

position, are intermediate between fibrous tissue and bone, and therefore the cartilaginous tumour has frequently a life history more closely allied to the malignant than to the simple type of tumour formation.

No attempt can here be made to classify the different forms of tumour. The surgeon at the bedside meets with tumours as living parasitic formations. He studies their life history; he observes their birth, their growth, their peculiarities, and their tendencies; he naturally attempts to classify them from a study of their physiological or clinical aspects. The pathologist, on the other hand, examines the tumour after it is removed; he studies it as it appears to the naked eye and under the microscope; and he attempts to classify tumours from an anatomical standpoint. Within recent years the pathologist's classification, associated with a recognition of the developmental division of the human embryo into different layers, has become the favourite; but it is hoped that, as science advances, the increase of clinical knowledge, assisted by microscopic and embryological research, will make a physiological classification a reality.

IV. OPERATIVE SURGERY.

Within recent years the main advance in surgery has been from the scientific side, due to increased precision in physiological knowledge and a careful study of the relation of organisms to various diseased conditions. And with this progress operative skill, in many directions previously unthought of, has kept pace. Cranial operative surgery has advanced as the motor areas on the surface of the brain have been localized with greater precision. The experimental physiologist has done his part; the clinical observer is now doing his. Cranial surgery necessitates special notice. In the thoracic cavity also diseased conditions are now relieved by surgical operations. The greatest advance of all, however, is in connexion with the abdominal cavity. Under this head the work of the last thirty years requires special notice. The peritoneum was at one time considered a closed book to the operator; now all is changed, and abdominal surgery has become one of the most important branches of operative work. Joints in a state of inflammation are also now freely opened and tension is relieved. With the relief of tension the inflammatory process subsides and the joint recovers. The excision of diseased joints has also become part of the everyday work of the surgeon. Cancerous affections—using the term in a clinical sense—of the tongue, rectum, and larynx are now treated by excision of these organs. But it is still a question in what cases the operation prolongs life, and what cases are specially suited for operation. While greater latitude has been given to surgical interference with the different cavities of the body, operations upon the limbs have been restricted in consequence of the acceptance of Lister's views with regard to wound treatment. Many limbs upon which formerly amputation was performed, as, for example, in the case of compound fractures, are now saved. The term "conservative surgery," which formerly had reference to the excision of a diseased joint instead of amputation of the affected limb, has now a wider meaning, and covers not only the different excisions which have taken the place of amputation but also those cases in which a limb is saved by careful antiseptic management after severe injury. At one time, perhaps, in the early stages of antiseptic wound treatment the brilliancy of the results obtained by these means, and the immunity which resulted from the prevention of blood-poisoning, encouraged surgeons to save a limb which, when the wound was healed, was not really useful. An upper limb saved, however inefficient, is better than any artificial substitute, and every endeavour in the direction of conservation should be made. Conservation in the case of a lower limb, on the other hand, may be carried too far. Unless the saved limb can support the weight of the body, it is far better to perform amputation, because a satisfactory artificial substitute can be found to take the place of the lower extremity. In performing amputation on a lower limb every endeavour

should be made to obtain a stump which will bear, in part at any rate, the weight of the patient's body. Since the introduction of anaesthetics rapidly in performing an amputation is not essential. Flaps can be carefully made; time can be taken to shape them; and they can be so arranged that the resulting cicatrix will not be opposite the sawn extremity of the bone. In order to obtain such flaps the surgeon is justified in sacrificing to some extent the length of the limb, if by so doing he can leave a mobile and painless stump on which an artificial limb can be comfortably fitted. But this does not hold good to the same extent for an upper limb. The pressure on the extremity is not so great, and the longer the stump the more easily can an artificial substitute be fitted on. As a result also of Lister's teaching operative procedure for the cure of various deformities, such as knock-knee, rickets, and club-foot, in which the bones affected are freely attacked, has done much to relieve unsightly deformity and increase the usefulness of the individual. In all operations absorbable catgut ligatures for the cut vessels have since about 1861 taken the place of silk, which had to come away by ulceration,—a destructive process antagonistic to rapid healing. Greater care is taken to save blood by emptying the part to be operated on before beginning the operation. Greater care is also taken to tie all bleeding points, so as to prevent reactionary hæmorrhage and the escape of blood between the surfaces of the wound, whereby healing is retarded. Free drainage by india-rubber and glass tubing, by absorbable tubes made of decalcified bone, by skeins of catgut acting by capillarity—all the outcome of an understanding of the local irritation and constitutional fever caused by tension—have done more than anything else to enable the surgeon to attain his triple object,—painlessness, rapidity, and safety in the healing of a wound. Lastly, the clear understanding of the term "antiseptic" in its fullest meaning, the knowledge of the power which the unirritated and healthy tissues have as germicidal agents, and the introduction of various antiseptic or rather antitheric substances, some of which destroy, some of which paralyse, those lowly organisms whose power for evil in an unhealthy tissue or an injured part is so great, contribute towards the same great end. By these means operations are to a great extent relieved of their dangers, and by anaesthesia, which prevents pain and suffering, they are robbed of their terrors. (J. C.)

1. Cranial.

The necessity for setting apart a distinct section of this article to deal separately with the region of the head does not depend upon any specialization in the principles of treatment peculiar to that region. The general laws of surgical procedure hold good here as elsewhere throughout the body; but they have to be exemplified in relation to a region so separated from others in its architectural and functional peculiarities as to call for special record and delineation. The surgeon has to deal with a most intricate series of considerations—anatomical, physiological, and psychic—in devising suitable treatment for abnormal conditions in this region; the interrelation of cranial tissues and organs, their capital importance in the physical economy, and the position of some of them as the substrata of mental activities render any surgical interference a matter of great delicacy and grave anxiety. So much is this the case that it has been left for the most daring and the most modern surgeons to prove that this is a region to which ordinary surgical rules may properly apply; and hence what must be here recorded is largely matter of quite recent history and to a large extent at variance with the doctrine of former epochs. The function of the cranium as a protective agent for the brain and the organs of special sense is strikingly shown by its architectural design. The proper discharge of this function is of paramount importance from the economic value of the cranial contents; and the demands upon it are the more exacting from the extreme delicacy of physical structure and the unstable physiological equilibrium present in the brain. Clothed externally by the densely resisting textures of the scalp, further protected by a layer of heat-deflecting hair, the cranium itself consists of a firmly welded bony basket of ovoid form, maintained in its balanced position upon the upright spine

column by a series of ligamentous and muscular bands. There is thus protection against the sun's rays and a general mobility that provides for the avoidance of impending blows. But the cranium has chiefly to receive and annul transmitted physical vibrations, the result either of blows upon the head or of those jars and oscillations, incidental to bodily movements, which would interfere greatly with the functions of the brain did they actually reach it. The function of the cranium in this respect has been fully described by Hilton, who shows that special bony ridges are present in the skull which arrest vibrations and divert them into channels where their action is no longer deleterious. Three series of such buttresses descend from the vault to the base of the skull, where they converge in the region of the sella turcica at a point termed by Felizet "the centre of resistance," and where the terminations of the ridges come into immediate contact with the cartilage of the foramen lacerum medium or the lake of cerebrospinal fluid which surrounds the anterior and posterior clinoid processes. The transmitted vibrations are thus annulled by transference to a liquid or a soft solid medium, and lose all further power. In addition to the special mechanism which mitigates the effect of considerable shocks and renders slight ones ordinarily imperceptible, here is a general elasticity of the skull which enables it to withstand great violence without material injury and so enhances its protective power. This elasticity is not uniformly present, but is much more developed in the bell-like vault than in the region of the base. The osseous texture also is much more brittle in the latter locality. When, therefore, such severe shocks are communicated to the skull as overcome its elasticity and its power of resistance, the fracture which ensues is found as a rule to involve the base much more seriously than the vault.

These physical qualities are of great importance as giving an index of the relative resisting powers of different parts of the skull, and as affording data that may assist in determining the position of a fracture from a study of the forces which caused it. Of such forces those that are closely circumscribed in their area of application produce strictly local effects, whilst diffuse blows produce their most marked effects at a distance from their point of application. The former fact needs no illustration; the latter has been made the subject of numerous researches in relation to the usual course of cranial fractures. From the results of these investigations three different etiological laws have been deduced—(1) Saucerotte's law of *contrecoup*; (2) Aran's law of radiation; and (3) Von Wahl's law of parallel cleavage. In its special sphere each of these laws probably holds true; but the sphere of each is a limited one and is dependent upon the local peculiarities of the skull already described. The theory of *contrecoup* is that a force produces its maximum effect at the opposite pole of the skull to the point of its application. That this law can have no general bearing is shown by the numerous cases in which the fracture bears no such relation to the force which causes it. In relation to a limited area of the vault, however, it appears to hold true; for isolated fractures of the base resulting from blows upon the vault are on record, but as these are the only fractures which this theory would explain, and as they are very rare, its range of action is very greatly curtailed. Aran's law of radiation is that, starting from the point where the blow is received, a fissure traverses the walls of the skull in the direction of the base and spreads itself in that fossa of the base of the skull which corresponds to the part of the vault that is struck. Thus a diffuse blow on the frontal bone causes injury to the anterior fossa of the base, and blows upon the parietals or occipital bone cause similar injury to the middle or posterior fossa respectively. This law holds true of the great majority of fractures of the skull and will assist in localizing the course of a fracture when the part of the skull first struck can be recognized. But numerous cases of fractured base are on record in which no fissure can be traced leading from the point first struck; and from a study of these Von Wahl has concluded that fractures of the base, whether connected with fissured vault or isolated, are always parallel to the direction of the force which caused them. Thus blows upon the frontal and occipital regions cause longitudinal fissures of the base, in the temporal region oblique fissures, and in the mastoid region transverse fissures. An index of the probable direction of a fracture is thus obtained by observing the exact point of incidence of the blow which caused it, whether other evidences of localized injury to the cranial contents be forthcoming or not.

The diagnosis of the presence of a fracture is often a matter of great difficulty, especially where the soft parts are still intact, and by their contused and swollen condition mask the true nature of the case. Apart from obvious external signs of injury, the following symptoms should lead to the suspicion of a fracture:—bleeding from the mouth, nose, or ears; local ecchymoses or lacerations, as that of the membrana tympani; circumscribed hæmorrhages, as under the scalp or visceral conjunctiva; interference with the functions of the brain or special sense-organs, as aphasia, motor spasms or paralysis, blindness, deafness, an altered condition of the respiration or the pupils, slight unconsciousness or profound stupor. The

immediate risks to life are from shock and compression, the latter due to depressed bony fragments or effused blood. The treatment of shock has already been alluded to (p. 680 above); that of compression consists in the early relief of pressure by trephining, with elevation of the depressed fragments and removal of the blood-clots, if the symptoms are advancing. These symptoms are increasing stupor, stertorous respiration (Cheyne-Stokes breathing), relaxation of sphincters,—the condition passing on to complete coma. In cases where pressure symptoms are not urgent (especially in young patients with elastic skulls) and in cases where no such symptoms are present, expectant treatment should be employed,—complete rest, local cooling applications, constantly applied, the exclusion of all stimuli to the special sense-organs or to the attention, and a careful watch for further symptoms. Should symptoms of compression appear and advance, or should slight symptoms already present become aggravated, immediate operative interference for the relief of pressure as above indicated must be resorted to, and in operating in this region it must be remembered that strict antiseptic precautions are essential, for in no region of the body—not excluding even the peritoneal cavity—are the effects of septic infection more disastrous and at the same time so hopeless of remedy.

Having thus alluded to the physiology and surgery of the cranial envelope, it remains to consider the corresponding aspects of the cranial contents. The older theory of Flourens and Hertwig, that all parts of the brain are equally concerned in producing its aggregate activities, has been displaced by the more recent theory of the localization of function. This theory is supported by the results of recent physiological and pathological investigations, the former carried on for the most part by Hitzig, Fritsch, and Ferrier, the latter by Broca and Meynert. The practical outcome of these researches—viz., an adaptation to the human brain of results obtained in that of the higher mammals, controlled by pathological observations on the human brain itself—is that the surface of the brain can be mapped out into a series of topographical areas, each of which occupies a definite relationship to some well-defined function—motor, sensory, or psychic—of the human economy. Of the areas connected with psychic activity little is at present known; they are generally believed to occupy the frontal lobes of the brain. In the parietal region grouped around the fissure of Rolando are the cortical areas connected with motor functions in the extremities, and around the horizontal limb of the fissure of Sylvius are arranged those concerned in general and special sensation. The results of these researches confirm the views of Hughlings-Jackson, who has conclusively demonstrated the cortical origin of those epileptiform seizures in which the motor phenomena are limited to particular groups of muscles. At the same time these results open a new field of anatomical and surgical inquiry, with the object of defining what relation the cerebral convolutions bear to external cranial landmarks, and of showing that circumscribed cortical disease or injury is capable of detection and relief. For practical purposes in the Relation present state of our knowledge of cerebral physiology, the first of conpart of the question limits itself to an exact delineation of the position of the fissures of Rolando and Sylvius in relation to well-known cranial landmarks. In regard to the position of the former face of several researches have been made, and its upper extremity has been localized at a point 2 inches behind the coronal suture in the mesial line by Broca, Turner, and Féré. For the purpose of its exact determination in the living subject, where the line of the coronal suture cannot always be detected, measurements have been made and formulae for its localization devised by Giacomini, Lucas-Championnière, Hare, and Reid (see the literature cited below). The commencement of the fissure of Sylvius is situated $1\frac{1}{2}$ inches behind the external angular process of the frontal bone.

As an outcome of these additions to our knowledge of accurate Trephinfacts, a new branch of surgical procedure is now firmly established and already sufficiently supported by successful results, viz., trephining for the relief of cortical disease. Encouraging cases have disease occurred in the hands of Hughes Bennett and Godlee, Fraser and Chiene, and Victor Horsley. The last-named presented to the British Medical Association meeting in 1886 three patients relieved by this operation from cortical lesions. As a result of wide experience in operating upon apes and upon human beings, Mr Horsley accentuates the importance of employing the following precautions in operative interference:—(1) thorough cleansing and disinfection of the scalp; (2) the use of chloroform as an anæsthetic, morphia having been previously given to reduce cerebral congestion and to obviate excessive hæmorrhage during the operation; (3) strict antiseptic precautions; (4) a semilunar incision through the soft parts; (5) the use of large trephines; (6) Macewen's method of replacing the bone in small fragments carefully purified. The occurrence of hernia cerebri signifies a failure in the antiseptic precautions, and a primary union of the integuments is a matter of the most extreme importance. In removing the tumour or scar-tissue the knife is preferable to the thermo-cautery.¹ (A. W. H.)

¹ Literature of Cranial Surgery.—Perceval Pott, *Injuries of the Head*; Sir Astley Cooper, *Lect. on Surgery* (Tyrell), vol. i.; Sir B. Brodie, *Med. Chir. Trans.*, vol.

2. Thoracic.

Purulent collections in the pericardium and pleural sacs may be treated as ordinary abscesses by incision. In the case of the pleural cavity the pus may be evacuated through an opening made in the axillary line at the seventh costal interspace; but it is quite possible to empty it thoroughly at the fifth. A drainage-tube is inserted, protected by a broad flange, that it may not slip into the cavity, and strict asepsis should be secured. Should sepsis occur, the wound should be washed out, and a counter-opening made if necessary. As the lung, however, frequently will not expand, and a large cavity is therefore left to heal by granulation, with little chance of it ever getting filled up, surgeons have excised portions of the ribs in order to bring about a collapse of the chest wall and thus ensure obliteration of the cavity. The second, third, fourth, fifth, and sixth ribs have been partially removed, together with a portion of the clavicle. It is better in young people to remove the periosteum also. Some surgeons cut away the thickened pleura as well. The possibility of opening into the pleural sacs and pericardium for the removal of tumours has been demonstrated by König and Küster, who have reported cases where growths in connexion with the sternum and ribs were successfully removed. Special care was taken that as little air as possible should gain access to the pleural cavities. Attempts have also been made to tap and wash out vomice in the lung, but as yet operative interference in such instances is not fully established.

3. Abdominal.

Modern surgery has made its greatest advance and has achieved its most signal triumphs in connexion with operations performed in those cavities of the body which are lined by a synovial or serous membrane. The older surgeons did not dare to systematically attack the joints and the cranial, thoracic, and abdominal cavities; but the surgeon of to-day performs the most daring operations here with confidence, and is rewarded with a success which at first sight appears almost marvellous. The timid extraperitoneal manipulations of former days made use of in the treatment of hernia and kidney disease and in the formation of artificial anus, have now given way to systematic intraperitoneal modes of treatment, whereby we aim at the radical cure of hernia and bring disease affecting any of the abdominal viscera directly under our control. We have to consider the conditions under which wound treatment of the peritoneum is placed, and in what respect this portion of the human framework reacts upon injuries as compared with the general behaviour. It is generally acknowledged that rest in the surgical sense, the factor necessary for healthy wound closure, is obtained by a condition of asepsis and fixation. Moreover, it is generally granted that tension as a condition of unrest is dangerous not so much in itself as in the character of the material that gives rise to tension; hence the extravasated serum and blood in a case of simple fracture give rise to comparatively little disturbance. The presence of ascites need not lead to fever. But once let sepsis gain entrance and the fermenting exudate is resented by the organism; violent attempts to throw it off are made; and forms of blood-poisoning more or less severe and variable ensue. In a severe injury of the extremities, say a compound fracture, the effused serum and blood-clot are not readily removed by the damaged lymphatic system, and, when that does act, sepsis having already occurred, the absorption of the putrid fluid does much harm. Fortunately the open character of the wound may allow the fetid discharge to escape. In any case, the surgeon ensures a good result when he makes use of splints, drainage, and antiseptics. He brings about local fixation, removes the excessive exudation, and so relieves the lymphatics and prevents sepsis. In the case of a penetrating abdominal wound, where the healthy peritoneum is injured, we have somewhat different conditions, mainly varying in degree. It must ever be borne in mind that here we open into a huge lymph-sac. The peritoneum consists of a sheet of vascular and lymphatic network, covered with epithelium and provided with stomata. It is easily injured, and then rapid effusion ensues. Like most vascular structures, however, it heals quickly with favourable surroundings, and, the source of irritation having been removed, it speedily returns to the normal. In comparison with the large absorbing surface the injured portion is but small, and the effusion thrown out at the seat of injury may readily enough be absorbed by the remainder of

Peritoneal wound treatment.

xiv.; Hilton, *Lectures on the Cranium*; Felzet, *Recherches anat. et exper. sur les fracs. du crâne*, 1873; Aran, *Arch. Gén. de Méd.*, 4th ser., vol. vi. p. 180; Saucerotte, *Mélanges de Chirurgie*, part I. p. 233, Paris, 1801; Von Wahl, "Fracturen der Schädelbasis," in *Volkmann's Series*, No. 228; Flourens, *Les propriétés et les fonctions du système nerveux*, Paris, 1824; Hitzig and Pritsch, in *Reichert and Du Bois Reymond's Archiv*, 1870; Hitzig, "Über den heutigen Stand der Frage von der Localisation," in *Volkmann's Series*, No. 112; Ferrier, *Functions of the Brain*, 1876, and *West Riding Reports*, vol. iii., 1873; Hughlings-Jackson, *Lond. Hosp. Rep.*, 1864, and *Clin. and Phys. Researches*, 1873; Broca, *Sur la topographie cérébrale*, 1876; Turner, "Relations of Convulsions to Skull and Scalp," in *Jour. Anat. and Phys.*, 1873; Giacomini, *Topografia della Scissura di Rolando*, 1878; Lucas-Championnière, *Le trépanation guidée par les localisations cérébrales*, 1878; Hare, *Jour. Anat. and Phys.*, January 1884; Reid, *Lancet*, vol. ii., 1884, p. 539; Hughes Bennett and Godlee, *Brit. Med. Journ.*, May 1885; Victor Horsley, *Brit. Med. Journ.*, vol. ii., 1886, p. 670.

the healthy sac. So long as the rate of absorption equals that of effusion tension cannot exist. If, however, the nature of the fluid be of importance, it is evident that nowhere in the body is this more marked than in the case of the peritoneum, and here above all other parts must we preserve strict asepsis. This may be gained in various ways. (1) By drainage, in which case the surgeon carefully draws off from the pouch of Douglas any excess of fluid thrown out as the result of injury, until such time as the peritoneum itself has recovered its full absorbing power and the excessive secretion has ceased. (2) Where by careful sponging the operator so far relieves the peritoneum and then, closing the wound to prevent entrance of further sepsis, leaves the rest to nature. For, if we do permit a moderate septic inoculation, it is evident that the rapid change of fluid may prove inimical to the development of septic ferments and the contact of healthy tissue will finally render impossible the existence of organisms. The presence, however, of any accumulation of putrid effusion is at once resented by the peritoneum and an attempt by local peritonitis may shut off the collection, or even previous to any local reaction septic absorption may prove fatal, or again severe general peritonitis may kill the patient. (3) From the above we at once see how applicable the antiseptic system must be to the abdomen, and the most signal success has crowned attention to matters of detail in this respect. By means of antiseptics we can securely close the abdomen, resting assured that the peritoneum is perfectly capable of carrying off effusions due to our interference. Where we dread that oozing may complicate matters, the drainage-tube can in addition be employed, but the necessity for its use becomes less marked as the operator acquires experience. Abdominal surgery requires from beginning to end the utmost care, and it is well that specialists reached a high standard of success before the adoption of the antiseptic system, since various points have been formulated, all of which, however, are of minor importance compared with the one great end in view,—that of asepsis from first to last. The utmost care should be taken to ascertain the general bodily condition of the patient, to see that the kidneys are healthy, and to select an anæsthetic suitable to the requirements of the case. The temperature of the room, the clothing during operation, rapid dexterous manipulation, and preventives against hæmorrhage require the utmost attention. The patient should be prepared by having had low diet and gentle purgatives for a few days prior to surgical interference, so that rest of the intestinal tract may readily be assured. As a material for ligature fine silk Chinese twist, of various sizes, may be employed. It must be carefully disinfected by boiling, and is readily preserved pure in a five per cent. solution of carbolic acid. The ends should always be cut short. It possesses certain advantages over catgut.

In reviewing the field of abdominal surgery we must study shortly the methods and results gained by ovariectomy, removal of the uterine appendages (ovaries, Battey, tubes, Tait), hysterectomy, myotomy, removal of fibroid tumours of the uterus, intraperitoneal operations on the kidney, liver, spleen, intestinal tract, including stomach, pylorus, duodenum, small and large intestine. Finally, attention should be given to the extraperitoneal operations for sarcoma and disease of the kidney and intestine.

From 1701, the date when Houston of Carlisle, Lanarkshire, carried out his successful partial extirpation, progress was arrested for some time, although the Hunters (1780) indicated the practicability of the operation. In 1809 Ephraim M'Dowell of Kentucky, inspired by the lectures of John Bell, his teacher in Edinburgh, performed ovariectomy, and continuing to operate with success established the possibility of surgical interference, and was followed in the United States by many others. The cases brought forward by Lizars of Edinburgh were not sufficiently encouraging; the operation met with great opposition; and it was not until Clay, Spencer Wells, Baker Brown, and Keith began work that the procedure was placed on a firm basis and regarded as justifiable. Improved methods were introduced, and surgeons vied with one another in obtaining good results, until by the introduction of the antiseptic system of treating wounds this operation, formerly regarded as one of the most grave and anxious in the domain of surgery, has come to be attended with a lower mortality than any other of a major character. We may now briefly outline the mode employed in operating. The room should be well heated, be free from draughts, have a good light, and above all a pure atmosphere. The patient is secured to a firm table and well protected with blankets. Anæsthesia having been obtained, the state of the bladder being known, and the urine drawn off if thought necessary, the surgeon purifies the integument with carbolic acid five per cent. solution, attending specially to the region of the umbilicus and pubes, which latter should be shaved. A large perforated waterproof sheet may be spread over and secured to the body, through which the more prominent part of the tumid abdomen protruding presents a localized field for manipulation; this also protects adjoining parts and obviates unnecessary exposure. An incision 2 or 3 inches in length in the linea alba and midway between the umbilicus and the symphysis pubis carries the surgeon down to the interval between the recti; bleeding points are seized with pressure forceps; and by

further use of the knife, the subperitoneal fat is exposed, the peritoneum divided, and its free edges seized with forceps. The operator next introduces his finger and with the scissors enlarges the wound downwards or upwards on the left side of the umbilicus if necessary. The entire hand is then introduced between the parietal peritoneum and the tumour and swept around so as to ascertain the condition of affairs, and even to separate gently slight adhesions. A few sponges are next packed round the exposed tumour surface, which serve to keep the intestines and omentum out of the way and to retain any tumour content which may escape during tapping. With a large trocar, aided perhaps by an exhausting jar, the contents are drawn off, and, as the tumour collapses, its folds may be caught by forceps and the whole sac gradually pulled outside the abdomen. The pedicle is clamped by strong forceps; the tumour is cut off; the stump of the pedicle is carefully ligatured, the clamping forceps removed, the peritoneum carefully sponged out, more especially the pouch of Douglas, the ligature cut short, and the pedicle dropped into the cavity of the abdomen. At this stage the forceps and sponges are counted, a definite number being always employed, and, their tale being perfect, the surgeon proceeds to close the wound. For this purpose his needle traverses the entire thickness of the parietes from peritoneum to skin; the stitches should be about one-third of an inch apart, and closer apposition is gained by secondary sutures, which go through the integument alone. A dressing is now applied, and for the next few days the patient gets little else than occasional spoonfuls of hot water and milk, unless brandy be necessary, until she passes wind, after which time the usual diet is gradually resumed. It is necessary that the most precise precautions be taken against septic infection. The sponges are steeped in a five per cent. solution of carbolic acid, then dipped in boiling water, and squeezed dry immediately before use. Should the contents of the cyst be too viscid to run through the trocar, the contents of the sac must be pulled out with the hand. Adhesions to various organs must be dealt with by careful separation and ligature. Rents in the peritoneum should be stitched up with fine catgut, and some operators also stitch over the stump of the pedicle, or bury it in a bared portion of the adjacent broad ligament, so that it may not contract adhesions. While the great majority of surgeons are at one as regards the use of antiseptic precautions, they do not agree as to the use of the spray. Many dispense with it altogether. Some employ it in the room prior to the operation. A few surgeons also, without availing themselves of the antiseptic system, appear to obtain as good, if not better, results than their fellows. It may also be noted that the antiseptic in use by different operators varies, and that, while the pedicle is usually ligatured, Keith attaches great importance to the clamp and cautery introduced by Baker Brown. The drainage-tube is not now so frequently employed as formerly. The statistical results show an increasing success in the case of every surgeon. Spencer Wells tells us that in his first five years one patient in three died, in his second and third five years one in four, in his fourth five years one in five, in 1876-77 one in ten, since the introduction of antiseptics (complete Listerism), 1878-84, 10.9 per cent.—the last series showing a marked absence of septic fatality. Keith in 1884 reported a mortality of 9.11; formerly, when using the spray, he once had a successful consecutive series of 80. Koerberle up to 1878 had performed 300 operations, of which 231 had a favourable result. Of 300 patients operated on by Schroeder up to 1882 258 recovered; in the last hundred cases there were only 7 deaths. Other figures are—Knowlsey Thornton, 423 cases, 40 deaths; Tait, 405 cases, 33 deaths, and in 1885 (including parovarian cysts) 139 cases, no deaths; Olshausen (1885), 293 cases, 27 deaths (in the last hundred only 4 deaths).

Removal of uterine appendages.

Removal of the uterine appendages, the ovaries and Fallopian tubes, is performed for three distinct conditions—(1) for disease, when the tubes are the seat of inflammatory changes and distended, or when the ovaries are the seat of cystic and cirrhotic changes; (2) for fibroid tumours, in which case by operating we hasten the menopause and bring about involution; (3) in cases where dysmenorrhœa is wearing out and rendering useless the life of the patient, and where less severe treatment is ineffectual. Oophorectomy, by which we mean removal of the ovaries only, was introduced by Battey of Georgia in 1872. It is now replaced by the more extensive procedure of Lawson Tait, sapingo-oophorectomy. The operation is sometimes followed by loss of sexual feeling and has been said to unsex the patient, hence strong objections have been urged against it. The patient and friends should clearly understand the object and results likely to be gained. According to Angus Macdonald, "as soon as we are certain that the ovaries or tubes are distinctly diseased and are not likely to yield to our ordinary methods of treatment . . . we are bound to at least inform our patient of the possibility of relieving her by operation. The operation presents greater difficulties and is associated with a higher mortality than ovariectomy." The greatest care must be taken in making the initial incision for fear of wounding the bowel. The organs are not uncommonly deeply placed and have contracted adhesions. Every trace of ovarian tissue should be

removed along with the tubes and the ligatures must be carried close up to the uterus. The stitches should be placed closer, since the tendency to hernia is greater.

In cases of fibroid tumour—myoma—the surgeon must be largely guided by the condition of the patient and the new growth as to whether removal of the uterine appendages is sufficient. If it is not and the patient is in such danger that the next period threatens life, he had better proceed to hysterectomy or entire removal of the uterus and appendages. When we consider the circumstances under which this operation is performed, the weakly anæmic state of the patient, the size of the tumour, and the rapidity with which procedure should be conducted, we must regard hysterectomy as one of the gravest in the domain of surgery. There is, moreover, a special danger which does not obtain in ovariectomy,—the risk of septic poisoning. Since we cut into the canal of the uterus, it is obvious that we open into a septic cavity, and it is impossible merely to ligature and drop the pedicle, since by doing so we should court failure. The surgeon, having made a way into the peritoneum, seizes and ligatures adhesions, projects the tumour through the wound, clamps the pedicle (cervix uteri), removes the tumour and uterus, and closes the wound, leaving the clamped pedicle protruding. It is advisable to scoop out the septic central canal of the pedicle and carefully to pare away surplus tissue, and as dressing to have a plentiful supply of some potent non-irritating antiseptic in contact with the stump. If we take care that the septic focus is removed without coming in contact with its surroundings, if we keep the stump aseptic and dry, there will be little fear of septic fluid trickling down the side of the pedicle and causing sepsis, peritonitis, or blood-poisoning. Attempts have been made, by careful disinfection of the stump, paring its centre, careful ligature, and stitching its raw surfaces together, to treat the pedicle by dropping it into the abdomen as in ovariectomy, but as yet with no marked success. The results of hysterectomy in the hands of Keith (33 cases, 3 deaths, in 1885) stand unrivalled. Similar principles guide the performance of cesarean section and Porro's operation.

Affections of the liver and gall-bladder have also been treated by laparotomy. In the latter case an incision is made over the swelling, and the gall-bladder, having been exposed, may be removed or explored, gall-stones cleared out, the walls stitched to the sides of the abdominal wound, and a drainage-tube inserted as occasion requires. The spleen has also been attacked. In removal of the entire organ special care must be taken that none of the larger veins give way during manipulation. Most careful ligation and subdivision of the pedicle is requisite. In recent years the surgery of the kidney has made gigantic strides. There are three modes of reaching the organ, each of proportionate value according to the nature of the case. (1) From the lumbar region. In this way we may open abscesses, remove calculi, and even extirpate if the kidney be not enlarged. Increased room may be obtained by removing the twelfth rib. By this method we gain sufficient and dependent drainage and we need not open the peritoneum. (2) As in ordinary laparotomy, making an incision in the middle line. This admits of our examining both organs and to a large extent determining the condition of each. We get free access and can more readily treat the pedicle of vessels and the ureter. We open into the peritoneal cavity and again divide the peritoneum; but our incisions are readily closed and we no longer dread interfering with this huge lymph-sac. For tumours of the kidney this method is clearly indicated. (3) Langenbuch has proposed making an incision along the outer border of the rectus, which is said to present advantages in certain cases.

Since the advance of ovariectomy the possibility of removal of portions of the intestinal tract with a subsequent suture of the divided ends has been repeatedly demonstrated, and thus resections for disease of the pylorus and bowel have been successfully performed. In cases of gunshot wound, laparotomy, arrest of hæmorrhage, careful cleansing of the peritoneum, and suture of the wounded gut is now the established practice. Bull of New York reports a recovery in a case where seven wounds in the gut were sutured. All laparotomies are founded on the type of ovariectomy; success depends on the fact that two opposed serous surfaces rapidly unite, and this fact must ever be borne in mind when we tear or injure the bowel and its coverings, or unite them. Sepsis is the main disaster likely to attend our interference, but with the means at our disposal, washing out the peritoneum if necessary, we should be able to obviate this.

In regard to operations on the abdominal organs in which we do not interfere with the peritoneum it is sufficient to note that from the lumbar region we can reach the colon, where it is uncovered by serous membrane, the kidney, and retroperitoneal tumours.¹ (F. M. G.)

4. Deformities.

- (1) For club-foot, see vol. vi. p. 42.
- (2) During the last few years, in consequence of the safety with

¹ The literature of abdominal surgery is very extensive. The most complete lists will be found in Olshausen's "Die Krankheiten der Ovarien," in *Die deutsche Chirurgie*, 1896, and in Hart and Barbour's *Manual of Gynecology*.

which bones may be divided, other deformities, such as knock-knee or *genu valgum* and bow-leg or *genu varum*, have been remedied by operation. Drs Macewen of Glasgow, Ogston of Aberdeen, Schede of Hamburg, and the present writer have been working at this subject and have devised, more especially in knock-knee, various methods of remedying the deformity. Operations are only justifiable when the deformity has become chronic. During the advancing stage, when the deformity is getting worse, when the bones are still cartilaginous and plastic, the evil can be remedied by mechanical means. This statement may be best illustrated by a short consideration of the development of the lower limbs and the changes which normally take place. At birth all children are more or less bandy-legged. The child lies on its nurse's knee with the soles of the feet facing one another; the tibiae and femora are curved outwards; and, if the limbs are extended, although the ankles are in contact, there is a distinct space between the knee joints. During the first year of life a gradual change takes place. The knee joints approach one another; the femora slope downwards and inwards towards the knee joints; the tibiae become straight; and the sole of the foot faces almost directly downwards. While these changes are occurring, the bones, which at first consist principally of cartilage, are gradually becoming ossified, and in a normal child by the time it begins to walk the lower limbs are prepared, both by their general direction and by the rigidity of the bones which form them, to support the weight of the body. If, however, the child attempts either as the result of imitation or from encouragement to walk before the normal bandy condition has passed off, the result will necessarily be either an arrest in the development of the limbs or an increase of the bandy condition. If the child is weakly, either rachitic or suffering from any ailment which prevents the due ossification of the bones, or is improperly fed, the bandy condition may remain persistent. As a rule, however, in children that are precocious as regards walking, if proper care is taken the bandy condition will disappear without any special treatment. In a healthy child who does not attempt to walk until the limbs are prepared to support the weight of the body, no further abnormal change takes place. But in a weakly child in whom the development already described has occurred, in whom the limbs as regards their general direction are prepared for the support of the body, but in whom the bones forming the limbs are not sufficiently ossified, as in the rachitic child, the shafts of the femora above the knee and the shafts of the tibiae below the knee bend forwards; at the same time a change takes place at the knee joint,—the condition called *knock-knee*. In the normal limbs, the tibiae being vertical and parallel, and the distance between the upper extremities of the femora being greater than that between their lower extremities, the femora necessarily slope inwards towards the middle line, and there is therefore in every properly developed person an angle at the knee joint. If at this stage the bones are sufficiently rigid to bear the weight of the patient, no further change takes place; but, if the limbs give way and are not sufficiently strong, the normal angle at the knee joint increases and the internal lateral ligament of the knee joint becomes stretched,—the result being knock-knee. The condition may be arrested in its earliest stage by an improvement in the general health of the child; but, if no such improvement takes place, and if the child is allowed to walk, then definite changes occur in the bones which form the knee joint. These changes are the direct outcome of a general law, namely, that diminished pressure results in increased growth, increased pressure in diminished growth. The best example of the former principle is the rapid growth that takes place in a child that is confined to bed during a prolonged illness. The distorted, stunted, shortened, and fashionable foot of the Chinese lady is an example of the latter. In the knee joint there is diminished pressure between the internal condyle of the femur and the inner condyle surface of the tibia; there is increased pressure between the external condyle of the femur and the outer condyle surface of the tibia. The result is an increased growth of the internal and a diminished growth of the external condyles; the knock-kneed condition is intensified, and will go on as long as the primary cause is at work, getting worse and worse, and will only cease when the bones become fully developed. As long as the disease is getting worse, the application of a rigid splint to the outer side of the limb fixed at the foot and at the upper part of the thigh, and the arrangement of an elastic bandage so as to draw the limb towards the splint, the person being kept in the horizontal posture, will cause a diminution in the pressure on the external condyles followed by their increased growth, and by an increased pressure on the internal condyles followed by

a diminished growth. This effect may be obtained by applying a weight to the limb; and by mechanical means founded on this general law cases of knock-knee that are getting worse can be improved. At first there is an arrest in the abnormality, which is soon followed by improvement. The different methods that have been recommended for division of the bones are only necessary in those cases in which they have become permanently distorted.

(3) Lateral curvature of the spine is a deformity which occurs during the developing period of life before the bodies of the vertebrae are fully ossified. In young people who are growing rapidly, and whose muscular system is weak, any bad habit, as, for example, that of standing and throwing the weight of the body constantly on one leg, gives rise to a drooping of the pelvis on one side; or, if, when writing at a desk, they are allowed to sit in a twisted position, a lateral curvature of the spine takes place. By constant indulgence in these bad habits the cartilaginous spinal column gets set in an abnormal direction. In the concavity of the curve there is increased pressure and necessarily diminished growth, in the convexity of the curve diminished pressure with increased growth. The patient's friends will probably notice first the right scapula being pushed backwards by the underlying ribs, which from their close attachment to the dorsal vertebrae participate in a rotatory movement occurring in the vertebrae themselves, and, unless means are taken to alter the abnormal distribution of pressure, the condition will become worse and worse, until complete ossification checks the progress of the deformity. The commonest curvature is one in which there is a dorsal convexity towards the right, with the right shoulder higher than the left. Compensatory curves in the opposite direction form in the lumbar and cervical regions. Along with the lateral curvature a rotation of the bodies of the vertebrae towards the convexity of the curve takes place; their spinous processes necessarily turn towards the concavity of the curve. Since the line of the spinous processes of the vertebrae can be easily traced through the skin, their deviation may mislead the superficial observer as to the true direction in which curvature has taken place. As the lateral curvature occurs the articular facets along the line of the concavity are pressed together, the line of these facets being posterior to the bodies of the vertebrae and their intervening elastic intervertebral disks. The result of this is that the vertebral column as a whole cannot fly away towards the convexity. The anterior parts of the bodies, being farthest away from the fixed point, are least restrained from movement, and they pass away to a greater extent than the posterior parts. The result is a rotation of each vertebra in the direction indicated. To counteract this deformity in the earliest stages, the patient (generally a girl) should be encouraged to walk about with a book on her head, to retain which in position she must necessarily keep perfectly erect. Muscular exercises, to strengthen the muscles of the back, ought to be enjoined and superintended by the surgeon. During the intervals of rest she should lie upon her back on a firm board, and should carefully avoid taking any exercise which gives rise to weariness of the muscles; for, whenever the muscles become strained, she will attempt to take up a position which throws the strain off them on to her ligamentous and bony structures. One of the best exercises is to lay the patient on her face, fix her feet, and encourage her to raise herself by using the muscles of the back. When the deformity becomes more marked the use of the trapeze should be prescribed. Hanging with her arms upon the trapeze, the weight of the lower limbs and pelvis will tend to straighten the spine as a whole, necessarily diminishing the increased pressure upon the cartilaginous bodies of the vertebrae towards the concavity, and increasing the pressure between the sides of the bodies towards the convexity. The tendency to rotation must be counteracted in another way. The pelvis being fixed, elastic bands attached to fixed points, one in front of the patient towards her left side, another behind her towards her right side, are to be grasped by her right and left hands respectively, the right arm passing in front of her body, the left arm behind it. When the patient stretches both hands simultaneously there will be an untwisting of the spine in a direction opposite to the abnormal rotation. In this description, the common curvature—namely, of the dorsal region towards the right—has been taken as a typical example to illustrate the treatment. When the dorsal curve is in the opposite direction, the untwisting of the curve must necessarily be in the opposite direction also. During the intervals of active treatment the patient must wear a rigid support, which in itself has no direct curative action, but will materially assist the treatment by preventing the good result obtained by the muscular exercises from being nullified. (S. C.)

SURINAM. See GULANA, DUTCH, vol. xi. p. 251.

SURRENDER is a mode of alienation of real estate. It is defined by Lord Coke to be "the yielding up of an estate for life or years to him that hath an immediate estate in reversion or remainder" (Coke upon Littleton,

337b). It is precisely the converse of release, which is a conveyance by the reversioner or remainderman to the tenant of the particular estate. A surrender is the usual means of effecting the alienation of copyholds. The surrender is made to the lord, who grants admittance to the