

The adequate treatment of the subject enzymes would naturally include a detailed account of the digestive enzymes and their action, but as this has already been given in the article *Digestion* in this handbook, it will not be repeated here.

**RELATION OF ENZYMES TO SERUM THERAPY AND TO IMMUNITY.**—There is no subject in the medical world at present which arouses greater interest than serum-therapy and immunity, and from the immense amount of work done in this field the following facts (among many others) are regarded as demonstrated:

(a) That the serum of certain animals destroys the red blood corpuscles of certain others (globulicidal action).

(b) That the serum of certain individuals has the power to destroy bacteria introduced into the system.

(c) That the blood (serum) of certain individuals has the power to destroy the toxic products of bacteria when injected into the system.

(d) The most potent factors in immunity from disease are (b) and (c)—especially (b).

The substances which confer this activity on blood serum have generally been regarded as proteid in nature, and these active proteids in (b) and (c) are commonly called "defensive proteids." Two of the most prominent authors who have written on this subject are Buchner and Hankin. Buchner called these active substances *alexins*, while Hankin divided them into two classes: *sozins* and *phylaxins*, and these names are in general use at present.

Quite recently, in a series of articles in the *Münchener medicinische Wochenschrift* (1899 and 1900), Buchner has come out for the theory that his alexins are proteolytic enzymes, and he has advanced certain explanations of their action, involving the theory of immunity. Part of his theory has been disputed by Ehrlich, and an interesting discussion of the subject has followed, the details of which would be out of place here. It is interesting to note, however, that the increasing scope of zymolysis has extended to giving enzymes a possible place in this most advanced line of medical research.

George T. Kemp.

**EOSOLATES** are salts of sulpho-acids of the aliphatic creosote esters, representing twenty-five per cent. of creosote. *Calcium eosolate* [ $\text{Ca}_2(\text{C}_9\text{H}_7\text{S}_2\text{O}_4)_2$ ] is a gray, gritty powder like pumice-stone, with a slightly pungent, rather ethereal odor, and a somewhat acrid and leathery taste. It is soluble in eight to ten parts of cold water, seven of hot water, slightly in alcohol and acetic acid, and freely in the presence of hydrochloric or citric acid. It is insoluble in chloroform or turpentine. H. Stern recommends it in dose of 0.25–0.7 gm. (gr. iv.–x.) three or four times a day for diabetes mellitus, diabetes insipidus, and phthisis. In larger dose it may cause diarrhoea and griping.

*Eosolate of silver* has been used in gonorrhoea, and *eosolate of quinine* in malaria and influenza.

W. A. Bastedo.

**EPHEDRA ANTISYPHILITICA.**—*Mountain Rush, Canutillo, Mormon Tea, Grease Wood, Whorehouse Tea.* The twigs of *Ephedra antisiphilitica* C. A. Meyer (fam. *Gnetaceae*). This peculiar shrub, and various other species of the genus used similarly, are found in great abundance over the arid regions of our great plains. The plant reaches a height of two or three feet and produces a dense mass of erect, green, leafless branches, half the thickness of a lead-pencil and striate or channelled, with membranaceous scales at the joints. Wherever it is known, it bears a high repute in the treatment of venereal diseases, which are seldom differentiated in the reports. It is both bitter and astringent. The latter property might give it some value in gonorrhoea, while the former would render it tonic and perhaps alterative. No systematic study of its properties has been made, and we can only conclude that it probably has some merit. It is chiefly given in decoction; the dose employed representing one to two drachms of the drug. The remedy may also be admin-

istered in the form of a fluid extract. The drug contains a glucoside, *ephedrin*. *E. monostachye* L., of Asia, has a similar reputation.  
Henry H. Rusby.

**EPHEDRINE** ( $\text{C}_{10}\text{H}_{15}\text{NO}$ ).—An alkaloid derived from *Ephedra vulgaris* Rich. and *E. helvetica* C. A. Meyer. It is crystalline, colorless, and soluble in alcohol. It is used in the form of the hydrochloride, which is soluble in water. It is poisonous, resembling atropine in some respects. While it lowers the blood pressure, it causes the temperature to rise and the pupil to dilate. It is used like atropine for the latter purpose, one to two minims of the ten-per-cent. aqueous solution being instilled. It usually requires nearly an hour to obtain the desired effect, but when once obtained it usually lasts for from a half a day to one day, but accommodation is not affected.

*Ephedrine, Pseudo-*, has the same composition as the above and its hydrochloride has the same properties and is used in the same way.  
Henry H. Rusby.

**EPICARIN** ( $\text{C}_9\text{H}_9\text{COOH.OH.CH}_2\text{.C}_{10}\text{H}_7\text{OH}$ ) is a condensation product of creosotic acid and beta-naphthol and is, chemically, oxynaphthyl-o-oxytoluyllic acid. In its crude form it is a reddish powder, much used in veterinary practice, and called "Epicarinum veterinarium." From this, pure epicarin is obtained by recrystallizing from glacial acetic acid, and removing the excess of acetic acid by heating to 120° C. or by recrystallizing from alcohol or benzol. It occurs in colorless or yellowish needles of a strong acid reaction, melts at 199° C., dissolves readily in alcohol and ether, and forms easily soluble neutral salts.

This remedy was introduced by Dreser as a non-toxic substitute for beta-naphthol, and was at once taken up by European dermatologists. Frick and Müller believe it to be slightly toxic, though others say it is harmless even to children. It is of especial value in scabies, for, though less destructive to the acarus than tar, lysol, carbolic acid, or creosote, it relieves the itching promptly, and is not unpleasant. Kaposi uses it in ten-per-cent. ointment, or in solution with alcohol and glycerin. He has had good results in certain eczemas, in scabies, prurigo, and herpes tonsurans. Pfeifferberger rubs in every evening without preliminary bathing the following:

R Epicarin.....	7.5 gm. (3 ij.)
Cret. prep.....	2.0 " (3 ss.)
Vaselin. alb.....	30.0 " (i.)
Lanolin.....	15.0 " (ss.)
Adipis.....	45.0 " (3 iiss.)

In his experience, epicarin is well borne by delicate skins; but, as the skin tends to become red and dry from continued use, he follows its application with diachylon ointment. In eczema pure and simple it does more harm than good. Some writers recommend epicarin highly in ringworm and other mycotic skin diseases. A good lotion would be:

R Epicarin.....	10.0 gm. (3 iiss.)
Glycerin.....	10.0 " (3 iiss.)
Tr. lavand.....	30.0 " (i.)
Ether.....	30.0 " (i.)
Alcohol.....ad	120.0 " (3 iv.)

For scabies the following is useful:

R Epicarin.....	15.0 gm. (3 ss.)
Sulphur.....	4.0 " (3 i.)
Ungt. zinci oxidii.....ad	90.0 " (3 iiij.)

Sig: Rub in every second day. W. A. Bastedo.

**EPIDEMIOLOGY.** See *Infectious Diseases*.

**EPIDERMIN** is made by mixing equal parts of melted white wax and powdered acacia, adding the same weight each of water and glycerin while boiling, and stirring until cold. It is used as a vehicle for skin medication.  
W. A. Bastedo.

**EPIDIDYMITIS.** See *Testes, Diseases of*.

**EPIGEA.** See *Ericaceae*.

**EPILEPSY.**—(Synonyms: *L'Epilepsie, Fallsucht, Epilepsia, Falling Sickness, Mal Caduceo, Morbus Hercules.*)

**DEFINITION.**—A disease in which sudden losses of consciousness are attended by more or less convulsive muscular action.

The seizures of epilepsy have been called—because of their varying degrees of severity—*epilepsia gravior*, or *grand mal*, and *epilepsia mitior*, or *petit mal*. The first is characterized usually by the severe attack, which consists ordinarily of marked loss of consciousness and complete violence of muscular movement; while the latter is manifested by a trifling seizure, with transitory mental obscurance and little or no muscular convulsion. There are irregular varieties which have been called *masked* or *aborted* epilepsy, owing to the imperfect development of the more familiar symptoms. In these masked cases the attack takes the form of a psychical derangement without definite motorial expression. An attack of this character is known as the "psychical equivalent" of an epileptic seizure. There are, besides these, a form known as *l'epilepsie partielle*, or *hemi-epilepsy*, which is always dependent upon cortical degeneration or unilateral disease, and another to which I have given the term *sensory*, in which more or less disturbance of the special senses exists with imperfect mental and motorial symptoms. A number of special names have been applied to epilepsies with reference to their etiology, "gastric epilepsy" being a familiar illustration.

The lighter form, or *petit mal*, may consist simply of a momentary loss of consciousness, during which the patient becomes suddenly very pale, while the color recedes from his lips and cheeks, and the respiration for the moment is temporarily arrested and then afterward accelerated. The eyes may remain open and be rolled upward; less often the lids are closed. While in the midst of some occupation the patient may be taken, and the particular act is interrupted in its performance. The glass or spoon drops from the hand, the pen is arrested in the middle of a half-written word, and oftentimes the patient's trouble is so transitory as to escape notice, he himself, as a rule, being utterly unconscious of it. Then afterward the sentence is finished, and beyond an occasional residual dizziness, nothing remains to remind the patient of the attack.

In other cases, or at other times, the seizure is more grave, as regards both the unconsciousness and the severity and extent of the spasms. The patient may become rigid and then agitated by limited twitchings and cramps of the fingers. The color leaves the face, and the pupils of the eyes are widely dilated. In a few seconds he is able to arise and go about his business. Delasiauve<sup>1</sup> and other French writers speak of *absences, vertiges* and *accès intermédiaires* as forms of *petit mal*, while Reynolds divides the light attacks into those without evident muscular spasm and those with spasm. The light attack may, according to writers generally, consist simply in an interruption of speech or the act of writing such as I have detailed; or of a sudden deviation of the eyes or head; or of a momentary confusion of ideas. The mouth is drawn to one side or the other, or widely opened, and there is a rapid alternate contraction of the muscles of the neck, so that the head executes movements backward and forward with great rapidity; or the chin is thrust forward and upward to one side, giving the individual the appearance of a person suffering from torticollis.

These attacks may simply consist in a temporary aphasia, the so-called *epileptic aphasia*, during which the patient is speechless or substitutes words.

The *petit mal* is either found alone, or the attacks occur in association with those of a more grave character. There are numerous cases in which light seizures alone exist, or for many years precede a more dramatic manifestation.

The fully developed attacks (*grand mal*) are frequently preceded by certain *warnings* or *auræ*, which may exist in a simple or complicated form. These, in their order of arrangement as regards frequency and constancy, are sensory, psychical, motorial.

The *sensory prodromes* of an attack are of the most diverse character, and the patient complains of such transient subjective sensations as tickling or tingling in the cutaneous surface, chiefly commencing in the extremities, on one or both sides, and centripetal in character, the morbid sensation appearing to advance toward the head from some distal point. This is a peculiarity of what is known as the *epigastric aura*, which consists of a very disagreeable sense of pressure beginning below the sternum and ascending. Patients complain of constriction of the throat, of a sensation as if ants were running, or wind was blowing over the surface, of fugitive pains, and of a great number of sensory troubles. Certain visual warnings are complained of as immediate precursors of the attack. The epileptic is occasionally apprised of the coming on of an attack by the perception of colored rings, spots, or broad fields of color, in which red or blue most commonly predominates. Scintillation and *muscæ volitantes* constitute the *auræ* in some cases. The existence of these latter is of much shorter duration than the distal sensory warnings referred to above, and so sudden is their onset that the patient is frequently unable to describe them. Sometimes the optical illusion is likened to the recession of objects or their advance; or again, the patient alludes to his being environed by a cloud. It is by no means uncommon for patients to complain of double vision and of hemiopia, and, as a rule, this accompanies a grave form of the malady dependent upon coarse cerebral disease. There are sometimes auditory hallucinations, such as rushing sounds, the ringing of bells, or the whistling of the wind. In some instances the sound of the ordinary conversation carried on by the persons who are in the same room with the patient, may be greatly intensified in pitch. *Psychical warnings* of a more complex nature take the form of imaginary voices which speak imperatively or give commands; and in rare cases a visual hallucination is the immediate precursor. Foul odors, such as that of smoke or of ordure, or those of aromatic substances, are sometimes perceived by the epileptic. Vile tastes of nauseating substances are spoken of occasionally. In such cases the individual often carries his hand to his nose, or smacks his lips, or makes efforts at expectoration. Sensations of great heat or cold are mentioned (Champier, Delasiauve). Among the rare prodromes may be mentioned a desire to defecate, to urinate, or to vomit, and certain patients belch forth large quantities of gas. The patient in some cases talks unintelligibly or utters meaningless cries, occasionally with something like regularity in expression.

There are many premonitory *motor disturbances*, such as limited trembling of the small muscles, blepharospasm, or twitchings of the facial muscles or of the fingers. Some epileptics present automatic disorders of motility which are continued for some seconds.

The condition of the patient may be such, for several days preceding the attack, as to indicate impending trouble. There may be despondency of manner, listlessness, malaise, or a sense of danger ahead. The eyes are often injected, and the temporal vessels stand out rather prominently. There may, on the other hand, be a state of unusual vivacity or excitement, possibly headaches, tremor of the lips or tongue, and varied subjective disturbances, which in some cases are very peculiar.

*Auræ* are by no means constant; in fact, the majority of patients cannot give a satisfactory account of any special warning.

Of 519 cases collected by Delasiauve, of which 229 were personal, but half presented any history of *auræ*. Of the writer's cases, only 40 per cent. gave the history of anything that could be called a true and distinct prodromal symptom. Gowers' experience, based upon 1,000 cases, is that a special warning "was always absent in

495, while some aura existed, at least occasionally, in 505"; this is a very large showing.

The major attack consists of three stages, viz.: the stage of tonic convulsion; the stage of clonic convulsions; and the stage of subsidence. The first of these is much the shortest, and is sometimes merged in the second. The last stage includes the condition after the subsidence of convulsive movement; during this stage the patient regains consciousness or sinks into a more or less profound sleep.

The attack may or may not be preceded by a warning, but it generally is by some exclamation or cry. The epileptic cry, which is a purely psychic feature, is loud, shrill, and terrible, and may either be the result of an unconscious cerebral effort or the direct expression of fright. It lasts sometimes but a few seconds, and is rarely repeated before the actual *about* of the convulsion. In other cases the noise made by the patient is alone due to mechanical causes, the tonic spasm of the muscles of the thorax forcing the air suddenly through the unprepared vocal cords. A coarse, gurgling noise, of low pitch and short duration, is the result. Then we see the development of the seizure. The victim usually falls to the ground rigid and helpless. The fall is ordinarily backward, though sometimes he pitches forward or to one side, and this may be preceded by throwing upward of the arms. Sometimes the head is thrown back, the forearm and hands being rigidly flexed; and then more conspicuous appearances are beheld. When recumbent, the patient is in a position of picrothotonos or opisthotonos, the body perhaps being laterally curved one way, while the head is drawn in the other direction. The eyes are usually widely opened, the whites of the eyeballs exposed, there being perhaps some tendency to conjugate deviation, or strabismus. The mouth is firmly closed or open, or if the onset of the attack be sudden and severe, the tongue or lips may be caught between the teeth, oftentimes to their severe injury. The arms and legs may be extended very violently, the dorsal surfaces of the hands approximated, and the fingers flexed; the feet overlap each other, and the toes are often extended; the abdominal muscles are flatly contracted, and for a moment breathing seems to be suspended; the patient's face, which at first was momentarily pale, becomes livid, and the lips, ears, and finger nails show how imperfect is the decarbonization of the blood; the skin of the hands is purplish, wrinkled, and cold, and all about the mouth is a dusky ring fading off to white at the points where pressure is made against the teeth.

The rigidity is so great that, if there be time to make such a test, it will be found that the exhibition of ordinary force will not enable the observer to overcome the extension. According to Mercier, who studied the disease very closely in an interesting case, "the rigidity is greatest in the hands, less in the wrists, still less in the elbows, and not very great in the shoulders. It is less in the legs than in the arms or neck; the head being retracted with a force approximating to that which immobilizes the elbows." The inequality of this rigidity, which may sometimes be unilateral, suggests certain structural cerebral defects, either due to previous disease, or to hemiatrophy, or to traumatism. Sometimes the mouth is drawn to one side, the head being turned to the other; this result is due to the fact that the cramp of the muscles of one side is distinctly more pronounced than that of the muscles of the other side. The pupils are now found to be widely dilated, insensitive to light and touch. The face becomes engorged, and with such a change the breathing is noisy and rapid. The lips flap loosely with each inspiration and expiration, churning the froth, which is perhaps tinged with the blood that may come from a wounded tongue. As Mercier has observed in his case, the spasm of the oral muscles may be synchronous with the respiratory movements. The movements of a clonic nature now occur, and these may be more or less violent. There is little regularity in their happening, though I find it the rule for a succession of jactitations to mark the discharge emanating from fresh groups of cortical

cells; the spasms in one extremity disappearing as those in another extremity become more prominent. The spasms, as a rule, are disorderly, and in no sense rhythmical. There is in some cases a fine tremor which is more or less pronounced, and this takes the place of active spasm. Mercier observed a patient in whom the tremor began in the periphery and spread toward the trunk. The clonic spasms of the upper extremities consist sometimes of alternate pronation or supination, flexion and extension of the hands, the thumbs being doubled under the fingers, which are strongly flexed. The movements which, as a rule, affect the extremities at first, finally become so general that the trunk is involved, and a diversified number of contortions take place, the pelvic movements being very marked. These clonic convulsions are so severe that the patient very often throws himself from the bed upon which he may be lying, and in severe cases it requires the exhibition of much force to keep him from injuring himself. This stage continues for a variable time, which usually seems much longer than it really is. There may be a fresh accession of clonic spasms, but ordinarily the attack is short-lived, and the person gradually becomes more quiet; the color returns to the face; there are some signs of subsidence, for the breathing grows regular and perhaps sighing; the pulse is more regular and less full, the rigidity disappears, and the subject makes movements, especially of the mouth, which are semi-volitional. The head may now be rolled unceasingly from side to side, and some effort to arise may be attempted. The patient may open his eyes and look vacantly about, or murmur indistinctly. Sometimes the confusion of ideas which attends the glimmering return to consciousness may manifest itself in incoherent talk and transposition of words.

During the convulsive stages the patient often has involuntary discharges from his bowels or bladder, and it happens that seminal emissions even may occur. This is true especially of the nocturnal attacks, and is often a valuable diagnostic point to observe, and in adults nocturnal incontinence of urine often exists with unsuspected epilepsy.

The cutaneous reflexes are lost during the attack, but after the subsidence of the clonic stage we find that there is a return, and that the deep reflexes are very much exaggerated, this being particularly true, in some cases, of the ankle clonus. In one instance, elsewhere reported, I found that an epirothian blow would produce a response in the opposite leg. The patient gradually regains his normal state and arises, or more commonly he sinks into a deep slumber, from which he awakens exhausted and with headache.

The temperature and pulse of the epileptic undergo very important changes. In the status epilepticus there may be a decided increase of the former, but during the attack there are but slight variations. The pulse is quite thread-like, especially during the first stage; while during the stage of clonic convulsion it is much more full and rapid.

The urine passed after the attack is found to contain urea and the phosphates in increased amount, indican, and occasionally albumin. Huppert holds that the presence of the latter is constant, and I am fully able to confirm his statement. Herter and Smith found that there is often a change in the proportion of sulphates in the urine, the ethereal sulphates being increased to an excessive degree.

**Immediate Results of the Attack.**—After the attack we sometimes find a variety of disturbances of the nervous system. These are exceedingly variable, and may consist of sensorial or motorial manifestations, and in the former I include the immediate mental derangement. I have already alluded to the headache, which is dull and vertical or frontal. Of course the injuries the patient may have sustained are quite apt to leave behind their painful effects, but there are disturbances which are connected with the fit itself which are exceedingly annoying. Excessive muscular violence may give rise to fibrillary rupture, and, in rare cases, to dislocation of the large bones.

Spots of cutaneous anaesthesia are complained of sometimes, and the skin is covered with petechiae.

The post-epileptic mental state has been studied by Jackson, and is of especial interest in light of imperfectly developed attacks. The aphasic state has been spoken of, and I will add only that, when there is a disturbance of speech of appreciable duration, the beginning of recovery is marked by the use, first, of words containing vowel sounds, and then only later of those containing consonants. This fact was first observed by Jackson and formulated in his rule—that simple and quasi-automatic processes suffer least, and are soonest recovered, while complex arrangements suffer most, and are more tardily recovered from. The post-mental state is often expressed by peculiarities in the behavior of the individual, by automatism, and occasionally by violence or the commission of purposeless acts. The patient may be dull, forgetful, or slow in all he does or says. Sometimes, however, the attack acts as an apparent vent, for the epileptic who is dull before the paroxysm is afterward exceptionally bright. In certain cases a blunting of the moral sense, with impulsive promptings, is shown in the performance of various mischievous and dangerous acts.

The motor disturbances are chiefly paralysis and subsidiary spasm. A condition known as post-epileptic paralysis is an occasional sequence of hemi-epilepsy, and may last for some time. In some instances there may be simply a loss of power, which is present for a few hours or days, while in others the paralysis is permanent, and perhaps is indicative of the commencement of widespread coarse cerebral disease. In some cases, subsequently the attack, convulsions may begin in the paralyzed members. In still other cases, although rarely, a vesical weakness may follow an unusually severe attack, or, as a result, a peripheral paralysis may follow the injury of some nerve trunk, either in connection with dislocation or as a result of violence connected with the patient's fall. Some diagnostic interest is connected with these cases.

**Remote Effects of Epilepsy.**—The epileptic whose disease is deep-seated presents certain conspicuous indications of his disorder. His expression is dull, the eyes lacking lustre, and the lines of his face are by no means well marked. His facial muscles may be the seat of a low grade of paresis, or an hemiatrophy may give rise to an easily recognizable asymmetry. Fibrillary tremors are by no means uncommon, and the lips are puffed and rather inclined to present a purplish tinge. Acne is common, even when bromides are not used to excess, and the tongue often presents old scars, the evidence of former attacks. The patient's movements are not characterized by vigor. Mentally he may present evidences of great weakness, especially if the form of attack has been that of the petit mal, but it does not follow that epilepsy should bring in its train any decided degeneration of this nature. Many epileptics who have occasional grave attacks preserve their original strength of intellect. There are many epileptics whose paroxysms are purely the expressions of the insane neurosis, and this is true especially of children with deformed crania and irregular teeth, and who are imbeciles or idiots. These subjects are, perhaps, able in a weak way to perform acts requiring little intellectual energy, or they grow up presenting characteristics which are overlooked by fond parenting characteristics which are overlooked for things, is rents. The "strange" child does unlooked-for things, is vicious, or unduly mischievous; applies itself to certain studies, learning with great ease, while it is hopelessly deficient in others. Such a child may display exceptional smartness in mastering some limited "accomplishment." Born of drunken or insane parents, at ten it becomes epileptic. Its "queerness" increases, and its fits are not cured; dementia follows, or the type of disease changes, and the infantile attacks are substituted by epileptic insanity; the latter developing, if the subject is a female, in connection with some menstrual derangement, or a trying pregnancy, or at the menopause.

Epileptic attacks may be divided into three classes as

regards their time of occurrence—*matutinal, diurnal, and nocturnal*. The mode of occurrence may be regular or irregular. So far as my experience goes, the greatest number of severe attacks occur in the early morning, or during the night, while attacks of petit mal may occur alone during the day. The attacks may be very numerous, several hundred perhaps occurring within the merous, several hours. Axenfeld reports a case in which twenty-four and fifty occurred in one day, and Newingham another in which no less than six hundred and twenty-two convulsions were counted in the same time. Such cases are, of course, very unusual. In point of rarity, I have had several patients who have had well-defined attacks as far apart as two years; and one gentleman comes to me almost yearly to report that he has had one or two attacks within one week after an interval of many months. By far the greater number of patients have attacks every two or three weeks, and women have them chiefly at the catamenial period, or shortly afterward. Of course, if the disease becomes established the intervals become shorter, and in hospitals for the epileptics the case-books show that most of the patients have from one to a dozen attacks daily. Attacks of petit mal, when the disease is well established, are of course much more frequent.

There is a tendency in epileptic attacks to occur in groups. Isolated attacks, as Gowers very properly says, are more common, and when the attacks occur in cycles there is little regularity, so far as number is concerned. Young children are very apt to have one or two convulsions, which are looked upon simply as eclamptic, and then they remain entirely free from any return until the eighth or tenth year, when several entirely unexpected seizures make their appearance. In many cases there is no antecedent history of trouble, but, without any cause whatever, one or more paroxysms appear. The possibility of further trouble keeps the patient's friends in a state of doubt and uncertainty.

The risk of a second attack within one month is considerable, and such risk does not disappear for a long time. Too great caution cannot be exercised as regards the giving of an opinion, and while it will not do to say that all early eclamptic attacks are suggestive of subsequent epilepsy, it is a fact that the early spasms of childhood, occurring perhaps at the third or fourth year, between the periods of the first and second dentition, are quite likely to be the precursors of others in regard to the character of which there can be no possible doubt.

The *status epilepticus* is a condition which marks the occurrence of a great number of attacks, and when consciousness does not return between them, the patient becomes increasingly comatose, the body-temperature rises to a considerable height (105° to 107° F.), and death soon follows. Recovery, however, is not impossible.

**Sensory Epilepsy.**—Under the caption of "thalamic epilepsy," Dr. William A. Hammond<sup>2</sup> described a form of the disease in which sensory disturbances predominated, and which he believed to be due to a lesion of the optic thalamus. The attacks, which belong to nothing more nor less than a sensory epilepsy,<sup>3</sup> are characterized by a few or no disorders of motility, but by the occurrence of hallucinations of a more or less elaborate character, and by hemiopia. With these are commonly associated some headache of a migrainous type, and occasionally anaesthesia, or the loss of the volitional power of speech. Jackson,<sup>4</sup> in his earlier articles, freely and fully explains the pathology of various sensory auras and minor attacks. The symptoms which I have observed in these cases all belonged to Exner's third group of hallucinations of sight (*Gesichtshallucinationen*)<sup>5</sup> and are undoubtedly of cortical and not of thalamic origin.

The lack of space will not allow me to give an account of more than one case of the kind which has just been under discussion. The details, in brief, are as follows: Miss J. D., aged 29, comes of a neurotic stock; a brother and sister both suffer from incomplete epilepsy, and her mother has had headache and incident hysterical epilepsy. The maternal grandfather was extremely ec-

centric, and possibly insane, and there are other instances of neurotic disease in the family history.

Since her early childhood she has suffered from vertigo and headache, and at the commencement of menstruation she became hysterical. She is at present a healthy-looking woman, somewhat nervous and excitable in manner, but clever, intelligent, and possessing an unusual memory. Her present attacks became quite marked three or four years ago, and during the past eighteen months they have occurred every three or four weeks—without any apparent relation to menstruation. Occupation and excitement alone seem to possess the power of diminishing the frequency of their recurrence.

As the first symptom of any disturbance of her vision she noticed a unilateral dimness of sight, and afterward a blindness which was sudden and absolute; she invariably "lost half" of the object at which she was looking. Her first attack of this kind was in a railway station, and while looking at the clock the figures from "XII." to "VI." disappeared. This partial abolition of sight lasted for a period of ten or fifteen minutes, and shortly after its occurrence she noticed a numbness of the tongue, and pain on the left side. This numbness next appeared in the fingers of the left hand and slowly extended up to the elbow, when it stopped. The right hand next became involved, and after a "furry feeling" of the tips of the thumb and forefinger her hand became "dead and without feeling" as far as the wrist. From five to fifteen minutes after this had occurred she lost consciousness, and while in this unconscious state she made quasi-convulsive movements which were undoubtedly psychical, as she rubbed the hands over each other, and made attempts to remove her rings. She stated that her fingers were swollen, and that considerable difficulty was experienced in removing the rings from her fingers. (Her sister corroborated this statement.)

As regards the subsequent attacks, the patient states that two or three minutes after the development of the anaesthesia there is often exquisite pain over the right eye, which augments in severity and extends over the entire head. This lasts sometimes for an hour or so after the attack, and is not relieved by any application.

During the unconsciousness, which is complete, she neither breathes stertorously, nor bites her tongue, nor shows any epileptic appearance, except it may perhaps be a slight pallor and dilatation of the pupils. It is impossible to arouse her for several minutes. The attacks are often aborted by strong mental effort, or by diffusible stimulants. Upon several occasions she has been suddenly deprived of the power of speech, and could not express herself, but this is exceptional. Such mutism was coincident with the hemipic stage, and did not develop subsequently to the loss of consciousness.

At the time when she first consulted me she had neither menstrual nor other disturbance of the pelvic organs. She slept soundly, and had dreams nearly every night, but she was not a somnambulist. After the attacks she passed large quantities of clear urine. There was no color blindness.

Physical examination revealed almost nothing except it may perhaps be a suspicious bulging of the left optic disc, and a tortuous and enlarged condition of the veins. The tongue pointed slightly to the right.

**Masked Epilepsy.**—There are many forms of irregular seizures which present interesting features. In some there may be a few of the ordinary manifestations of the familiar attack in association with others which are quite bizarre. In several cases which have come under my observation the patients began to run violently about the room, and finally became convulsed. In others the whole attack consisted in continued running, the subject being unconscious throughout. In two or three patients there was a tendency to remove all their clothing, without the least appreciation of what they were doing. A form of the disease in which the epileptic remains in a species of trance is occasionally presented. Sometimes the attack will take place without attracting attention. I have recently had under my care a clergyman who wan-

dered in an aimless sort of way about the country, and when afterward found could give no account of himself for the week previous to his discovery. While in this dual state the patient will get into altercations with strangers, or commit purposeless acts. Such cases are of great interest from the standpoint of medical jurisprudence. As a rule, the reprehensible acts are motiveless, and are not remembered after commission.

The *interparoxysmal state* may be one free from any nervous trouble whatever, the patient remaining perfectly well until a new explosion takes place. At other times, on the approach of the paroxysm, there will be a change in the patient's manner which betrays itself in an apprehensive melancholy, that may still later give way to a condition of great irritability. Occasionally an aphonia may exist during the entire interparoxysmal period, but this is rare. Romberg speaks of dysphagia, tympanites, trismus, and ischuria as possible sequelae, which may last a long time. Romberg believes that epileptic individuals are less likely to contract contagious diseases, but, as Axenfeld very properly says, these observations lack sufficient proof. The pupils during the interparoxysmal period are, as a rule, very mobile, and act too readily to light stimulation. The pulse during the interparoxysmal state is usually soft, slow, and compressible; the cutaneous circulation, especially in old epileptics, is poor, and the hands are inclined to be livid and dry. Hang-nails and other evidences of malnutrition are quite common.

The influence of pregnancy has been the subject of much controversy. The burden of proof goes to show that epilepsy does not interfere with the process of gestation in any serious way, and, as a rule, does not induce miscarriage. Pregnancy, on the other hand, seems to aggravate the epileptic state itself, though quite exceptional cases are reported in which a cure was effected through the establishment of this condition. Such cases are mentioned by Landre, Beauvais, and Delasiauve. Suppression of the menstrual flow is apt to precipitate the convulsions.

In certain rare cases the course of epilepsy is greatly modified, if not cured, by the occurrence of one of the eruptive fevers. Minor attacks may be transformed into major through the agency of an illness which may, perhaps, be of this character.

**ETIOLOGY.**—It is an undeniable fact that heredity plays the most extensive part in the causation of epilepsy. Of the 980 cases no less than 435 presented some family history of neurotic or pulmonary trouble.\* Thirty-five per cent. of Gowers' cases were characterized by the same state of things, and with other authors—among them Reynolds and Echeverria—the proportion of cases in which there is a neurotic inheritance varies from thirty-five to forty per cent. As the result of such inheritance we find that female cases rather preponderate. Of very young subjects this is the rule, but when the disease begins after twenty it appears that there are more males who become epileptic than females. In the greater part of all cases the disease first manifests itself before the twentieth year.

Of 980 collected cases in which the beginning of the disease was known, there were—

	Females.	Males.	Total.
Under ten years . . . . .	103	95	198
Between ten and twenty years . . . . .	171	97	268
Between twenty and thirty years . . . . .	145	92	237
Between thirty and fifty years . . . . .	81	136	217
Over fifty years . . . . .	11	49	60
Total . . . . .	511	469	980

**Cranial deformities,** especially microcephalus, are found with epilepsy, and children whose crania have undergone pre-ossification are quite apt to suffer from irregular forms of epilepsy. Ten or fifteen per cent. of chil-

\* Drunkenness included.

dren, according to Delasiauve, present epilepsy conjointly with idiocy. The convulsions are quite apt to be associated with some curious form of intellectual perversion.

The *traumatic causation* of the disease is exceedingly interesting, because of the occasional strange character of the injuries. As a rule, blows which leave only slight or no external signs of their violence are apt, after the lapse of years, to be followed by the outburst of epilepsy. Depressions over the paracentral lobes may be found in connection with unilateral paroxysms. Bullet wounds which perhaps have caused extensive erosion of bone may also be mentioned as causes. In one case, for example, the patient presented a large excavation in the petrous and mastoid portions of the temporal bone, and this wound, which had excited a meningeal inflammation, also gave rise to a very severe epilepsy with maniacal outbursts. Blows producing fracture of the internal table of the skull frequently account for the disease. A scar left from a head injury may be the starting-point of a painful aura which is the precursor of an attack, and various writers allude to injury of the nerve trunks, and the sciatic especially, as an important though rare factor.

**Syphilis,** in either its secondary or its tertiary stages, but more often in the latter, may give origin to an epilepsy of a peculiar type. The seizure, as a rule, is preceded by headache, and is often associated with other neurotic changes and monoplegiæ. The interparoxysmal state is quite apt to be characterized by more or less loss of memory, intellectual weakness, and, in some cases, a great desire to sleep at odd times and places, such a tendency being apparently irresistible. In many cases there is disease of the cranial bones as an intermediate factor.

Fournier says that when epilepsy manifests itself for the first time in a patient of twenty or thirty it is of specific origin in eight or nine cases out of ten.

The *exanthemata* may be followed by the development of epileptic attacks which are often very intractable. Especially true is this when it is scarlet fever that has preceded the paroxysms. Not only may this disease have such an influence, but measles, smallpox, diphtheria, and a number of maladies of like nature, may directly cause the epilepsy.

Metallic poisoning is a rare cause, and when we find epileptic convulsions in such cases it is usually symptomatic of some advanced encephalopathy. The use of absinthe and alcohol, when excessive, is quite apt to give rise to convulsions, which are usually of a violent type. The latter, as a rule, are imperfectly formed, and the loss of consciousness is peculiar. In some the mental derangement is of the nature of a trance, and the patient's seizures resemble the form of the disease known as "masked epilepsy."

Malarial poisoning may underlie an epilepsy which is seemingly periodic and attended by great rise of temperature; it may be cured by large doses of quinine.

In certain cases *great and repeated losses of blood* will give rise to epilepsy. In some cases there is an initial migraine, which exists for some time before the occurrence of the seizures. *Sunstroke* occasionally is the exciting cause of a series of convulsions, which, however, can rarely be called epileptic.

It is not uncommon for an epilepsy to develop at the time when the menstrual function is established. Herpin reports the case of a girl whose convulsions appeared at the menstrual epoch, and recurred with each succeeding period; Maisonneuve reports similar cases. The suppression of vaginal fluxes is naturally a determining etiological influence.

Sexual excesses are too often supposed to give rise to epilepsy, and masturbation especially is given great prominence as a cause. Onanism is very common among epileptics of low moral gauge, with physical anomalies of development, but it can hardly be considered in the light of a cause. Excessive copulation and lustful excesses are mentioned by Continental writers as playing a part in the creation of the disease.

Of *fear* and *mental worry* and *anxiety*, many authors are disposed to speak as important exciting or predispos-

ing causes. There is no doubt of the bad influence of the latter, but the importance of the former is to be admitted with some reluctance, although it cannot be denied that a sudden shock or fright has caused attacks.

Various exciting causes are quite likely to be discovered, especially among young subjects. Many so-called eclamptic, or rather epileptic, seizures are caused by *intestinal worms*, or by the presence of undigested food and the absorption of ptomaines.

Intestinal worms, while they are often responsible for infantile eclampsia, rarely produce epilepsy in adults. Luykx and Michel report cases in which the disease seemed to be dependent on tænia, and in that reported by Michel the seizures occurred during five years, and ceased with the expulsion of the worm.

Muscroft<sup>7</sup> reports a case of stone in the bladder which gave rise to epileptic convulsions. The successful removal of the stone effected a cure of the epilepsy.

Irritation of the auditory apparatus is likely to produce epilepsy, and the paroxysms may follow such simple excitation as blowing into the ear. The attacks from such a cause may even be very violent and general.

So far as the influence of diet is concerned, we find that continued or excessive indulgence in animal food is likely to predispose to the disease in some persons. Many first attacks may be dated back to an engorgement of the stomach or to some act of gluttony, and in many cases immoderate indulgence in food often constitutes an exciting factor. Portal speaks of several subjects who became epileptic after gluttonous indulgence in beans (Delasiauve), and the older writers also refer to cases in which the ingestion of poisonous fungi or of ergot has been the assigned cause.

**MORBID ANATOMY AND PATHOLOGY.**—There is nothing that can be called constant or characteristic in the way of a morbid anatomical appearance in the epileptic brain. This disease has existed in connection with almost every variety of pathological change. Meningeal or osseous thickening, exostoses, vascular dilatation and sclerosis, cerebral atrophy and hypertrophy, the presence of tumors—all these lesions have been found to exist in epileptic cases. Epilepsy is found among children whose sutures have closed prematurely, and I have seen a number of such cases in which the fits have appeared between the fifth and tenth years—which is due, as I suppose, to the fact that the brain rapidly develops at the fifth year, but, owing to preossification, and the resulting limitation of the space afforded by the cranial cavity, this organ is denied sufficient room for expansion. In traumatic cases we find all varieties of fracture and depression, and occasionally the existence of old subdural cysts.

Lunier<sup>8</sup> found that the crania of many epileptics presented various abnormalities. In some he found a flatness or depression of the frontal bone; in other cases an asymmetry between the lateral halves of the skull, which was the result of undue prominence of the parietal bone of one side. Lasègue called attention to a fronto-facial asymmetry which was the result of a consolidation of the sutures at the base of the skull, the union being a slow one, and usually requiring for its accomplishment the space of eighteen years, at the end of which period the attacks would appear. The cerebral deformity resulting from this asymmetry consisted in an inequality in the size of the two frontal lobes, the depression being most often noticed upon the right side (Axenfeld). Certain facial peculiarities, as well as deformities of the vault of the palate, were associated with this.

Echeverria,<sup>9</sup> Van der Kolk,<sup>10</sup> Luys and Voisin,<sup>11</sup> and others, have observed morbid appearances in the medulla: the presence of amylaceous cells, an exudation of a granulo-albuminous nature, cell degeneration and pigmentation, as well as destruction, in part, of certain important nuclei, notably of the hypoglossus and pneumogastric nerves. Echeverria found lesions of that portion of the great sympathetic which is located in the neck.

Ogle and Jackson have reported many cases in which there was cortical degeneration, especially of the paracentral lobule. In cases in which dementia or other men-