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CEREBRO-SPINAL SYSTEM,

INCLUDING EPILEPSY,

Its Physiology, Pathology and Treatment.

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[Read before the Medico-Chirurgical College, March, 1861.]

Gentlemen—On retiring from the chair, at the meeting held at Dr. A. B. Mott's, I offered for the subject of discussion, "Epilepsy, its Physiology, Pathology, and Treatment." As the habit in this College is to read a preliminary paper, I shall occupy your time only with such views as have been more recently propounded by others, and with the conclusions and results derived from my own observations, rather than by the repetition of more ancient surmises, which were founded on no scientific investigations, and which therefore offered no rational deduction for treatment.

But after considering in what manner I should treat the subject so proposed, numerous difficulties arose as to whether it should be merely taken up by a rigid adherence to the matter itself, or whether a more general and broader outline, embracing other connections and disorders,

but which are not unfrequently precursory concomitants, or subsequent complications, would not be profitably adopted. I have concluded upon the latter, and beg that you will excuse a more discoursive entrance into the subject, than a mere logical adherence to the matter would permit; since epilepsy is a disorder starting from many points of induction, although the chief seat of its objective phenomena is encompassed in a strict regional boundary—the medulla oblongata. Yet, to understand in what manner this cranio-spinal portion of the cord becomes the great focal point of radiation in the manifestations of this terrible disorder, a knowledge of its central actions, and of its reflective enlistment, whether from the conducting nerve-fibres of the brain and spinal cord, or from the various viscera and periphera, is highly essential.

Therefore, in a disorder implicating so many conditions of the sensific, motor, and psychical apparatus of the body, a clear conception of their reciprocal relations, as well as of their independent action, is necessary, in order to comprehend their disturbances, either as direct sequences, or as indirect manifestations in the course of the epileptic disorder. By this comprehension the nature of the disease will be more clearly unfolded, the premonitory symptoms will become more instructive, and a nearer approach to a scientific therapeutical conduction can be made.

In searching for the seat or cause of any disorder of the motor nervous system, the objective phenomena should be correctly classified. A single muscle, or groups of muscles, may be affected, either by central disturbance in the ganglionic cells themselves, or by their incitement to action through eccentric or reflex conduction. This reflex incitement may reside peripherally, extra-cranial, or spinal; or, it may arise within the cranium, or in the cord itself. For instance, the point of irritation may be seated in any part of the superficies, or it may reside in the posterior spinal columns, and thence be reflected to the associated ganglionic motor origins in the anterior or true motor columns. When intra-cranial, the point of irritation may lie either in the cerebrum proper, whereby its conducting fibres are implicated, or in those portions in which the psychical manifestations originate. Every irritated sensory fibre can induce or increase reflex sensibility of the cord, by centripetal action.

In these conditions, two things are to be remembered. The motor centres may be in a normal state themselves, the inciting condition being anormal; or the conducting fibres may be in a true physiological state, whilst the motor ganglionic cells may be overexcitable, or hy-

pertrophic either as to number, by which the amount of muscular action is exaggerated; or as to inherent irritability or excitability, by which the force is proportionately overgenerated.

This hypertrophic excess bears an inverted proportion to the opposite condition—viz., the atrophic. In the former, an undue supply of arterial blood may serve for the increase; or, the supply being normal, some special constituent of the blood may be in excess, or defective in quality, by which nutritive energy or functional manifestation is exalted. But, both these latter conditions are not unfrequently established, independently of any peculiar blood composition, through an irritable or overexcitable state of the conducting fibres.

In nervous atrophia, the opposite exists. The arterial blood may be insufficiently or defectively supplied, whereby the organic products are stinted, or rendered inert, although the cerebral impulse may be healthy. These states are instanced by those in whom the order or will is greater than the power or execution. Another form of atrophia is found in the executive portions of the nervous centres, from the impeded or impaired condition of the conducting fibres, or of the psychical portions of the brain. Here the motor centres fall into the peculiar changes incident to parts whose functions have been long abrogated, and which may be termed the *abuse of disuse.*

It is in these latter, particularly, that a paralytic state may exist in the structures deriving their nerves from these atrophied centres, whilst a convulsive, spasmodic, or tetanoid condition of the associated or consensual parts exists, especially when the muscles thus partially paralyzed are endeavored to be acted on by the will, the impulse being distributed through those ganglionic cells giving origin to the nerves going to the associated muscles. Reflex causative action, both peripheric and cerebral, may happen in several ways. The impression may be conveyed through the peripheral sensory filaments of the paralyzed muscle or limb to the motor centres, or it may excite involuntary contraction in the sound limb, but which can be more or less restrained by the voluntary action of the brain; or the organic system may be excited, producing static changes in the various viscera, with spastic retention or expulsion of their contents, &c.

Although these various manifestations of the nervous system relate more to the multiform states of paralyses, yet the comprehension of the anatomical dependencies and physiological relations is all-important in the study of many nervous disorders, and especially of epilepsy. But I shall endeavor, in the physical details, to mingle as much physiological and pathological result from disordered regional action as

will relieve the tedious tension of the mind, which is so apt to accrue from mere anatomical description.

The medulla oblongata is the additional intermediate organ between the spinal cord and the brain. And, in advance of entering on the subject, I will here state that this intermediate portion is without doubt the seat of the chief objective phenomena of epilepsy. From this point of radiation the muscular disturbances ensue; and whether the *punctum saliens morbi*, or point of irritation, be in the brain, spinal marrow, mucous or cuticular surfaces, yet the phenomena constituting the fit of true epilepsy must arise in great measure from the engagement of the medulla oblongata, or from its being centrally affected.

In the medulla oblongata, as in the spinal cord, a median furrow exists, interrupted by a decussation of fibres below the pons varolii. Internally, on each side of this furrow, arise the pyramidal bodies, which extend into the pons varolii. Externally, are seated the corpora olivaria, which do not extend into the pons, but are separated from it by a deep sulcus. Each olivary body is connected to its fellow by intercommunicating fibres, which arise from the ganglionic cells, to pass through the raphe of the medulla oblongata; whilst the nuclei for the hypoglossal nerves, on which the motions of the tongue chiefly depend, are in close apposition to these bodies on their respective sides. These latter nerves take their origin from a large number of multi-polar ganglionic cells. The corpora olivaria are thus anatomically connected, and become physiologically auxiliary to the hypoglossal nerves, whereby certain lingual motor combinations are effected. It may be well to remark here, that the olivary bodies do not exist in fishes, or in the amphibia, whilst in the lower mammalia they are more or less rudimental.

In other words, these bodies are developed according to the two great functions of the tongue—viz., combined movement and articulate speech. The hypoglossal nuclei lie close to each other, near the raphe, their simultaneous action being secured through fibres of intercommunication. By a like arrangement, the corpora olivaria are acted on bilaterally. The hypoglossal intercommunicating fibres are limited, so that unilateral motions of the tongue can be voluntarily excited. But, for the combination necessary for articulate speech, the bilateral harmony must be insured. Hence, in hemiplegia, paralysis of the movement of the tongue, differs from that of the combined consent for articulation and the sustained action of speech. The orders of the will must be communicated simultaneously to both olivary bodies, to secure their harmonious engagement, and that of both hypo-

glossal nerves. In deglutition the same conducting influences must be preserved.

Sustaining the results of direct experiment are the records of pathological investigation, showing that the corpora olivaria are frequently found in various morbid conditions in paralysis attended with loss of speech. And more confirmatory are the researches establishing, in cases of congenital atrophy, or of arrested development and growth in these bodies, the coincidence of aphonia, difficulties of deglutition, and more or less loss of command of the tongue. Cases have also been reported, and have been examined by myself, in which loss of speech resulted from inflammation of the pons varolii, as well as of the corpora olivaria. In the former, neuralgia is generally a prominent symptom.

But these ablations of special functions are not to be always attributed to lesions of these bodies, or of the associated hypoglossal nerves, since the defects of muscular consensual performances may be confounded with absence in the mental conception of language and memory of words; or with those lesions implicating the traditional action of the will, as when the striated bodies are impaired, and which are attended with paralysis of motion of other portions. Injuries to the anterior frontal cerebral lobes, especially, are apt to be followed by what is commonly termed imperfection or loss of speech. But in these cases the conception of language, or rather of ideas *for* language, is more impaired than the power to execute is destroyed. Nor must those cases where both the conception and the olivary function are not disturbed be confounded with those in which the *conducting fibres* are exclusively at fault. In several cases falling under my own observation, I have found that the patient could not voluntarily communicate his thoughts by speech, although the reflex movements of the tongue were perfect; yet he could do so by writing, indicating an interruption through the conducting fibres, but showing that the *conception* of language was intact. Again, I have witnessed the imitative or repetitional actions perfect, without corresponding conception; thereby evincing the integrity of the conducting fibres and of the corpora olivaria, but showing that injury to the originating sensorial portions of the brain had taken place, as was afterwards verified by post-mortem examination.

Traumatic injuries of the frontal bone, whereby the anterior portion of the cerebrum has been compressed or otherwise temporarily injured, have not unfrequently resulted in loss of speech, which has

been in some cases restored by surgical aid, or by the recession of the local disturbance.

These cases indicate the ablation of the conceptional power within the brain, and not of the capacity of performance through the olivary bodies and hypoglossal nerves. For although articulate speech is lost, yet the *voice* can be excited through reflex actions of the various surfaces, and especially by those attended with severe pain. But these centres, during long-continued arrest of the cerebral actions, are liable to fall into pathological changes, or into a physiological proportion of functional relation. Hence softening, fatty, or atrophic degeneration, induration, &c., occur, whereby not only the voluntary, but the reflective actions are lost, or rendered feeble. Even if the injury of the anterior lobes be recovered from, yet the olivary bodies are apt to undergo certain transmutations, which may abrogate their function, in accordance with the law which governs the propagation of consensual morbid states in organs correlated in function, or from the more general law which regulates the reproductive energies in parts functionally reciprocal.

The congenital cases of the deaf and dumb cannot all be placed to arrest or imperfection of development in fœtal life. The injuries sustained during labor by the anterior lobes from mechanical pressure of the pelvic bones, or by the instrumental or digital manipulations, must be taken into consideration. Nor need we expect to find a direct traumatic lesion, or its indication, when examining the brain in such accidental cases; since the pressure so exerted may merely induce a change in the molecular constitution of the impinged-on lobes, by which their nutrition is disturbed. And the same may happen to the posterior occipital region, whereby the medulla oblongata and its auxiliary ganglia, the pyramidal and olivary bodies, may be damaged, since the position of the parts are constantly varying, according to the flexed or extended position of the head. In some of these cases, a mere physiological atrophy is apparently established; as, in course of time, both hearing and speech become more and more established; differing in this progressive recuperation from pathological degeneration, in which there can be no improvement. Aphonia, alternating with sudden return of speech, is not uncommon in hysterical cases; but when accompanied by persistent hemiplegia, either in the male or female, some cerebral lesion must be concluded on. In one gentleman, whose voluntary command of deglutition and of speech was constantly varied from trivial indistinctness and inability to complete loss, I found, after death, a tumor in the pons, which pressed more or

less, according to the vascular condition, on the medulla oblongata, whereby the functions of the auxiliary ganglia, the olivary and pyramidal bodies, were interrupted. In this case, the legs and bladder were at times greatly paralyzed, probably from the interference with conducting fibres in the pons, and from the pressure exerted on the pyramids, whose function apparently presides over the movement of the extremities. There was also intense neuralgia.

Visible alterations or encroachments on the cerebro-spinal structures do not always appear on autopsical examination, to account for losses of function of their various parts. The changes are those of molecular nutrition, at times scarcely recognizable by the microscope. Yet in many such cases neither proper conception nor power of speech has been destroyed, but the memory of words and of their combination is lost. When spoken to, they are slow of comprehension, or are totally deprived of intellectual translation. Yet they will imitate the sound, or sometimes repeat like an echo a portion of the spoken sentence. It is, so to speak, a paralysis of memory, and not of the organs for speech. In others, I have witnessed a complete loss of memory of the customary language, with perfect return of another for years unemployed and forgotten. But these effects are not, generally, from special cerebral disorder, although I have seen them in the hemiplegic. They happen mostly as consecutive complications in diseases of other organs. But, when happening, they are generally prognostic of fatal issue. The temporary exchange of one language for another, arising from traumatic injury, or from fever, with cerebral engagement, must not be confounded with those just cited. In the case of a young medical gentleman from Georgia, who had suffered from the effect of deep cellular pelvic abscess, accompanied by delirium, and had been ignorantly bled into deliquium, followed by violent mania, I found that he had lost the memory not only of his language, but also of his parents, friends, and letters. His education had to be begun again, from the very alphabet, and for months he made but slow daily progress. One morning, on rising, like a flash of light, all returned to him, and the comparative imbecile of the night before became the son of science once more.

Injuries to the olivary body are apt to be followed by more or less paralysis of the facial nerve, through which the expression and motion of the corresponding side of the face are interfered with, as the superior portions of the olivary bodies are connected with the seventh pair of nerves; whilst the inferior are connected with the hypoglossals, which may be included in the lesion, producing great difficulty of

speech, &c. On the floor of the fourth ventricle the facial nerves are reciprocally connected, and are united to other ganglionic groups—viz., the trigeminal, which lie between the auditory and seventh pair. To the corpora olivaria thus belongs the power to express by the movements of the face the various passions. Paralysis or section of the first branch of the fifth destroys the reflex excitement for winking on *touching* the eye; yet it may be excited by the impression of a strong light on the optic nerve, after section of the fifth, arising apparently from a connection between the roots of the optic nerves and the nuclei of the seventh pair.

The anterior spinal columns pursue their course into the brain, through the pyramidal bodies. Injuries to these bodies are attended with muscular disturbances of the extremities. The lateral columns of the spinal cord do not pursue their course into the brain, but terminate in the medulla oblongata. They are brought into action by the pneumogastric nerves and by the orders of the will. These lateral columns preside over the movements of the trunk. Hence, in hemiplegia from cerebral hæmorrhage, whilst the muscles of the side opposite to the lesion are paralyzed, the movements of the chest remain intact. From the intimate junction of the vagi nerves with the fifth pair, and the connection of their nuclei with the longitudinal fibres constituting the upper portion of the lateral columns, any irritation applied to them will bring into action the muscles of the chest and abdomen. During ordinary respiration, the normal stimulus of the carbonic acid upon the peripheral portions of the pneumogastrics is conveyed to the lateral columns and phrenic nerves, by which the combined movement of the chest, diaphragm, and abdomen is established.

When the stimulus is persistent to these columns, and through them to the medulla oblongata, the muscles of the chest become fixed as in tetanus, and respiration may be fatally stopped. The descending longitudinal fibres convey the orders of the will to the centres of respiration; so that, although ordinary breathing is due to reflected stimulus, yet voluntary acceleration or retardation of the respiratory acts can be obtained. Hence we can understand how, in certain cerebral hæmorrhages attended with palsy, that although ordinary reflex respiration continues unobstructed, yet it may remain uninfluenced by the orders of the will, from the injury to the higher conducting fibres. In hemiplegia from decussative cerebral disorder, voluntary inspiratory efforts fail to excite equal dilatation of both sides of the chest; not because the respiratory centres themselves are

damaged, *but because their action can be only unilaterally invoked.* These independent sources of respiratory conduction form, at times, a valuable basis of diagnosis.

It is to be remembered that the medulla oblongata consists (or at least partly) of the longitudinal fibres derived from the cerebrum—that is, from the corpora striata, thalami, and crura cerebri—so as to connect them with the ganglionic groups from whence the nerves of the medulla oblongata arise, in order to convey to them the orders of the will. Other fibres also leave the medulla to ascend to the seat of perception in the gray cerebral matter. The olivary bodies thus become the instruments of the voluntary acts of deglutition, even after the reflex sources from the trigeminus are interrupted. The act of swallowing, voluntary or reflex, to be correctly performed, requires a bilateral adjustment of the necessary muscles, and therefore the bilateral integrity of the corpora olivaria is essential.

Although the medulla oblongata is generally called a continuation of the spinal cord, yet there are numerous other parts which either originate in it, or are derived elsewhere than from the cord. The pyramidal bodies are to be considered as the prolongations of the anterior columns of the spinal cord; decussation of their fibres taking place before they enter the medulla oblongata, to pass through the pons varolii as the four principal columns, which serve, according to Van der Kolk, for the regulation of the extremities. There are also transverse filaments rising from the medulla oblongata, which unite the two halves, and serve to insure its bilateral action, for the movements of the face, tongue, larynx, and chest.

We will now call attention to the numerous ganglionic cells contained in the gray matter of the spinal cord. From these cells in the cortical substance originate the nerve-fibres, which do not pursue, as formerly supposed, (until refuted by Ehrenburg and Remak,) a direct course through the spinal cord to the brain. These ganglionic cells are connected in groups, in harmony with the *anatomically prearranged* muscular groups, by which, from a stimulus applied, co-ordinated or consentaneous movements are insured. If this stimulus is diffusive, or has a peculiar affinitive property of acting on other cells, either associated or disjoined, the groupal movements will vary from simple motion, to convulsion or spasm. And this excitative or depressive influence may be communicated directly through the blood, or through the will, or by reflective excitement. The carpo-pedal spasms of teething children—the circulation or local absorption of certain poisons, as in hydrophobia, or in the special affinitive actions

from strychnine, woorara, &c., &c., are instances of these conditions. Some forms of cerebral affections, wherein the will is preternaturally exercised through certain channels, and of hysteria from utero-ovarian irritability, whereby reflex actions are propagated, are proofs of the direct as well as of reflected impulsion.

The ganglionic cells are more numerously collected in those depots from whence the larger muscular groups receive their innervation. The medullary matter or nerves act merely as conductors of the impulse so excited in the ganglionic cells. This power, being conducted to the muscles, either adds to, or excites into action, the inherent contractility of the sarcous elements.

It has been established by experiment, as also from symptoms during disease, that pain is not excited on transverse section or erosion of the gray matter of the spinal cord. The motor fibres for the extremities lie in the anterior columns, which are continued into the pyramidal bodies, and extend into, or receive fibres from, the brain; whilst the anterior portions of the posterior columns are received into the restiform bodies, or the peduncles of the cerebellum, whereby these bodies are endowed with sensibility. These lateral columns, as before stated, preside over the motion of the trunk. The posterior pyramidal and restiform bodies are probably derived from the cerebellum, and terminate in the medulla oblongata, by resolving themselves into numerous transverse fibres, through which the co-ordinate impulses are conveyed. But the anterior spinal columns do not merely give origin to the motor nerves. They probably receive organic filaments from the stomach and other viscera. It is well known, from vivisection or other special injuries to the anterior spinal columns, that these organs are apt to undergo certain pathological changes; whilst, from morbid irritation of the sympathetic filaments in the viscera, spinal complications have resulted.

As the pyramids pass and divide in the pons varolii a portion of the cerebellum, the transverse arched fibres passing to the restiform and pyramidal bodies probably form the conductors of the action of the will for co-ordination of movement. Pathological inquiry confirms this view: as, in injury to the cerebellum, the power of voluntary bilateral adjustment has been observed to be injured; although involuntary or reflex harmonization, as in yawning, leaping, &c., may ensue, either in the muscles whose nerves issue directly from the medulla oblongata, or in those from the spinal cord; whilst injuries of the pons varolii are found to coincide with loss of motor power of the extremities, as in hemiplegia, paraplegia, or crossed palsies, where the right

arm and left leg are affected. In cases of tumor or other growth pressing on, or developed within the pons, the symptoms vary from convulsion to irregular paralysis; or from paralysis of a single member, to the engagement of two or more, according to its extension, or the accidental vascular conditions of the surrounding parts. These may be accompanied by neuralgia or aphonia, dysphagia or vesico-renal derangements, from encroachment upon, or by irritation of, the medulla oblongata. These conditions I have seen verified on autopsy, and possess the specimen from one case.

In diseases affecting the structural integrity of the spinal cord, reflex actions not only occur, but are apt to become exceedingly troublesome, as the anterior and posterior nerve-roots are closely connected on the same level. In spinal paraplegia induced by softening, partial tabes, dissecting abscess, &c., reflex actions may be excited by tickling the foot, or by acts of defecation or urination, &c., although all direct voluntary command is lost. In some instances, the *act* of coition can be performed, although the *sensation* may not be transmitted to the brain, from the solution of continuity of the conducting fibres. Of this singular condition I have known several instances. Others, again, can only cause their muscles to contract by the voluntary effort being first excited through sight. They walk awkwardly, with their eyes constantly viewing the ground, so that the brain can be informed of the necessity for voluntary action, but they fall if their sight be interrupted, or if left suddenly in the dark; since the transmission of the impression on the soles of the feet is annulled, by which either the cerebral perception for voluntary progression is destroyed, or by the reflex actions becoming uncontrollable and purposeless. From these causes, I have known such sufferers ignorant of the position of their legs or arms when in bed at night, or at table, and who could not *rectify*, although they might *change*, their positions when wishing to do so, unless the sight could be employed for the direction. These cases are generally hopeless, and require great care in their conduction, as troubles from the bladder, rectum, and kidneys are apt to complicate the disease; whilst troublesome abscess or posture sores are of frequent incurrence. Some die, worn out by the mere local derangements of function making such vast drafts on the constitution; whilst others, in addition to these, exhibit cerebral extension, resulting from the severe efforts of the brain in effecting voluntary movements, by which more intercellular albuminous fluid is effused, productive of fibrillar atrophy, and its special results; or of softening, inflammatory or non-inflammatory, with disturbances or exaggeration

of intellect, varying from the incipient stages of mania to complete dementia or idiocy.

Although the chief seat of reflex motor action is in the spinal column, yet the brain exhibits like reflex conditions, both sensory and motor. Nor is the cerebro-spinal axis in itself merely subject to these states, as the nervous centres of organic life, from their connection with the spinal cord, may have induced in them reflex conditions, attended with disorder of secretion and nutrition. It is not uncommon, from injuries to the spine involving sensation and motion, to find the various internal organs disordered in function and changed in structure.

Most of the manifestations of cerebral function appear to be unilateral above the level of the medulla oblongata. Hence local hæmorrhagic effusion, softening, tumor, specific or other structural alterations of one hemisphere, or corpus striatum especially, induce unilateral decussative paralysis. Strictly localized *irritation* in a hemisphere may result in unilateral spasm or convulsion, unless abnormal irritability of the medulla oblongata exists at the same time, by which a bilateral action is propagated into those parts served by the nerves of that region, through its transverse fibres, or the commissures between the nuclei of the nerves, or their trunks, as in the facial, hypoglossal, &c.

The termination of the spinal sensific nerves is not in their point of entrance. They proceed upward, to terminate in the medulla oblongata. Nor do they penetrate into the gray matter of the anterior horns, the true seat of motor energy, or into the posterior horns of gray matter which appear to preside over the reflex and combined movements, and whose ganglionic cells give rise to the sensory nerves of the spinal cord. But the posterior sensory columns terminate in the medulla oblongata, and perhaps, according to recent investigations, partly amongst the group of ganglionic cells above. Hence the medulla oblongata is to be viewed as the seat of sensitivity, whilst the brain is the seat of perceptive sensation. The insensitivity of the brain proper, in its normal state, is known to every experimenter and operative surgeon.

From this arrangement for the reception of the descending and ascending cerebro-spinal fibres, the medulla oblongata becomes the focus of radiation of sensory impressions.

Although the fifth nerve is, in its thicker portion, termed a nerve of sensation, yet we must not allow ourselves to be led astray in reference to the true function of the nerve itself, and its terminations. These serve merely to convey the impressions received to the

medulla oblongata and the centres originating higher up, that the brain may exercise its function of perception. For the medulla oblongata can only be viewed as the seat of sensation when in connection with perceptivity. When the influence of the brain is cut off, the medulla oblongata becomes the seat of excitability or sensitivity. Wherever the filaments of this portion of the fifth are distributed upon an organ of special sense, the peculiar function of the part is heightened or lowered according to this relative condition. Hence we find that either taste, facial touch, smell, hearing, or sight, are influenced more or less in injury of its branches, independently of the alteration of certain secretory or nutritive actions. The fifth nerve then becomes a nerve *for*, rather than *of*, sensation. Its influence over secretion does not appear to depend so much on its own special endowment, as from its reticular connection with the organic filaments, although a reflex motor protection to the secretory surfaces is essential. Hence, severe injury or section of this nerve high up, may result in destruction or sloughing of the parts supplied by it.

The olfactory, optic, auditory, and gustatory nerves are called nerves of special sense; yet, in themselves, they do not convey to the brain the full measure of their functions for its perceptibility. This is effected through the fifth, which is everywhere distributed over the portions receiving the impression. Hence, injuries to the branches, or to the roots of the trigeminus, are always more or less attended with alterations of one or more of the perceptible functions of the organs of special sense. During insensibility, arising from pure cerebral causes, the organs of special sense may remain intact. The eye may be open and perform its office as a mere optical instrument; the ear and its special nerves may receive the sonorous vibrations, yet the focal point within the brain being disturbed, the measure of their impressions is lost. It is in this special condition of relation between the inner world of perception and the outer world of mere manifestation of function, that the sensific branches of the fifth pair hold so prominent a position.

The ganglionic cells of each organ of special sense differ from one another, and although their physical or functional actions may be correctly performed, yet the sensory transmission of the results of their peculiar offices appears to depend chiefly on the accompanying filaments derived from the fifth pair. And this special preparatory registration for cerebral interpretation seems to reside in the gangliaform vesicles, near the tactile papillæ or sensitive surfaces, and partly in the ganglia themselves, since destruction of the first of these especially, by cauterization, sloughing, or pressure, interferes with the per-

ceptive manifestation of the sense special to the part; surgical as well as experimental operations prove this, whilst medical records attest the same. My attention to the influence of the fifth pair over retinal sensitivity, and the nutritive actions of the organs of special sense, was attracted in 1843, by the results attending an accident to a lad at that time. He received a wound from a clam-shell, which accidentally cut completely through the supra-orbital branch of the fifth. Dimness of vision in the eye of that side immediately followed, whilst in the course of a few months a hard cataract formed, by which the eye was entirely blinded. In this case, I was early struck with the fact of the immediate injury to vision following the section of this branch of the fifth. It was too rapid to attribute it to alteration of nutrition, and hence I looked upon the disorder of sensory relation as the most prominent; whilst the nutritive changes, probably through injury to the accompanying organic filaments, were effected more slowly.

An impression generally exists that the brain becomes first affected during the administration of anæsthetics, by their absorption in substance into the blood. This opinion is only partially correct, as proved daily by the phenomena. All the upper portions of the peripheral nerves directly subjected to the influence of the anæsthetic agent during inhalation, become more or less rapidly impressed, by which a retardation of impressional conducting power is induced, in advance of the effect upon the brain. This, in very many cases, is consummated slowly. In some persons, the intelligent perception of surrounding circumstances remains; they can answer questions, rectify their positions voluntarily, and are conscious during the operation of not suffering pain. These conditions obtain mostly in superficial operations of parts supplied by the fifth pair of nerves, and which can be rapidly performed. In the operation on parts possessing sensory nerves from the spinal system, the absorption in substance of the chloroform or ether into the blood has to be effected. And even here, it is not always essential to carry the administration to the extent of submerging the brain. Held in the blood, the anæsthetic bathes every fibril of the nervous system, rendering both local conduction and central perception more tardy and less acute. With lying-in women I have communicated intelligibly, and have been assured that they were perfectly conscious of the uterine efforts being without pain. In these cases, the arrest of conduction resembles that produced by tumor or pressure on some portion of the tract of a sensory nerve. If, however, the etherization is carried beyond the point of local anæsthesia

to saturation, the whole brain becomes deadened, the respiratory functions decline, whilst the natural surfaces of the lungs cannot eliminate from the blood the agent which is already surcharging the brain, and which, in its retardation in the bronchial extensions, still further increases the non-conducting condition of the pneumogastric terminations, through which the necessity for aeration is communicated. Hence the central power for inhalatory movements and the peripheral impression for supply are both lessened. In some patients, this local or nervous inconductibility does not apparently precede the loss of perception. Unconsciousness is first established, whilst reflex muscular movements become greatly exalted. These are frequently mistaken for manifestations of pain, as cries are sometimes uttered and purposive actions are apparently effected. But these latter are mere groupal co-ordinations, and are similar to those seen in vivisections, where the cerebral lobes have been removed. During the complete cerebral anæsthesia the individual may revel in fancies or dreams. The brain, except in the power of outward manifestation, is active beyond its usual wont; it is æsthetic to every internal pleasure, but anæsthetic to every pain. Oftentimes, this brain revel is distorted by incomplete remembrance into apparent reality on awakening, and has given rise to statements which have resulted injuriously to the operator.

When the anæsthesia is complete, every fibre and ganglionic cell of the sensory spinal columns and of the fifth pair are locked in impassibility. Reflex muscular impressibility becomes more and more obtuse, till the respiratory centres are paralyzed, and death may stand imminently near. Yet, during all this approach of apparent dissolution, those organs whose reflective actions in part depend on the nerves of organic life still perform their duty. Nutrition is not entirely arrested. Secretions pour forth, and the uterus expels its contents. Sometimes, from the inequality of the anæsthetic effects on the right or left divisions of the sensory nervous system, or from some error of the central equilibriation, one side may be inertly relaxed, whilst the other may be convulsed by reflex action.

In this light, the fifth pair, in their thicker portion, must be viewed as nerves of connective relation between the automatic sensitive centres of the medulla oblongata and the upper irritable districts, and the perceptive cerebral lobes. These special relations of the trigeminal nerves, in their connective central manifestations, can be best studied in animals without distinct cerebral lobes, or during the progressive developments in the human embryo, in whom the basilar contents of the cranium begin first to be evolved. In acephalous monsters, although

the fifth pair may be anatomically distributed to the surfaces, as instruments of impressional translation, and of excito-respiratory action, yet they do not convey any true sensation, any more than is perceived during the anæsthesia from chloroform. Although such brainless children may cry when pricked or otherwise irritated, it is merely the cry of reflex vocal action, and not of voluntary response from perception. In other words, they may cry because they were pricked, but not because they were pained. In the normally growing fœtus, the cerebral hemispheres are developed subsequently to the basilar portions with intercommunicating fibres, whose office it is to submit the impressions received to the proper seats of perception, and to convert the mandates of the will, or the phenomena of the higher cerebral functions, into sensory manifestations.

From the views expressed above, a nearer approach to the interpretation of many of those remarkable and so-called mysterious phenomena witnessed in cataleptic, ecstatic, somnambulic, and like states, may be arrived at. In one, all power of voluntary motion may be lost, although the perception of impressions may exist, attended with reflex movement or not. In another, the power to will is intact, but the conducting fibres are paralyzed; whilst in a third, only such tracts are exalted which convey feelings and expressions of the highest ecstasy.

Of such conditions I have seen many examples. I have seen it even affect the person unilaterally, one side being willing to move, as she would say, whilst the other could not be persuaded to follow! In most of these so-called nervous cases, there has not been found, on examination, any definite structural changes to which they could be attributed. Not even to the microscope has been revealed any marked anormality of texture or of conformation. We have, then, to conclude that a specific influence has been exerted by some anormal condition in the nutritive fluids, as known to exist in many internal disorders, and in others, induced by external administration; or, that there has been a molecular perversion of the nervous masses themselves.

As molecular changes occur by the minute incidences of the rays of light, thrown from the surrounding objects upon the staff-like bodies of the retina through the auxiliary optic nerves and tubercula quadrigemina, so does every molecule of the transmitting ganglionic vesicles and in the recipient sensory centres change, in order to record upon the perceptive portion of the brain the impressions that have been received. This property of molecular variation may be likened

to that produced by the changing beads in the kaleidoscope, in which new forms are registered upon the eye at every movement. The beads remain the same, but new figures are induced at every change of position.

Through the sensory portions of the trigeminus the varying conditions of the acts of the nerves for special sense are rendered more acutely and rapidly to the seat of perception, independently of the fibres which pass from their central nuclei to the brain. In this respect the action of the fifth pair is similar to the application of the galvanic pole by the daguerreotypist to the reception-plate in the camera, by which in an instant of time the impression is etched. It is very certian that in themselves, the mere nerve-filaments exercise no influence beyond their power of conduction, the transmutations and combinations ensuing in the ganglia and ganglionic central cells. Through the same conducting channel travel pleasure and pain, which in many instances are but variations in degree; whilst through the same cerebral filaments traverse the orders of intelligence or the wild impulses of insanity. As, in written language, the alphabet becomes its molecular basis for intelligible combination, so in the nervous system molecular perturbations convey the results to the centres of motion and of perception; and these perturbations are focalized upon, and translated by the special recipient organs, according to their inherent properties.

The recognition of this principle is of more importance than at first would be supposed, since it gives a definite substantiality for the actions of thought, in place of mere metaphysical conjecture. Nutrition, as cognizable to us, is but molecular substitution—innutrition is molecular subtraction. Disease, whether from tumor, misplaced structural constituent, or subtle poison, from without or within, is but the cumulative evidence of molecular abnormities, be it in brain or ganglion, fluid or solid. For as there is a law of conformity, so is there one for inconformity. Oscillatory or perturbatory actions doubtless attend every corresponding impressional change in the nervous substance, attraction or repulsion ensuing in each ultimate particle, according to the laws governing the regulation of affinities. And these affinitive changes, and their results, are either normal or anormal, typical or atypical; healthful relations attend one, whilst deviations from the sound standard follow the other.

By this method of studying and comparing the natural processes with those inducing disease, a sound scientific basis can be attained. For it is to be remembered, that pathology is but perverted physiology. They stand to each other in the organic world as do right and wrong in the moral world.

The causes working disease are to be recognized—the cumulative evidences of its seat, or of its progress, are to be rigorously scrutinized, in order to detect the individuality of the agent, as men know the type of the bird or beast by examining its nest or lair, and can attract or repel, either by supplying or denying the materials necessary for their habitation. But neither nest nor lair describes the natural habits or configuration of the animal, or would make it known when seen. They must be studied and compared together. Hence, in disease, the natural phenomena are to be contrasted with those perverted or destroyed. The accidental, as well as the precursory organic changes as discovered on autopsy, are to be carefully separated.

In no disease are the autopsical findings more unsatisfactory than after fatal epilepsy. Although expert cerebral anatomists have clearly stated the results of their examinations, yet the essential causes of the disorder remain latent. Gross anatomical lesions are confounded with causes. The vital phenomena of the normal condition, their correlations and their irrelations, are yet too little comprehended to be able to define sharply the post-pathologic additions by the act of epilepsy, from the proximate lesions. The same apparent deviations from normal structure are daily discovered in the brain, and other structural portions of individuals, in whom the departure from the normal vital phenomena have totally varied. Ossific deposits in the dura mater or falx cerebri, enlargement of the Paccionian glands, stalactite or osteophyte growths from the base or dome of the cranium, tumors, tubercles, local or diffusive softening, induration, changes of consistence and color, aneurismatic pressure, hæmorrhage, congestion, or so-called vascular inflammatory changes, with exudation or transudation, arrest of development or local hypertrophy, plethora or anæmia, and a host of other pathological abnormities have been found, and set down as causes both of the symptoms and of death, in the cases examined. Yet these same lesions have been found, where neither insanity of perception, sensation, or of motion has attended, or were in correspondence with, the symptoms.

In the brains of the epileptic or maniacal, in whom other losses of function especially attended, many morbid conditions are at times discoverable on autopsy, and as yet no pathologist has clearly defined those findings in their relation to cause and effect. The laws which govern pathologic sequences or co-regulate morbid structural deviations, through mutual incongruities of assimilation, or through corresponding retrogression of cell-action, have not been kept rigorously in view, whilst the differential degrees between reparative excess and

reparative deficiency, or between the deposits of compensation or those of encroachment, have not been pointed out.

It is true that many expert cerebral pathologists can predict the nature and the seat of the morbid changes to be discovered on autopsy. They can foretell that inflammation, degeneration, or certain depositions will be found, and they can lucidly detail the results of the disease; yet it is equally certain that, with all their meritorious research, they have thus far failed to know for themselves or to teach others the differential morbid conditions between the proximate cause and the results. Nor, with all the knowledge gained by experimental study of the normal vital phenomena, has treatment advanced in successful antagonism to the morbid action, or with helpful assistance to the processes of reparation. Their labors so far have indicated the inutility rather than the utility of the treatment adopted; so that the remedial basis is at this day more of restriction than of active interference. Experimental as well as clinical observations, however, have shown that, as far as certain objective phenomena extend, they may be produced by, or are incurrent with, opposite conditions of the system. Thus, convulsions and other nervous manifestations may attend the reverse states of plethora, anæmia, &c.

The premonitions of the epileptic attack are various. They may issue from the organs of intelligence, of sense, or from the centres of locomotion or of function. So regular are these premonitions in some, that they will quietly announce and prepare for the convulsive stage. Others will exclude themselves, and pass through the attack unobserved. Unnatural conditions of taste and smell may afford timely intimation, or noticeable disturbances of vision and hearing may precede the seizure. The organic system in some is at fault, and evinces, by insufficiency or derangement of secretory action, the antecedence of the nutritive disturbances to the muscular engagement. Excessive or decreased micturition, sometimes accompanied by scalding; salivation or buccal dryness; acrid discharges from the nostrils or bowels; bitter, unsavory regurgitations, or seminal discharges, with or without dream, may give unerring signals to the afflicted.

Psychical changes more or less rapidly ensue in others. There is a misconception of time, place, and space. Errors of impersonation, or of the relative condition of rest and motion, occur, wherein all self-identity is lost, or others are clothed in unreal forms. Many are filled with visions of happiness for themselves, whilst they see their friends doomed to unutterable woe. Passions dormant during health, or restrained by moral force, burst forth with uncontrollable violence,

with risk to themselves or others. The timid become brave, the gentle become murderous, or the conscientious become unscrupulous and surreptitious. There is no phase of the human mind that may not either precede or follow the attack, and the knowledge of these conditions is most valuable in forensic as well as in clinical medicine.

In others no such warnings exist. The loss of consciousness is immediate, whilst convulsive struggles pervade every muscle; or beginning with facial distortion, extend regularly from the upper to the lower extremities, whilst the trunk is writhed backward and forward, or from side to side. Frequently the loss of consciousness is preceded by facial spasm or drawing of the head to either shoulder, whilst the shriek, so peculiar to epilepsy, announces the reflex engagement of the larynx and chest. Many dash rapidly forward, or run staggeringly backward, and fall violently on the face or occiput. In others a twitching of the muscles, with gradual rigidity of the limbs and trunk, precede for a second or two the more manifest tension of the muscles of the neck, by which the large venous channels are more or less impeded, whilst the glottis rises high towards the chin with a stridulous noise, produced by the reversed action of the diaphragm and by the intercostal muscles, from the increasing demand for air. The eyes protrude, or are moved from side to side, or upward and downward, with inconceivable rapidity, whilst the lids are opened or shut with spasmodic quickness, or are widely retracted. The mouth is distorted, the teeth are ground crushingly together; a thick foam is shot from the lips by the explosive contractions of the diaphragm, or it wells over the chin, streaked with blood from the bitten tongue. The integuments of the head, face, and neck are gorged with venous blood; the head is drawn rigidly back on the upper portions of the occiput, raising the shoulders in an arch from the ground, whilst the respiration is short and struggling from the tetanic fixing of all the muscles of the trunk and of the glottal aperture. The heart throbs violently; the bowels and bladder may be evacuated, and not unfrequently semen is ejaculated. Some die at this time of the fit from the fixing of the respiratory muscles; whilst in others, the high carbonization of the blood appears to subdue the nervous centres, and relaxation of all muscular tension ensues. The respiratory movements languidly recommence; the heart becomes less wild; the swollen veins assume their natural calibre; the countenance becomes pallid, although disfigured in some by dark ecchymotic effusion from the ruptured capillaries; whilst the mouth is relaxed, and the swollen, lacerated tongue fills its cavity. This is the "grand mal" of the French. The re-

newal of the fit may ensue suddenly, the duration varying according to the exhaustion of the nervous centres, and the contractile condition of the muscles themselves; or the interval may last from hours to months. Sometimes the injudicious and busy interference of the bystanders may again arouse, by reflex actions, the irritability of the centres, and fit after fit may be repeated, which otherwise, by cautious rest, might not have been excited.

In some attacks, when the spasms are about to relax, the involuntary muscles especially, and functions which were held in antagonistic submission, may evidence, by an overexcited physiological condition, their participation in the disorder of the nervous centres; vomiting, or other evacuations, hoarse, spasmodic coughing, screaming, phrenzied exclamations, or mad ragings, alternating with ecstatic vociferation or sputtering garrulity, may ensue. In others, the muscular paroxysms cease suddenly, and the brain instantly reacts. The previously distorted face becomes calm, the limbs assume positions of languor, and the patient, as though suddenly awakened from sleep, with a look of bewilderment repeatedly asks, "What it is all about!" when, admonished by the wounded tongue, and by the exhaustion of the aching muscles, he becomes conscious that he has just passed through an attack. Others, again, gradually emerge from unconsciousness into sleep, and many times are ignorant of having gone through the fit; or they pass from stupor into the heavy stertorous sopor of the apoplectic, which, after a time, again blends itself into calm and refreshing sleep.

The intervals between the attacks vary. Sound and vigorous health is enjoyed by some, whilst others, passing their time in constant dread, become peevish and irritable, or dull, morose, and selfish, with evident alteration persistently accruing in the cerebral functions. The temper becomes uncontrollable, thoughts explode as it were in the brain, and drive the unfortunate victim into expressions and acts beyond his power of resistance.

The epileptic attacks, by which the nutrition of the brain was first deranged, may cease in frequency, leaving the memory permanently weakened, or the higher intellectual faculties completely sapped. In others a reverse condition may ensue. The irritability of the reflective centres apparently subsides, whilst exaggeration of the cerebral functions increases. The memory and intellect assume greater power and vivacity, till the very confines of insanity are reached. But suddenly the attacks, which had been submissive to the irritation accruing in the upper brain, burst forth again; whilst the mind loses its excitement and tenacity, and debility bordering on general loss of volun-

tary motion or power pervades the body. A mid condition of these two states sometimes exists. There is an alternation betwixt insanity and epilepsy. The irritability of the intercommunicating fibres takes place, so that from any undue action in the brain, either of anger, joy, or fright, or from any unusual amount of muscular expenditure, paroxysms of insanity or of epilepsy may alternately ensue.

It appears impossible to discover in some cases of epilepsy what are the disturbing or exciting causes. But whatever may be the errors in secretion or of nutrition, it is necessary that the medulla oblongata should be in an already irritable state, or that this condition should be readily impressed. The centripetal points of irritative induction vary not only in different cases, but even in the same case. And where this impressible habitude exists in the medulla oblongata, or in the irritable districts above, a mere touch, especially when the conservative actions of the brain are withdrawn, as during sleep, or during intense application to any one thing, will serve to bring on the attack, the patient leaping, or rather springing like a fish, out of bed upon the floor. A misstep which either shocks the spinal column, or from apprehension calls suddenly on the co-ordinative regulation of the muscles, will sometimes be sufficient to induce a paroxysm. In one or two cases falling under my notice, the patients have stated that they were conscious of the commencement of the convulsive stage before losing their recollection. Others will say that they were "conscious of having become unconscious." In one case of this kind, this brief condition was rapidly followed by violent intertwining of the feet and legs, accompanied by grinding of the teeth, and with tumultuous action of the heart before sleep, or in the morning as just waking.

It is from their relation to paralysis, insanity, or imbecility, that the culminating issues or sequelæ of epilepsy become so anxiously interesting to the physician, and so fearfully dreaded by the patient and his friends. In no disease are the relations between the corresponding or associate functions of the brain more strikingly defined than in epilepsy. In the early conditions, either in childhood or more advanced life, idiocy may attend. The injury by which the intellectual functions are amerced may or may not induce paralysis. The result is as much a matter of situation, as of condition of nutrition. But when, with the early mental insufficiency, there exists muscular invalidation merging from complete paralysis of voluntary motion from certain destructive causes, into muscular atony from arrested cerebral development, or from defective nutrition, then the recognition of the laws mentioned in the foregoing portions of this paper must be made, in order to arrive at

therapeutic as well as at diagnostic conclusioms. Although it is true that many idiots are neither paralytic nor epileptic, yet it is equally true that these conditions are sometimes combined. And the same pathologic correlations exist in the deaf and dumb, (the statistical data of which I am ignorant.) But of the generalization of the law I am certain, having under my knowledge wherein, from intermarriage, epilepsy, insanity, paralysis, and idiocy exist in the same family. Thus seeming to prove that diseases are as progressively related as are the successive developments followed out in the animal creation. In the individual, diseases are intercurrent or consecutive; or they are non-intercurrent, and sometimes antagonistic. Of this every experienced physician and surgeon must have seen examples.

During the attack of epilepsy in those previously paralyzed, the phenomenon of convulsive movement may occur in the limbs, which had been long immovable by the orders of the will.

Sometimes an individual is attacked by cerebral paralysis with epileptiform convulsions, which may sooner or later assume or merge into the periodic seizures of epilepsy. In these cases, it is not uncommon to find either great hebetude or irritability, which may gradually pass into meaningless idiocy, partial dementia, or acute mania; and these resultants may accrue from mere physical causes, or from direct morbific extension, or from some deviation in the integral nutrition of several special portions of the cerebral lobes. This deviation of nutrition may be marked as hypertrophic or atrophic; or it may be only recognizable by the objective changes in color, softness, or density. They may coexist with inflammation, with intercellular albuminous exudation and fibrillar displacement or adhesion, attended or not by membranous implication.

These conditions are not merely persistent in those in whom epilepsy has followed an apoplectic seizure with paralysis. They may also be found in those in whom the epileptic phenomena have preceded the apoplectic. In minor degree they may accompany epilepsy alone, being probably as much resultants from the intercranial disturbances caused by the convulsive efforts, as from any peculiar morbid action. In some epileptics, the cranial bones are found thickened and eburnated, whilst bony excrescences from mere roughness to exostosic growths, from the vault or base of the skull, may encroach on its contents, and become sources of irritation or of progressive disease. Commonly ossific deposits exist in the dura mater and falx cerebri.

The convulsions occurring during childbirth are, in many instances, epileptiform. The reflex sources from the irritative propagation

through the uterine nerves especially are sufficient of themselves to induce convulsions. But owing to the immense demand on the function of the medulla oblongata by the fixing of all the muscles of respiration during the propulsive strainings, the conditions which have been referred to as inductive of epilepsy may be established. If the medulla oblongata has been already irritable or impressible, convulsive movements are more readily induced. Besides these regional disturbances, certain changes at times occur, not only within the brain, coincidental with the uterine development apparently in some, and during the parturient efforts in others, but also on the inner portions of the skull itself. These changes are the exostosic impingements found on the inner cranium of puerperal women. The changes within the brain are mostly vascular, or from intercellular albuminous effusion. The paralytic conditions after childbirth, as well as the convulsions or eclampsia during or before birth, are at times attributable to these states. When costal exostoses take place, the various neuralgic pains or local spasms are referrible to their irritation of the neighboring nervous filaments.

In the other cases, previously referred to, the vascular changes vary from lessened or obstructed calibre to aneurismal dilatation. In some the corpora striata, the thalami and cerebellum, have been found extensively diseased or evidencing hæmorrhagic changes, which have, by their impairment of function, indicated their lesions previously or coincidentally with that of the medulla oblongata. As above remarked, during the epileptic attack the limbs that were paralyzed for voluntary motion may be convulsed, and the face, whose expressionless apathy masked every emotion, may start into spasmodic life and purposeless motion. In the aphonic, the voice, long unused to articulation, may issue in wild shrieking, from the reflected action of the medulla oblongata. The sensific centres, both spinal and cranial, may be premonitorily affected, and before consciousness is lost may agonize the sufferer with unbearable pain, till the suffocating spasms, by inducing anæsthesia, destroy all perception, whilst the body is writhed in every possible contortion by the violence of the reflex actions.

Although by many epilepsy is considered to be attended by unconsciousness, yet from my own observations this opinion is to be received with reserve. Epilepsy, like other disorders of innervation, has its degrees; and although unconsciousness may attend or usher in the convulsive stage in most severe attacks, yet I have seen cases in which the spasmodic muscular exhibitions were most powerful, without the perception of the surrounding conditions becoming effaced. It is true that the nervous centres of motion, being so engaged by the action of

the disease, they cannot be made amenable to the orders of the will, yet the perception of this condition may be manifest to the patient.

The varieties of the attack greatly depend on the anatomical seat of the affection. In some the involuntary or reflex expressions of the passions merely take place; the upper portions of the corpora olivaria, which are connected with the nuclei of the facial nerves, being the demonstrative seat. It may embrace the nuclei of the hypoglossal, causing the tongue to be convulsively moved. In others there may be mere spasm of the extremities, from irritation or lesion of the corpora pyramidalia, extending into the anterior spinal columns, or from some congestive irritation of the corpora striata. The objective symptoms may be the resultants of the combined states just mentioned, or there may be merely partial spasm from regional exclusions; and these regional exclusions have lately been pointed out by Van der Kolk, in his observations on those patients who bite or do not bite the tongue, to which reference will be hereafter made.

The influence of the medulla oblongata over the calibre of the minute vessels, especially through the vaso-motor nerves, by which the supply of blood to the whole brain is diminished or increased, is not to be forgotten. And here, although the primary conditions were in this upper spinal portion, yet the immediate objective symptoms are of apparent cerebral origin, since vertigo and loss of consciousness are the only recognizable conditions.

From what has been necessarily so hastily said, it is easy to perceive how narrow are the boundaries which are assumed, and how insensibly they merge into each other, as to the medulla oblongata or the brain being the originating seat of epilepsy. But it is well for practical purposes to remember that the spasms, for the most part, occur in those muscles deriving their innervation from the nerves of the medulla oblongata, viz.: the facial, the accessory, the hypoglossal, and the third branches of the fifth. It is also convenient to recall that for the most part the functions of the medulla oblongata are bilateral, corresponding to the muscular exhibitions in true epilepsy.

But there are seizures with epileptiform convulsions which, at their first incurrence, render the diagnosis between them and true epilepsy somewhat difficult. A stout, plethoric man may be suddenly struck down, and by the time the by-standers have summoned medical aid, he may be found epileptically convulsed, and insensible. There is both stertor and foaming at the mouth, but the respiration, although labored, is yet freer, and more regular, than in true epilepsy. The pulse varies, but it is rarely slow and hammer-like to the touch. The mouth,

instead of being bilaterally acted on, is drawn more to one side than the other, whilst the facial muscles, in the intervals of spasm, appear unequally relaxed. The coming-to is longer than in uncomplicated epilepsy; the mind is more sluggish, and the voluntary transmissions, either for motion or speech, are impaired or imperfect. The arm and leg of one side become inactive, the speech is thick, indistinct, or confusedly labored. These and other paralytic conditions point to the brain as being the chief seat of lesion, although from some cause there may have existed at the time irritability of the medulla oblongata, which has been called into active participation by irritative lesion of the conducting fibres. Cerebral hæmorrhagic laceration has been found in some of these cases, and accounts for the symptoms which progressively occur. At intervals, other attacks ensue; and although insensibility may be the earliest symptom in a particular case, yet in others the spasmodic actions first evince themselves. These varying resultants depend as much on the situation of the hæmorrhage as on the quantity and rapidity of the effusion. I have known the pressure so gradually made, that the patient has stated he felt drowsy, and whilst apparently asleep, the stertorous respiration of apoplexy would ensue, quickly followed by the head being drawn rigidly to one side, whilst convulsive movements pervaded the extremities, and sometimes the trunk. At every renewal of the hæmorrhage the same symptoms are repeated.

During the reparative processes in these epileptiform apoplexies, insensibility may not again occur; but from the contraction of the clot, and other efforts towards cicatrization or repair, spasmodic twitching or convulsions of the facial muscles especially, may recur. The spasms are in most cases unilateral, and on the side opposite to the cerebral injury; thus, in the very beginning, the convulsions are epileptiform, but not epileptic. The post-objective appearances also differ from those of true epilepsy. On opening the mouth, the whole palate may sometimes be seen to be so relaxed as to fall on to the tongue, or one side only droops, with the uvula horizontally retracted. The constrictors of the pharynx are sometimes paralyzed, and the food, collecting in the pouches at the base of the tongue, becomes a source of intense misery, from the liability of portions to fall into the opening of the glottis on raising the head, thus inducing suffocative efforts for their dislodgment.

The accessory nerves of Willis, which act on the muscles of the larynx, and on the constrictors of the pharynx, together with the palatine ramifications of the second branch of the fifth, appear to be chiefly

affected. Nor is it uncommon to find the œsophagus in the reverse conditions of contraction or dilatation; these structural differences depending upon the local nervous conditions of irritation, or of paralysis. A more immediately dangerous condition exists from the incurrence of œdema of the glottis. In one patient this was a rapid cause of death, whilst the difficulties from the paralytic retention of portions of the food, and its delay of transit through the œsophagus, existed in a most pitiable degree.

The after-effects of an epileptic attack in some patients require discrimination. In many there are no prominent sequelæ, but in others simulative disorders arise. Deglutition, both voluntary and reflex, may continue difficult. The lungs may assume a pneumonitic, bronchitic, or asthmatic state. The stomach may reject its nourishment, or refuse to digest. The heart may be deranged in its rhythm or sounds. The diaphragm may be acted on through direct irritation, producing explosive cough, hiccup, sighing, or anhelation. The abdomen may shrink from the slightest touch, as in inflammatory invasion. The kidneys and bladder may pour out their irritating contents, scalding the urethra in its passage, or complete suppression may ensue. The urine may become albuminous, and deficient in extractive matter, or it may be loaded with lithates, purpurates, and other materials arising from the surcharge of animalized decomposition, or from the insufficiency of function in other organs. These conditions, although for the most part transitory in their excess, yet are to be carefully examined into, inasmuch that they may serve to point out some latent difficulty, which has stealthily induced morbid states of nutrition in the nervous centres implicated in the phenomena of the epilepsy itself. The variety of remedies which have proved successful in different cases indicate the truth of the above assumption, and inculcate the doctrine that, although the nervous phenomena of the fit itself have their starting-point in certain regional bounds, yet the origin of the disturbances in the normal nutritive actions of these districts must be for the most part searched for elsewhere. For the structual changes which ensue during the epileptic condition are not peculiar to that disorder alone; they occur in other disorders as well.

In chronic epilepsy, the intellectual faculties are prone to become weakened and changed. Perception and volition, the simplest conditions of mind, become enfeebled or vitiated. Irritability passes into more or less continued excitement, which, after a time, may assume at first the form of temporary mania, again to be tempered down to partial imbecility or complete idiocy, or to be increased into hopeless

lunacy. In some, there is intermittence, but no respite. The epileptic expenditure may exhaust the frame and restrain the maniacal manifestations for a varying interval, but to recur in new force, till death takes place.

Statistical records show that four-fifths of epileptics become subject to more or less mental alienation. Dementia is more frequent than mania. As might be supposed from the vast amount of morbid action discovered in the brains of the epileptic, monomania rarely occurs. But it is to be remembered that the monomaniacal may become subsequently epileptic.

As before mentioned, the causes of epilepsy are various; but from the instinctive passions, none so frequently conduce to its incurrence as the venereal, when indulged in to relative excess. It is an instance of the infringement of the law already cited, viz., the correlation existing between the central and centripetal nervous actions, independently of nutritive disturbances. Irritation or injury of the cerebellum is frequently attended with derangement of the genito-urinary system; whilst the disorders of the sexual organs, and especially when arising from overindulgence, usher in qualificative alterations of nutrition and function of the basilar contents within the occiput. The recognition of these neural reciprocities is highly important, both in a diagnostic and in a therapeutical point of view.

The necro-statistics of epilepsy are generally unsatisfactory. The intercurrent morbid changes of the complications have not been satisfactorily distinguished from the pathologic essentiality. Post-mortem changes have not been rigorously separated from the nutritive alterations happening during life, and which were either causes or the sequences of the attacks. Reparative processes ensuing during the retraction of the disorder, or perhaps long anterior or subsequent to the epileptic phenomena, have been frequently set down as elemental departures from normal structure; whilst the true morbid sources have not been compared in their various stages with the symptoms in their periods of manifestation.

The localization of the originating causes of epilepsy has ever been a matter of dispute, and will continue to be, so long as the phenomena are mistaken for the existing causes. Wenzel regarded the pituitary body as being the chief pathologic seat; yet I have in more than one instance seen this body greatly diseased without any epileptic tendency, but in none without great derangement of the general nutrition. In two cases there was unbearable ophthalmic neuralgia, with distortion of the eye, apparently confirming the statements of Littre and Lieu-

taud that some of the branches of the fifth and sixth pairs of nerves penetrate this body, but which have not been demonstrated by other anatomists.

In one case the emaciation was extreme, although nourishment was taken in large quantities. Involuntary spasms affected the face, tongue, neck, and shoulders, but unattended by loss of consciousness. The spasms may be termed epileptiform, but not epileptic, as previously remarked when speaking of the unilateral facial spasms during cerebral hæmorrhage. Had irritability of the medulla oblongata existed at the time, there might have been excited a true epileptic seizure, with cerebral unconsciousness.

Hereditary transmission has been statistically proved to exist in about one-third of the individuals affected; a proportion much greater than can be traced from any other one cause. But in what the essential nature of this transmission consists, whether in deviation of the structural or dynamic conditions of the ultimate cell, in which a specific so-called "taint" is engrafted, or in some elemental changes in the nervous structures themselves, or in local hypertrophies reproduced in the offspring, or in certain radical alteration in the constituents of the blood, sufficient data have not yet been collected to justify the adoption of any one in preference to another.

From my own observation, the children of the scrofulo-tuberculous are more prone to epilepsy, other things being equal, than are those in whom no such dyscrasia exists. The causes of this epileptic tendency arise chiefly from certain regional development of tuberculous matter within the brain, whereby its irritation or an exalted sensibility of the medulla oblongata is established, and from the erythism of the general nervous system, so commonly the attendant of this peculiar diathesis. Indications of tubercle, in the pulmonary tissues especially, are found in many in whom the epilepsy has been more or less chronic. Their original incurrence, or their development as sequential to the strain on the lung during the fits, must be diagnosticated on examination of the cases. The irritative or convulsive cough, with more or less bronchitic râles, especially in children who are growing rapidly and retain an outline of comparative vigor, should not lead into an erroneous belief of the lungs being primarily affected. These bronchial conditions, in very many cases, proceed from an exalted sensibility of the respiratory centres, and yield more rapidly to derivatories at the upper cervical portion of the spine, than to pectoral syrups. In some, smart slapping on the neck and shoulders relieves the convulsive coughing and shortness of breath. If, after a time, the irrita-

bility of the medulla oblongata increases, cerebral disturbances from the suffocative or long-continued coughing ensue, and the child, complaining of vertigo, becomes suddenly unconscious, and is attacked with the convulsions of epilepsy. The same frequently occurs in persons of more advanced age, who, from frequent masturbation or excessive sexual indulgence, have impaired the general nervous system, as well as excited an erythism of certain central districts. From the recovery attending many cases of so-called pulmonary consumption under my charge, in whom the central nervous causes were early recognized, I can attest to the soundness of the pathological statements just offered, as to the pulmonary sequences without epileptic disorder.

The period for the exhibition of these hereditary influences lies chiefly between the first and the twentieth year. And this predisposition has some curious features. The child may be attacked before either the mother or father has exhibited at the time any epileptic tendency, of which I have seen several instances. Although excesses in venery or masturbation, and the changes incident to the period of menstrual decline, have been stereotyped as the most efficient productive causes, yet, when viewed apart from the coincidental or sequential regional derangement of the medulla oblongata, they form less frequent conditions than supposed. Vast excesses or severe menstrual difficulties are daily occurring without any noticeable convulsive disorder. But when from any cause the neuro-relations of the medulla oblongata, or of the districts behind or before the thalami, are disturbed, then epileptic, cataleptic, or other departures involving the normal reciprocations between the cerebral and spinal functions may be engendered. In the old, the very changes incident to their age may produce epilepsy, (with more or less paralysis,) since ossification, obliteration, or dilatation of either the great or small arteries may become an inductive cause, through passive hyperæmia or local anæmia, as may be relatively induced. Scholars both young and old, the overworked, the anæmic or the plethoric, may alike be attacked, as the brain or the medulla oblongata may suffer together or correlatively. In the young, paralysis and idiocy threaten as subsequent events. In the aged, dementia, mania, or imbecility, with creeping palsy, closes the scene of all useful life.

Both the centric and eccentric causes of epilepsy have been studied by various authors. Marshall Hall early taught that the convulsions of apoplexy and of epilepsy were due to the venous congestions resulting from the pressure on the large vessels by the cervical muscles. Kussmaul and Tenner, in their admirable essay, make issue with these doctrines, by experimentally inducing through compression of the great

cerebral arteries an opposite state of the brain, by which an anæmic condition of the brain is induced, resulting in convulsions in every way resembling those of epilepsy. They consider that, by thus cutting off the supply of blood to the brain, and especially to the medulla oblongata, the active nutrition of these parts is interrupted, and thereby certain material changes ensue, productive of convulsions. On slicing away the cerebrum and the thalami, and then renewing the pressure on the arterial vessels, convulsions immediately occurred, thereby indicating the medulla oblongata as the radiating centre. They conclude from their experiments that the central seat of epileptic convulsions is to be sought for in the excitable districts of the brain lying behind the thalami optici; and that anæmia of those parts of the brain situated before the crura cerebri, produce unconsciousness and paralysis in the human being. If spasms should occur with these symptoms, some portion of the excitable district behind the thalami optici must likewise have undergone some change; whilst anæmia of the spinal cord, instead of convulsions, produces paralysis of the limbs, of the muscles of the trunk, and of respiration. Although mere spinal anæmia does not induce epileptic convulsions, as insisted on by Kussmaul and Tenner, yet this impoverished vascular condition must not be confounded with traumatic lesions of the cord, as experimentally proved by Brown-Séquard, where the epileptic seizures could be produced by peripheric irritation of the integuments of the face and neck on the same side of the injury.

Although Marshall Hall's theory is incorrect respecting the compression on the venous trunks being the exciting cause of the convulsions, yet it cannot be denied that the reactive effect from this condition may serve to induce a more violent and rapid manifestation, and especially if the medulla oblongata had been in a previously irritable state. This differs, however, from laryngismus as an exciting cause; since, in this condition, the medulla oblongata is either primarily affected, or it is called into violent action by the exalted condition of the peripheric excitor nerves of the larynx itself. Hence the suffocative conditions vary according to the persistence or power of the irritative cause. In some, fatal tetanoid epilepsy results, from the fixed condition of the respiratory muscles, inducing complete asphyxia. In others, the cause is less persistent, and there is no fixing of the muscles of the chest. The spasms are more distinct in their alteration of tension and relaxation, whilst their subsidence corresponds with the carbonization in the pulmonary and cerebral vessels. The effect is much the same as produced by etherization; reflex muscular actions

ensue at first, but subside during the advancement of the anæsthetic influence.

The exciting causes of these central or eccentric phenomena are very various, and the conditions of the nervous centres deviate from mere molecular perturbation to absolute disorder in their nutrition. The eccentric epileptic originations are more apt to be attended with the premonitory aura, consciousness being less speedily lost (and sometimes not all) than in an attack from cerebral or central causes. When the result of wounds on the fingers, wrists, feet, limbs, &c., the aura not unfrequently attends, and the attack may sometimes be delayed or stopped by ligaturing tightly just above the point of irritation, by which either the perturbatory influences are checked, or a venous condition of the part is produced. When the result of mere internal irritations, many epileptics will, from instinct or from accidental discovery, throw themselves violently against some body, by which pressure can be made, thereby impeding the nervous perturbations, or inducing local venosity. That epileptic seizures, attended or not by laryngeal spasms, are apparently induced by mere nervous changes, independently of alteration of the calibre of the nutrient vessels, is verified by the mode which may at times be effectively pursued in arresting the epileptic attack that would have otherwise ensued. By calling imperatively to the patient to resist, and to make forced inspiratory efforts, the perturbations conveyed to the brain and medulla oblongata are neutralized by those caused by the exercise of the will, and the spasms do not ensue. Equilibrium is thus established. Some patients can in this way resist, by the exercise of strong voluntary impulse, the full effect of the attack.

That these points of irritation, no matter where seated, should cause epileptic phenomena, it is necessary that two conditions should be established. The first is, coincident disorder of the medulla oblongata, and of certain cerebral districts already mentioned. The second is, that these points of irritation should convey the impression to other organs or centres correlated in function or innervation, and from thence to the focal regions at the base of the cranium.

After all consciousness has departed, when all perception of sensation has ceased, the convulsions of epilepsy continue unabated or increase, from the exalted capacity of the medulla oblongata for reflex actions.

An important addition to our knowledge of the pathology of epilepsy has recently been made by Prof. Schrœder Van der Kolk, who has verified, by his own minute dissections, the connections existing between the two sides of the medulla oblongata, whereby normal or

morbid excitations of this part are distinguished by bilateral actions, thereby differing from the unilateral lesions of the spinal cord, and sometimes from the manifestations of injuries to the upper cerebral lobes. Hence, the early convulsions of epilepsy commence in bilateral movements of the face, tongue, and organs of respiration. The seat of these spasmodic actions lies in the ganglionic cells of the medulla oblongata, which, when irritated, excite the associated nervous filaments. The arterial supply of blood to these cells is even greater than to the gray matter of the brain and of the spinal cord. The medulla oblongata becomes the focus of reflexion through the conducting fibres from the brain, from the spinal cord, and from the viscera and sexual organs, by the influence of the sympathetic on the spinal cord through its filaments or its vascular reticulations. Although it may happen, in early epilepsy, that no appreciable organic change exists, yet, from the repeated congestions, an albuminous intercellular fluid is exuded, causing more or less induration, which may subsequently undergo softening or fatty degeneration. Dilatation of the arterial capillaries in the medulla oblongata, especially, has been found to accompany this state. These dilated vessels are found running chiefly in the region of the septum, corpora olivaria, and the roots of the hypoglossal and vagi nerves, the posterior half of the medulla oblongata appearing more hyperæmic than is normal.

A memorable distinction is drawn by Prof Van der Kolk between those biting and those who do not bite their tongue. In the former, he usually discovered the capillary vessels wider in the corpora olivaria, and in the course of the hypoglossals; whilst in the latter, the vessels in the course of the vagi were dilated; and in these latter, from the greater disturbance of respiratory action, was induced a greater fatality during the fit. He also considers that epileptic dementia affords no proof of incurability, as it may result from the pressure exerted on the gray cerebral substance by the vascular distention, which may disappear after the cessation of the attacks. But it is different with the dementia following acute mania, as this depends on degeneration of the cortical substance, and is incurable. Attacks of unconsciousness, attended by little or no spasm, depress the mental powers more rapidly than attacks of convulsions without loss of consciousness.

Strong and unexpected impressions made on the senses have originated some of the most violent and irremediable epileptic attacks. Fright, grief, excessive joy, the immaterial influences from sudden or

long-continued bright light upon the retina, of sound, and of mental conjurations, have produced every manifestation of the disease.

The traumatic causes of epilepsy, from injuries to the head, have been purposely omitted, as their consideration would occupy too much space for this paper. The only remark that I will venture here is, that these traumatic cases, as a general rule, partake more or less of the epileptiform character, and on post-mortem examination, the medulla oblongata and the irritable districts about the optic thalami are not found in the pathologic states as seen in uncomplicated epilepsy. The relief that has been immediately and permanently gained by the surgical aid of the trephine or elevator in some cases, also corroborates the statement, especially when these means have been employed before the mere functional derangement of the medulla oblongata has eventuated in its structural alteration.

The diagnosis of epilepsy from other convulsive disorders, implicating psychical or sensational manifestations, has been partially included in the delineations already made above, and will also be incidentally mentioned in the following portions of this paper, when speaking of treatment. The detection of spurious epilepsy affected by street impostors, or by army delinquents, criminals, and sympathy-craving individuals, can only be satisfactorily made by the scientific investigation of the subject, wherein the adoption of certain practical experiments on the reflex conditions of the nervous system afford the most reliable evidence, since they are unknown to, and beyond the control of the suspected person. But even these reflex phenomena are to be carefully separated from the voluntary efforts of the experienced pretender, who either modifies by restraint or exaggerates by will the sought-for effects. In tetanoid epilepsy, where the muscular tension of the trunk and upper portion is very great, the dashing of cold water on the face or over the chest does not, at times, produce any noticeable reflex change, and the observer might wrongly conclude that the quivering or vibratory sustentation of the spasm was kept up by powerful voluntary act. I will also remark here, that sometimes this mode of treatment in these terrific cases may result in immediate relaxation, the nervous centres not being able to sustain the double action of the diseased exciting cause and of the peripheral excitation at the same time. But care is to be exercised, as cases have been reported in which the sudden dashing of cold water on the surface has proved almost immediately fatal, either by the sudden debility of the respiratory centres, or by their explosive increase of pow-

er, inducing an unyielding rigidity of the laryngeal and thoracic muscles.

As a general rule, however, the voluntary sustentation by the impostor is longer, provided he is surrounded by a wondering or sympathizing crowd, than the reflex spasmodic tension of the true patient. But it is well to remember that in both the same regional tracts are really brought into action—in one by voluntary engagement, but in the other by involuntary reflex action. The impostor has an object to attain: he selects a place suitable and somewhat comfortabe for his imitations, and only accidentally endangers himself, and I believe never bites his tongue; whilst the unfortunate epileptic falls anywhere, is unconscious of pain and danger, may bite his tongue, and evacuate the bowels or bladder, or vesiculæ seminales, and never runs away at the approach of any well-known medical man, who might, for experiment, light the clothes or straw on which he is lying.

A more difficult point of diagnosis lies in the interpretation of those cases wherein the incurrence of the disorder is unsuspected by the patient or his friends. Night-fits, especially, happen unnoticed by the sufferer, the sequelæ of which are complained of as original conditions, and may frequently be so treated by the medical attendant. Dullness of intellect, or irritability of temper, defective memory, stammering articulation, moral confusion, changes of habit and of affections, are frequently the early objects for professional consultation or observation, when the discovery is made, after a time, that the dread disorder of epilepsy had been latently existing, and had gained an impregnable foothold. Children, who sleep soundly, or others who sleep alone, may pass from slumber into epileptic sopor with rapid convulsion, and back into sleep again, without consciousness of the passage of the attack on waking, save a sensation of fatigue or of general malaise. Others merely notice a little blood on the pillow from the slightly-bitten tongue, but which is generally supposed to have come from the nose. Some cases of involuntary seminal emission, unattended, generally, by pleasurable dreams, are referrible to these latent epileptic manifestations. Our space forbids further attraction to these unsuspected cases of stealthy epilepsy, but enough has been said to render a more wary attention to many obscure cases of so-called ill health.

REMARKS ON TREATMENT.

From the antecedent portions of this paper, it must necessarily appear that as the causes and conditions leading to epilepsy are variable and very numerous, that no specific remedy or class of remedies can

be relied on in regard to treatment, either as to eradication, or even amelioration. It has been shown that, although the paroxysms of epilepsy are generally exhibited by convulsions, or static disturbances of those parts receiving innervation from the medulla oblongata, either directly or indirectly, yet other phenomena besides those of muscular convulsions may ensue. In some, vertigo, with subsequent loss of consciousness, or with unconsciousness to every other condition, is substituted for the epileptic paroxysms, which appear merely to affect the larynx more or less, without implicating other special regional portions of the medulla oblongata. In some, indeed, the medulla oblongata, so far from being rendered excitable, seems to be temporarily paralyzed, and unable to sustain even the automatic actions so essential to life. Hence, in these cases, which appear to depend on some blood condition, either as regards its mechanical distribution from disease of the heart for instance, or its quality from some error of the organs of assimilation, the treatment must necessarily differ from those in whom no such condition exists, and in whom the phenomena vary. Epilepsy from disease of the basilar portions of the brain calls for a treatment differing from the attack induced by suppressed customary hæmorrhages, by abdominal tumors, or by reflected points of irritation in the genito-urinary organs, &c., &c. In one, epilepsy may result from causes purely nervous; in another, from disturbances purely vascular; whilst in a third, both nervous and vascular derangements may arise from a mechanical or accidental source.

Depravities of the blood, whether from kidney or liver disease, or other secernent impairments, are frequent causes of epilepsy. These depravities cannot be eliminated, or rendered innocuous, by mere treatment addressed to the local centre of radiation; it must be more comprehensive. The indications of blood-poisoning must necessarily be various; and this diversity depends mainly on the amount and quality retained, on the affinitive conditions of the different organs, and on the states of the nervous centres at the incursion of the blood pollution. The phenomena vary according to the various groupal connections, and the special derangements of nutrition. Poisons internally developed do not differ as regards their selective affinity and manifestation from those externally administered. Some are generated by excess of nutritive supply; others by its deficiency, independently of any fault in the organism. And this proportion of nutritive supply is as frequently relative to the organic capacity of the individual, as to the amount ingested. Some organisms produce, by a peculiar vito-chemical action from moderate sources, the very agents so injuriously

reactive in those who have habitually abused their powers of assimilation by excess of supply. The lithic condition, for instance, resulting from organic generation in the former, represents a like state of non-transformation in the latter. It is seen in the gout of the starver, as well as of the feeder. So in rheumatism, where both the lithic and lactic poisoning are exhibited. In one, a mere affection of the non-epithelial fibrous structures ensues, resulting in general disorder from some known or traceable cause, as cold, damp, and exposure; whilst in another, the epithelial tissues become invaded, their disorder not being traceable to any undue exciting outer cause, but indicating a blood-dyscrasia from depraved secernent actions, with constitutional results more or less threatening to life, as well as impedimentary to motion.*

In toxæmia, not only do the symptoms vary, but the causes of collection in the blood differ. Uræmia, with defective or contracted kidney, from which qualitative retention of noxious salts, or non-elimination of urea with urinary decrease ensues, is very different from the condition of the system by which the blood is surcharged with the same poisons, from their overgeneration, whilst the watery excretion is normal as to quantity, and its specific gravity higher as to qualitative extraction. In one, hydropical effusions ensue; in the other, emaciation with an ex-serous condition of the cellular tissue attends. Both may be convulsed, and the convulsions may be epileptic, apoplectic, or local, according to the portions invaded and the nature of the changes induced. If within the hemispheres, and the changes are those from congestion, apoplectic coma may result; if from mere irritation, the functions of the brain may be exalted into delirium or mania; if from depression of the nervous centres, stupor or lethargy may obtain. The convulsive actions or the paralytic inertness will depend on the reciprocative condition of the medulla oblongata, and the conductive or non-conductive irritability of the medullary matter. In many, the uræmic symptoms are not prominent as deviations in the intellectual or automatic portions of the brain. They may arise from the intermediate regions, viz., the emotional. Hence, cataleptic, ecstatic, euthanastic states are impressed, at times without and sometimes with convulsion, the flexor or extensor tension being frequently confined to one limb, or to certain muscles in groupal co-ordination.

Yet, as regards treatment, these toxæmic cases differ essentially,

* See my article on Rheumatism of the Epithelial and Non-Epithelial Tissues, in this Journal, vol. viii., 1857.

and hence the necessity for exactness of diagnosis. Since in one, a disorganized kidney may exist, from which there is no power of recuperation; whilst in another, the eliminative organs are sound, and performing extra duty. The cause of death in the first really lies in the kidney; whilst in the second, it lies in some portion of the nervous or cell system.

The epilepsy of the anæmiated from sexual abuses differs greatly from that of the plethoric, in whom the venereal function is restrained. In one is established an erethism, which responds violently to any cause invoking the function of the medulla oblongata; whilst in the other, the power is overgenerated, and explodes, so to say, as a spontaneous mode of relief. In females, the derangement of the utero-ovarian function forms a like condition. In both the male and female, epilepsy may be the result of a mere functional derangement, or it may ensue upon certain organic changes, which, whilst they are mostly irreparable, yet can be rendered less injuriously excitant through appropriate treatment. Epilepsy from erethism of the vascular nerves, by which the cerebral circulation is interfered with, resembles that excited through the changes induced in the vessels of the brain by disease of the heart. In one, the excitement of the vessels themselves is great; in the other, the vessels are mere carriers or holders, according to the cardiac condition, by which either more blood is forced into the brain, thereby exalting its nutrition, or, by overdistending the chambers of the heart, a surcharged venoid condition is established, which depresses the nutritive energies, whilst the pressure is increased. The treatment required in the one case is opposite to that of the other.

In the epilepsies of children, especially when happening after the period of dentition, and in whom hereditariness cannot be traced as regards either parents or grandparents having been subject to the disorder, it is imperatively necessary to inquire into any syphilitic disease having been incurred by the father or mother prior to the conception of these children. It is not uncommon to find eruptions, inguinal ulcerations, and follicular disease of the throat in the offspring of such parents, in whom no secondary affection has as yet manifested itself. The anti syphilitic treatment relieves the condition of the child so afflicted, and is confirmatory of the origination, and as to the appearances of the parts affected. After a variable period, the parent may evidence the syphilitic taint by the various tegumentary eruptive disorders, or by nodes or cranial exostoses, or deep excavative ulceration of the glands and follicles of the posterior pharynx and larynx. As, in the parent, the affection yields according to the condition of the

other organs, and of the local specific manifestation, to Hydrarg., bichlor.: Proto.-iod. merc., or Iod. or Bromide potass., &c.; so, in the child, do the same remedies, judiciously administered, prove valuable in arresting the epileptic attacks.

In some cases of hysteria greatly resembling epilepsy, with uterine ulceration or erratic erosions of the cervix, I have been able in several cases to trace a syphilitic infection in the parent, and have, by cautiously administering the iodides and bromides of potash, &c., in conjunction with local treatment, been successful in removing the hysterical condition. The muscles which derive their nervous supply from the medulla oblongata are, in the syphilitic cases of hysteria, brought into action more by the reflex irritation from the ulcerated or eroded portions of the posterior fauces, pharynx, and larynx, than by any specific central action. The cases are originally those of simple hysteria, aggravated by nervous conduction from the latent syphilitic conditions affecting the inner throat. They differ from cases of syphilitic epilepsy in these essential features: that in the latter, the primary inoculation of the virus originated in the individual, and not from an hereditary taint; that the syphilitic eventuations are elsewhere distinctly recognizable by nodal exostoses, allopecia, or eruptive, ulcerative conditions. The phenomena are also those of epilepsy, viz., the solitary cry, unconsciousness, insensitiveness, biting the tongue, disregard of danger, tetanic condition of the larynx, deficient respiration, turgid or blackened face from capillary rupture, involuntary passing of the bowels or bladder, &c., &c.; and are not those of hysteria happening in persons tainted through syphilitic parents. In these, the hysterical element is prominent, as exhibited in the repeated cries or sobs, emotional exclamations, unsubdued consciousness, watchfulness against injury of the tongue and person, globus, alternation of laughter and sobbing, and comparatively free respiration, with relaxed larynx, &c.

When the cranial bones, becoming affected by syphilis, give a fair ground of suspicion as to the cause of the epilepsy, the preparations of mercury, of iodine and mercury, iodide of potash, &c., conjoined with tonic remedies for the debilitated, will do more to effect a cure than any of the medicines vaunted as specifics. If the skull becomes thickened, independently of any venereal taint, and organic disease of the brain appears threatening from the various symptoms of paralysis, disturbed mental functions, neuralgic pains, &c., the long pericranial seton or issue should be resorted to, in conjunction with internal remedies. The neck seton, high up to the base of the skull, answers well in those cases where, besides an undue excitability of the medulla

oblongata, there appears a hypertrophy or overgeneration of the ganglionic cells, by which a periodic discharge of nervous force is established. In some, the irritability appears at first to be increased; but, if the case be really suitable for the seton, this speedily diminishes as the suppuration increases.

In the anæmic, the seton fails of success. The drain is too exhausting, and local irritation is added to the nervous erethism. So far from becoming a point of divarication, it becomes a radiating cause of eccentric irritation. The ulterior effects, in such conditions of the system, are the same as happen in certain spinal diseases, in which, besides the constitutional injury, a local exhaustive irritation is established by the worse than injudicious application of suppurative agents.

There are other cases, however, in which a suppurative drain relieves the fullness of the vessels, and appears as equally efficient for good, as does the mechanical application which relieves in spinal disease the crowding pressure of the vertebræ. When the blood is loaded with more or less impurity, a certain source of its elimination is established by opening a drain near the organ so greatly concerned in the phenomena of epilepsy. In local hypertrophy of the ganglionic cells, in which the amount of organic force and nutritive supply is in excess, a certain quantity will be expended in the wastage.

In some syphilitic tumors found pressing on or within the brain, the changes are seemingly effected in the same manner as when the ulna and tibial bones to all appearance become enlarged, as a result of syphilis. A fibrinous material is effused around the bone, and is attended with a hardness so great as to give rise to the idea of true ossific enlargement. The pain is tormenting, both night and day; and where the effusion is not great, or is so situated as to be covered by the muscles, and is detected with difficulty, the case is generally viewed as simply neuralgic. That the disorder is periosteal, and not a real increase of the bones, is readily discovered by the rapid subsidence of the enlargement under leeching, and the internal and external use of iodide of potassium. Such tumors I have seen emerging from the coverings of the brain, which is pressed on and progressively absorbed or condensed by the gradual encroachment. When examined, they are of a waxy, fibroid nature, without any appearance of cerebral texture. These tumors are indicated by the severe and continued neuralgic pains, the loss or exaggeration of function, either mental or motor, being subsequent to the physical or molecular alteration of the cerebral substance, which conduces either to the excitation or abnega-

tion of power in the motor nerves below, since nutritive changes in the brain may eventuate in convulsive movements, as well as in paralysis. When such tumors are developed in situations by which the pons varolii is more or less encroached upon, neuralgia is a prominent symptom; the muscular symptoms being those of convulsion and paralysis, as referred to in the fore-part of this paper. Deafness in one or both ears, more or less varying, from time to time, as to the amount of hearing lost, is a not unfrequent attendant. The protoiodide of mercury and iodide of potassium are the sheet-anchors of treatment; whilst pustulation or a seton in the neck will act as a derivative, or as a source for organic waste. As a matter of diagnosis in these cases, it must be remembered that the convulsions are not always epileptic; that is, they are not in the groupal muscles served by nerves from the medulla oblongata. They may merely affect the extremities, or one side only, without inducing general participation, whereby the larynx is more or less implicated. In place of convulsions, complete paraplegia, or of one leg only, or hemiplegia, one-sided or crossed, may take place.

Epilepsy accompanied by nocturnal pains should always lead to the suspicion of syphilitic contamination. Iod. potassæ, with lactucarium, hyoscyamus, or conium, will be found most trustworthy.

In dilatation of the left ventricle, attended with thinning of the parietes and general cardiac asthenia, the nutrition of the brain is more or less interfered with, by the assimilation within its structures of the arterial blood to the venous. From such cardiac conditions, epilepsy is not an uncommon eventuation, and is frequently termed cerebral, when in reality it is the result of a disabled heart. In these states cure is impossible, but the treatment for temporary relief is at times practicable, although difficult to be decided on. When highly-carbonized blood circulates, or rather is delayed in the brain from such causes, it becomes highly important to know how long such a state can be safely borne, and if the spasms can be relaxed within a given time. Hence the propriety for the administration of chloroform depends on its power, in a certain case, to relax the spasmodic closure of the glottis, by which oxygenation may be re-established, or on its acting as a paralyzing agent over the peripheric and central respiratory functions. Without regard being paid to this latter contingency, the remedy at times so efficacious in the first condition would in the second become dangerous, by increasing the venoid stasis within the brain.

In the poor-blooded, debilitating passions are apt to be of more

frequent occurrence than in the plethoric. As a general rule, they are more prone to voluntary and involuntary losses of semen; and if addicted to the saturating abuse of alcohol, opium, or tobacco, or if affected with anæmia, they are more liable to epilepsy than are those of more robust physical endowment. And the treatment in the one is less difficult than in the other, inasmuch as the organic constitution of the blood itself, in the rich-blooded, is not degraded, and does not require the additional medication for its reconstruction.

It is highly important to discriminate between the alterations of the brain-substance, inducing the epileptic attack, and the causes working such a deviation in the normal nutrition of the brain. The poison of syphilis in itself, for instance, does not excite the spasms, but the specific alterations of structural nutrition ensuing from its incubation induce the phenomena of the attack, which also in its turn may give rise to certain demonstrable local disorders, eventuating in an aggravation of the convulsions, or in a paralytic or maniacal condition, according to the situation. The treatment, therefore, in such cases, whilst it recognizes the proximate syphilitic entity, and is so directed as to destroy its specific action over the normal nutrition yet has to include such remedies as may possess the power of retarding the conduction for spasmodic action, and of reducing the quantity or quality of the fluids effused during the convulsive strainings. After the extinction of the syphilitic contamination, the normal type of the structures invaded may be reproduced, in preference to the anormal modifications, which were renewed during the specific toxæmia.

The extra-cranial causes of epilepsy, such as cicatrices of the skin, or even of the cord itself, irritations from foreign bodies in the nerves, as from glass, thorns, needle-points, &c., or neuromas, or irritable districts in the mucous membrane, utero-ovarian derangements, &c., are to be searched for; and the knife, caustics, cathartics, emmenagogues, and the like, are to be resorted to. Both tardy and too profuse or frequent menstruation are sometimes premonitory exciting conditions: one by the hyperæmia and uneliminated material; the other by the nervo-vascular excitement and anæmia. The treatment in these states has to be specially directed; antiperiodic remedies, such as quinine, chinoidine, beberine, and arsenic being conjoined or employed externally with those addressed to the disordered function. And this disordered function has to be redressed, either by overcoming the local condition which imperils the general system, with epilepsy as its indication, or through the general system which effects the reactive derangement of special function.

In many cases there are no apparent conditions, as tubercles, or other morbific growths or alterations in the brain; but the proximate cause seems to lie in some derangement of the nervous centres themselves, which excites the paroxysms. Psychical changes, suddenly induced by fright, repelling sights, or imitative impressions, produce certain physical or molecular alterations of the central ganglionic cells, through which contraction or dilatation of the minute vessels ensue, giving rise to loss of consciousness, sensibility, and to convulsions. In the generality of such cases, the conditions are those of anæmia, and hence require the judicious selection of the preparations of iron, zinc, and silver, combined with a nervo-stimulant or sedative, as valerianic, phosphoric, or hydrocyanic acid, in conjunction with a special tonic, as may be indicated. But remedial treatment is valueless, unless associated with rigid moral training. Exclusion from the special and all-exciting causes must be rigorously enforced, whilst the will of the patient should be perseveringly educated to oppose the effect of the sudden changes in the nervous centres, by instituting another and more powerful impression of resistance in the same centres or in others antagonistic to them. When glottal closure ensues, leading to almost complete suffocation, the application of a sol. of nit. arg., 40 to 60 grs. to the ounce, will be found of great benefit. If any warning is given before insensibility attends, the determined order by any one for the patient to take his breath, or the patient's self-determination, will produce most marked results. If there be much arterial throbbing, direct pressure should be made over the carotids, *avoiding compression of the jugular veins.* During the intervals between the attacks, air and non-exhaustive exercise, and the cautious use of the shower-bath, should be advised; the water being at first just below the temperature of the body, as otherwise the shock would induce a state similar to the one exciting the epileptic seizure. After a few trials, the temperature of the water can be gradually lowered. In conjunction with this, the patient must be subjected to self-moral training, the tonic remedies being cautiously administered. In the very fair-skinned, whose faces redden or pale easily by any emotional act, the preparations of iron, if given in even moderate doses, excite a certain erethism, which increases the susceptibility to every emotion and to vascular changes from the increased nervous impressibility which is apt to be excited. Zinc and silver act more favorably; and as the appetite and capacity to bear food in greater quantities are generally increased by them, the blood recovers its normal composition. If it does not, then a grain of lactate or phosphate of iron can be mingled with the food, to be gradually increased

as may be borne or required. The susceptibility of the mind must be changed by such studies, conversations, and employments of a sound practical nature as will tend to fortify the centres against emotional excitation.

In these cases is seen the same condition of the emotional tract as found in previously strong-minded persons who have suffered from depressing illness or from debilitating losses of blood, viz., the complete powerlessness of the intellectual centres, with uncontrolled action of the emotional. This happens not from any sudden access of strength in those portions presiding over these manifestations, but from the complete inability of the reasoning powers to govern them. When this emotional erethism is fairly established, habit is engendered. In other words, the nutrition being changed from the normal condition to the anormal, the function becomes anormal instead of normal. Hence dreams, fanciful reveries, sudden emotional excitement, or even reflex impressions from touch during sleep, or absence of mind, may cause an attack of convulsions. Now these very cases, from the irritability of the basilar brain portions, are very apt to indulge in erotic feeling and actions, and to impair their general system by venereal excesses, or by secret vices. Hence, it may become essential to conjoin those remedies which apparently exercise a controlling power over the venereal functions, such as the infusion dulcamara, hyd. potass., camphor, bromide of potash, &c. But whilst directing attention to the fact of this condition, a warning is also to be inculcated, viz., to be certain that such erotic mania exists before administering any so-called anaphrodisiacs, since when absent (and in many, complete inappetency exists,) the very state suspected may be alarmingly excited, as known to me in several instances. It is readily comprehended from this fact, that no remedy is specific in regard to its phrodisiac virtue, this condition being a result of a relative physical state induced.

As a general rule, during the attack, even when practicable, the administration of narcotics is valueless, and such also is the result of their trial during the interval. But there are conditions in some cases in which the epileptic seizures are sequential to certain premonitory phenomena, that narcotics or anæsthetics prove valuable. In some neuralgia precedes the attack, and if this can be arrested, the convulsions are not excited. Hence both narcotic remedies or even local stimulants of rapid action, and anæsthetics are to be employed. I have known the application of diluted ess. ol. sinap. or Granville's lotion over the appropriate regions stave off a paroxysm, even when not premonished by neuralgia. By the reflected action from the surface on the centres,

an impression (molecular change) is made, which is more powerful than the one from the disorder, independent of the peculiar nature of that change. But in central epilepsy, where the medulla oblongata is especially the radiating point, peripheric stimulation is injurious, inasmuch *as its function is overexcited, and thereby more blood is invited to it by the distal irritation*, and that blood being at the time poisoned, as regards the normal assimilation of that great centre. This effect of irritants applied to the surface is readily seen in hæmorrhagic effusion, from concussion especially, where the medulla oblongata or pons varolii is more or less impinged on by the pressure of the condensed brain, whilst the vascular condition is proportionately increased. By applying mustard or ammonia, &c., to the extremities, reflex movements ensue, and frequently add to the mischief of the case by the exhaustion attending the violence of the motions.

Even injections of mucilaginous materials are responded to in these cases by spasms of some portion of the body, the manipulations necessary to their administration aiding not only in the excitement of the reflex movements, but also in fatiguing the patient. If the respiration be easy in the position assumed, *no attempt at movement of the head* should be made, as fatal consequences may suddenly ensue, as is so frequently seen in cases of fracture of the upper vertebræ. The bladder, in these cases of epileptiform convulsions from effusion of blood, (and sometimes even from serous collection,) is apt to become greatly distended; and although its expulsion is restricted, yet the distention is sometimes sufficient to arouse reflex spasms, whilst the ureters filling, the kidneys become irritated and congested by the reflux of their secretion. The bladder can in almost every case be felt enormously enlarged above the pubes, and the withdrawal of the water in these cases is all-important. But the bladder should not be suddenly emptied, as in some it acts almost as fatally as a blow upon the stomach, or after sudden evacuation of ventral fluid.

In all cases of epilepsy, it is important to inquire into the previous state of the urinary apparatus, since in many renal disorder is either an attendant or precursor; and where there is reason to suspect the forms of Bright's disease, or other conditions rendering the renal functions more or less inoperative, it is not to be forgotten that a large amount of animalized matter is thrown into the blood from the exhaustion of the tissues by the spasms themselves. In some a tetanoid affection is induced by a toxic condition of the blood. Generally, peripheric irritation causes no reflex spasms in these cases. The tetanoid spasm arises from central poisoning of the portions chiefly deranged

in the original attack. When the immediate spasmodic conditions have been subdued, the intervals may be occupied by an apparent rheumatic condition of the spinal region or of the extremities; but it is really from a disordered membranous and neural nutrition from the poisoning of the blood, not only by the retention of urea, but of other animalized excretion, rendered unfit for further uses of the organism. The treatment by sudorifics, hot-air baths, proportionate exercise, regimen, and the *stimulation of the compensatory functions*, must be supplied from the hints already given.

Cutaneous repressions are in many cases followed by epileptic exhibitions. Their appearance is not unfrequently significant of some irritation of the nervous centres themselves. This irritation may arise from toxæmia, induced by a derangement of elimination in some organ, by a plusage of supply to the blood from without, or by superorganic action of the secernent functions. At all events, the sudden suppression of the eruptions, by any topical treatment especially, is injurious and dangerous. The treatment must divide itself according to the constitutional condition. The cutaneous disorder is a mere topical product, frequently arising from a central disturbance, or from a blood condition interfering with the normal nutrition of the distal or of the peripheric portions, and is not an independent process through which the blood is contaminated, and the nutrition of the centres degraded. The direct treatment consists in endeavoring to reproduce the eruption which has been repelled, and in the employment of such sedatives or stimulants that may arrest, or restore if deficient, the central nervous irritability, and of such alteratives which may specifically change the blood composition and induce the normal status of the organs affected. The eczema of the habitually intemperate points as much to the disturbed central conditions of the cerebellum and medulla, as to the blood depravity from depraved secernent action. If the eruption is suddenly repelled in these inebriates, a fatal issue is not uncommonly induced or premonished by epileptic or epileptiform convulsions, with paralysis from cerebral causes. The hemiplegia of the drunkard, which causes the paralyzed arm to droop forward and to be apparently lengthened by the relaxation of the pectoral muscles, and the leg to drag the pointing toe wearingly along the ground, is not only ushered in by convulsions, but is apt, if not fatal at first, to be attended with their constant returns; whilst uræmia, with its dropsical heart and chest, and puffy, tallowy face, or cholæmia, with its ascitic belly and shrunken, tawny skin, evidences the vast organic changes in the kidney or liver.

In all skin diseases with uræmic and cholæmic pollution, and even

where no such conditions apparently attend, attention should be directed to the condition of innervation of the basilar portions of the skull. Causes which act on these portions, by which the circulation is impeded, are apt to induce congestions of the pulmonary vessels, attended more with the physical manifestations of transudation, than of exudation, which is an organic process. Hence hydrothorax and œdema, &c., are more frequent than pneumonia and pleurisy. In the inebriate a tardy decomposition of tissue attends the alcoholic absorption. In these the organic processes are more exhausted by their efforts of transformation than of conformation, and these transformations are more of accommodation than of repair.

The term enteric epilepsy may be used in contradistinction to cerebral or central epilepsy. The radiating points are somewhere within the intestinal canal, the participation of the medulla oblongata or of the superior irritable districts being established by preceding irritability, or by some trophic irregularity. These points of reflex irritation may be in themselves direct lesions, or they may be established by abnormal growths, by worms, by acrid ingesta or secretions, &c. The remedial measures are to be selected according to their specific or alterative action: Nit. or oxide of silver, hydrocyanic acid, oxide, phosphate or valerianate of zinc, turpentine, croton oil, belladonna, opium, valerian, alterative prep. of mercury, of muriate of ammonia, &c. Sometimes an impacted gall-stone, by its reflex action, lies at the root of the epileptic evil, and the potash, opiate, turpentine, and the sweet oil treatment, which insures the dislodgment of the biliary calculus, relieves the convulsive tendency. The same may ensue from the irritation by intestinal concretions, either crystalline or fæcal. The latter may be merely local, or the distensive pouches of the colon may become impacted, which may, however, allow the partial passage of fæcal matter, or even give rise, by frequent watery, slimy dejections, to the opinion of chronic diarrhœa. Together with eccoprotic measures, these latter cases are relieved by the injection of a sol. of bicarb. soda through the O'Beirne tube, which not only partially dissolves the accumulated masses and scybalæ, but induces a free discharge of bile from the liver. Epilepsies of this kind have arisen from the frequent and incautious use of charcoal and magnesia, which have collected in hard boluses, and tended to give supply for the formation of the magnesian concretions sometimes lodged in the intestines. It is in these enteric epilepsies that the internal administration of chloroform will be found so beneficial.

Kidney complications have already been referred to, but independent of albumen, lithic conditions of decrease or increase, with or with-

out renal calculi or sand, oxaluria, &c.; another condition of urine may exist which indicates not only uræmia, by which the centres are poisoned, but also a state of constitutional dis-assimilation or disintegration, by which the whole cerebro spinal nervous system is exhausted. This condition is indicated by phosphatic urine, with deficiency of urea. Besides out-door exposure, which must not be accompanied by muscular fatigue, or by the indulgence of sexual excitement, (if the power be not already lost,) the nitro-muriatic acid bath, and its internal use, forms a valuable adjuvant. Where the exhaustion is great, quinia, with phos. zinc, is indicated. As in this disorder the red blood-corpuscles rapidly diminish, and there exists a proportionate increase of the white, attended with defective respiration, an elegant and serviceable preparation will be found in the elix. calisaya et ferri phosphorat.

Albuminuria is not an unfrequent attendant in convulsive diseases; but mere albuminous urine should not be viewed as indicative of certain renal changes, since oftentimes it is found in urine having no deficiency of extractive salts, or of normal specific gravity. In many cases, the albuminuria is a condition of compensation. It mostly exists in undeveloped scrofulosis, and when the albumen is accidentally stopped or interfered with, its arrest becomes coincidental with tuberculous development elsewhere. And the same albuminuria of excess sometimes ensues in scrofulosis on arresting or healing up of old sores, the excess being compensative, and not destructive. These states result more frequently in scrofulosis of the syphilitic than where the taint is absent. The gauge for treatment depends on the quantitative analysis of the urine. If the extractive salts are normal in quantity, it will not be found safe to interfere with the albuminous contingent. Air and proportional exercise, and surface depuration, are the only remedies, unless syphilosis exits, the regimen being strictly followed that has been found to agree, by the patient's own experience, which affords the best mode of analysis. It will be only necessary to remember in case of violent convulsion in those states, epileptic or not, that the exhaustion following powerful and long-continued exertions (voluntary or involuntary) are apt to induce cerebral congestion and effusion, with their sequential accompaniments.

In the trismus attending epilepsy, opiate enemata or local hypodermic injections are sometimes advisable, the latter being found most serviceable in enteric radiation. But locked-jaw in epilepsy may give place to the fixed open jaw. This result indicates no difference in the essential nature of the disease; it is merely a variation of groupal action.

There is one distinguishing symptom as regards the jaw between hysteria and epilepsy. In the latter, the teeth never chatter.

The ancient Scots castrated their epileptics as a matter of cure; it has of late days been attempted, and sometimes successfully, when the eccentric cause laid in the testes; as a means of arresting its propagation in offspring, it certainly forms, when complete excision is made, a most effectual remedy. Some years ago, whilst in a city of another State, I was consulted by the owner of several whaling ships relative to a man about 32 years of age, who was regularly seized with epileptic mania when about thirty days out at sea. Learning that this man when on shore was erotic to a great degree, and that otherwise he was well behaving and always enjoyed his health, excepting a severe pain in his left testis, I gave as a rough opinion, that the fits at sea, when apart from women, were probably owing to reflex irritation from the testicle upon the cerebellum and medulla. On his return from the voyage, during which he was constantly seized with epileptic convulsions, and violent but temporary mania, he heard of my opinion, and sought in a neighboring town the advice of a very skillful surgeon, who relieved him of the diseased testis. From that time to the time I last heard of him, about three years, he had enjoyed perfect health, without return of the symptoms. But in central epilepsy, with *subsequently* diseased testicle, no such favorable result could be predicted, unless the exalted sensibility of the testis propagated through its nervous relations fresh organic changes, attended with vascular dilatation in the medulla oblongata, thereby hypertrophizing the ganglionic cells, and rendering them more liable to surcharge.

As a rule in epilepsy, the torpid cannot be treated like the nervous and irritable; nor do remedies having control over the male act similarly over the female, since amenorrhœa, uterine ulceration, and leucorrhœa, or prolapsus and other displacements, affect the epileptic female in a special manner, the mere regulation of womb difficulties frequently insuring a cure.

From its peculiar action in diminishing the red blood-corpuscles, belladonna offers in the plethoric to form a valuable remedy, independently of its action over the sympathetic nerve, as also does digitalis in over-excitation of the heart, and especially when, from hypertrophic dilatation, the brain evidences a maniacal tendency. In anæmia with nervous erethism, inducing frequent, short attacks of epilepsy, the hydrocyanate of iron, steadily persisted in, induces the return of red corpuscles, whilst the nervous susceptibility is kept soothed. By many of the older practitioners indigo was esteemed as almost specific

in the treatment of epilepsy. It acts more favorably on females, in whom some uterine derangement exists with the epilepsy.

Both the oxide and phosphate of zinc are valuable alterative tonics; their employment is indicated in the anæmic and brain-wearied. In the plethoric they do not serve well. The valerianate of atropia has been recommended by high authority, in the dose of 120th of a grain. Atropine by injection has also been recommended; as yet, I cannot offer an opinion as to their adaptability, but should not recommend their use in the anæmiated, or those with heart complications. If given to the rather plethoric, and the fits are reduced considerably in interval one caution must be observed, lest an accumulation of force through apparent hypertrophy of the ganglionic cells should ensue, and prove fatal by the violence of the convulsions. Where this is dreaded, the seton should be employed as an exhaustive drain, and such exercise continuously but moderately enjoined as will tend to discharge a certain amount of power.

In conclusion, I will state that in eccentric epilepsy, where the glottal spasm is one of the first symptoms, I have been satisfied with the results of the application of the sol. nit. silver to the larynx, followed by a solution in glycerine of quinia as a local antiperiodic, and with the rubbing in of a strong sol. quinia in the spine after irritation, by ess. ol. sinapis dilut. Arsenical solution, internally administered, (and sometimes by injection per rectum, in a mucilaginous vehicle,) is also restrictive of the periodicity of the attacks. Arsenic appears to act through the peculiar influence it exercises over the rapid arrest of the albuminous tissues, and probably through its power of constricting the capillaries and minute arterial terminals. This influence is sometimes exercised over the matrix supply of the nails, which have been known to drop off during its long or over use.

The results of the trials known to me of the cotyledon umbilicus have not been favorable as to the arrest of epilepsy; yet, when scientific are forced to yield to empirical indications of treatment, it may be tried.

Ice to the upper spine and back of the head I have found useful in controlling the violence of the fits; as a cure, it is inapplicable. Tracheotomy is a last resort, whilst scarifications of the internal larynx during the interval may relieve the tendency to engorgement, œdema, and reflex irritability. Powerful stimulants, as ammonia and ess. ol. sinap. dilut., to the spine, in proper eccentric cases, induce such changes in the centres as render them inoperative to those effected by the disease, or attract to superficial expenditure.

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