

**TRENTHAM SPRING.**—Campbell County, Georgia. POST-OFFICE.—Fairburn.

ACCESS.—Via Atlanta and West Point Railroad to Fairburn, thence by private conveyance three miles north to spring.

For a number of years this spring had considerable local reputation. The principal ingredients of the water are as follows: Calcium carbonate, magnesium carbonate, iron carbonate, potassium carbonate, magnesium sulphate, sodium chloride, alumina, organic matter. The waters of this spring are said to be highly efficacious in the treatment of syphilis and scrofula.

James K. Crook.

**TREPANNING; TREPHINING.**

By common consent these terms are applied, not merely to the application of that form of circular saw known as the *trepán* (or diminutive *trepheine*), but to any procedure by which a piece of bone is elevated, or is removed, in order to permit the elevation of some adjoining portion, or the exposure of the membranes or brain beneath. The operation dates back to the remotest antiquity, and seems to have been practised at various times among various peoples as a rite or ceremony. Except when performed by surgeons, it seems to have been done usually with the rudest of implements, and even the instruments used by the previous generation of surgeons were in most respects clumsy and coarse.

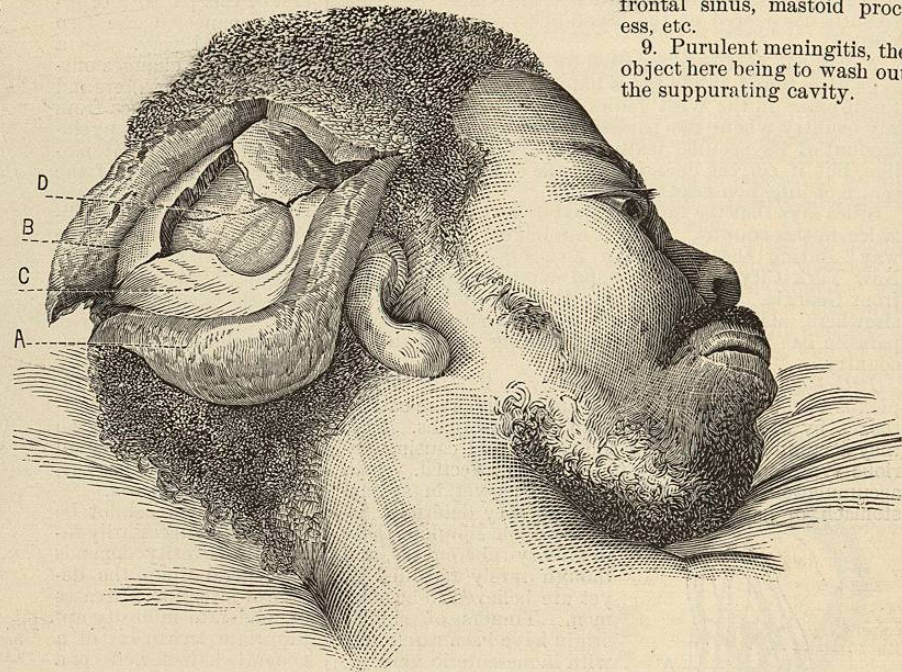


FIG. 4797.—1. A Fractured Skull after the Application of the Trepheine and the Removal of the Fragments. (After Charles Bell.) A, B, The flaps of integument; C, the cranium; D, the dura mater exposed.

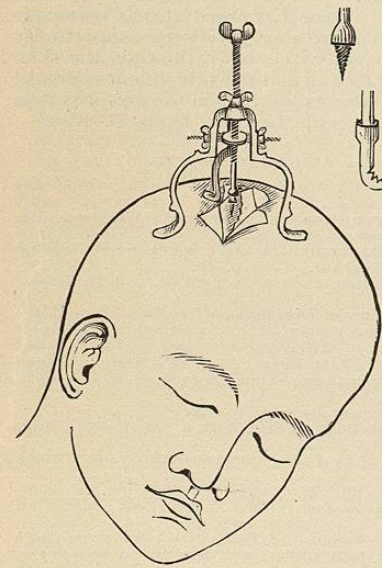


FIG. 4798.—The Operation of Trepanning in the Early Part of the Eighteenth Century. (From Heister.)

signs of compression, contusion, or laceration of soft parts, without fracture of the external table.

5. Hemorrhage. The operation is done in this case either to tie a vessel or to remove a clot. This is partially included under heading 4.

6. Abscess of brain.

7. Tumor of the brain or meninges.

8. Bone abscess in the frontal sinus, mastoid process, etc.

9. Purulent meningitis, the object here being to wash out the suppurating cavity.

10. Acute infectious osteomyelitis of the diploë.

11. Epilepsy or insanity, when any lesion can be located with sufficient definiteness.

12. To afford a so-called "relief opening," for relief of pain or cerebral irritability. (See also under *Brain, Surgery of*.)

Each one of the foregoing conditions is an indication for working through and underneath one or both tables of the skull, in order to effect whatever may be possible beneath the level of the bone removed. The various conditions are discussed in their appropriate places; we speak here only of that which pertains to the operation proper.

**DANGERS.**—The South Sea Islanders scrape through each other's skulls with pieces of glass, we are told, and with impunity. Among the Cornish miners the operation was, up to a comparatively recent date, according to Michel (*American Journal of the Medical Sciences*, October, 1879), one of daily occurrence. The Count of Nassau was trephined by Chadbourn some twenty-seven times. And all this at a time when, or among a people in whom, fear of sepsis has not prevailed. And yet, until very recently, there has been a recognized school of practising surgeons who have uttered solemn warnings against even a properly discriminating resort to the procedure, and fierce wordy battles have been waged concerning it. But the medical profession is now almost a unit in favor of a diagnostic use of the instrument, as it is in favor of an exploratory abdominal section. We are now in a position where one may boldly affirm, even in courts of law, that *trepheining is not, by itself, a dangerous operation, when properly done*, but it must be insisted that the proper performance of the operation includes the most careful attention to antiseptic or aseptic

4. Coma, with

measures. When these are rigorously carried out the operation is no more dangerous than the amputation of a finger with the same precautions. The condition which



FIG. 4798.—Crown Trepheine.

necessitates the operation constitutes the main element of danger. Patients frequently die after trephining, but very seldom because of it. This statement cannot be too strongly emphasized.

Moreover, the operation is frequently too long delayed. Michel's dictum, "The early trephine is gold, the late trephine is lead," should sink deeply into the mind of every one who may ever be compelled to use the instrument. This obtains especially with regard to fractures of the skull. Much better is it to make a puncture and then find it unnecessary to proceed further, than it is to have it appear later that early operation might have saved a life.

**THE OPERATION.**—Even the instruments and methods of twenty years ago are almost abandoned in favor of those of recent introduction. The Hey's saw and the old bone-cutting forceps are now relegated to the past. The former is never used and the latter are superseded by so-called rongeur forceps, which not only divide the bone, but bite out a small section. They are of various patterns, and can be made extremely useful. Three different methods of operating are now in vogue:—

(a) The old-fashioned method, which called for the use of the trepan or trephine, such as is shown in Fig. 4798. When the surgeon's intent is merely to make an opening in the skull through which he may elevate depressed bone, or drain an abscess, this pattern of instrument will still be found useful. It is made in various sizes, but for ordinary work one about 2 cm. in diameter will be found the most serviceable. Small trephines will answer for the introduction and exit of small wire saws, such as those introduced by Gigli and known by his name. These had recently a short vogue, but have been found likely to injure the dura.

(b) The mallet and chisel have come into quite general use especially among the continental surgeons. Chisels of various sizes or gouges, variously patterned, will be

found in many instances very serviceable, and with them openings of any desired shape and size can be made. The use of the chisel is, however, attended by the theoretical danger of injury from the repeated blows of the hammer, which it has been supposed might cause some molecular disturbance or concussion. Moreover, frequent blows of the hammer may under certain circumstances produce a noise which would be distasteful to those within hearing. Still it is not always possible to dispense with these instruments in this kind of work.

(c) The osteoplastic method of operating has come into general use since the previous edition of this work. It consists of raising trap-door flaps of bone by circular or lateral cuts, which leave a base at that point where the largest vessels enter the scalp, and of springing back this bone flap by breaking it across the base without separating from it the overlying scalp and soft tissues, through which it may still be nourished after its replacement. This method has a very great advantage over any other in that it provides a perfectly adequate bony covering for the bone defect made by the operation, that this covering is of the patient's own tissues and not a foreign body, and that the area thereby exposed can be made of any desired extent in almost any desired location. Thus it has an advantage over all other methods in suitable cases.

This bone flap may be cut out with the chisel, which often takes a long time, by the electric saw or surgical engine, which is an elaborate, expensive, and unreliable device, or, best of all, by the Stellwagon trephine as improved by Da Costa (Fig. 4802). This is a recent device corresponding very nearly to the carpenter's expansive bit.

It contains an arm whose outer extremity carries a small saw, which can be

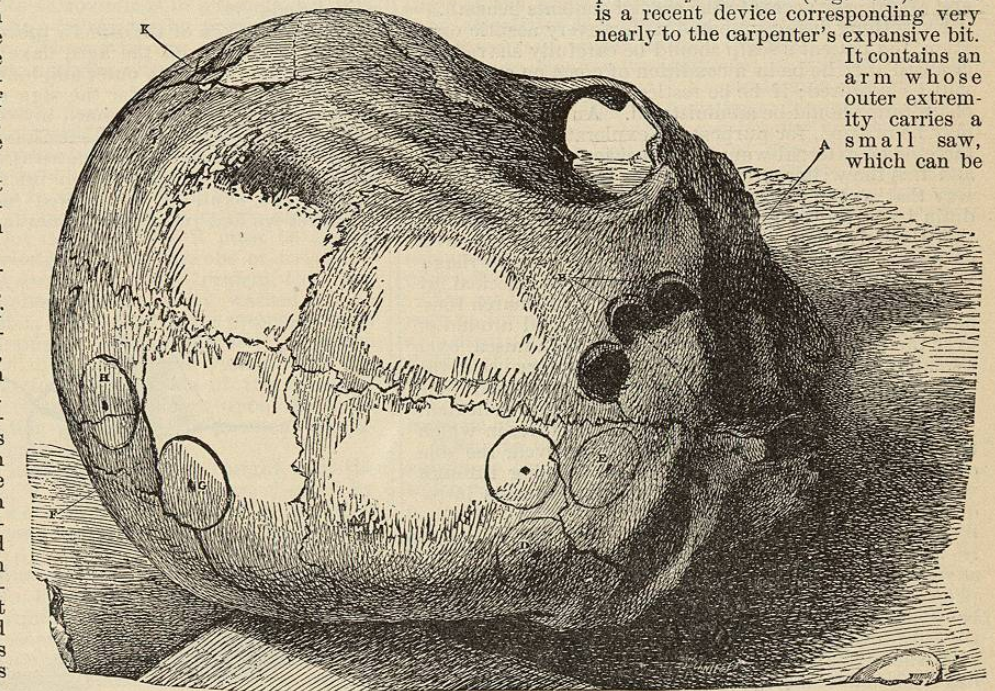


FIG. 4799.—1. A Skull showing Various Examples of Fracture. (After Charles Bell.) A, A triangular portion of the os frontis fractured and depressed. B, The three perforations found necessary for its elevation and extraction; the second and third were rendered necessary by the fact that the edge of the inner table lay under the sound bone. C, A point where the trephine was employed for a fissure of the os frontis represented on its right side; a second perforation was made in the sound bone a little higher up, still the bone could not be extracted; the trephine was then applied at E and the bone lifted up. It should have been applied at E in the first place. D, A fracture with depression at the lower angle; the trephine was placed at G; it ought to have been a large one, and placed at H, by which a portion of the bone would have been saved and a more favorable form of opening obtained; by perforating at G an acute angle of bone was left between G and F. K, A comminuted fracture.

fastened into the axis of the instrument so as to cut in a circle of any desired diameter. The centre pin may be fixed in a small metal plate with sharp point, which may be made to perforate the scalp and penetrate the bone deeply enough to serve as a centre for the rotation of the instrument. With its sections of a circle may be success-



ively cut out from the bone without having to make an opening for the centre pin, and, if it is desired, a small knife may be inserted in place of the saw and made to cut the first circular incision in the scalp. This should be made

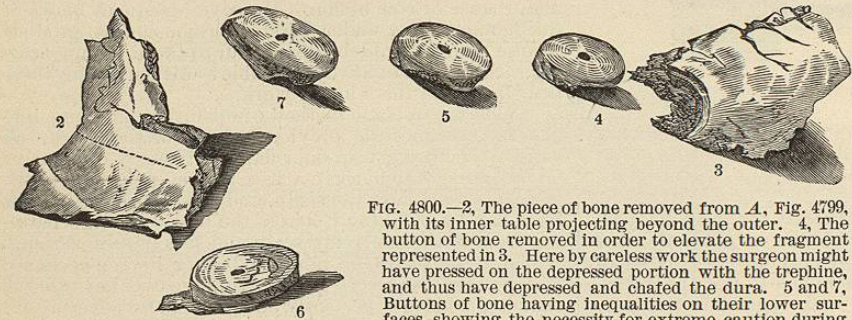


FIG. 4800.—2, The piece of bone removed from A, Fig. 4799, with its inner table projecting beyond the outer. 4, The button of bone removed in order to elevate the fragment represented in 3. Here by careless work the surgeon might have pressed on the depressed portion with the trephine, and thus have depressed and chafed the dura. 5 and 7, Buttons of bone having inequalities on their lower surfaces, showing the necessity for extreme caution during the operation. 6, Another button having considerable inner table attached to it, as occurs when the surgeon is obliged to break up the circular portion.

at a point outside the line where it is proposed to cut the bone, in order that the skin incision shall not exactly overlie that in the bone. If three hundred degrees of a circle be cut with this instrument, it will be easy to snap across the base of the circular bone flap thus made. In this way a veritable trap door may be made to open and afford easy access to the cranial contents beneath.

Everything being prepared as for every aseptic operation, the patient's scalp should be carefully shaved and cleansed. If he be in a condition of coma no anæsthetic will be required; if he be restless though unconscious, chloroform should be administered. An existing wound may be utilized, for purposes of exploration at least. If there be no external wound, an incision should be made; and this the writer prefers to make U-shaped, in such a way that, as the patient lies on his back, the wound may drain by virtue of gravity from the cut made in raising this U-shaped flap. A flap of scalp is thus made over an area as large as may seem indicated. Hemorrhage, which will usually be quite free, must be checked by means of the hæmostatic forceps. Or an Esmarch tourniquet or a thick rubber ring may be passed around or over the cranium. The pericranium is then raised, over a small area, if it be merely for the exploratory use of the trephine, or from the entire area of the depressed bone which is to be removed, if such a measure seem indicated.

If we are dealing with a compound fracture, in which the depressed bone is yet not easily removed, the sole object in trepanning is to make an opening through which leverage can be exerted and instruments introduced. Here the ordinary trephine, like that shown in Fig. 4798, may be employed. In order to use it to advantage it must therefore be planted on a rigid and unyielding bony surface. The exigencies of the case can alone make it clear just where this spot may be. Unless it be unavoidable, the trephine should not be applied in the middle line (over the superior longitudinal sinus), nor over the course of any of the large sinuses or vessels, e.g., the middle meningeal. The instrument is provided with a centre pin which is thrust forward a little beyond the level of the teeth so as to secure accurate implantation and prevent sliding. A good way of beginning is to make a little depression—by means of the point of a chisel and a few light blows with the hammer—at the point where one desires to place the centre pin of the trephine. The latter is then applied perpendicularly to the plane of the skull and worked by an alternating

motion (pronation and supination of the operator's hand) till its teeth have cut a circular groove. The centre pin is then withdrawn, and the trephine is again applied with the same motion till it has cut through the outer table. Its entrance upon the diploë will be known by the free flow of venous blood. It should now be handled with extra precaution, and a probe or fine-pointed instrument should be frequently passed around the groove to ascertain if the inner table has yet been perforated at any point; if it has, the instrument must be made to bear upon the opposite side of the cut. At last, when a locking of the instrument, combined with a definite but indescribable sensation, makes the operator aware that he has nearly perforated the

inner table all around the cut, the instrument may be gently rocked, and thus, by a little leverage, the button of bone is sprung loose and either comes out with the instrument or is left somewhat tilted in its place, attached perhaps by dural adhesions or undivided spicula of bone. A probe or the point of an elevator will now dislodge it.

We have spoken of the diploë; the reader must remember that children and the aged have no such tissue between the two compact outer and inner cranial surfaces; hence he must not look for the sign of its being perforated which has been mentioned above, i.e., free venous oozing, nor for the diminished resistance to the hand, nor the altered character of the detritus thrown up by the saw. Moreover, skulls vary in thickness within wide limits. The skull of the colored race is proverbially thick, yet we find just as thick ones in individuals of the

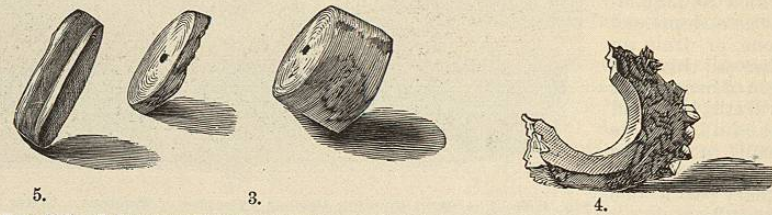
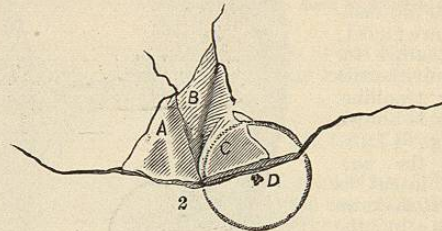


FIG. 4801.—2, Sketch of the Fractured Bone; A, B, C, the three portions of the fractured bone, with depressed edges, which, being sharp, are irritating the dura; they must therefore be removed. They are, moreover, so separated from their attachments as to have lost their vitality. There being no "purchase" for the elevator, the trephine is applied at D, and the broken pieces are elevated and picked away. 3, Two discs of bone cut by the trephine, showing the varying thickness of the skull. 4, Exfoliation of bone after use of the trephine. 5, Button removed by the trephine, showing the two tables of the skull with diploë between.

white races. The better rule, then, to follow is to act as if each skull were very thin. As every one should know also, its inner surface is liable to be very irregular; therefore to cut through every particle of bone would be to make a serious wound of the dura with the saw teeth.

The accompanying illustrations (Figs. 4799, 4800 and

4801) from Charles Bell's "Illustrations of the Great Operations of Surgery" (London, 1821), with their commentary and explanation, will serve to illustrate, much better than can be done by a long description, some of the practical points in the operation. They are also of historical interest since they were drawn by himself.

This is the classical operation with the trephine. With the removal of the disc of bone the first part, at least, of the operation is ended; depressed bone may be elevated, pus or blood evacuated, etc. Still it may be found that one such opening is not enough. In this case another suitable position is selected and the manœuvre is repeated, once, twice, or thrice if need be. By means of openings thus made sufficient room may be secured for any further proceeding. Now the rongeur forceps, the Gigli saw, the chisel, or the surgical engine, as the fancy or the equipment of the operator may dictate, may be used to enlarge the openings in any desired direction.

When the opening through the skull has been made for exploratory purposes, or when the contour of the circular aperture has not been disturbed, the disc of bone which was removed, and which may have been kept in a clean, warm, and moist place, may be utilized for the closure of the defect; in other words, a species of osteoplasty may be practised. A little notch is cut, for drainage purposes, on the edge, at what will be its inferior margin when the patient is lying on his back; it is then carefully replaced, the periosteum sutured above it, and over this the scalp, as usual. If the operation has been, as it should be, aseptic, this portion of bone should be firmly united with its surroundings in a few days. But if there have been any failure in the precautions such union cannot occur. Those who are unskilled in such technique had better, perhaps, refrain until practice has made them sure.

When the dura mater bulges into the wound, or appears very much discolored, one reasonably infers that it does so because distended by blood or pus within its cavity. In this case it is not only proper but indicated to incise it and explore further. If there be fluid blood it should be allowed to escape, and its source should be looked for. If a clot is found, then it must be gently broken down or dislodged with the probe or irrigating stream and washed away. If pus is present, the dura should be freely incised and its cavity washed out as thoroughly as possible, while subsequent provision must then be made for drainage. We are discussing here the mechanical features of the operation rather than the theoretical and practical applications of the measure, else we should be tempted to enlarge upon the more widespread application of the same to purulent meningitis, whether traumatic or idiopathic.

Bleeding vessels in the dura may be caught with the hæmostatic forceps; if the bleeding be not checked by such forcipressure, a curved needle threaded with catgut may be carefully passed under the vessels and the ligature then tied. So also a wound of a sinus may be treated, only it might be better to use a very fine needle and fine braided silk. When, however, suture of a sinus wall is impracticable, antiseptic gauze may be packed in, or a piece of absolutely aseptic sponge may be used as a compress and allowed to remain without attempting its subsequent removal. Even should a single sinus become obliterated from such treatment, no apprehension need be felt, as Schellmann's researches have shown ("Ueber Verletzung der Hirnsinus"). Injuries to the middle meningeal artery and its large branches are by far the most common of vascular lesions, and when distinct hemiplegia and signs of compression, even without any external signs of fracture, make it probable that this vessel has been ruptured, it is a legitimate and well-recognized operation to trephine over its course, find, and tie it, and remove any clot that may have formed. Parker (*Med. Times*, 1877, i, 91) trephined a case on one side, there being no external lesion, though coma was profound, and found nothing; he then trephined over the artery on the other side, and found no coagulum outside the dura, but since the latter had a distended and bluish appearance,

he incised it and removed a considerable amount of blood. In three days the patient became conscious, and then quickly recovered.

The middle meningeal is to be found about one and one-fourth to one and one-half inches back of the external

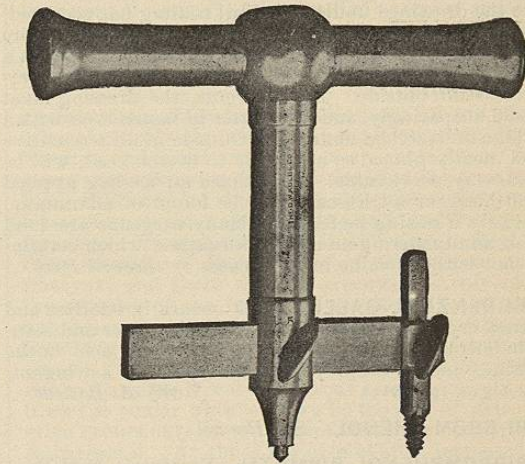


FIG. 4802.—The Stellwagon Trephine.

angle of the orbit. It runs sometimes quite within the bone, sometimes in a groove on its inferior surface, and sometimes quite within or upon the dura.

When one operates for compound fracture every loose piece should be removed. A considerable area of bone, especially in children, is sometimes depressed without being broken loose. In this case it must be raised to its proper level by a combination of dexterity and force properly applied. So much of the periosteum must be saved as is clean and viable. Any portion which has had dirt or foreign material ground into it must be cut away. The scalp will adhere nicely to bare bone, and the periosteum is not necessary, though of advantage, especially over a bony defect.

The medium-sized needle of a good aspirating syringe may be introduced, almost with impunity, to a reasonable depth, in the search for blood, pus, accumulations of fluid in the lateral ventricles, or in testing the density of the brain tissue when hunting for subcortical tumors. It may be used before or after opening the dura. In certain cases its use affords information of great value.

When the brain itself is injured, so that portions of its substance come through the wound, there is not very much to do save to wash away, with extreme care, with a gentle irrigating stream, so much as will easily come away, and then provide for drainage.

All indications having been met, all that remains is to properly close and dress the wound. In a serious compound fracture with deep laceration, the dura should be sutured over the wound in the brain, enough room being left at one point for the introduction of a tent of horse-hair, or of catgut, or a decalcified bone or rubber drainage tube, according to the exigencies of the case or the preferences of the operator. If it be so decided, the piece of bone may be replaced and the pericranium united over it in such a way as to hold it in place, provision being made at the same time for a drainage outlet from the deeper parts. The periosteum is best sewed with catgut, and the union should be made as neat and complete as possible. Over this the scalp is united, preferably with catgut; silk or silkworm gut being used only when considerable tension is expected, and with such attention to drainage outlets as the condition beneath demands. A fresh opening or a counter-opening should be made if a more direct outflow may thereby be secured. In an absolutely aseptic exploratory operation there will scarcely arise any occasion for drainage, and it will be enough to omit a suture here and there.



When discharge of pus or any fluid is expected, it is well to provide for it in the dressing. In this case a piece of protective, perforated opposite the drain outlets, may be laid over the wound, and this may be covered with such absorbent material as the operator prefers. But when no discharge is expected and it is desired to leave the dressings undisturbed till healing has occurred, it will be well to cover the wound with one or more thicknesses of gauze, and over this to apply in layers a smooth, equably distributed dressing, with some impermeable stuff outside. At all events, the dressing must be used unsparingly, and it is better to fasten it on with a bandage of starched material. Outside of all a retentive towel, neatly pinned so as snugly to fit the head, will be found very serviceable. Sometimes an ice-bag applied to the head, or an ice-cap, will be found of advantage, especially if oozing be feared. Many surgeons are fond also of administering an active purgative, which certainly is not without value in some cases. *Roswell Park.*

**TRI-BENZOYL-GALLIC ACID** occurs in odorless and tasteless crystals which are insoluble in water and soluble in alcohol. It is said to set free gallic acid in the intestine, and is employed as an intestinal astringent. Dose 1 gm. (gr. xv.). *W. A. Bastedo.*

**TRI-BROM-PHENOL.** See *Bromol.*

**TRIBROMPHENOL-BISMUTH,** Xeroform,  $C_6H_2Br_3 \cdot O \cdot BiO$ , is a fine yellow, almost tasteless powder of slight carbolic odor. It is insoluble in water, alcohol, chloroform, and the oils, but dissolves in two-per-cent. hydrochloric acid. It is unimpaired by heat below  $120^\circ C.$  ( $248^\circ F.$ ), and so may be sterilized.

Reynders states that in the gastric juice this substance splits into bismuth oxide and tribromphenol. It would seem, therefore, to be a serviceable gastric and intestinal sedative and antiseptic. R. W. Wilcox recommends it especially in the fermentative diarrheas, though Brochcock failed to obtain good results in twelve cases of tuberculous enteritis, four of acute gastro-enteritis, three of catarrhal dysentery, and three of typhoid fever. The dose is 1 gm. (gr. xv.) three times a day. It may be found in the urine for twenty-four hours after ingestion, and one of Reynders' patients showed the carbolic reaction with brown urine. In daily doses of 6-7 gm. (gr. xc.-cv.) Hueppe saw no untoward action, and 1 gm. (gr. xv.) administered to a frog, and 8 gm. (3 ij.) to a guinea-pig produced no undesirable effect.

The chief use of the remedy, however, is as an external application. There is much clinical evidence showing it to be an antiseptic, deodorizing dusting powder of great value, stimulant to granulation, analgesic, and preventing the formation of pus. It has also been much employed in the treatment of eczema, furuncles, tuberculous ulcerations, chancreoids, etc. In ophthalmic work it has been applied as a five- or ten-per-cent. ointment in conjunctivitis, eczema of eyelids, and corneal ulcers; in nasal, pharyngeal, and laryngeal catarrh, and in suppurative otitis media as an insufflation; in gynecological and venereal disease as a local application. There is also on the market a ten-per-cent. xeroform gauze, which has the advantage of being sterilizable by heat.

*W. A. Bastedo.*

**TRI-BROM-SALOL,** Cordol,  $C_6H_4 \cdot OH \cdot COO \cdot C_6H_2Br_3$ , is made by acting on salol with bromine in excess. It occurs in long white needles, which are insoluble in water and slightly soluble in chloroform or glacial acetic acid. It has been proposed as a gastric sedative and intestinal antiseptic in dose of 1-2 gm. (gr. xv.-xxx.), and is said to split in the intestine into salicylic acid and tribrom-phenol. The methyl compound of tri-brom-salol, known as "cordeine," and the acetyl compound "cordyl" are also in use.

*W. A. Bastedo.*

**TRICHINOSIS; TRICHINIASIS.**—Although previously observed after death in the muscular tissues of human beings by others, the trichina spiralis was first

fully described by Owen in 1835. In 1847 it was discovered by Leidy in the flesh of swine, and in 1849 by Guret in the cat. In 1851-52 Herbst succeeded in developing trichinosis in the dog by feeding the flesh of a trichinous badger. It remained, however, for Zenker, in 1860, to make the first clinical record of a case of trichinosis in man. The disease simulated typhoid fever, but, death resulting, post-mortem examination disclosed the presence of sexually mature parasites in the intestine and of living unencapsulated parasites in the muscles. It was further discovered that others who had partaken of some pork in company with the patient had been made ill, and on investigation this meat was found to contain trichinae. Subsequent inquiry showed the course of events to be as follows: Human beings become infected through the use of trichinous pork. The capsules of the ingested parasites are digested in the intestine, where sexually mature trichinae then develop. These begin to give birth to young in the course of a week, and the embryos bore their way through the wall of the intestine into the abdominal cavity, and pass thence by way of the connective tissues to the muscles or to other serous cavities; or they make their way through the mucous and muscular coats of the intestine and between the layers of the mesentery to the vertebral column, whence they migrate to the muscular tissues. In the muscles they penetrate the primitive bundles and cause destruction of the contractile substance. Occasionally the parasites are distributed through the blood stream and the lymph channels. They continue to develop in the muscles for a short time—from two to three weeks—and as a result of their activity febrile symptoms arise, together with others referable to the invaded muscles. In the course of another week the worms curl upon themselves, and in the further progress of the case the irritation to which their presence gives rise causes the formation of a capsule of connective tissue, by which they become surrounded, and which eventually may undergo calcification. The calcified capsule appears as a small grayish nodule, just visible macroscopically. Sometimes the parasites themselves undergo calcification, and occasionally both parasite and capsule disappear entirely. On the other hand, the parasite may retain its vitality for many years and it may even survive the death of its host. It can be destroyed by a temperature of  $-11^\circ$  or of  $55^\circ C.$ , although greater extremes of temperature are required when the parasite is encapsulated within muscular tissue.

In addition to human beings, trichinae have been found in rats, mice, cats, foxes, polecats, martens, and raccoons, and trichinosis has by feeding been induced in rabbits, hares, marmots, hedgehogs, moles, sheep, calves, horses, hens, pigeons, and ducks. Dogs are not readily infected. Trichinae ingested with food remain at times alive for several days in the larvæ of flies. Swine are generally infected through eating the flesh of infected swine fed to them, and occasionally through the flesh of rats infected by eating the refuse from infected porcine cadavers. It is possible also for infection of swine to take place through the ingestion of intestinal discharges from infected human beings or other animals. In man the danger of infection is greatest from the use of raw or imperfectly cooked pork, and it is slightest when the pork is well cooked or roasted. The trichinae can be destroyed by cooking, provided the temperature in the interior of the meat reaches  $75^\circ C.$  Well-pickled meat is less infective than fresh meat, the trichinae being destroyed in part by the necessary withdrawal of water. The danger of infection from meat is lessened also by thorough smoking.

**MORBID ANATOMY.**—When opportunity is afforded for post-mortem examination in cases of trichinosis, the mucous membrane of the small intestine is found swollen, in recent cases injected, at a later stage pale. At times there is capillary hyperæmia and there may even be ecchymoses. Swelling of the solitary follicles and of Peyer's patches has been observed, with enlargement of the mesenteric glands. The parasites may persist in the bowel for as long as seven or eight weeks. The spleen is little changed, if at all. The liver becomes pallid and

anæmic and of doughy consistence, and its cells the seat of fatty infiltration. The kidney exhibits cloudy swelling or fatty degeneration. The myocardium also may undergo cloudy swelling. The lungs exhibit the signs of bronchitis, with hypostasis, and they may undergo splenization or lobular hepatization. Rarely they are the seat of metastatic abscesses or of hemorrhagic infarction. The muscles may in the first week be light grayish-yellow, dark-red or bluish-violet in color. At a later period the muscle fibres undergo longitudinal and transverse splitting, and degenerative changes take place in the contractile substance, together with hyperplasia of the interstitial connective tissue. Trichinae may be present in large numbers, especially at the junction of the belly and the tendon of the muscle. They predominate in the diaphragm, the intercostal, the cervical, the laryngeal and the ocular muscles. In the extremities they occur especially in the biceps and the triceps. They have been found also in the heart muscle. Large numbers of polymorphonuclear leucocytes, more especially eosinophile cells, have been described in the affected muscles, particularly in the more degenerated areas.

**SYMPTOMATOLOGY.**—The intensity of the symptoms of trichinosis varies in accordance with the number of parasites introduced into the digestive tract. Three phases of the disease may be considered, namely, that of the entrance of the parasites into the stomach and the small intestine, that of their migration to and through the muscles, and that of encapsulation, with subsidence of the myositis. These are, however, not distinguishable clinically. The ingestion of trichinous meat is followed shortly by symptoms of marked digestive derangement. Among the more common of these are malaise, nausea, eructation, vomiting, and cardialgia, and with them may be associated vertigo, a sense of fulness in the head, and of heaviness in the lower extremities. In some cases the symptoms of an acute gastro-enteritis develop, with diarrhoea, hypogastric pain, weakness, and fever. The diarrhoea may be succeeded by constipation. The appetite is lost, or there may even be repugnance for food. Thirst is increased and sweating may be free. On the other hand, this train of symptoms may be wanting, wholly or in part. The tongue may be dry; it is often swollen and painful, and it may be movable only with great difficulty.

Rheumatoid pains in the extremities develop gradually, with ill-defined feelings of illness. Fever appears, and some of the muscles begin to swell. The affected parts become œdematous and the seat of pain and tenderness. The muscles exhibit weakness and want of elasticity, and there is a sense of soreness such as is observed after unusual exercise. This is noticeable especially in flexion and in the muscles of the neck, and often also in the lumbar muscles. Patients complain further of a sense of heaviness and weight in the extremities.

Febrile symptoms appear, as a rule, on the third or fourth day of the disease, being ushered in by repeated chilliness, rarely by a severe chill. There is slight elevation of temperature in association with the gastro-intestinal symptoms, but the pyrexia becomes more marked with the onset of the symptoms referable to the muscles. The temperature may reach  $40^\circ$  or  $41^\circ C.$  in the afternoon, declining a little in the morning, and being of remittent or subcontinuous type. This higher degree of pyrexia persists for from nine to eleven days, and it is succeeded by a lower range of temperature for a further period of from three to five weeks. In mild cases the temperature may return to the normal level in the third week, or it may become intermittent in character. Defervescence is usually gradual and slow. The pulse frequency corresponds with the degree of pyrexia.

œdema of the face, especially of the eyelids, appears in the second week of the disease, and is one of the most characteristic and most constant symptoms. There may be an associated chemosis of the conjunctiva. œdema of the extremities is less common. This symptom, when present, disappears in from two to five days, but it may reappear later.

The trichinae invade the muscles, and the symptoms referable to these appear at the end of about nine or ten days, though sometimes later, in accordance with the intensity of the infection. The affected muscles become swollen, hard, and sensitive to touch and pressure. Movement induces cutting or boring pain. Such pain as is present is naturally less when the parts are at rest. In mild cases there may be merely a sense of stiffness and of tension. Any muscle of the body may be invaded, but especially those of the extremities and of these particularly the flexors are affected. The patient assumes a characteristic attitude, in consequence of his efforts to relax the involved muscles. In the dorsal decubitus arm, forearm, and hand are flexed at an acute angle, and the lower extremities are partially flexed at the knee and the hip. Stiffness and rigidity are apparent especially in the masseters and the muscles of the neck and the upper extremities. Frequently there is difficulty in deglutition from invasion of the muscles of the tongue and the pharynx, and there may be trismus. Involvement of the muscles of the larynx gives rise to hoarseness and aphonia; of the respiratory muscles, to difficulty in breathing and dyspnoea. Deep inspiration induces dry cough. œdema of the glottis may develop and give rise to alarming if not dangerous symptoms. In severe cases the ocular muscles may be the seat of pain. This often occurs only on movement, which in consequence is embarrassed. At times the eyes exhibit increased sensitiveness to light, and there may be conjunctivitis and ecchymoses in the scleral conjunctiva. Mydriasis has been observed in some cases.

Pruritus is a frequent symptom, while formation and cutaneous anaesthesia are less common. Eruptions on the skin, such as acne, furunculosis, herpes, petechiae, prurigo, and urticaria, are not rare as late manifestations. Free desquamation occurs frequently during convalescence. Sweating may be a troublesome feature in both mild and severe cases, and not rarely it continues throughout the course of the disease. Bronchitis is often present early, while in some cases hypostatic and even fibrinous pneumonia develops, and occasionally pleurisy. At times cardiac irritability appears in the second week. Pericarditis also has been observed. In severe and protracted cases venous thrombosis may occur, particularly in the lower extremities, as a result of marantic enfeeblement of the circulation. Rarely epistaxis and intestinal hemorrhage occur, while oligæmia, oligocythæmia, and hydræmia develop early. In the acute stage of the disease the blood exhibits characteristic alterations. The number of leucocytes is increased, at times to a remarkable degree. As many as 35,700 in the cubic millimetre have been reported. This increase involves especially the eosinophile leucocytes, both absolutely and relatively, with coincident diminution in the proportion of polymorphonuclear neutrophile leucocytes. The percentage of eosinophiles has been reported as high as 68.2 per cent., as against the normal of two or three per cent., the percentage of neutrophiles at the same time being 6.6 per cent.

The urine is diminished in amount and is high-colored during the febrile stage, and when sweating is profuse. At a later stage the amount may be increased. Occasionally albuminuria is present, together with tube casts and renal epithelium. Disorders of menstruation are frequent in women, and abortion is not rare when pregnancy exists. Trichinae have, however, not been found in the fœtus. Insomnia is a constant symptom at the height of the disease, and is invariably present in severe cases. Even in mild cases sleep is disturbed by restlessness. Children, however, may sleep well throughout the disease. The superficial and deep reflexes and the electric irritability to both faradic and galvanic currents are enfeebled. Consciousness is rarely deranged. In some cases impairment of hearing occurs.

The period of incubation of trichinosis—that is, the period of time that elapses between the ingestion of trichinous meat and the development of symptoms—is variable, and may be from a few hours to many days or even