with oxygen, owing to swelling, exudation, or other abnormality in or around the alveolar walls, preventing the diffusion of oxygen inwards quickly enough to saturate the blood in the limited time during which it passes through the alveolar capillaries.

The swelling or shedding of the lining cells of the alveoli and the widespread interalveolar and interstitial hæmorrhage seem quite sufficient to bring this about, and the capillary bleeding in the brain and other organs would further prevent the tissues from obtaining their requisite amount of oxygen from the already anoxæmic blood. The same process taking place in the kidneys, acting in the same way, would be a sufficient cause of the anuria or albuminuria described in many cases and attributed to the direct toxic action of the arsenic. The forced breathing, rapid, deep, and stertorous, which occurs in these patients would also tend to increase the degree of anoxæmia.⁵

Conclusion.

The conclusion arrived at is that the widespread capillary hæmorrhages, demonstrated by microscopic sections, afford a clear anatomical basis for the hypothesis put forward by Surgeon Commander Dudley that the symptoms are due to anoxæmia, that this anoxæmic condition is mainly produced by interalveolar hæmorrhage into the lungs, and to a less extent by interstitial capillary bleeding into other organs, and that the *continuous* administration of oxygen as carried out by Surgeon Lieutenant Commander Parnell offers the best hope of recovery in these unfortunate cases.

These appearances would also seem to explain in part the rapid development of the symptoms and the comparatively slow recovery, as instanced by Surgeon Lieutenant Commander Parnell's case, resulting from the continuous administration of oxygen.

I wish to express my thanks to Surgeon Commander E. L. Atkinson for his kind assistance, especially in preparing the accompanying photomicrograph.

References.—1. Wien Klin. Wchnschr., 1918, xxxi., 1365. 2. THE LANCET, Jan. 24th, 1920. 3. Brit. Med. Jour., July 19th, 1919. 4. Loc. cit. and Brit. Med. Jour., Jan. 31st, 1920, p. 151. 5. Loc. cit.

TRAUMATIC RUPTURE OF THE HEART.

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TRAUMATIC rupture of the heart is generally due either to gunshot or to stab wounds. These being commonly received in front, one or other of the right chambers of the heart is the usual site of the rupture. Such ruptures, where not immediately fatal, offer a prognosis distinctly better than do spontaneous ruptures. The wound in the pericardium permits the escape of blood from that sac and so diminishes the risk of rapidly fatal embarrassment of the heart's action; the circumstances of the case, the site, and direction of the wound in the body wall make diagnosis less difficult and so facilitate treatment, and the patient and his heart tissue are often healthy. That such ruptures of the heart have been recovered from, with and without operative treatment, is familiar enough.

An Unusual Case.

The following case is of interest for two reasons—because of the nearly complete absence of skeletal and superficial injury following upon extreme violence and because of the unusual nature and circumstances of the heart's rupture.

A well-built, healthy shipwright, aged 23 years, sustained a clean, unbroken fall of 45 feet, alighting on a wooden plank and some steel plates lying on the ground. The precise position of his body at the end of the fall was not known. He was not killed outright, but was dead on his arrival at hospital some 20 minutes later.

On post-mortem examination of the body about six and a half hours after death rigor mortis had not begun. Preliminary inspection revealed no damage beyond a few scratches and bruising at the right elbow. A deliberate examination by inspection and palpation showed no further evidence of bruising, laceration, fracture, or dislocation. The peritoneal cavity contained about 2½ to 3 pints of fluid blood, of which the source appeared to be five transverse lacerations of the right lobe of the liver—four on its upper, one on its under surface immediately to the right of the transverse

fissure. There was a considerable quantity of blood effused into the retroperitoneal tissue. There were two transverse tears about half an inch apart on the front of the right kidney near its middle, one through little more than the capsule, and one about ¼ inch in depth through practically the entire width of the kidney. No other source of retroperitoneal hæmorrhage was found. No other abdominal injury was discovered.

I failed to identify the source of a moderate extravasation of blood into the cellular tissue of the posterior mediastinum. This blood extended to the back of the root of each lung underneath the pleura, but not into the substance of either lung, which, indeed, appeared to be normal throughout. The pericardium was intact and contained about a pint and a half of fluid blood. After considerable search a slit-like opening into the cavity of the left auricle was found, about a quarter of a centimetre in length, and situated exactly in the length of the free edge of the left auricular appendage.

Professor S. G. Shattock kindly made a microscopical examination of the appendage wall, and reports that there is no trace of any form of disease.

Remarks on the Case.

The height above the ground of the planks from which deceased fell was 45 ft., and the fall was unbroken. The injuries were thus caused by the violent impact of the body against the plank and plates on the ground. The visceral injuries, and particularly the fact that the ruptures in the liver and right kidney were transverse in direction, suggest antero-posterior compression of the trunk, and the complete absence of bruising of the body wall is remarkable. It would seem on first thought almost incredible that such a fall should occasion no injuries other than visceral. It is probable, however, that such cases are not so very uncommon, and it is therefore important that they should be recorded, as the question is one of considerable legal importance.

In this case the nature and accompanying conditions of the cardiac rupture raise questions as to the mode of its production. Cases of cardiac rupture are commonly divided into two classes, spontaneous and traumatic. The former occur from within because a local weakness of the heart's wall renders it there unable to withstand the pressure of the contained blood. Such local weakness is most commonly the result of disease, and its favourite seat is the left ventricle. Spontaneous rupture of the entire thickness of the heart's wall is rapidly and, doubtless, invariably fatal, because the shed blood, accumulating within the intact pericardium, quickly embarrasses the heart's action to the point of stoppage, and because it is practically impossible to diagnose and so directly treat the condition in the short time available. That spontaneous rupture of a quite healthy heart ever occurs may be doubted. A cautious reference to a possible case of this is given in Wilks and Moxon, "Pathological Anatomy" (p. 120).

Delayed Traumatic Rupture of the Heart.

But there are cases of traumatic rupture of the heart without wound of the pericardium, and these tend to resemble cases of spontaneous rupture in their rapid course. Again, trauma may cause injury of the heart's wall without immediate rupture, but after an interval the injured area may prove the site of a rupture, which may be described as "delayed traumatic" or "spontaneous" according to predilection. Where the interval between the receipt of injury and death is considerable difficult questions about the cause of death may be raised by claims for monetary compensation or damages for fatal accidents.

An excellent illustrative case of delayed traumatic rupture of the heart has been described to me by my colleague, Dr. J. Donaldson, as occurring in his practice.

The patient was a bricklayer, aged 68, unusually deep-chested, who enjoyed good general health. He was working beside a large iron pipe close to which were the rails on which bogey trucks ran. On the approach of a truck he stood with his back pressed close against the pipe in order that the truck might clear him. Owing to his depth of chest the truck which had cleared others just failed to clear him, and squeezed the front of his chest, scraping the skin, but doing no further apparent local injury. He was in bed for two weeks and resumed work after three weeks. His pulse-rate showed no departure from the normal, and his general condition called for no special remark or anxiety. After three days' resumption of work he felt unable to

continue, his chief complaint being pain in the chest. He was confined to bed again for two weeks, during which his pulse-rate rose gradually from 30 to 60. He appeared to be progressing favourably when he suddenly died. A post-mortem examination revealed no injury of any part of the chest wall, except the scraping of the skin. The pericardium was intact and full of blood. No disease of any part of the heart substance was found. The left ventricle alone was injured. Its wall was bruised in five places, three in front and two behind. The largest bruise, the size of a shilling and extending through the greater part of the wall's thickness, was in front near the apex. Here the ventricle wall was ruptured.

Results of Pressure.

Traumatic rupture of the heart within an intact pericardium is almost certainly due either to compression or concussion. Pressure may act in two ways. It may either directly injure the heart tissue (by bruising) so that the injured part gives way immediately or later, or else, without directly injuring the heart tissue, it may so raise the intracardiac blood pressure that the healthy heart wall is burst from within. Compression depends on the amount of force, concussion on the rapidity of its application. In Dr. Donaldson's case the circumstances suggest that compression alone was operative, the heart being squeezed between the front and back of the thorax. Professor Shattock has been kind enough to inform me of three cases of traumatic rupture with intact pericardium. Two of these are among the "gunshot" injuries from the seat of war in the Royal College of Surgeons of England.

In one (specimen No. 657) there was a shell wound of the skin in the left midaxillary line, comminuted fracture of the fourth and fifth ribs, and laceration of the left lung. The anterior wall of the left ventricle shows a vertical perforation occupied by clot in which no missile was found, and no wound was found in the pericardium. The interval between the times of wound and death is not mentioned. Such an injury points to contusion of the heart wall by the broken ribs acting through lung tissue and pericardium. Its mode of production also permits of the action of concussion. The latter factor may have been still more operative in the other gunshot case (specimen No. 486) in which there was a non-penetrating wound of the thoracic wall, without fracture of ribs or sternum, the pericardium was found distended with blood, and the anterior wall of the right ventricle showed a minute rupture. In the third case, related to Professor Shattock by Mr. C. F. Beadles, a lunatic was struck on the chest with a spade. A rupture of the heart was found without fracture of bone.

In these two last cases, as in that of the shipwright, the circumstances suggest that concussion, as distinct from compression, *may* have played a part. But what that part amounted to it is impossible to calculate. In the shipwright's case the fact that the heart wall showed no sign of injury except the rupture itself indicates that pressure probably operated through its effect on the blood within the left auricle. This would be most effective when the auricle was at its maximal distension, and the site of the rupture suggests that the incidence of the pressure on the distended auricle has been such as to tend to drive the contained blood away from the natural openings and towards the blind extremity of the chamber.

PROPOSED HOME FOR INVESTIGATION AT HARROGATE.

—The establishment at Harrogate of a clinic for the investigation (as opposed to the prolonged treatment) of chronic diseases and of disorders of metabolism, on lines similar to those of the well-known Duff House, Banffshire, is in process. Suitable premises are being adapted to accommodate 30 beds in the first instance, further extensions being made as the need arises. The staff will consist of a resident physician, visiting physicians and surgeons, a radiologist, and a pathologist. Certain members of a fully trained nursing staff will be detailed to control the department of dietetics. Special lines of investigation will be undertaken as opportunity offers, and the results will be collated and published from time to time. It is stated that the scheme is to be constituted as a limited liability company under the management of a board of directors, on which the medical profession is to be represented in sufficient numbers to ensure that the institution is conducted on lines conformable with professional requirements and traditions.

Clinical Notes :

MEDICAL, SURGICAL, OBSTETRICAL, AND THERAPEUTICAL.

CONGENITAL STENOSIS OF THE AORTA.

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THE special points of interest in this case are the very few symptoms calling attention to the heart, combined with the pronounced physical signs and the comparatively slight impairment of the boy's general activity.

D. R., a boy, aged 11 years, came as an out-patient to the Heart Hospital in March, 1919, complaining of "headache, looseness of the bowels, and some recent epistaxis." There was nothing of importance in the family history. During the first 18 months of his life he had apparently been somewhat delicate, and in the early weeks of infancy his mother said that "he had seemed to strain for breath at times," but had never been taken to a doctor for it. When 18 months old he had measles and shortly afterwards he was taken to the Children's Hospital, Kensington, when the parents learnt for the first time that his heart was diseased.

At the age of 3½ years he is said to have brought up a large quantity of blood, which seems to have been vomited, and was taken to St. Mary's Hospital, where he remained for six weeks and "congenital morbus cordis" was diagnosed, a thrill over the aortic area and a basic systolic murmur being specially noted. After this his general health remained good apart from occasional attacks of epistaxis. He would, however, often complain of headache and have to stay away from school for a day or two on that account. He was always active and energetic and could always walk a fair distance and even play football without becoming breathless or tired, though he got breathless sooner than other boys. In general appearance he was distinctly undersized, very pale, but bright and intelligent-looking. The apex beat was in the fifth space in the nipple line with a somewhat forcible cardiac impulse and the dullness a trifle increased to the left. Over the aortic area there was a very coarse systolic thrill, which was also palpable over the carotid arteries. All over the præcordial area there was a harsh systolic murmur, having a maximum intensity at the second right interspace, where it could be heard several inches from the chest wall. Pulse was small in volume, rate 70.

The X rays showed nothing abnormal, but in the electrocardiogram the T-wave was inverted in Leads II. and III., while in Lead III. the P-wave was inverted. There was no evidence of left-sided preponderance. The Wassermann reaction was negative. The boy was brought back to the hospital six months later, feeling quite well, for permission (which was given) for an anæsthetic for the removal of teeth. Some three weeks later I heard that he had died quite suddenly at school, having seemed perfectly well in the same morning.

Dr. K. E. Eckenstein, who did the post-mortem, found a much enlarged thymus gland. Lungs, liver, spleen, and kidneys were normal. The heart weighed 8½ oz. Thickness of left ventricular wall 3·5 cm.

Professor Sir G. Sims Woodhead kindly made a special examination of the heart for me, and his report is as follows:—

There is well-marked evidence of old endocarditis on the left side, though little on the right side. The aortic cusps are enormously and irregularly thickened, "cartilaginoid," rigid and adherent at the angles, with rounding and retraction at the margins. During life, owing to stenosis, this must have given rise to marked interference with the passage of the blood from the ventricle to the aorta with, in all probability, a certain degree of regurgitation through incompetence from the rigidity of the valves and thickening and irregularity of their margins. At one point near the edge, and apparently at the junction of two cusps, is a slightly more recent fibrous mass, which seems to me to be an indication that the process of cicatrization and fibrous tissue formation has been going on intermittently for a considerable period. At the base of the mitral flap, just below the aortic valve on the ventricular side, there is some thickening and fatty (?) degeneration, apparently the result of some past inflammatory condition. The mitral valve itself appears to be slightly contracted, and on the side of the ventricular wall divided by two indentations, also indicating mischief at some very remote period. The ring at the base of the valve is irregular, but I do not think there has been either obstruction or incompetence in any marked degree, though the thickening of the ring and the imperfect closure may have allowed of some reflux and of the formation of fluid veins as the blood passed directly through. The marked stenosis has led to very great hypertrophy of the wall of the left ventricle, but the muscle appears to be sound, though at points where the musculi papillares join the chordæ tendineæ, and from some distance down into the muscle there is an increase of fibrous tissue. This, however, is not an important feature. There is little or no dilatation. In the hypertrophied muscle there appears to be an increase in the amount of fibrillar tissue; this, of course, being much more marked near the endocardium where the endocarditis is a prominent feature.

The external cusp of the tricuspid valve appears to be similarly irregularly divided, slightly thickened and retracted, and is very interesting. The pulmonary valves are normal. There was no abnormal communication between the chambers.