this extreme lowering of the amount of vital fluid does not effect the purpose aimed at, the heart becoming more irritable under the repeated abstraction of blood, and the process of repair hindered at the same time. Recourse may be had to leeches occasionally with advantage, but rarely can venesection to the extent it was formerly carried be justifiable.

In wounds of the heart simply, or where there is concomitant wound of the lung, I believe that large general bleeding is seldom required, and in support of that conclusion I am happy to find I am confirmed by the opinion of two recent writers on

this subject, Dr. Fraser and Mr. George Lawson, who derived their experience from the Crimean campaign, and both of whom are decidedly opposed to copious bloodletting. The progress of the patient towards recovery must, at any rate, be delayed by the repeated loss of blood, and I very much question if the object sought to be attained thereby, namely, prevention of the separation of the clot, is at all likely to be promoted by such a course of treatment.

The use of digitalis and acetate of lead are undoubtedly indicated—the one from its power of moderating the force and frequency of the circulation, and the other from its tendency to promote the coagulation of the blood. The nervous irritability and excitement which are prone to come on for a considerable time after the accident will probably be allayed by the subcutaneous injection of morphia more effectively and with less constitutional disturbance than by the use of sedatives given by the mouth.

Locally, the wound should be interfered with as little as possible; dry lint and strapping, the application of collodion, or the antiseptic plan of Professor Lister, would seem to be the most suitable kinds of dressing.

When the præcordial dulness is very extensive, and when, from the indistinctness and apparent distance of the heart's sound it is evident that a large quantity of the serosity of the blood, or at a later period of the serous effusion of pericarditis, or in a still more remote stage, when it is probable that a collection of pus exists in the pericardium, it will be expedient to draw off the fluid, either by a small trocar, as in the operation of paracentesis pericardii, or by passing a sharp-pointed probe through the newly-formed cicatricial tissue intervening between the lips of the wound, to allow the exit of a moderate quantity of the contained fluid. Only a little should be withdrawn at a time, as less risk of disturbing the clot will arise from repeating the process than from suddenly drawing off a large quantity of the fluid which has been surrounding and compressing the heart.

The third indication to be observed is to moderate the force of the circulation, and to prevent the mischief which would accrue from severe pericardial or endocardial inflammation.

This indication is called for as a natural sequence of the

adoption of the former indications, and the necessity for attention to the proposition conveyed in the latter part of it arises when the early danger of the case is passed; when the patient has survived the first gush of hæmorrhage and the syncope incidental to it; when the heart has continued to carry on its functions in spite of the presence of a large quantity of blood in the pericardium, or of clots lodged in the interior of its cavities, or in the neighbourhood of its valves.

Pericarditis must ensue in all cases of wounds of the heart, whether penetrating or non-penetrating; and endocarditis will frequently accompany the latter class of wounds, and always those of the former.

How are these conditions to be combated?

Are we, as recommended by the older military surgeons, by Ballingall, by Guthrie, and others, to treat them by profuse and repeated bleeding, and by the most vigorous antiphlogistic treatment? I am disposed to believe that such a practice is erroneous in theory and unsuccessful in practice. I would prefer the occasional application of a few leeches, the moderate use of calomel and opium, or the inunction of a mercurial ointment, combined with perfect rest and a moderately low diet.

After the patient is able to sit up it may be useful to give the iodide of potassium, and to apply some absorbent application, as iodine, to the chest.

In all cases the firm application of a broad flannel bandage seems to give the greatest comfort to the patient, and to afford the most efficient support to the weakened parietes of the chest.

The symptoms incident to embolism must be treated as they arise on the same principles as in cases where that condition comes on from ordinary causes.

A steady, careful life, and avoidance of all active employment requiring muscular exertion must be strictly enjoined during the whole of the patient's subsequent career.

Appendix of Cases of Wound of the Heart to which special reference is made in this Paper.

No.	Part of heart injured.	Name of surgeon or reporter.	Period during which the patient survived.	Nature of wound or instrument with which it was inflicted.
1	Right ventricle	West.	4½ years	Incised wound with a shoemaker's knife.
2	" "	Wood	25 days	An iron wire propelled by the explosion of a small cannon.
3	" "	Fournier	6 years	Gunshot.
4	" "	Spencer Smith	5 days	Instrument not stated, but the wound was of the punctured variety.
5	" "	Erlangen Museum	About a year	A thorn of <i>Prunus spinosa</i> .
6	" "	Hosp. for Sick Children	About a month	Needle.
7	" "	Leaming	9 months	Needle.
8	" "	Babington	24 hours	Bayonet.
9	" "	Dr. Balch	20 years	Gunshot.
10	" "	Dr. Grant	26 days	Pistol-shot.
11	" "	Prof. R. W. Smith	Death immediate	Clasp-knife.
12	" "	O'Flaherty	3 months	Penknife.
13	" "	Dr. J. T. Fraser	3½ hours	Gunshot.
14	" "	Le Gros Clark	14 days	Gunshot.
15	Left ventricle	Indian Ann. of Med. Sci.	10 weeks	Gunshot.
16	" "	Thompson	4 days	Bayonet.
17	" "	Prof. Aitken	3 days	Gunshot.
18	" "	Dr. Neill	Not stated	Worsted needle.
19	" "	Dr. Graves	8 days	Needle.
20	" "	Dr. G. Hicks	48 hours	Gunshot.
21	" "	Dr. J. D. Ward	10 minutes	Contused wound from explosion of a pistol.
22	" "	Dr. Hopkins of Ohio	15 days	Pistol shot.
23	Coronary artery	Dr. J. Ferguson	8 days	Cobbler's awl.
24	Coronary vein	Andrews	Not stated	Fish bone.
25	Both ventricles	West.	Death immediate	Fragments of the ribs and sternum.
26	" "	Brugnoli, of Bologna	19 years and 7 months	A knife.
27	" "	Mühlig	10 years	Stiletto.
28	Right auricle and right ventricle	Dr. Randall of Ohio	67 days	Gunshot.
29	Point of heart	Chassaignac	5 days	Pistol-shot.
30	With no precise data	Hamilton, of New York	30 years	Gunshot.
31	" "	Carnochan	11 days	Pistol-shot.
32	Wound of pericardium	Sir A. Cooper	2 or 3 wks.	Reaping-hook.
33	" "	Hennen	3 months	Bayonet.
34	" "	Prof. Parkes	3 days	A juggler's sword.

Note.—Since the above paper was written a valuable addition has been made to the literature of this subject. In vol. ii of the second edition of 'Holmes' Surgery' will be found statistical tables of 452 cases of wound of the heart and pericardium, taken from Dr. G. Fischer's work "Ueber die Wunden des Herzen und des Herzbeutels."—'Archiv. f. Klin. Clin.,' von Langenbeck. 1868. Band ix, p. 571.

Dr. Fischer gives the following analysis of the situation of the wound: 258 cases in front of the thorax, of which 165 were on the left side and 38 on the right side, 30 over the sternum and region of the heart, and 25 uncertain. There were also 5 cases on the lateral region of the chest, 26 cases from wounds of the abdomen, and 11 cases from behind.

He observed that syncope or collapse was the first and most important symptom, and might occur even at the moment of receipt of the injury, or not take place until some time after, and hence he classifies the cases into three categories according to the rapidity of the development of this symptom.

Thus in 87 cases where it was recorded, the following results were noticed.

The *first set*, where the collapse occurred at the time of the accident, comprised 30 cases, of which 20 were punctured or incised, 6 gunshot, and 4 lacerated and ruptured wounds. The symptoms lasted from two minutes to four hours; and death generally followed from a few minutes to two months, most frequently from the sixth to the tenth day.

The *second set*, where the collapse was not immediate, but came on some moments after, were 38; of these 33 were punctured and incised, 2 gunshot, and 3 ruptured wounds. In one of these, the wounded person could run 450 steps, another ascended several steps, a third walked one mile and a half.

The *third set*, where the collapse did not supervene for some time, but came on during the progress of the case, comprised 19 instances, 16 of which were incised and punctured, and 3 gunshot wounds. In them the collapse was due probably to the giving way of the clot or plug in the heart and secondary hæmorrhage.

Some cases were going on well for twenty-eight days, when sudden death took place.

