cund, where the regiment was obliged to encamp for several days. After that, although the march continued and the effects of fatigue augmented, siriasis greatly diminished, and at Banda no cases occurred.

In the American Civil War, when the troops were hurried along at a rapid rate of thirty-five and forty miles a day, although many soldiers fell out of the ranks from exhaustion, not a single case of siriasis occurred.

Very frequently regiments have been attacked in barracks. Officers have been struck while riding at a gentle pace in the marching column (Smart).

Overcrowding.—It has been frequently noticed in India that siriasis is more prevalent under conditions of overcrowding, defective ventilation, and filth. Of the cases occurring on board ship, the majority are among the third-class passengers on account of their worse accommodation.

Previous Illness.—Siriasis may occur in robust and healthy individuals, but again and again it has been observed that it attacks more especially those exhausted by previous infections. Very frequently it supervenes on malarial diseases. In such cases the comatose stage of siriasis appears suddenly without any preliminary indications just as cholera might do, and not as if the former symptoms were merely aggravated (Longmore). In the epidemic at Assouan (1887) patients suffering from enteric fever were attacked (Hunter). Most interesting are the cases which occurred in 1868 on board the Abyssinian hospital ship (Annesley Bay). From May 12th to June 4th 7 cases occurred. One patient was brought in from the camp at Zoulla, but 6 cases happened on board ship in patients convalescing from dysentery and diarrhoea. It is important to note that no cases occurred in the cookhouse, with a temperature of 130° to 150° F., or amongst the firemen in the engine room with a temperature of 130° F., while they took place on the lower-after hospital deck in a temperature of from 82° to 90° F.

Mode of Infection.—The specific organism of siriasis is probably spread in the superficial layers of the soil, like other pathogenic micro-organisms, and may be conveyed to man with dust blown by the wind or thrown up under the tread of a marching column. It is then inhaled into the lungs, or ingested into the alimentary canal, where it produces the deadly toxin which probably, as in cholera, becomes absorbed and sets up the symptoms of the disease.

DIAGNOSIS.

Siriasis has marked characteristics, and now that we have a clear sketch of its symptoms it should not be confounded with syncope, alcoholic coma, cerebral hæmorrhage, and epilepsy. But there are two diseases with which it may be easily mistaken: cerebro-spinal fever and pernicious malaria.

Cerebro-spinal Fever.—Cerebro-spinal fever may closely simulate siriasis. In cerebro-spinal fever an early, frequent, and important symptom is the painful stiffness of the muscles of the neck; the patient lies with the body rigid and the head drawn back. The pupils may be contracted, but they are usually dilated or unequal. Strabismus is a frequent and important symptom. Herpes is very common. Cerebro-spinal fever begins with a chill which may recur several times in the course of the illness. In some cases the temperature may run as high as 106° or 108° F., but it usually averages from 101° to 103° F.; its characteristic in this disease is irregularity. The respirations are often increased in frequency; in the graver conditions breathing becomes embarrassed but not stertorous. Profound coma is exceptional, and delirium is always present at some stage of the disease. Constipation is the rule, and the urinary secretion is normal in quantity notwithstanding the fever. Foudroyant cases may end fatally in a few hours, but ordinary cases last from one to three weeks. Cerebro-spinal fever prevails mostly in temperate regions, and is more frequent during the colder months.

Many of the cases put down to sunstroke in England and France were undoubtedly cases of cerebro-spinal fever; take, for example, the cases described by Donkin⁵ in 1888, some of those described by Bullar⁶ and Strange⁷ in 1868, by Armitage in 1881,⁸ those reported by Ducleaux in 1859.⁹

Pernicious Malaria.—Manson and others have described a comatose form of malaria which greatly resembles siriasis. I am strongly inclined to believe that many of the cases reported as malaria in China and India were really cases of siriasis, but undoubtedly pernicious malaria may closely simulate this disease, and the diagnosis may be almost impossible, especially when the two conditions are found concomitant in the same patient, as not infrequently occurs. Pernicious malaria never occurs with the first attack, but

shows itself in the second or third. Rigors usually precede the paroxysm.

CONCLUSION.

I know the title of this paper will startle many, but what I think most surprising is that siriasis should have remained so long in the domain of astrology. I have endeavoured to extricate it from the confusion in which it was enveloped, and I hope I have succeeded in giving a clear and correct sketch of the disease, and of the conditions under which it prevails. To have a correct notion of the etiology of any disease is undoubtedly important, but in the case of siriasis it is especially so, because this malady has been used as the strongest argument to prove some of the most hypothetical theories on fever, and, in another field, the noxious influence of a tropical climate.

NOTES AND REFERENCES.

¹ The ancients called it siriasis because of its prevalence during the hottest season, when Sirius, the dog star, rises and sets with the sun, and they called it siriasis *Egyptiaca* because they had observed it in the valley of the Nile and on the coasts of the Red Sea. ² See Kelsch, *Bull. Acad. de Méd.*, Paris, 1895, 3 s., xxxiii, 168-176. ³ In 174 post-mortem examinations of soldiers dying at Netley Dr. Davidson found 22 cases of atheroma of the aorta, *Army Med. Dept. Repts.*, vol. v, p. 481. Dr. Lawson calculated that aneurysm was eleven times more frequent among soldiers than civilians. On the effect of exertion in war in causing cardiac hypertrophy, see Dr. Fränzel's paper in *Virchow's Archiv*, Bd. lvii, p. 215. ⁴ This example has been frequently mentioned by authors, but erroneously, because they say: "The French army lost 2,000 men out of a force of 12,000" thus conveying the idea that 2,000 men died on that day of sunstroke. ⁵ *Westminster Hospital Reports*, 1888, iii, 103-169. ⁶ *BRITISH MEDICAL JOURNAL*, August 22nd, 1868. ⁷ *Ibid.*, August 29th. ⁸ *St. Bartholomew's Hospital Reports*, 1881. ⁹ *Comptes Rendus de l'Acad.*, 1860, 1, 543.

ERASMUS WILSON LECTURES

ON

THE PATHOLOGY AND TREATMENT OF THOSE DISEASES OF THE LIVER WHICH ARE AMENABLE TO DIRECT SURGICAL INTERFERENCE.

Delivered at the Royal College of Surgeons of England.

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LECTURE III.

TRAUMATIC AFFECTIONS OF THE LIVER.

NON-PERFORATING.

A NON-PERFORATING injury may cause a solution of continuity in the hepatic tissue, together with the overlying portion of Glisson's capsule, or the injury may simply affect the hepatic tissue proper, the capsule remaining intact. When the capsule escapes the injury is called a contusion, and when it is involved it is called a rupture or laceration. Ruptures may be partial or complete, according to whether a portion is partially or completely separated from the rest.

The severity of the injury depends to a certain extent upon the condition of the liver tissue at the time of the injury. When the liver is hard and slightly cirrhotic, or more fibrous than usual, it is able to withstand the application of a physical force more easily and without suffering much damage; but when the gland has undergone fatty or amyloid degeneration, or is engorged with lymph and blood, and hence is much softer than usual, severe ruptures or contusions are very readily induced. Infiltration of the liver by a malignant growth or the presence of a hydatid cyst act as predisposing causes when the liver is exposed to mechanical injury. In the latter cases the bulk of the liver is much increased, and hence there is a larger area of the abdominal and thoracic walls to which violence may be applied and cause an injury to the liver. The fibrous tissue which forms the capsule of Glisson assists the liver to withstand slight injuries.

Direct Violence.—A blow with the foot or fist, a kick from a horse, a fall against an obstacle, or a blow in the hepatic region with a blunt body, such as a log of timber, are examples of this form of injury. Injuries of this kind vary in their effects according to the strength of the mechanical

force, the suddenness with which it is received, and the part of the hepatic area to which it is applied. Thus, if the violence is not severe and the abdominal muscles have time to contract, little or no injury is produced; but if the force is considerable and is suddenly applied, so that the abdominal muscles have no time to prepare for its reception, an injury is caused which may be anything between a small subcapsular contusion and the complete separation of one lobe of the liver from the other. The damage to the liver is usually less when the thoracic wall is the seat of the reception of the injury; in old people, however, in whom the ribs and costal cartilages are brittle, a severe blow upon the thoracic part of the hepatic area may cause fracture of several of the ribs, the extremities of which may be driven inwards so as to pierce the diaphragm and cause a severe and extensive laceration of the liver. In cases of this kind the pleura and lung are also damaged, and complications, such as pneumothorax and surgical emphysema, are induced. In young people fracture of the ribs, with laceration of the liver, rarely occurs as the result of a non-perforating injury, since the costal arches are very elastic, and it is with difficulty that they are fractured by a mechanical force.

Indirect Violence or Contrecoup.—This is generally due to a fall from a height, the patient alighting upon his feet, knees, or head. When the fall is upon the feet or knees, the rupture usually affects the upper part of the liver, and is associated with tearing of the suspensory and lateral ligaments, whilst in rare instances the inferior vena cava is torn through immediately below the diaphragm. The inferior aspect of the liver may be ruptured, owing to contraction of the diaphragm. The possibility of this must not be forgotten when an injured liver is being treated surgically. According to Heinzelman, out of a series of 151 cases of rupture of the liver, 52 were caused by indirect violence.

Pressure.—A patient may be knocked down or falls down, and the wheel of the vehicle passes over the hepatic region of the trunk. The liver is then compressed between the costal arches in front and the vertebral column behind, and a rupture results, the laceration of the hepatic tissue being most commonly in an antero-posterior direction, and in the region of the suspensory ligament of the longitudinal fissure. Other causes of rupture owing to pressure are buffer accidents, as when a patient is crushed between the buffers of two railway wagons, or he is crushed between a cart and a wall, or between two heavy bodies. In these cases there is usually no sign of external injury, although superficial bruising may be apparent. Ruptures of the liver which are due to pressure are generally severe, and often prove fatal.

Muscular Contraction.—This is rare. In one case (specimen shown) a large subcapsular hæmorrhage, was produced by a muscular contraction in a fit of vomiting, in a woman well advanced in pregnancy. Taylor has recorded the case of a man in whom a rupture of the liver was caused by a violent muscular effort made to evade the kick of a horse. Chiari mentions a patient with carcinoma of the liver, in whom a rupture of the liver occurred as the result of the muscular contractions necessary for turning in bed. This case, however, may have been due to a blow which was not noticed.

Situation of Rupture or Contusion.—The rupture or contusion is usually situated in the right lobe; in my list of 24 cases the right lobe was alone involved 16 times, the left lobe alone twice, the median portion twice, and both lobes twice. In Meyer's list of 85 collected cases, 54 ruptures were located in the right lobe, 21 in the median portion, and 10 in the left lobe, whilst in Ogston's list of 26 cases 11 were in the right lobe, 9 in the median portion, and 6 in the left lobe. In some cases the most protected part of the liver is the portion which is injured; this is due to doubling of the gland upon itself. This is especially the case when the upper and posterior portions of the right lobe are ruptured as the result of external compression.

TREATMENT.

The plan of treatment which ought to be adopted in dealing with injuries of the liver or abdominal injuries in which the liver is probably involved depends upon the character and severity of the injury, and the amount of internal hæmorrhage which takes place. In most cases the first treatment is that which has for its object the abatement of the symptoms of shock and collapse. The patient should be placed in bed

and kept absolutely quiet, warmth applied, and, if the pulse is feeble, hypodermic injections of strychnine should be given. It is not advisable to administer either alcohol or ether, since both these substances dilate the small blood vessels, and tend to increase any hæmorrhage which may be taking place. After the patient has recovered from the shock and collapse, and there are no signs of internal hæmorrhage, or symptoms of injury to the abdominal part of the alimentary canal, rest in bed and careful nursing will often be followed by recovery. During the early stages it is not advisable to give highly nitrogenous foods, especially those which contain an excess of extracts, such as beef tea, since they throw increased physiological work on the liver.

When signs and symptoms of hæmorrhage into the peritoneal cavity develop and gradually or quickly increase, immediate recourse must be had to surgical operation. The sooner this is performed the greater are the chances of recovery of the patient. The patient, if he is not unconscious, should be anæsthetised, and the hepatic area rendered aseptic by the usual measures. The abdomen is then opened by making an incision either in the upper part of the linea alba or in the right linea semilunaris, usually the former. When the signs point distinctly to injury of the right lobe of the liver the incision should be made on the right side. The incision should be 4 inches or more in length, and should commence either at the ensiform cartilage or at the ninth costal cartilage. All hæmorrhage from the vessels in the abdominal wall should be arrested before the search for the seat of internal hæmorrhage is commenced. When this has been done an attempt is made to locate the source of hæmorrhage. All blood or other fluid should be removed from the exposed part of the peritoneum by

careful sponging and the source of the blood traced. If the blood appear to come from the liver or a rupture of the liver at once become visible, the bleeding should be temporarily arrested, either by applying sponge pressure to the wounded area or by compression of the hepatic vessels as they lie in the gastro-hepatic omentum. Often it is advisable, when the blood appears to come from the liver, at once to apply pressure to the hepatic artery and the portal vein. This can be done either by passing the hand underneath the inferior margin of the right lobe, placing the forefinger in the foramen of Winslow, the thumb in front of the lesser omentum, and applying pressure, or by using an instrument such as the one I have here (Fig. 1). This instrument I have used in my later experiments upon dogs, and have found it very serviceable. It does not take up so much room as the hand, and is more efficacious in controlling the circulation. In order to apply it to the portal vein and the hepatic artery the blades are separated; the distal one is placed in the foramen of Winslow, the proximal is put in front of the gastro-hepatic omentum, and then the two are approximated until the circulation in the compressed blood vessels is arrested. When the hepatic circulation has been controlled, all traces of blood are removed by careful sponging and the extent of the injury made out. If either the anterior or the inferior portions of the liver are found to be the seat of injury and the site of hæmorrhage, it will generally be possible to at once deal with the damage through the abdominal wound. It may, however, be necessary to enlarge this incision in a vertical direction, or to make a second incision in the abdominal wall at an angle to the upper extremity of the vertical one. When the rupture extends to the

Fig. 1.—Compressor of Hepatic Vessels.

in the abdominal wall at an angle to the upper extremity of the vertical one. When the rupture extends to the

superior surface it may even be necessary to remove portions of the exposed costal cartilages in order to render the rent in the hepatic substance accessible for the application of sutures. In every case the damaged portion of the liver must be brought as far into the abdominal wound as possible. This may be facilitated by one assistant exerting pressure in a forward direction from the right lumbar region so as to lift up the organ, and a second assistant rotating it slightly from the front. The intestines should be carefully covered with flat marine sponges and kept out of the way. The repair of the rupture in the liver may now be proceeded with. The ruptured surface is carefully sponged so as to remove all blood clot, and any blood vessels which are visible on the surface of the wound are picked up with forceps and ligatured with silk. Next the pressure on the vessels in the portal fissure is relaxed, so as to make sure that a large branch of the hepatic artery or portal vein has not escaped observation.

When this has been done the margins of the rupture are brought into exact apposition, and fixed by the insertion of a series of sutures. The suture material should be medium sized silk; catgut is more liable to slip, and gives rise to secondary hæmorrhage. A fully curved Hagedorn's needle with a blunt point should be used for inserting the sutures. If too sharp a needle be used the hepatic vessels may be pierced and hæmorrhage take place from them along the sutures. Each suture should enter the liver tissue about one-third of an inch from the margin of the rupture, pass through the liver tissue to the bottom of the wound, and then through the liver tissue on the opposite side until it emerges at a point one-third of an inch beyond the other margin. These sutures should be introduced at intervals of one-quarter of an inch, and all should be inserted before any are tied. When all the sutures have been inserted they are carefully tied and their ends cut short. Great care is requisite in tying the sutures, otherwise they cut through into the wound. This is avoided by only tightening them sufficiently to hold the margins of the rent in apposition. Further injuries are now sought for, and if found treated in a similar manner. The area of operation is then sponged dry, and the artery compressor which controls the circulation in the hepatic artery and portal vein relaxed and removed if no further hæmorrhage occur. The sponges are now removed from the peritoneal cavity, and the exposed viscera examined for injury. If none is discovered and there is no sign of hæmorrhage, the margins of the abdominal wound are approximated and fixed in apposition by careful suturing. If slight hæmorrhage or oozing occur from the margins of the rupture or the suture apertures in the liver, a strip of aseptic gauze should be carefully packed over the bleeding part and one end brought out of the abdominal wound, a small part being left open for the purpose. This will usually arrest slight hæmorrhage; it is withdrawn at the end of twenty-four or thirty-six hours, when the wound is dressed.

I have made a considerable number of experiments in order to test this method of treatment, and with one exception have had good results. In one animal, however, in which I used catgut as the suture material some of the sutures gave way, and the animal died from intraperitoneal hæmorrhage. This may have been due to defective suturing on my part, but as far as I know I took the same precautions as when I used silk. Martin has recently reported a case of rupture of the liver which he successfully treated by immediate laparotomy and suture.

When the injury to the liver is extensive, and it is not possible to bring the margins of the rupture together, the best method of treatment appears to be ligature of all accessible bleeding points, and then careful packing of the entire injured area with long strips of aseptic gauze. This method of treatment will be required in those cases of injury in which the liver tissue is very friable, and also when, owing to the position of the rupture, it is not possible to gain access to its deepest part; this especially is the case when the convex surface is damaged and rupture extends far back underneath the diaphragm.

When a portion of the liver is completely detached, the shock and collapse will usually be fatal. This is a specimen in which a portion of the liver has been separated as the result of an injury, and become adherent to a coil of intes-

tine. The patient lived for ten days after the accident. It seems possible, however, if the left lobe is the part detached, that opening the abdomen as soon as possible after the reception of the injury, and the adoption of treatment based upon the principles which I have just discussed, may in favourable cases terminate in recovery.

In order to control hæmorrhage when the extremity of the left lobe is the seat of the rupture, it will be sufficient to pass an elastic ligature around this portion of the liver, and tighten it until the circulation in the blood vessels of the part is arrested.

PENETRATING WOUNDS.

Some wounds, such as a stab with a penknife, may be small and only penetrate the superficial part of the liver, whilst others, such as those produced by a bayonet, or wounds which have been inflicted with a homicidal intent, may be wide and pass through the greater part of one lobe, and divide large branches of the hepatic artery or portal vein, or even the inferior vena cava. The late President of the French Republic suffered from an injury of this nature.

Gunshot wounds differ considerably in severity owing to the varying size of projectiles. In some cases there is only a slight superficial grazing or grooving of the peritoneal and fibrous coverings of the liver, whilst in others there may be deep perforations and extensive lacerations which involve the greater part of one lobe, or even both lobes. These differences are due to the size, shape, velocity, and direction of the projectile which causes the injury. According to Otis, when a projectile is discharged from a firearm in the immediate neighbourhood of the person injured, a considerable and widespread laceration is the invariable result, even when the ball is discharged from a pistol or a rifle. Gunshot wounds of the liver are usually complicated by other viscera being injured at the same time.

TREATMENT.

When a patient is suffering from a wound in the hepatic region, and the symptoms point to an injury of the liver, the locality of the injury should be very carefully examined, and any surgical treatment which is necessary carried out without delay. The patient should be anæsthetised, and the external wound, if necessary, enlarged until the full extent of the damage can be made out. The main precautions which are to be observed are similar to those which have been recommended in connection with ruptures. Hæmorrhage should be controlled, and then arrested by the application of ligatures. The wound is closed by the insertion of a series of sutures. In the case of deep wounds it may be impossible to reach the bottom. When the injury is due to a bullet or other foreign body, and this remains within the liver, an attempt should be made to remove it with forceps; the track which it has made is then carefully irrigated and packed with strips of gauze. Packing with gauze will in most instances arrest hæmorrhage, except when one of the larger hepatic vessels has been injured. In this case, if packing does not suffice for the arrest of the hæmorrhage, the wound must be enlarged and the bleeding vessels picked up with artery forceps and ligatured.

An interesting case of this kind has recently been reported by Schlatter. A man, aged 20, was stabbed in the hepatic region of the abdomen. The liver was injured, and the transverse colon and great omentum protruded from the external wound. Three hours and a-half after the infliction of the injury the external wound was enlarged. The liver was found to be the site of a penetrating wound from which hæmorrhage was proceeding. The wound was sponged clean, the deep parts united by two buried catgut sutures, and the superficial parts fixed in apposition by the insertion of a row of silk sutures. The peritoneum was sponged dry, and the wound in the parietes closed by three tiers of suture. The patient recovered. A similar case has also been reported by Ruepp.

Injuries of the liver are frequently followed by the development of serious complications. The most important of these are the formation of an abscess, the occurrence of peritonitis, and the occurrence of secondary hæmorrhage. An abscess should be treated in the manner advised in my first lecture; peritonitis requires abdominal incision, irrigation, and drain-

age; whilst secondary hæmorrhage can best be combated by careful tamponade of the bleeding area. It is usually impossible to find the bleeding vessels in cases of secondary hæmorrhage. Secondary hæmorrhage from the liver is generally fatal. Injuries of the liver are frequently complicated by the occurrence of injuries to other abdominal viscera. These, if they are discovered, are treated by appropriate surgical measures at the time of the operation upon the liver.

PROGNOSIS AND RESULTS OF OPERATIONS.

The prognosis in injuries of the liver has improved considerably, since it has been considered possible to treat them by ordinary surgical measures.

I have been able to collect from surgical literature 25 cases of rupture of the liver which have been treated by a surgical operation; 16 of these terminated fatally, and 9 recovered. Terrier and Auvray state that in their list of 11 cases 6 recovered and 5 died. The time of operation appears to have an important bearing on the success of an operation for a rupture of the liver. The earlier this is performed the greater is the prospect of recovery.

Concerning perforating wounds of the liver which were submitted to operation, the prognosis appears to much better advantage than in the case of non-perforating ones. Thus in Terrier and Auvray's list of 34 cases 25 recovered and 9 terminated fatally. Of these 20 were incised wounds due to stabs or bayonet wounds, 15 recovered and 5 were fatal, whilst 14 were gunshot wounds, and of these 9 recovered and 5 were fatal.

RESECTION OF THE LIVER.

By the term resection of the liver is understood the removal of a portion of the liver by a surgical operation. This is quite a modern operation, and it is only during the last ten years that surgeons have performed operations with the object of removing pathological growths from the liver. According to Keen, up to the present time 59 cases have been recorded, in which a portion of the liver has been removed.

In all operations upon the liver hæmorrhage from the hepatic blood vessels has been a source of trouble, and in some cases it has been the cause of death. In order to control hæmorrhage or to avoid its occurrence during removal of a portion of the liver, a number of different procedures have been devised.

I shall first deal with the control and arrest of hæmorrhage from the hepatic tissue, and then consider the separate forms of operation. There are five methods of dealing with hæmorrhage which may be employed:—

1. *Ligatures to the Cut Extremities of the Hepatic Vessels.*—Liver tissue, in which some of the blood vessels have been divided, tends to bleed freely, and so obscure the points from which the hæmorrhage is taking place. This renders the application of a ligature difficult. Firm sponge pressure on the bleeding part will, however, usually enable the surgeon to see the bleeding points, and seize them with artery forceps. The veins in the hepatic tissue have walls which are as resistant as those of the arteries, a circumstance which facilitates the application of ligatures. When the bleeding points have been picked up ligatures are applied. Floss silk of medium thickness should be used for the purpose, and each knot should be tied slowly and firmly. Too much force must not be exerted, otherwise the hepatic tissue and vessel will be cut through. This also occurs if the silk be too hard or too fine. In some cases it is advantageous to pass a ligature under the vessel with a needle. In this case the point of the needle should be blunted, otherwise it may pass through other blood vessels and cause fresh hæmorrhage. When large branches of the hepatic artery or portal vein are cut through, the hæmorrhage is severe and difficult to control by sponge pressure.

2. *Packing with Tampons or Strips of Aseptic Gauze.*—This is a valuable method of arrest of hæmorrhage when only small vessels are cut or torn through, but when large vessels are involved it is of little use. In arresting hæmorrhage by this method the bottom of the wound should be carefully packed with strips of gauze; this packing is continued until the entire wound is filled, and then firm pads are fixed in position over the incised portion with a bandage.

3. *Cautery.*—Paquelin's cautery has been used most frequently for this purpose, but a cautery iron, heated to a dull

red heat, is more satisfactory. One objection to the use of a cautery is the necessary destruction of a layer of hepatic tissue. This must separate before healing of the affected parts can take place. This is not a very satisfactory method, as it fails to arrest hæmorrhage from large vessels, and it is difficult in its application. It is most useful in the incision of a deep-seated hepatic abscess, since the cauterised surface prevents absorption of septic matter as the pus escapes from the interior of the abscess. This method has been used by Keen for making an artificial pedicle to a tumour in order to apply an elastic ligature. When a Paquelin's cautery is used for incision of liver tissue it should be at the lowest dull red heat possible.

4. *The Elastic Ligature.*—The elastic ligature has been employed both for the temporary control of hæmorrhage and for the constriction of tumours which have either a normal or artificial pedicle. When the amount of liver which it is wished to constrict is large, a blunt cannula should be passed through the middle of the base of the tumour and a rubber tube drawn through. The pedicle can then be constricted in two halves. An objection to the use of the elastic ligature for the constriction of tumours, and the promotion of their separation by gangrene, is that the operation must be extra-peritoneal and the stump be left in the wound. When a tumour has been treated by elastic constriction and it has sloughed off, the base of the stump which remains usually takes a long time to heal.

5. *Compression of the Hepatic Artery and the Portal Vein in the Gastro-hepatic Omentum.*—This may be effected either by digital compression, the forefinger being placed in the foramen of Winslow and the thumb in front of the lesser omentum, or by the application of a compressor after the style of the one which I have devised, or by perforating the lesser omentum and applying a temporary ligature to the hepatic artery and portal vein. The safest and easiest of these methods is the application of the compressor. I have made a number of experiments to test the relative value of the different methods, and find that this is the most reliable and is moreover less likely to cause damage to the structures compressed. From a consideration of all these methods of controlling and arresting hæmorrhage during and after operations upon the liver, and in the treatment of hepatic injuries, I think that the best methods are the application of temporary pressure to the hepatic artery and portal vein as they lie in the hepatic omentum, and ligature of the separate vessels which are cut across.

REMOVAL OF TUMOURS.

1. *The Elastic Ligature.*—In this operation the abdomen is opened by making a vertical incision over the prominent portion of the hepatic tumour. The tumour with the adjacent portion of the liver is brought well into the wound, and fixed in this position by the insertion of a ring of sutures. Each suture passes through the abdominal wall and through the hepatic tissue immediately beyond the diseased part. When the liver has been fixed thus, an elastic ligature is applied to its base and tied tight enough to arrest the circulation in the part distal to the line of application of the ligature. Aseptic dressings are applied. This ligature causes gangrene of the tumour and the portion of liver beyond the ligature. At the end of ten days or less the gangrenous mass can be separated. The base of the stump will then heal up by granulation. Strict care must be taken to prevent the dead tissue becoming septic, otherwise suppuration will occur and give rise to unpleasant results. Many tumours of the liver cannot be treated by this method owing to the fact that they are embedded in the liver and have no distinct pedicle. In order to obviate this difficulty Keen proposes that a deep groove should be made in the hepatic tissue surrounding the tumour with the knife of a Paquelin's cautery. An elastic ligature is then applied at the bottom of this groove, and the parts are well packed with gauze. Keen has recently reported a case which he successfully treated in this manner.

2. *Fixation of the Affected Part of the Liver in the Abdominal Wound, and Removal at a Later Period.*—In this operation the abdominal cavity is opened by an incision over the hepatic tumour. The tumour and the adjacent parts of the liver are brought into the parietal wound, and fixed there by the insertion of a ring of sutures as in the preceding operation.

Aseptic dressings are then applied. After the expiration of several days (three to five) the removal of the tumour is carried out. It may be removed either with a knife or with a Paquelin's cautery by cutting through the base of the tumour. As the liver is cut through, and the diseased part removed, the cut surface should be covered with a sponge, and pressure applied, so as to arrest temporarily any hæmorrhage which may occur, and also prevent the entrance of air into the intra-hepatic veins. When the portion of liver has been detached the sponge pressure is relaxed, and all bleeding points on the cut surface ligatured with silk. When all hæmorrhage has been arrested the cut surface is sponged dry, and aseptic dressings are applied. The wound which is left heals up by granulation. This often takes a long time, and a sinus from which bile is discharged may remain.

3. *Dissection of the Tumour or Cyst from the Liver: Suture of the Hepatic Wound, and Closure of the Parietal Wound.*—Tumours of the liver which are encapsuled, such as adenomata and some forms of hydatid cysts, may be separated from the liver by careful dissection. When this has been done the margins of the wound in the liver are brought into apposition, and fixed by the insertion of a series of silk sutures. The external wound is then closed in the usual manner.

4. *Excision of the Diseased Portion of the Liver by a "Wedge-shaped Incision."*—The operation is performed thus: The abdomen is opened and the diseased portion of the liver exposed. The circulation in the hepatic artery and portal vein is controlled by the application of pressure to the gastro-hepatic omentum. When this has been done the diseased portion is brought out through the parietal wound and surrounded with flat marine sponges. The liver is now incised by making an incision around the tumour. This incision is deepened in such a manner that the two sides of the incision meet one another in the substance of the liver beyond the tumour. The piece of liver with the tumour thus separated is now removed. It has the form and shape of a blunt wedge, and the wound which is left after the removal of the diseased portion presents two surfaces which can easily be brought into apposition in a manner similar to that in which the flaps of an amputation are approximated. The blood vessels which have been divided are now picked up with artery forceps and ligatured with silk. These vessels can be recognised by their open mouths. When all visible vessels have been ligatured the pressure on the blood vessels in the portal fissure should be gradually relaxed, and any further bleeding points which become apparent should be picked up and ligatured. The margins of the hepatic incision are now brought into apposition and fixed by sutures. When the wound is deep it may be necessary to unite the deeper parts by buried sutures, but usually this is not necessary. The sutures should be inserted with a blunt-pointed fully curved Hagedorn's needle. Each suture should enter the liver tissue one-third of an inch from the margin of the wound, pass to the bottom, and then through the tissues on the opposite side. The sutures should be inserted at intervals of one-quarter of an inch, and all should be introduced before any are tied. When all have been inserted they are tied and the ends cut short. Each suture is tied tight enough to hold the margins of the incision in apposition, but not tighter, otherwise it is liable to cut out. The stump of liver tissue is now sponged dry and returned into the peritoneal cavity. The protecting sponges are then removed, and the abdominal wound closed in the usual manner. If there is much oozing from the suture apertures in the liver tissue, it may be advisable to pack the area of the wound with a long strip of gauze, one end of which is brought out through the parietal wound, a small part of which is left open for the purpose. This, however, will generally be avoided, if a blunt-pointed needle is used for inserting the sutures.

INDICATIONS.

The clinical conditions which may be considered to indicate the performance of a surgical operation for the removal of a portion of the liver are as follows:

1. Carcinoma of the gall bladder, in which the disease has not extended beyond the gall bladder and the adjacent portion of the liver, and there are no signs of secondary growths either in other parts of the liver or in other viscera.
2. The presence of a localised non-malignant tumour of the

liver, such as angioma, angio-fibroma, fibroma, or adenoma, which is increasing in size and is giving rise to trouble.

3. The presence of a localised hepatic tumour which is due to a mass of echinococcus multilocularis.

4. Congenital hernia of a portion of the liver in which the herniated portion cannot be returned within the abdomen.

5. Sarcoma, primary in the liver, occasionally occurs, and has been treated by excision. In one case the patient was alive two years afterwards, and in the other the disease recurred in a few weeks, and the patient died.

Primary carcinoma of the liver is exceedingly rare. If it is in the form of a localised tumour, an attempt may be made to remove it.

The liver is frequently the seat of secondary malignant growths; it is, however, a contraindication against the performance of a surgical operation for their removal.

When a tumour of the liver is under consideration, and there is a possibility that it may be due to syphilis, an operation should not be attempted until a course of antisyphilitic treatment has been tried, and failed. If by any chance the abdomen has been opened, and a tumour of the liver has been found to be a gumma, the wound should be at once closed, and no attempt at removal made. Antisyphilitic treatment should then be adopted.

In doubtful tumours in the hepatic region which do not improve under a course of antisyphilitic treatment, it is advisable to open the abdomen and make an examination of the tumour. No harm can be done if the strictest aseptic precautions are observed, and often much valuable information as to the condition of affairs may be obtained. When the tumour is found to be suitable for removal, the operation is proceeded with, and when it is found to be syphilitic or to be a secondary or a multiple malignant growth, or on account of its size and connections removal is not practicable, the wound should be at once closed.

PROGNOSIS.

Of the 59 cases of removal of portions of the liver which have been recorded in surgical literature and collected by Keen, the operation has been performed for hydatids 14 times, for tumours syphilitic in character 11 times, for carcinoma 10 times, for adenoma 6 times, for angioma 5 times, for sarcoma 4 times, and for endothelioma, cystoma, angio-fibroma, and calculi each once. Of these cases 49 recovered, 9 terminated fatally, and in 1 the result was not known. The cause of death in 7 cases was shock, hæmorrhage, and exhaustion, and in 2 it was septicæmia.

I have made a considerable number of experiments upon animals with the object of ascertaining which is the most satisfactory method of removing a portion of the liver. The result of these experiments has been to show that in animals the best and safest method is that by the wedge-shaped incision which I have described, and intraperitoneal treatment of the stump. If care be taken to have a reliable assistant, and to properly control the circulation in the hepatic artery and the portal vein, removal of a portion of the liver can be carried out almost bloodlessly. I have, however, had no experience of Professor Keen's modification of the elastic ligature. I think that in this method there is a greater liability to the occurrence of hæmorrhage than by incision, and there are also the dangers of sepsis in connection with gangrene of the constricted part.

Amount of Liver which may be Removed.—In animals I have several times removed half the liver without producing any ill-effects. If, however, two-thirds or more of the organ are taken away the operation is usually fatal. Ponfick has made a similar series of experiments, and has come to like conclusions.

REGENERATION OF LIVER TISSUE.

The liver tissue appears to be regenerated by a new formation from the part of the organ which remains. If half the liver of the animal be removed, and it be killed at the expiration of two months the liver has regained its ordinary size.

From the series of experiments which I have made upon animals, and a study of all the recorded cases of removal of portions of the liver in man, I have come to the following conclusions, namely:

1. That the dangers of hæmorrhage after removal of portions of the liver have been much exaggerated.
2. That the best method of controlling and arresting hæmor-

rhage from liver tissue after it has been incised or torn is by temporary compression of the blood vessels in the gastro-hepatic omentum, and then ligature of the divided vessels.

3. That when the liver is the seat of growths such as I have mentioned a surgeon ought to be prepared to carry out an operation for their removal.

4. That the mortality which will result from operations of this kind is not greater than in many of the recognised abdominal operations, such as resection of the intestine.

THE HYDERABAD COMMISSION: A REJOINDER TO DR. LAUDER BRUNTON.

By LEONARD HILL, M.B.,

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Two Commissions were appointed by His Highness the Nizam's Government to examine into the alleged dangers of chloroform. The first Commission "was applied for by Surgeon-Major Lawrie because having always believed in the truth of Syme's teaching that chloroform can be used judiciously so as to do good without the risk of evil, he desired to show by experiments upon dogs that in death from chloroform the respiration always stops before the heart."¹ This Commission determined "that secondary syncope has no more real existence than primary syncope. In poisoning by chloroform the heart fails when the respiration ceases and never before. With the cessation of respiration the further accumulation of the drug in the blood necessarily ceases, and the heart rapidly or gradually stops beating as a direct result of the stoppage of respiration."² "This point having been proved, the second Commission was applied for because it was felt that Syme's principles, which both experience and experiment had shown to be practically sound, must be founded upon a firm physiological basis."³ His Highness the Nizam's Government desired to offer £1,000 to the Editor of the *Lancet* to send a representative to Hyderabad to repeat and continue the experiments of the Hyderabad Chloroform Commission.⁴ The Nizam's Government had "been advised that if the experiments are continued and amplified by the Hyderabad Commission associated with a trained scientist whose position and attainments will ensure the acceptance of his opinions by the profession the subject might be threshed out thoroughly, and the question whether chloroform does or does not affect the heart directly might be settled once for all."⁵ The *Lancet* appointed Dr. Lauder Brunton as their representative. In announcing this appointment the *Lancet* fully recognised that "the question whether chloroform paralyses the heart or not is one of the greatest possible practical importance, for upon its correct solution the lives of thousands of people and the happiness of thousands of families may depend. Both in Europe and America," the *Lancet* continues, "clinical experience and physiological experiments have led to the conclusion that it has a paralysing effect on the heart, while ether exerts such an action in a very minor degree, if at all. It is almost impossible to believe that the conclusion at which European and American surgeons and scientists have arrived is, after all, destitute of foundation and little better than an idle dream."⁶

In Dr. Brunton's reply, in the *BRITISH MEDICAL JOURNAL* of March 5th, to my "accusations" he states that he had less than a fortnight in which to collect apparatus. "I reached Hyderabad," he says, "on the evening of October 21st, and the Commission began work without apparatus on October 23rd, with apparatus on the 25th, and continued until December 18th. I had in all less than a fortnight in which to collect the equipment of the laboratory, four days in which to fit it up, and (Sundays being excluded) forty-seven days in which to do the work with the apparatus." In the offer to the *Lancet* it is stated that "the gentleman selected should take a return ticket for three months, to be extended if necessary." We learn from these statements two things:

1. That 47 days' work was sufficient to give "the direct denial" to the "conclusion at which European and American surgeons and scientists had arrived."

2. That His Highness the Nizam's Government was advised that original scientific research work, like any other public work, could be done by contract in seven weeks.

We may also infer with some justice from Dr. Brunton's statement, that the work of the first Commission was carried out without apparatus or the proper equipment of a laboratory. It is a curious excuse to bring forward in defence of deficiencies that the work of scientific investigation was done in a hurry. Why, then, if "with the exception of time nothing was left to be desired," was not the three months' ticket extended? Every trained scientist is aware how impossible it is to undertake to carry out an investigation in a given time. Weeks slip by before the best methods of observation and the most fruitful line of research is determined upon, and years of training do not lessen this hindrance that meets one when tackling any fresh subject in that vast and unknown field the study of life. Surgeon-Lieutenant-Colonel Lawrie himself states that "the Hyderabad Commission did not discover the key to the safe administration of chloroform until they had made observations upon 565 animals, and had reached their 148th manometric experiment." Now the total number of manometric experiments recorded is 186, and near the end of the research Dr. Brunton was unfortunately absent for some time owing to an attack of dysentery.

Had Dr. Brunton been allowed to carry on his research quietly and at his leisure in London, equipped with all the best apparatus and aided by the suggestions and criticisms of English scientific societies, I cannot help thinking that his results would have greatly advanced our knowledge of chloroform syncope. At this point I will take the opportunity of saying that I never intended any attack that I have made upon the conclusions of the Hyderabad Commission as a personal attack upon Dr. Lauder Brunton, for whose work I naturally have the highest appreciation. One can hardly be expected to have imagined that the whole Commission was personated by Dr. Brunton. Were Surgeon-Lieutenant-Colonel Lawrie and Dr. Lauder Brunton the first and second Commissions respectively and the Commissioners Bomford, Rustomji, Hehir, Kelly, Chamarette merely assistants? If so, why is the work of these two investigators upheld and glorified before the world in so Oriental a way? We read in the first page of the Commission "that His Highness the Nizam visited the laboratory on two special and memorable occasions. The Nawab Munir-ul-Mulk, son of the late Sir Salar Jung, the Maharajah the Peshkar, and the Nawab Fakhr-ul-Mulk also paid visits to the laboratory and witnessed several of the experiments. The same interest was displayed by the Nawabs Mohsin-ul-Mulk, Vikar-ul-Mulk, Imad-ul-Mulk, Fattah Nawaz Jung, and Mr. Furdonji Jamshedji."

The Commission, equally with the *Lancet*, insists upon the fact that His Highness's Government had carried out "a work which is not only of scientific interest, but of the greatest practical importance to the whole human race." Its object was an essentially practical one, and could not be better defined than in the words of His Highness the Nizam himself, "to save people's lives."

Considering the gravity of the subject, and the Oriental pomp with which the work of the second Commission was thrust upon the scientific world, I have felt justified in attacking with some vigour a doctrine which I believe to be erroneous and dangerous.

My object, too, was essentially a practical one, and the strength of my attack is justified to the full by Dr. Brunton's statements that he stands alone responsible for the work of the second Commission—in other words, that no such thing as an independent Commission of trained scientists ever existed—and that the work was done in a hurry in 47 days, with such apparatus as could be scrambled together in a fortnight's preparation.

My attack was directed against the work of the Commission. Dr. Brunton has chosen to make it a personal attack upon himself. The Commission invites criticism. It states that as far as possible experimental data were given, "so that at any future time, and in any part of the world these data will be as available to others as to themselves, and may be used by them either for the purpose of criticising the Commission's conclusions, or drawing conclusions of their own." Dr. Brunton protests against the vigour of my criticism; he would clap me into an Oriental dungeon for *lese majesté*, for daring to attack the Commission's experiments, and refusing to bow down the knee in spite of the witness of the Nawabs-