The movements usually classified under this category differ slightly among themselves, and may be subdivided into the *flowing movements* which in plant cells become a distinct *circulation* of streams of protoplasm in the form of threads or strands of varying diameter from the region of the nucleus out to distant portions of the cell, usually along one side or through the middle, and returning along the opposite side or, in the latter case, along both sides. It is inconceivable that these movements could take place in protoplasm formed in part by a reticulum, much less that the reticulum could be active in causing the *flowing* and *circulation*. In this form of movement we probably have to do with the most primitive, spontaneous movements of living matter. That the terms contraction and expansion may be applied appropriately to this kind of movement is evident from the response which the protoplasm gives to any sudden, efficient stimulus it contracts into globular masses either along the course of the threads or around the nucleus (see Fig. 1511).

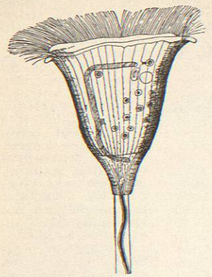

Fig. 1510.—A Vorticella (*Carchesium polypinum*). Note the converging fibrillæ developed from the exoplasm; also the muscle fibre of the pedicel.

The other form of amœboid movement shown by the higher Rhizopoda and by leucocytes is characterized by a slow pushing out of a pseudopod from any point in the surface of naked animals, but from the foramina of the foraminifera.

The mechanism of this pushing out is a matter of interest. A pseudopod cannot be thrust out as a result of simple relaxation. Relaxation is passive, and passivity never pushes. We must then have to do with some other factor than simple relaxation. There is relaxation in one dimension only and contraction in the other two. When one thrusts his tongue out of his mouth the transverse muscle fibres contract, while the longitudinal ones relax. The result is a sudden change in the dimensions of the tongue; the longitudinal axis elongating at the expense of the transverse dimensions. Something analogous to this takes place in the pseudopod of an amœba.

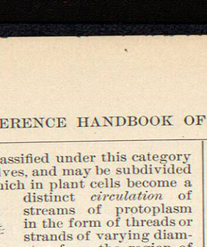

Fig. 1511.—Showing the Protoplasm of a Stamen-hair Cell of Tradescantia, expanded (*a*) and contracted (*b*).

What we call the contraction stage is a contraction in all dimensions. This leads to the assumption of the spherical shape.

Some, at least, of the organisms which possess the power of amœboid movement, possess also a reticulated spongioplasm (see Fig. 1504). The threads of the reticulum lie in the three dimensions and, therefore, from a mechanical standpoint may cause the movements. Inasmuch as contraction in its higher differentiation is clearly the function of the fibrillated spongioplasm or its homologue, we are justified in searching for the beginnings of this differentiation as soon as we find contractility and fibrillated spongioplasm possessed by the same organism.

B. The Character of Ciliary Movements.—In ciliary contractions we have for the first time an indubitable relation between fibrillated spongioplasm and contractility. Note that the contraction is transverse to the axis of the fibres (see Figs. 1508 and 1509). This can be accounted for only on the grounds of a contraction upon one side of the fibre or cilium, the other remaining relaxed (see Fig. 1512). (Verworn, *Allgemeine Physiologie*, p. 258).

Nobody seems to have raised the question as to how a cilium regains its erect position. Is it through a contraction of the opposite side or through elasticity?

The time and rhythm of ciliary contraction must be governed by the cells of which they are extensions, because all of the cilia of one cell contract in rhythmical unison. Upon ciliated surfaces all of the cilia act in harmony, sending a series of undulations over the surface similar to those which run over a field of wheat under the influence of the wind.

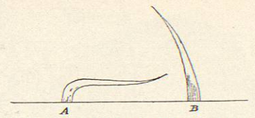

Fig. 1512.—Showing the Position and Condition of the Large and Slow-moving Cilia from a Rib of a Tunicate. *A*, Stage of relaxation; *B*, stage of contraction.

The ciliary contraction is strong and quick in one direction, while the relaxation is slow in the other; this results in a transportation, over the ciliated surface, of any bodies or matter which may be resting upon the surface, the transportation always being in the direction of the contractions.

The ciliated surfaces of the body are the respiratory tract below the larynx, the oviducts, and the vasa deferentia. The columnar epithelium of pharynx, œsophagus, and small intestine in many of the lower vertebrates is ciliated; while in man there remains of this ciliated field only a sort of vestigial, non-motile, crown of short cilia upon the columnar epithelium of the small intestine.

The function of the cilia is evidently to carry secretions along a duct or passage, or, in addition to that, to remove foreign matter, as in the case of the cilia of the respiratory tract.

Ciliary contraction may be grouped in two classes: (1) Concerted, rhythmical, undulatory movement over a ciliated area; and (2) the whip-like movements of a single large cilium called *flagellum*. A good example of flagellate ciliary movement is found in the spermatozoon. The zoöspores of the algæ usually possess one or two flagelli. The locomotion of a spermatozoon is a sculling movement.

C. The Character of Muscular Contraction.—Muscular contraction is characterized by the shortening of fibrillæ. We have already discussed at some length the minute structure of a muscle cell of some of the higher orders of animals. Biedermann ("Electro-Physiology," vol. i., pp. 3–5) traces the muscle fibrillæ phylogenetically back through the whole invertebrate division of the animal kingdom, back to the longitudinal contractile fibrillæ of the stentor and the vorticella (see Fig. 1510). In the case of the stentor the fibrils are separate throughout their course; but in the vorticella note that the separate fibrils of the exoplasm are gathered into the contractile fibre of the pedicel. The spiral course of this fibre down the inside of the elastic sheath of the pedicel causes the latter to be thrown into a cylindrical spiral when the fibre contracts (see Fig. 1513). Biedermann ("Electro-Physiology") demonstrated that a contracted vorticella returns to the expanded condition through the elasticity of the pedicel. Muscle fibrils never push; they are capable of active contraction of their longitudinal dimensions, but not of the transverse dimension to restore the original length. In this respect muscular contraction differs fundamentally from the amœboid movement. Muscle fibres may *contract and relax*, but they cannot *contract* and *expand*. During their condition of relaxation they are absolutely passive. They are, during this stage of their change, expanded; but the expansion depends upon the action of some factor outside of the fibre itself. In the case of the vorticella it depends upon the elasticity of the pedicel; in the case of the ciliary muscles of the eye it depends upon the elasticity of the tissues to which the muscles are attached; in the case of hollow viscera it depends upon intravisceral pressure; while in the case of the skeletal muscles the return to the expanded condition depends in part upon the elasticity of tissues and in part upon the active contraction of opposing sets of muscles.

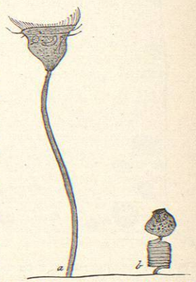

Fig. 1513.—A Vorticella Expanded (*a*) and Contracted (*b*).

Other topics on the subject of muscular contraction are discussed at length in Dr. Simon H. Gage's admirable article on *Muscle* (*q. v.*). *Winfield S. Hall.*

CONTUSIONS.—A contusion is a surgical injury—other than a fracture or a wound proper—in which the skin remains intact. If there be a solution of continuity of the skin also, the term contused wound is used.

The force producing a contusion is necessarily blunt in its nature—a blow or a fall with resulting violent compression. The lesion produced thereby is chiefly a laceration of the subcutaneous structures, varying in amount according to the degree of force applied and the resistance or state of health of the part subjected to injury.

A contusion may, of course, involve the skin alone (without breaking it), or any deeper structures, as muscle, blood-vessel, nerve, viscus, or bone. There is, in a contusion, probably always vascular rupture of some degree. The resulting extravasation has received various names, according to its apparent shape, its amount, etc. For instance, hemorrhagic spots when small and round are called *petechiæ*; when elongated, as in stripes from a whip, *vibices*; when of irregular shape, though small, *ecchymomata* or *ecchymoses*. *Hæmatomata* are localized collections of blood of some size. The term *purpura* while sometimes applied to small extravasations into the parenchyma of the cutis, is more generally given to a systemic disease (Werlhof's) in which such hemorrhages are a prominent symptom. *Peliosis* is used in a similar sense. *Suggillation* is sometimes considered synonymous with ecchymosis; some medico-legal writers, however, have employed the former term to indicate certain post-mortem appearances produced by the settling of the blood beneath the skin. The diagnosis between these conditions may be made by examining a section of the skin—which, if the injury was ante mortem, will be found infiltrated with blood, and firmer and thicker than natural; but if post mortem, the blood will be beneath, or upon, but not in, the cutis. Moreover, the post-mortem mottling will generally occur at the most dependent parts, and the effused blood will be found fluid.[1]

Of medico-legal interest also is hæmophilia, as those subject to this diathesis are liable to extensive extravasations resulting from slight violence; and this is also true of certain chronic cardiac, hepatic, splenic, renal, and blood diseases, in which the blood is unhealthy and the vessels of diminished resisting power. It is a fact of common observation that certain people—perhaps women more often than men—even though not subjects of serious disease, nevertheless have such delicate blood-vessels as to suffer rupture of these from even trivial causes. "Black-and-blue" spots of even extensive degree will in them consequently result from the most trifling blows or falls; and in divorce suits where "cruel and inhuman" treatment is alleged, also in suits for assault and battery, this fact should be borne in mind.

The *amount* of extravasation in any contusion will vary with the extent of vascular involvement, the degree of vascular tone, and the density of the surrounding tissues. If the bleeding take place from an artery of some size, a false aneurism, either circumscribed or diffused, may result. Or, it may be that there is no immediate escape of blood from a large vessel, and yet its walls have been so injured as finally to disintegrate, and permit a violent secondary hemorrhage beneath the skin. Or, again, an immediate true aneurism may be produced through partial rupture, usually involving the inner and middle coats.

We sometimes see cases of contusion in which the pulsation entirely ceases in the main artery of a limb beyond the point of injury. Here there has generally been rupture of, at least, the inner coat, with consequent thrombosis; or, if pulsation is lost only after some time, this is due to obliteration from adhesive inflammation. Such instances may well be followed by dry gangrene, or moist if the accompanying vein or veins be occluded.

Diagnosis.—It is impossible to estimate the gravity of any case of contusion from mere inspection of the patient. The weight and velocity of the missile, or the distance fallen, the posture in which the injury was received, etc., should be ascertained. The surface may show no evidence of a contused and ruptured viscus within. If the vascular lesions have taken place deep in the tissues, several days may elapse before the extravasated blood reaches the skin, becoming thus of diagnostic value; and not infrequently it makes its appearance several inches distant from the seat of contusion, commonly in the direction of gravity, having dissected its way to the surface between layers of dense fascia. A late-appearing ecchymosis is thus one of the signs whereby in difficult cases a fracture may be diagnosticated.

Contusion presents a certain superficial resemblance to gangrene, but is to be differentiated by the following points: 1. The discoloration, although present in both, becomes gradually less marked and lighter colored in ecchymosis, and steadily more marked and darker in gangrene. 2. There are often numbness and diminished sensibility over a contused surface, but in gangrene the dead part is devoid of sensibility, while the dying portion adjoining is often hyperæsthetic. 3. The local temperature is frequently elevated in a contusion, whereas in gangrene it is lowered. 4. In moist gangrene, more frequently than in contusion, the epidermis becomes raised in blebs; these are less sharply defined and more easily moved about, in gangrene. 5. Emphysematous crackling may be felt in gangrene when decomposition with consequent liberation of gas has set in. 6. The foul odor of putrefaction, very faint at first, may be detected in gangrene.

The diagnosis between hæmatoma and abscess, or between it and soft malignant disease, is not always easy; but the history, the employment of the aspirating needle, and microscopic examination of the fluid withdrawn will suffice.

In the scalp a hæmatoma with hard, sharply defined border and soft centre is sometimes mistaken for depressed fracture. Here deep pressure, if need be preceded by aspiration, will show the bone to be at its proper level.

Symptoms and Course.—The immediate pain from a contusion is commonly not great. There is usually numbness of some degree, followed by heavy aching, or throbbing during the inflammatory stage, and accompanied by loss of function.

The inflammatory symptoms are simply those occurring after any traumatism, but with less tendency to become of the septic or the suppurative order than those following similar lesions exposed to the air.

Shock, in contusion, is generally proportionate to the amount of injury inflicted; but bruising of certain parts—as the breasts, testes, and large joints—induces shock in an unusual degree.

Pulping of the tissues, or injuries of the large vessels, will often be followed by gangrene.

The discoloration of the tissues and the swelling are due sometimes to the extravasation of pure blood, and sometimes to blood-tinged serum. In extravasation un-

der a mucous membrane—as the conjunctiva—a red, aërated color is often maintained; but in other parts the well-known "black and blue" is observed in varying intensity, according to the distance from the surface and amount of blood in the effusion. Subsequently, as the blood corpuscles gradually disintegrate and become absorbed, the purplish hues fade, giving way successively to violet, olive-brown, greenish, and yellow, and the abnormal color finally disappears in from ten days to a fortnight. Several of these colors may generally be seen at once in different parts of the same contusion. When, owing to the depth at which extravasation takes place, it does not show itself for several days, it will usually appear in the form of irregular yellow spots, marbled with green and blue.[2]

The blood in a hæmatoma may remain fluid for months or years, becoming, however, gradually darker and disintegrated, and often mixed with inflammatory products. More often it is completely absorbed in a few weeks. If air be allowed to enter a hæmatoma, rapid decomposition of its contents and suppuration ensue.

The discussion of the symptoms and treatment of ruptured viscera comes more properly under other heads.

Treatment.—The indications are: 1. To limit the amount of extravasation. 2. To subdue pain, shock, and inflammatory action. 3. In severe cases to maintain vitality in the part. 4. To promote absorption of effused blood. 5. To treat complications and sequelæ.

1. Here we obtain the greatest benefit from either *heat* or *cold*, together with rest, gentle rubbing, and such a posture as will aid the return circulation. In the more superficial contusions, *heat*, as intense as can be borne, is particularly effective, and is sometimes more grateful, quieting pain better than cold. Either heat (not mere *warmth*) or cold contracts the calibre of the smaller vessels, and hence diminishes congestion and extravasation. If the cold be too intense or applied for too long a time, —as ice for several hours continuously — there will, through temporary exhaustion of the vascular muscles, be paralytic dilatation, and the congestion will no longer be diminished by this means.

The neatest and least troublesome way of applying locally either heat or cold is by the rubber coil. This I prefer to the metallic coil, because it is lighter and more easily adjusted to any part. In water-supplied rooms, the simplest method is to fasten the inlet end of the pipe over the cold or hot-water faucet. If this cannot be done, siphonage must be used.

2. To subdue pain, either heat or cold is of value, but some other analgesic agent, such as morphine, acetanilid, phenacetin, or antipyrine, by mouth, or the first and last by needle, may be required, or cocaine hypodermics may be needed.

In severe cases, systemic shock may require the use of strychnine by hypodermic and hot saline solution (normal) by the intravascular route, or the rectal; in either case at a temperature of 120° F.

The treatment of the inevitable inflammatory reaction in the irritated or partially disorganized tissues still depends mainly upon the use of cold or heat. Local bloodletting, by leeches or otherwise, may be used, but I prefer to accomplish the same result by aconite, a watery purge, and low diet.

3. Whenever a case presents itself of such severity that from disintegration and pulping of the tissues local sloughing threatens; or when coldness and a lack of pulsation beyond the injury point to occlusion of a large vessel and probable gangrene; or when local tension from extravasation or serous effusion interferes with circulation and thus indicates danger; we must not employ cold, lest we diminish still further the vitality of the part.

In the first two cases local warmth should be applied, the limb being also swathed in cotton wadding, and somewhat elevated. The best way of applying heat to tissues threatened with death is again by means of the coil. Fasten the inlet end to the hot-water faucet, and regulate the temperature of the application by varying the number of layers of cloth between coil and skin. If the whole limb is becoming cold, place hot bottles about it.

If sloughing actually takes place, poultices aid the separation of the sphacelus; and, since a poultice is simply warmth and moisture, our simplest way is to moisten (preferably with an antiseptic solution) the dressings beneath the hot coil.

In the third contingency mentioned under this heading—viz., in cases threatening gangrene from local tension,—this must be relieved by free incisions, made with aseptic precautions; after which warmth may be used, if needed, to aid the circulation. It has been demonstrated that the greatest degree of relief to tension with the least proportion of necessary wounds, is obtained when the cuts are made to take the shape of a quincunx, or five-stroke figure.

The severest cases of contusion may call for immediate amputation, or this may be demanded by subsequent gangrene.

4. Extravasation having ceased, and inflammatory reaction subsided, moderate heat, pressure as by a Martin's rubber bandage, or gentle friction are to be employed to remove the effused blood.

According to Gross, the following application proves a satisfactory sorbefacient: Apply upon folded flannel a strong solution of hydrochlorate of ammonia, plus a small quantity of vinegar. Cover with oil silk, and renew six or eight times in twenty-four hours.

To hasten the disappearance of hæmatoma we should use elastic pressure—as by the rubber bandage—or frictions. Blisters also aid absorption, as does the use of watery purges or diuretics. If under these means there still remains a collection of fluid blood, we may as a final resource either aspirate, with a sterile needle, through sterilized skin, or freely and aseptically open and drain the cavity. Should suppuration or septic change in the contents of the sac occur at any period in the history of a hæmatoma (indicated by local heat, pain and throbbing, chills or other constitutional disturbance), free incisions and irrigation are demanded.

5. For the treatment of aneurisms, ruptured viscera, paralyses, neuralgias, hypertrophy, atrophy, etc., sometimes complicating or forming sequelæ of contusions, the reader is referred to the sections devoted to these subjects respectively.

Save for a greater degree of crushing of tissues in the former, contusions and lacerations have close resemblances. To control bleeding from the torn vessels a treatment successful in laceration would be of value in contusion. Perhaps our commonest form of laceration is a sprain—which is a tear, of varying degree, of the ligaments of a joint.

From time immemorial it has been the custom of ballet dancers, a class especially subject to sprained ankles, to immerse the injured limb at once in very hot water, meanwhile having it gently rubbed. After an hour or so, if pain permits, dancing is resumed. This plan is greatly preferable to the one until recently the custom in our profession—viz., that of simply splinting a sprained joint for a long period. Such splinting should be used only when a dislocation is otherwise to be feared, the tear of the ligaments being an extensive one.

The following is the modern treatment of a sprain: prolonged massage, in a proximal direction, while the member is subjected to moist heat; and, subsequently, the application of a moderately firm support by adhesive plaster strips. Immediate resumption of use of the joint is thereupon advised. This is often surprisingly painless, after such treatment; and the final results are not only better, but much more promptly obtained.

To some extent a contusion should be treated, if seen equally early, as is a sprain or other laceration of some subcutaneous part. In either case the prompt massage prevents the effused blood from firmly clotting where it escaped, and redistributes it. This is highly desirable, for then the torn flesh can quickly unite in natural relationship, instead of being separated by blood-clots, which would have to organize slowly. Again, the heat has the

effect of contracting the blood-vessels—a thing which poulticing does, always and everywhere,—thus rendering the bleeding less, both in amount and duration.

Massage is also of extreme value later on, in promoting nutritive activity, absorption of plastic or inflammatory deposits, loosening adhesions, soothing irritated nerves, sometimes even restoring their function when it has been mechanically lost through pressure effects,—and in many ways aiding nature to overcome the results of the contusion or the laceration. Indeed, massage applied by skilled hands is doubtless our chief reliance; and in conjunction with heat (or sometimes cold) may be considered to fulfil in some measure each of the five indications mentioned under the heading of Treatment.

Robert H. M. Dawbarn.

[1] Beck's Medical Jurisprudence.
[2] Devergie: Médecine légale, tome ii., p. 57.

CONVOLVULACEÆ.—(*The Morning-Glory Family.*) Aside from the use of the sweet potato as a food and starch-producer, this family is of medicinal interest only because of the resinous substances yielded by the tubers and tuberous roots of a number of species, and used as purgatives. The most important of these are discussed under the titles *Jalap* and *Scammony*. Others deserving of mention for the same properties are *Ipomœa pandurata* (L.) Meyer (Man-in-the-Ground, Man-Root: Wild Jalap), *I. Orizabensis* (Pel.) Ledal (Male Jalap), *I. simulans* Hanbury (Tampico Jalap), *I. Turpethem* Br. (the Turpeth of East Indian medicine) and *I. biloba* Forsk., also of India, and which contains an alkaloid. The properties are not confined to the parts named above, as the stems and seeds of some species are used similarly.

Henry H. Rusby.

CONVULSIONS.—Convulsions consist of abnormal, exaggerated muscular contractions.

Classification.—Some modern writers make the term convulsion synonymous with hyperkinesis, and thus include under it all the different clinical forms of abnormal exaggerated muscular contraction. This, is, however, an arbitrary extension of the common and accepted use of the word. The true relation of convulsions to the other hyperkineses is shown in the following table:

The hyperkineses or spasmodic disorders.
- Tremor
  - Fibrillary.
  - General.
- Contracture.
- Cramp.
- Chorea and Tic.
- Myotonia.
- Myoclonus.
- Muscular tension. (Hypertonia.)
- Tonic spasms } Convulsions.
- Clonic spasms }

Thus the term convulsions does not include those forms of hyperkinesis known as tremor, cramp, muscular tension, and contracture.

Convulsions, as indicated above, may be of a *clonic* character, that is, the muscles rapidly and alternately contract and relax, or they may be of a *tonic* character, that is, the affected muscles remain persistently contracted for minutes or hours. Clinically we find that these two types are often combined, as in epilepsy. Convulsions may affect the voluntary or the involuntary muscles. In the former case they have been termed *external* convulsions, in the latter *internal*.

Convulsive affections of the involuntary muscles are, from physiological necessity, of a tonic character. Something almost like a clonic convulsion, however, occurs in post-partum uterine contractions, in colicky affections of the stomach and intestines, and probably in the movements of the stomach in vomiting. The spasmodic disorders of the involuntary muscles, as in asthma, vasomotor spasms, intestinal spasms, etc., are not generally considered under the head of convulsions, and the reader is referred to these special topics. The term internal or *inward* convulsions has become popularly applied to laryngismus stridulus. Convulsions, as regards their extent, may be divided as follows:

I. General convulsions.

II. Partial convulsions: (*a*) unilateral; (*b*) those affecting certain muscles or muscular groups, known as local spasms or "tics."

The term spasms has come to be used as a very general one, identical with hyperkinesis, and it is in this general sense that I shall employ it. To avoid confusion, however, the reader should remember that older writers (Willis, Cullen, Linnæus) used the word spasm to designate the tonic form of convulsion; later writers, especially those of the French school (Savary, Georget, Brachet, Ferrand, Fauvel), define spasm as a convulsion of the muscles of organic life; while some German and English writers use the word when referring to localized convulsions.

A convulsion is only a symptom, and its presence may indicate in different cases very different pathological conditions. In many cases, however, the fact of the convulsion is about all that we know of the morbid state. In accordance with this we divide convulsions into the symptomatic, or those which are the expression of a tangible morbid change, and the idiopathic or essential. Practically we cannot perfectly carry out such a division, since such diseases as epilepsy, eclampsia, and chorea, although usually idiopathic, are sometimes caused by a morbid structural change or irritant, which is not recognized. It is customary, however, when an organic lesion is known to be at the bottom of those convulsive attacks, which are ordinarily idiopathic, to indicate the fact by some change in the terminology. Thus symptomatic epileptic convulsions are spoken of as epileptoid. Much confusion exists as to the terminology of the different pathological forms of convulsions. It is better, however, to adhere, as a fundamental distinction, to the division of convulsive disorders into only two types, viz., the idiopathic and the symptomatic, while the much-used terms sympathetic and reflex should be made subdivisions of these; for certainly the convulsions that result from a gross intestinal irritation or a pronounced blood poison are truly symptomatic. On this basis we make the following classification:

I. *Essential or Idiopathic Convulsive Disorders.*—(*a*) Those of a general character: epilepsy, hysterical and hystero-epileptic or hysteroid convulsions.

(*b*) Those of a partial character: Wry-neck, writer's cramp, spinal trepidation, salaam spasm, various peripheral nervous spasms or "tics."

II. *Symptomatic Convulsions.*—(*a*) Reflex, from wounds, injuries, inflammatory or other irritations of excito-reflex nerves. (*b*) Direct, from meningitis, tumors, hydrocephalus, focal brain lesions, brain compression, cerebral anæmia or hyperæmia, blood poisons, acute diseases.

There is such considerable confusion in the terms used by medical writers on this subject that the following further explanations are necessary. Eclampsia in infants is in many cases only symptomatic. In other instances, however, no known direct or reflex cause exists, and these form the genuine "essential" convulsions. In puerperal eclampsia, also, there is often a toxic agent at work, of which the convulsion is the clinical expression; but at other times it is a true convulsive neurosis. These true non-symptomatic cases of eclampsia are spoken of as *acute epilepsy*.

It is very evident that, as pathological knowledge advances, many of the convulsive neuroses will be relegated to the category of symptomatic diseases. This seems to be already the case for hydrophobia.

Etiology.—In studying the general etiology of convulsions I necessarily exclude tetanus and hydrophobia, which are markedly distinguished from the other forms.

Predisposing Causes.—There is a certain unstable condition of the nervous system which predisposes toward convulsions. The nerve cells are like a too inflammable tissue, which flares out at the smallest spark. The state may be spoken of as one of convulsibility. This "convulsibility" is greatest during the first two years of life,

during which time eclamptic attacks are most frequent. It then falls till the fifth year, to rise again as puberty approaches. During these years, from six to sixteen, most cases of epilepsy develop. Convulsibility then gradually declines, and few cases of the convulsive neuroses arise after the age of thirty. Convulsibility is somewhat more pronounced in girls and women; and is heightened at the menstrual periods and climacteric. It is, as a rule, lessened during pregnancy, and is increased by sterility in women, and by sexual excesses or depletions in both sexes. The convulsive diathesis may be inherited, connate, or acquired. It is inherited in about one-third of the cases from ancestors of a neuropathic or tuberculous constitution. It is connate as the result of frights, injuries, or nutrition disturbances received by the pregnant mother; perhaps also as the result of intoxication of the father during the sexual act. Convulsibility is acquired, in the young, by infectious fevers, bad food and air, chronic diarrhœa, hemorrhages, and especially by rickets. As the child grows older convulsibility may occasionally be developed by bad systems of domestic and school training, and over-indulgence in emotion. At the time of puberty the abuse of the sexual function, great excess in the use of alcohol, tobacco, and absinthe, worry, fright, and mental strain, come into play. After manhood or womanhood is fully reached, it is only by the powerful and persistent action of depressant and disturbing forces that a convulsive temperament is acquired. Latent tendencies may, however, be brought out at this period.

Climate and season have a slight influence over convulsibility. Tetanus occurs oftener in cold weather; epileptic and choreic attacks occur oftener in the spring and autumn, and on wet, cloudy days, and these diseases are more frequent in temperate climates.

Race is undoubtedly a factor in predisposing to convulsions.

Exciting Causes.—These are very numerous, but vary in character chiefly with age. For details on this point the reader is referred to the special articles. Here it can only be said that in infancy the most frequent exciting causes are: pressure on the brain from meningeal, hydrocephalic, or hemorrhagic effusions, and depressed occiput; blows, acute diseases, fright, and dental or gastro-intestinal irritations. At an older age we find scrofulous tumors, uræmic poisoning, sunstroke, sexual irritations, intemperance, syphilis, the puerperal state, as active factors. Still later, cerebral tumors or hemorrhages, and injuries to the skull are potent. At all ages there is a large class of drugs which can excite convulsions; among these are lead, strychnine, thebaine, papaverine, and narcotine.

Physiopathology.—For the special pathology of the convulsive neuroses, the reader is referred to the special articles on these diseases. There are certain facts in the mechanism of their production, however, which are common to all. In a convulsive attack there are brought into functional activity—

1. A nerve centre, which is discharging its force with excessive violence.
2. Outgoing or efferent neuraxones.
3. Their peripheral end plates, and the muscle or end organ.

In reflex convulsions we must add—

4. Afferent excito-reflex neurones, carrying excitations to the irritable centre.

In order that a convulsion may occur, the nerve centre (1) must be unduly irritable or unduly stimulated, until it is made unstable; the other factors in the mechanism, (2) and (3), must be intact, and the convulsion will be favored by their being in an over-irritable state.

The agents which affect the nerve centre (1), making it over-irritable and explosive, are:

(*a*) Some inherent defect in cell nutrition, as in essential convulsions.

(*b*) Some direct chemical or mechanical irritation, as in toxic and sympathetic convulsions, and in those caused by organic disease.

(*c*) Powerful excito-reflex impulses.

Local and limited convulsive movements may be caused by irritation or interference in the regular conduction of the efferent nerves (2).

To the machinery thus described modern physiology adds another factor, viz.: 5. An inhibitory mechanism. Certain parts of the cerebral nerve centres have an inhibitory action over the function of other parts, rendering the motor cells more stable and less liable to part unduly with their energy. A convulsion may result from a too great weakening or entire loss of this inhibitory force. In the developing and undeveloped nervous system of the child, the inhibitory powers are imperfect; hence a greater convulsibility at this age.

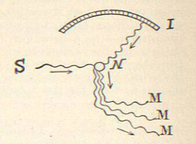

Fig. 1514.—Diagrammatic Illustration of Convulsions. I, controlling centre; N, motor nerve centre, from which neuraxones run to M, groups of muscles, and S, excito-reflex neuraxones. A convulsion may be caused by an over-irritation of N or of S, or by a depression or paralysis of I.

The more localized convulsive movements in chorea and the "tics," or local spasms, have a different origin from the foregoing. Here there is some irregular irritation of the motor cells. Thus, choreic movements are produced by irritation of some parts of the voluntary motor neurones; facial spasm generally by some irritation of the neurones of the seventh nerve. The part that the spinal cord plays in producing convulsions in man is not great and has been exaggerated. Eclampsia infantum, for example, is not the result of the defective inhibition of the brain upon the spinal cord, but rather a defective inhibition of certain higher brain centres upon lower. We see instances of true spinal convulsion (spinal epilepsy, spinal trepidation) in chronic diseases of the spinal cord implicating the pyramidal tracts, at the beginning of the third stage of anæsthesia, and in infants, children, or sensitive adults just as they are dropping off to sleep.

Symptoms.—The general convulsions of eclampsia, epilepsy, hysteria, and hystero-epilepsy have common features. There are often prodromal symptoms, indicating an over-irritable or depressed state of the nervous system. The attacks themselves come on suddenly, sometimes with an immediate prodromal symptom or aura. The muscular movements are irregular and incoördinated, except in some phases of hysterical and hystero-epileptic convulsions. Consciousness is generally abolished, as are also sensibility and the reflexes. Very marked secretory disturbances occur. The vasomotor system is greatly involved, especially that part which controls the blood supply of the brain. The face and probably parts of the brain are at first blanched, but the anæmia is soon followed by pronounced passive hyperæmia. In eclampsia infantum, however, the first sign of the impending attack is sometimes a cerebral hyperæmia, and the convulsion may be arrested by pressure on the carotids. Respiration is disturbed, and the heart beats at first more slowly, then more rapidly than normal.

Diagnosis.—The diagnosis of a convulsion is easy. One has only to differentiate it from malingering. The state of the pupils, of the reflexes, and of the sensibility, and the want of art upon the part of the malingerer, are generally quite sufficient to clear up the case. As to the form of convulsion, the difficulty in diagnosis may lie first in determining whether an attack is one of eclampsia or of epilepsy. Eclampsia occurs oftenest before the age of two years; the attacks are less sudden, more irregular, more prolonged, and less severe than in epilepsy. Usually there is no frothing at the mouth. After the age of two, idiopathic convulsions are most probably epileptic. It is important to distinguish between hysterical, hysteroid, and epileptic convulsions. All that I can say here, however, is that in the two former types the movements are more co-ordinated, consciousness is not entirely lost, sensibility may be present, and hallucinations may develop.

It is very important to determine whether the convulsion is idiopathic, or symptomatic of some general disease, reflex irritation, or organic central affection (see *Chorea*, *Eclampsia*, *Epilepsy*, *Hysteria*).

In some forms of convulsions it is necessary to make an anatomical diagnosis. If the symptoms are in the main bilateral, the cause is to be referred provisionally to the medulla; if they are unilateral, or involve special muscular groups, the convulsion is presumably symptomatic of a lesion in some part of the intracranial pyramidal tract, basal ganglia, or motor cerebral cortex of the opposite side.

There is a certain probability that convulsions in infancy are essential; in childhood are meningitic, febrile, or epileptic; in maturity and old age are symptomatic of syphilis or structural lesions; in women are hysterical.

Prognosis.—As regards the attacks, the danger to life is greatest in infantile and puerperal eclampsia; next in the degree of danger comes a special form of convulsion, viz., laryngismus stridulus; then follow choreic and epileptoid convulsions, epilepsy, hystero-epilepsy, and hysterical convulsions. As regards recurrence and final cure no general comparisons can be profitably made.

Treatment.—The general principles governing the therapeutics of convulsions are nearly the same for all. For the attacks, removal of sources of irritation, the use of chloroform, ether, morphine, amyl, nauseants, bromides, and chloral are indicated. For the disease, removal of all direct or reflex irritants and a treatment calculated to lessen the irritability and increase the tone and nutrition of the nervous system are indicated.

In the convulsions of children the common and effective practice is to place the child in a warm bath. In convulsions of adults, when drugs cannot be given by the mouth, enemas of thirty to forty grains of chloralamid are efficacious. In hysterical convulsions hypodermic injections of apomorphia, gr. $\frac{1}{4}$, or morphia, gr. $\frac{1}{4}$, may be given.

Charles L. Dana.

COOPER'S WELL.—Hinds County, Mississippi.

Location.—Twelve miles east of Jackson (by stage) and 4 miles from Raymond.

This is one of the famous old-time resorts of Mississippi, and the waters of the well have attracted more attention in days gone by than any others in the State. The well is one hundred and seven feet deep and its flow very abundant (Walton). The following analysis was made by Prof. J. Lawrence Smith:

One United States Gallon Contains:

Solids.	Grains.
Potassium sulphate	0.61
Calcium sulphate	32.13
Sodium sulphate	11.71
Aluminum sulphate	6.12
Magnesium sulphate	23.28
Sodium chloride	8.36
Calcium chloride	4.32
Magnesium chloride	3.48
Iron peroxide	3.36
Calcium crenate	0.31
Silicon crenate (?)	1.80
Total	95.48

This is a very valuable mild chalybeate water, containing a certain proportion of purgative salts and bearing considerable resemblance to the waters of Bocklet, near Kissingen, in Bavaria. This combination adapts the waters to numerous conditions in which anæmia is associated with constipation or abdominal plethora. Its effects are found to be very satisfactory in dropsy and in chlorosis. In chronic diarrhœa it has long held a high repute. The water acts as a diuretic or aperient according to the quantity used and the mode of drinking.

James K. Crook.

COPAIBA.—Balsam of Copaiba. "The oleo-resin of *Copaiba Langsdorffii* (Desf.) O. Kuntze, and of other species of Copaiba (fam. *Leguminosæ*)" (U. S. P.). Of the sixteen gigantic trees of this genus, twelve are tropical American, and of these seven are known to contribute to the copaiba of the market, as follows:

C. Langsdorffii (Desf.) Kuntze, *C. confertiflora* (Benth.) Kuntze, *C. coriacea* (Mart.) Kuntze, *C. oblongifolia* (Mart.) Kuntze, all of Brazil, *C. officinalis* Jacq. in the Orinoco valley, and *C. Guyanensis* (Desf.) Kuntze and *C. multijuga* (Hayne) Kuntze of the Amazonian region.

Several species furnish ornamental woods for cabinet work, the so-called "amaranth," or purple wood, being one of them. The timber is also highly prized for boat and wheel making in tropical America, and the seeds are used like vegetable ivory, for small objects.

Collection.—The stems of the copaiba trees contain numerous oil canals and cavities, in which the liquid is accumulated as turpentine is in those of the pine trees. But the copaiba canals are much larger, sometimes even exceeding an inch in diameter, and they traverse the whole length of the stem. Into these the copaiba is freely secreted. Indeed, the pressure of it in them is said to be sometimes so great as to split the trunk itself and to find spontaneous exit, as is also true of one or two other oleiferous trees. As may be supposed, the process of collection is simple enough: a deep gash cut into the trunk, reaching the heart-wood, hollowed and slanting below so as to collect the flow, provided with an improvised spout made from the bark itself, or with a leaf, and a receptacle to contain the oil as it flows in a steady stream, are the essentials. It is carried on mostly by the Indians. The yield is enormous, and may reach from ten to fifteen gallons from a single tree.

The principal amount, as well as the finest quality of this drug, is exported from Pará, in Brazil, generally in barrels. Other Brazilian ports, as well as Angostura, Cartagena, Maracaibo, and Trinidad, also export that which is collected in their respective neighborhoods. The products of different countries vary a little in their sensible qualities, and are, in trade, designated by their geographical names; that of Pará is thinner and paler, and rotates the polarized ray to the left; those of Venezuela and Trinidad are thicker and brownish, and rotate to the right. Some species are, moreover, opalescent, others perfectly clear. There is the greatest difference in their medical efficiency.

Copaiba has been known in Europe something more than two hundred and fifty years. Its usefulness was learned from the aborigines of Brazil, among whom it was highly esteemed.

Description.—The consistence and color of this substance, although probably depending in part upon its natural amount of oil, vary also with age and exposure, becoming thicker and darker as the oil evaporates. Fine fresh Pará copaiba is a clear liquid, about as thick as Canada turpentine, and of about the same color. It is often darker, however, and may have a deep golden yellow, or even a sherry tint. Copaiba has a peculiar, aromatic, somewhat terebinthinous odor, and a persistent, bitter, biting, disagreeable taste. Its specific gravity varies from 0.916 to 0.993, and it is soluble in absolute alcohol and in four times its bulk of petroleum spirits. Some varieties, as noted above, are not quite clear, and are sometimes fluorescent. In evaporating a small quantity, there should be no odor of turpentine, and the residue, when cold, should be hard and easily rubbed to powder. It should not boil under 482° F. and should rotate to the left 28° to 34°. Four drops, carefully added to a mixture of half an ounce of glacial acetic acid with four drops of nitric acid, should not afford a reddish or purple color.

Composition.—It contains from forty to sixty, or even eighty per cent., according to its fluidity, of an *essential oil* of the composition $C_{10}H_{16}$, or $C_{20}H_{32}$, of high boiling point, and the odor and taste of the drug itself. A good Surinam article contains seventy-eight per cent. This is also official (*Oleum Copaibæ*, U. S. P.). The crude *resins* left behind in the distillation are also official, under the name Resin of Copaiba (*Resina Copaibæ*, U. S. P.). It is a brownish-yellow, brittle substance, with the appear-