

comparatively slight destruction of tissue interferes materially with the conduction of nervous impulses.

Vomiting is a not infrequent symptom, and may occur when the stomach is either full or empty.

In certain rare cases, the sole symptoms observed during the period of latency are those of mental derangement, and the patient is supposed to suffer from insanity as the result of injury to the head. In a case recently under our observation, such an error in diagnosis was made by a very eminent neurologist, and the true nature of the case was revealed only at the autopsy, as the psychical symptoms persisted, uncomplicated with any other manifestations, until the terminal meningitis set in.

As a general thing, the latent period is brought to a close by a sudden irruption of symptoms, beginning either with an epileptiform convulsion or a series of convulsions, with great exacerbation of the headache, mental irritability and delirium, or with sudden coma. The symptoms which follow are very similar in character to those which we have described above as occurring in acute abscess. After a short period (varying usually from a few hours to several days), the symptoms either terminate fatally (this is the rule) or they gradually clear up. But sooner or later, after another period of latency, in which the symptoms are more violent than in the first period, a second outburst occurs, which terminates fatally.

From the reports of a few isolated cases it seems probable that chronic abscesses may undergo spontaneous recovery, inasmuch as the pus becomes cheesy or even calcareous. But such an event, if it happens at all, must be extremely rare.

DIAGNOSIS.—In making a diagnosis of abscess of the brain great importance attaches to etiological considerations. We are rarely justified in making the diagnosis unless we obtain a history of a previous injury to the head, of a purulent disease of the ear, nose, or other adjacent parts, or of some source of infectious emboli in distant parts of the body, notably in the lungs.

Injury to the head is followed, in rare cases, by tumor of the brain. But in such cases it will usually be found that the primary wound was not infectious in character, and, moreover, the symptoms follow one another in a steadily progressive manner. Furthermore, choked disc is much more constant and pronounced in tumor cerebri, while the subnormal temperature, or the fever and chills of abscess are wanting.

Injury to the head may also give rise to other symptoms which simulate abscess of the brain but which are in reality due to hemorrhagic encephalitis. In the latter affection the symptoms begin suddenly. They may terminate in complete recovery or rapid death, or the majority of the symptoms may disappear and leave permanent focal symptoms.

In considering suppurative disease of the middle ear as a factor in the diagnosis of cerebral abscess, it should not be forgotten that severe cerebral symptoms may be produced by the mere retention of pus in otitis media independently of the existence of cerebral lesions. A number of cases have also been reported in which optic neuritis or choked disc was associated with simple otitis media. This peculiar combination has been explained in various ways, viz., as the result of thrombosis of the sinuses, of infection of the carotid canal and extension along its lymph channels to the sheath of the optic nerve, and of serous meningitis.

Extra-dural abscess often cannot be distinguished from cerebral abscess; indeed, in many cases the two lesions are combined. According to Jansen, extra-dural abscesses exhibit the following characteristic features: (a) thickening of the bone, subperiosteal abscess or oedematous swelling behind the mastoid process; (b) pain on pressure and percussion in this region; (c) impaired mobility of the head, particularly around the sagittal axis; (d) nystagmus of both eyes, on voluntary motion, chiefly toward the side of the healthy ear.

Otitic thrombosis of the sinuses is also difficult of differentiation. In the majority of cases there is considerable intermittent fever, and the pulse is irregular and rapid. Many cases are attended with chills, sweats, and profuse diarrhoea. In some cases all these symptoms may be wanting. In thrombosis of the cavernous sinus we find oedema of the eyelids and surrounding parts, and protrusion of the eyeball. In thrombosis of the transverse sinus, certain symptoms may be due to impaction of the upper part of the jugular vein. This vein is tender on pressure and may be felt occasionally as a hard cord. Small abscesses may develop in surrounding parts. Oedema behind the mastoid process is very frequent.

Focal symptoms are usually wanting in thrombosis of the sinuses.

When abscess and thrombosis are combined the condition becomes still more difficult of diagnosis.

It is also difficult in many cases to differentiate meningitis from abscess. The former disease usually runs a more rapid course than abscess, is attended with considerable fever and acceleration of the pulse, general convulsions are frequent, and there is also hyperæsthesia of the entire skin in many cases. Rigidity of the neck is a common symptom, together with retraction of the abdomen and increase of the tendon reflexes. In children all these symptoms are sometimes produced by retention of pus in the middle ear and may be relieved by evacuation of the pus.

The regional diagnosis must be made according to the principles laid down in the articles on *Diagnosis of Local Lesions* and on *Functions of the Cerebral Cortex* (both in the present series of brain articles).

PROGNOSIS.—The prognosis of this affection has been modified very materially in the last fifteen years by the progress in antiseptic surgery. Spontaneous recovery by caseation or calcification of the abscess or by rupture externally is extremely rare. But operative interference now promises a good measure of success. Oppenheim found that in 53 cases of operation upon traumatic cerebral abscess 36 terminated in recovery. Koerner collated 92 operative cases of otitic cerebral abscesses; 51 cases recovered and death occurred in 41 cases. Macewen's results were remarkably favorable. Among his 25 cases of cerebral abscess he operated upon 19, and of these 18 recovered.

The poorest chances of successful surgical interference are presented by metastatic abscesses in which there is general pyæmic infection. Complication with thrombosis of the sinuses or meningitis also makes the prognosis more unfavorable.

TREATMENT.—Medical treatment of this affection, apart from meeting the individual symptoms as they arise, is utterly useless, as we possess no remedy which will cause the absorption of the pus after it has once formed.

Prophylactic measures are useful, perhaps, in preventing encephalitis after injuries to the head. The chief measures are absolute mental and bodily rest (the patient kept on his back, not allowed to sit up, to read, or to talk with those around him), which should be continued, if the injury has been violent enough to produce unconsciousness, for at least a week or two after the subsidence of the cerebral symptoms. In addition, the bowels should be kept thoroughly open by some mild saline, or by small doses of calomel.

Prophylaxis may also prove of benefit in diseases of the ear and nose. Free vent to the pus should always be secured, and paracentesis performed as soon as retention of pus develops.

As soon as the diagnosis is assured, operative interference is indicated. In some cases this has proved successful, even when the patient was in a moribund condition or a complication with purulent meningitis had developed. In some instances repeated operations have been necessary, either because the abscess refilled or because fresh abscesses developed in the immediate vicinity of the primary one.

Leopold Putzel.

BRAIN, ANÆMIA OF.—Anæmia is a condition and not a disease in the proper sense of the term. Moreover, it is a condition which rarely or never exists uncomplicated. The causes which produce it are very apt to produce independently irritation and inflammation, or the same conditions which at first bring about an anæmia of the brain may, if their action be longer continued, excite in its place a cerebral hyperæmia. In the present state of our knowledge it is, moreover, often impossible for us to prove whether certain symptoms are really produced by an anæmia or by a hyperæmia of the brain, and in such cases we are forced to come to a decision on very imperfect grounds.

Of the fact that the anæmia in itself acts as an irritant on the nerve centres there can be no doubt, but its chief effect on them is produced through the deprivation of nutrition which it causes. In considering anæmia of the brain, it is not possible for us to differentiate the symptoms caused by deprivation of nutrition to the cerebral tissues through loss of blood and those caused by deprivation of nutrition to the same parts on account of the poverty of the blood in nutritive material suited to their needs. Hence the term cerebral anæmia has come to denote not only that condition in which there is an absolute diminution of the amount of blood in the brain, but also all those, so long as no toxic element is involved, in which the blood supplied to the brain is, from its composition, incapable of affording due and sufficient nourishment to the tissues. As a change in the condition of the blood is in most cases concurrent with a diminution in its amount, we may fairly say that cerebral anæmia, when universal, is usually "a complex condition, depending not merely upon a deficiency of the quantity of blood supplied to the brain, but also upon a change in its quality, and upon a diminution in the intracranial pressure" (Ross, ii., 611).

Anæmia of the brain may be either universal or partial, according as the whole or a portion only of the organ is involved. Partial anæmia, except when caused by occlusion of a blood-vessel through pressure, thrombosis, or embolism, is rare, and its symptoms are often not recognizable during life.

We shall hence consider here only universal cerebral anæmia. This may be either acute or chronic, and it may be due to a condition confined to the brain alone or may form part of a general anæmia.

Acute universal anæmia of the brain is always the result of the sudden withdrawal of a large quantity of blood from that organ. It occurs typically in ligation of the large arteries in the neck, the innominate, the carotids, or the vertebrals. These operations are performed usually either on account of injury, or for some tumor or aneurism. The vertebrals were formerly sometimes tied as a cure for epilepsy.

1. The most common cause of acute cerebral anæmia is, however, undoubtedly hemorrhage. This may occur from any part of the body, provided only that sufficient blood be lost with sufficient rapidity. Putting aside hemorrhages due to injuries, the more common forms are metrorrhagia, especially post partum, epistaxis, hæmoptysis, and hemorrhages from the stomach and intestines; occasionally also the rupture of aneurisms.

In cases of hemorrhage from injury the influence of shock must always be taken into account, as there are few cases of severe injury in which it does not exist to a greater or less degree. The pathological condition existent in shock is as yet unknown. One hypothesis is that maintained by Grönigen, that the complex of symptoms known by this name is due to an exhaustion of the medulla oblongata and of the spinal cord, produced by violent and severe drains upon their strength. Other writers consider shock as due to sudden changes in the calibre of the blood-vessels. Thus it is defined by Fischer as a reflex paralysis of the vaso-motor nerves, especially of the splanchnic, produced through a traumatic concussion. However this may be, cerebral anæmia is certainly produced by shock, and, as Travers says of shock

and fainting: "They differ in degree and duration more than in kind."

2. Acute cerebral anæmia may be produced by any sudden change in the distribution of the blood in the body at large. Any cause which suddenly attracts a large quantity of blood to one portion of the body will naturally reduce the amount which can go to the other parts, and hence will induce an anæmia in them. This sudden change in the general distribution of blood in the body is said to occur after violent labor, when, the uterine vessels being suddenly released from pressure, large quantities of blood enter them freely and are thus withdrawn from the rest of the body. To this cause are probably in part also due the serious symptoms which sometimes occur after the withdrawal of large quantities of fluid from the pleural or peritoneal cavities. Another example of this form of disturbance is given in the action of Junod's boot, which, if carelessly used, may provoke dangerous symptoms.

3. A third cause of this form of anæmia is want of energy in the action of the heart. This is a common cause of chronic anæmia, but the acute form may readily be produced by any sudden demand for increased exertion on the already weakened heart. This is readily seen in anæmic persons and those suffering from insufficient action of the heart, in their liability to faint on any slight exertion, or even on rapid change of position. More especially is this the case in convalescents from acute febrile diseases, and it is particularly apt to occur after acute pneumonia. This frequently takes place when the patient rises suddenly from the horizontal position, the change in the distribution of the blood, which under normal circumstances would not be perceived, making itself felt.

In organic diseases of the heart cerebral anæmia in the acute form frequently occurs, more especially in aortic regurgitation, in which death from syncope is not uncommon. Persons suffering from myocarditis or from fatty degeneration of the heart are likewise peculiarly liable to attacks of fainting.

Anæmia of the brain may in like manner be produced by irritation of the vagus nerve through its action on the heart. Brown-Séquard and others have found that crushing of the right semilunar ganglion causes stoppage of the heart, and the deaths which sometimes occur from syncope in nervous and delicate persons, who are suffering from hepatic colic, may perhaps be referred to some similar cause. We may also mention here, though without any special reference to the method of their causation, those cases of syncope and collapse which occur in perforation of the stomach or intestines, and in which death is not infrequent. Hill believes that "the cerebral circulation is controlled by the vaso-motor centre acting on the splanchnic area."

That intestinal disturbances even of a light character are especially liable to produce syncope is well known. Even a transient abdominal pain or a slight attack of intestinal colic frequently causes the symptoms of faintness or even actual syncope. Syncopal cardialgia and a tendency to faint are said to be especially common in those suffering from the dyspepsia of gout.

4. Again, a diminution of the amount of blood in the brain sufficient to produce the symptoms of cerebral anæmia might be caused through the spasmodic contraction of the cerebral arteries. This is supposed to occur, when, from emotion or mental excitement, there is pallor of the countenance, and even loss of consciousness, without any failure of the action of the heart. The not uncommon occurrence of fainting at the sight of surgical operations, or at the sight of blood, would come under this head. Syncope, and even sudden death, may be caused by the sudden advent of any strong emotion—surprise, terror, grief, or joy. How far shock or the irritation of the vagus comes into play in these cases is yet undecided.

Nothnagel considers it possible that in attacks of epilepsy we have to deal with a spasmodic contraction of the cerebral blood-vessels, due to the irritation of a cere-

bral vaso-motor centre; but this cannot in the present state of our knowledge be considered as proved. Hill states that there is no evidence of the causation of cerebral anæmia by spasm of the cerebral arterioles.

The occurrence of vaso-motor nerves on the vessels of the pia seems probable according to the latest investigations (Obersteiner, Hill).

Hill states that "in every experimental condition the cerebral circulation passively follows the changes in the general arterial and venous pressures."

That cerebral anæmia may also be excited by irritation or stimulation of the sensitive nerves is well known. Intense pain may produce faintness or even syncope, but the exact method of action by which this effect is brought about must still be considered undecided. Nothnagel's and Krauspe's experiments on the sciatic and crural nerves do not appear conclusive, more especially in the face of the conflicting results obtained by Riegel. Ross states that these symptoms "may result from reflex irritation of the vagus or direct irritation of the sympathetic. But the direct effect produced on the nerve centres must also contribute to the result." Nothnagel considers the cerebral anæmia caused by catheterization to be likewise due to irritation of the vaso-motor centres.

5. Cerebral anæmia may in like manner be produced by the sudden introduction of foreign substances into the cavity of the cranium, thus inducing compression of the blood-vessels. The most common cause of this is an effusion of blood; but in cerebral or meningeal hemorrhage the pathological condition is a complex one, and it does not properly come within the limits of this article.

6. It is probable that acute universal anæmia of the brain may be induced by certain poisons, but direct proof in this regard is still wanting.

Chronic universal anæmia of the brain may be produced not only by all the causes mentioned above, provided that their action be gradual and continued for a sufficient length of time, but also by all conditions of the system in which the amount of blood as a whole is much lessened or its active power much diminished. Hence in all cases of general anæmia and chlorosis we find a corresponding anæmia of the brain. This is especially apt to occur after long and wasting diseases, such as phthisis pulmonum, Pott's disease, or long-continued suppuration in any form. More particularly is this the case whenever large quantities of fluid of any sort are steadily withdrawn from the body for any length of time, as in chronic diarrhoea. Hyperlactation is a not infrequent cause. Nothnagel, moreover, considers that many of the symptoms occurring in cases of starvation are directly referable to cerebral anæmia, although in these cases there probably always exists a greater or less amount of cerebral irritation.

Anæmia of the brain and meninges is specially apt to occur in the convalescent stage of acute febrile diseases, "the late cerebral anæmia of severe fevers" of Jaccoud, who considers, however, that this is not a simple anæmia but an anæmia with dyscrasia.

Affections of the heart, moreover, are not uncommon factors in the etiology of chronic anæmia. Whenever there exists a weakness of the cardiac action, whether due to functional causes or to organic lesions, we may suspect anæmia of the brain. This is probably always present to a greater or less extent in cases of fatty degeneration of the cardiac walls and in most cases of uncompensated valvular disease. It is most frequent in insufficiency of the aortic valve.

How far chronic anæmia may be brought about by the presence of extraneous substances in the cranial cavity is an open question. The presence of inflammatory exudations, transudations, or tumors is supposed at times to cause an anæmia by pressure, but in many cases an irritative process seems to preponderate and a hyperæmia exists.

Partial or circumscribed anæmia of the brain is caused by the diminution of the calibre of the blood-vessels supplying a portion of the brain, or by their occlusion. Unilateral anæmia is produced by ligation of the carotid.

In many cases it is but temporary, and the symptoms soon disappear, but in others they are said to remain and become more or less permanent. This depends, at least in part, on the condition of the communicating arteries of the circle of Willis, irregularities in which were found by Ehrmann in from nineteen to twenty per cent. of the bodies taken at random and examined by him.

The commonest cause of partial anæmia in the brain is thrombosis, or embolism, by which a blood-vessel is partially or wholly occluded. The presence of tumors or exudations may likewise cause a partial anæmia by pressure exerted over a vascular area, or on a special blood-vessel. How far local spasm of the cerebral blood-vessels may cause circumscribed anæmia is still doubtful. Nothnagel states that it may occur in hemiplegia and in the petit mal (epilepsy). Eulenburg says: "The group of symptoms called hemiplegia sympathico-tonica is to be explained by supposing a unilateral tonic spasm of the vessels of the head caused by tetanus in the cervical region of the sympathetic, or in the spinal centre of the cervical sympathetic."

SYMPTOMATOLOGY.—Experiments made on compression of the carotids in healthy male adults show that the following effects are produced. In the first place, there is pallor of the countenance, then convulsive efforts to close the eyes are seen, with contraction, to be followed later by dilatation of the pupils, a sighing respiration, dizziness, staggering, and finally unconsciousness. A sensation of choking may occur, and sometimes vomiting and general convulsions. How far these symptoms may depend on the anæmia pure and simple, and how far they may be due to other causes, we cannot consider here. In the present condition of our knowledge it is not possible to determine with absolute certainty, in regard to many of the symptoms which are present in conjunction with anæmia, as to whether they are due to the anæmia itself or to various concomitant conditions; while, on the other hand, there are many conditions in which the symptoms generally ascribed to anæmia are present, and in which the condition and circumstances of the general body would point most strongly to an anæmia of the brain, and yet in which, on post-mortem examination, the actual state of the cerebrum would seem to be rather hyperæmic than anæmic. Thus Flemming, in the "Pathologie und Therapie der Psychosen," says: "The fluctuations in the quantitative relations of nutrition in the brain vary between the extremes of lack and of excess of blood, anæmia and hyperæmia. Under circumstances which, as well from the precedent injuries as from the whole behavior of the organism, would lead us to conclude, in so disproportionate a blood supply (oligæmia), that even the brain could not readily be provided with its normal needs, we still see the psychical functions altered in a manner which points far more to an increased supply of blood. The autopsy also, in such cases, shows the opposite of what we should expect from the general oligæmic condition of the body. It shows the brain throughout, or partially, on its surface, or in its internal portions, reddened by the blood seen through the tissues, while the cut surface is dotted with numerous bloody points and the vessels are distended with blood. In short, there where we expected anæmia it shows far more a hyperæmic condition."

Hence, in describing the symptoms which are usually referred to anæmia of the brain, we desire that these facts be constantly borne in mind, that in many cases symptoms have been ascribed to anæmia which were in all probability due to other conditions of the brain, and even when the anæmia coexists there is in a large proportion of cases no proof that the symptoms are due to it alone.

In acute anæmia of the brain we have a series of symptoms extending all the way from general weakness to profound insensibility, and which are known according to their intensity by the names *eclipsis*, *lipothymia*, and *syncope*. All these are apt to be classed together under the name of fainting fit. These symptoms are subjectively usually as follows: A person about to faint usually notices first a slight oppression in the breathing, and a sensation of lightness in the head. He is often inclined

to gape, and finds difficulty in fixing or concentrating his attention. Gradually the respiration becomes deeper and more labored, and a feeling of nausea and weight in the epigastrium comes on. At the same time his face becomes paler and paler, and he becomes more and more dizzy, until he finds it difficult to maintain his equilibrium. His head feels tense and his ears begin to ring, a mist comes over his eyes, and at times he is scarcely able to see, though still able to stagger toward the fresh air. He is often nauseated, and perhaps vomits. Surrounding voices can be heard but not distinguished, and, unless relieved, he becomes insensible and falls without a cry to the ground. If now left to himself he generally soon recovers, but recovery can be readily hastened by the presence of fresh air, or by gentle stimulation of the olfactory nerves. Objectively, the principal symptoms noticeable are, in the first place, the extreme pallor of the face, especially marked on the mucous membrane of the lips, the gaping and deepened respiration, then the staggering or loss of control over the equilibrium. The pupils contract at first and then dilate, and the pulse becomes small and its tension is diminished. The skin is pale and cold, and a cold perspiration breaks out over the forehead and sometimes over the entire body. This stage ends in the abolition of consciousness and of voluntary movement.

These are the usual symptoms in a slight attack of fainting coming on gradually from exposure to heat and close air, or from mental emotion. When the fainting, however, comes on rapidly, the prodromal symptoms may not appear, but the patient turns pale and falls insensible almost immediately. In severe cases, in addition to the previous symptoms, we may have Jacksonian epilepsy or generalized convulsions, sometimes extremely violent, and resembling in all respects epileptic convulsions. These are liable to occur in all cases of sudden and profuse hemorrhage in previously strong and healthy individuals.

When the anæmic condition is produced more slowly, either from long-continued undernutrition of the body or as the result of a severe physical strain, as a serious fever or other acute illness, the symptoms present themselves in a somewhat different form. In children, after any severe strain on the physical forces, and particularly after intestinal diseases, in which a considerable amount of fluid is rapidly withdrawn from the tissues, we meet with the so-called *hydrecephaloid* disease, for our knowledge of which we are still principally indebted to its first describer, Marshall Hall, who "first gave a cursory sketch of this morbid affection in a little volume of 'Medical Essays' published in 1825." He there says: "The state of exhaustion is very apt to be induced in early infancy, and as the reaction is feeble at this period of life, the case soon assumes the character of sinking. This state of things is often mistaken for inflammation of the brain or hydrecephalus."

In adults as in children, chronic universal anæmia of the brain is liable to be characterized by a condition of abnormal stimulation, both mental and physical. In both there is the same restlessness, uneasy sleep, and intolerance of light and sound; while in adults the mental irritability is probably more prominent only because it is more readily shown. In the severer forms, and more particularly in cases of starvation, delirium, the "delirium of inanition," is liable to occur. This is usually active and frequently maniacal in character, and is accompanied by hallucinations, illusions of sight and hearing, and not infrequently by delusions of persecution. Nothnagel states that there is almost always an undertone of sadness, and that hence the symptoms as a whole belong to the type named melancholia agitata. It is said that occasionally this may pass into permanent insanity. In regard to the delirium of starvation, Longet writes as follows: "There is some consolation for us, after considering the pathological conditions in which hunger presents itself, with the character of inexorable irresistible force, in turning to the analogous phenomena which are produced in the healthy individual when deprived of

food. We are compelled to believe that under these circumstances there supervenes a pathological state; a peculiar delirium, that of hunger, the delirium of starvation appears; were it not so, we should refuse to admit that the sentiment of egotism could reach the degree to which we see it carried in the starving man. Hunger speaks louder than laws, religion, feelings; all is hushed before its imperious commands."

In the case of Lieutenant Greely, who was exposed to slow starvation in the late Lady Franklin Bay Expedition, the following record was made by Dr. E. H. Green, June 23d, 1884, the day of rescue: "On admission fainted after being carried below in the wardroom, and vomited. Nervous system: excitable and irritable, at times almost emotional, eyes wild and staring; insists on talking, craving news, and demanding food, complains of no pain." His bodily weight was then one hundred and twenty pounds. In August, 1883, it had been one hundred and sixty-eight pounds. The next day: "No sleep, mind more tranquil but too active, great desire to talk and read; less persistent in demanding food; complains of soreness in limbs. June 25th, marked improvement, mind more tranquil; talks quietly without excitement; slept two or three hours naturally, awoke refreshed." After this there was steady improvement. The details in regard to the other organs of the body are purposely omitted, as not being relevant to our subject, but there was no organic lesion anywhere. All the symptoms here present were probably due to lack of food.

We must here again emphasize the fact that in these cases it is impossible in the present state of our knowledge to decide how far these symptoms are actually due to a condition of cerebral anæmia, or whether, as some observers think, there is present a fluxional hyperæmia of the brain.

Some of the symptoms present in cerebral anæmia deserve especial consideration, and among these we should place first the disturbances of the organs of special sense. Tinnitus aurium is one of the commonest symptoms of cerebral anæmia, even in its lighter forms, and is usually accompanied or followed by partial deafness. It is probable that these symptoms are due, at least in part, to irritation of the auditory nerve, for although the blunting of the mental perception might readily be adduced as the cause of deafness it could hardly be held to produce a ringing in the ears. Abercrombie's oft-quoted case of a much-weakened and anæmic patient, who was deaf when he sat upright but could hear well when he lay down, or when his face was reddened, would tend to confirm this view. In the same way the appearance of specks before the eyes and the blurring and dimness of vision which so frequently occur may be referred to irritation of the optic nerve. The occasional occurrence of total amaurosis would also seem to point to this. It is most common after severe hemorrhage, especially from the stomach, rarer in connection with inanition. It may or may not be accompanied by severe pain in the head. It may come on suddenly in the course of a few hours or it may take several days to develop. Travers says: "It succeeds somewhat abruptly to uterine flowing and large and sudden depletion for acute diseases. The pain is not confined to the region of the orbit, though it affects chiefly, if not exclusively, the same side of the head; it is that peculiar nervous pain to which women are subject after uterine hemorrhage, attended with a sense of defined pressure, as of an iron finger on the brain, and sometimes a distressing, jarring noise, like that of a mill or threshing-floor, or the rattling of the shingles as a heavy wave of the sea recedes." Samelsohn found cause in one case to suspect hemorrhage into the sheath of the optic nerve. A. von Graefe in his cases found nothing on immediate examination, but afterward atrophy of the optic papilla. Schweigger (Transl., Philadelphia, 1878) declares that the relation between loss of blood and disease of the optic nerve is wholly unexplained and that the latter cannot be due to simple anæmia.

Disorders in the sphere of the motor nerves may be either convulsive or paralytic. Kussmaul and Tenner

have shown conclusively that in rabbits convulsions are almost uniformly produced in cases of rapid, profuse hemorrhage, or where the great arterial trunks leading to the brain are ligatured, except in the case of very weak animals or in such as were under the influence of ether. They found, however, that closure of all four of the arteries, both carotids and both vertebrals, was necessary in order to produce rapid convulsions. In all their cases the convulsions were epileptic in character.

In man convulsions have been noticed in connection with fainting, from the earliest times. Hippocrates says in his Aphorisms: "Σπασμοὶ γίνονται ἢ ὑπὸ πλήρωσις ἢ κενώσις" (convulsions arise either from plethora or from anæmia). Marshall Hall, in his observations on blood-letting, declares that "convulsion is, after syncope, the most familiar of the immediate effects of loss of blood. It is most apt to occur in children and in cases of slow and excessive detraction of blood." . . . And again: "It is most apt to occur in cases in which the patient has been freely bled in a more or less recumbent position, in which the blood has flowed slowly, or in which time has been lost during the operation."

Anæmic convulsions rarely occur except after hemorrhage, when the amount of blood lost must be considerable. The loss must occur all at once, or nearly so, and the patient must not have been previously in a much debilitated condition. Thus, children in a hydrencephaloid state, and persons suffering from chronic anæmia, are not likely to be attacked with anæmic convulsions.

In contradistinction to convulsions complete paralysis without coma does not occur in universal cerebral anæmia, though after ligature of a carotid temporary hemiparesis and paralysis are not uncommon. If the paralysis be permanent there is probably some organic lesion present.

The general weakness of the limbs in syncope may be regarded as a form of paresis. "Cheyne-Stokes respiration and Traube-Hering blood-pressure curves are very common in states of partial anæmia of the bulbar centres" (Hill).

The DIAGNOSIS of anæmia of the brain, except in those cases of partial anæmia due to the obliteration of blood-vessels, which do not come under consideration here, can be made only through consideration of the accompanying general symptoms. Inasmuch as in hyperæmia of the brain the local symptoms are in many cases the same as in anæmia, the differentiation of these two opposite conditions will depend much on the history of the case. Even the condition of the vessels of the face and head is no positive proof of the condition of the internal vessels, nor would an increase or diminution in the supply of blood in the retina afford more than a presumption that the same condition existed in the meninges. The condition of the heart and the influence of posture and of alcoholic stimulants afford further aid in determining the diagnosis.

The PROGNOSIS in common cases of syncope is decidedly favorable, although even in ordinary cases of fainting from mental influences fatal results now and then occur. Less favorable is it in cases due to severe hemorrhage, even when not complicated by shock. On the other hand, in those cases of acute syncope where we have reason to suspect some weakness or lesion of the heart, —for example, in all cases of cardiac disease, and in convalescence after acute febrile diseases,—the prognosis is more serious. This especially applies to those cases in which the immediate cause of the syncope is some sudden change of position. In cases of chronic anæmia in the adult, syncope, as a rule, is not in itself a very serious symptom, but whenever a prolonged coma occurs, especially if accompanied by convulsions, there is cause for anxiety. In the hydrencephaloid condition in children, if the patient be seen and the disease recognized in time, recovery is probable under judicious treatment. The prognosis must in all cases depend, in this as in other diseases, in great part upon the severity of the symptoms. The condition of the pupils is said to form an important element in the prognosis, contraction al-

ways preceding dilatation, while they become normal again as the patient approaches recovery.

TREATMENT.—In simple syncope from mental emotion or from reflex irritation but little treatment is needed, except that the patient should be placed in a horizontal position and should be allowed plenty of fresh air, when recovery generally occurs quickly. Stimulants, such as ammonia, applied to the mucous membrane of the nose and air passages, are of assistance. As the syncope becomes more severe, we employ cutaneous stimulants, the simplest and best of which is the sprinkling of cold water over the face and chest. Mustard may be applied to the skin, especially over the cardiac region; but the most effective external stimulant is the electric brush. Internal cardiac stimulants, such as coffee, alcohol, or ether, are often of decided benefit. The carbonic dioxide in champagne is said to promote the rapid absorption of the alcohol, and hence this form should, when convenient, be used. In the severer cases, when the unconsciousness becomes prolonged, especially in those in which the loss of blood has been very great, the limbs should be bandaged, so as to drive all the blood as far as possible into the body and head. As a last resort, transfusion should be attempted.

In cases of chronic anæmia all means should be used to improve the general condition and strengthen the bodily forces. Milk is often the best form of nutriment, but when it can be borne a generous diet, including eggs and meat, is advisable. Wine is frequently of benefit when given in suitable doses, and in severe cases it is often indispensable. Alcohol is generally of much importance in cases of hydrencephaloid, and in these Nothnagel recommends the early use of musk. In all cases the surface of the body should be kept warm, if necessary, by the direct application of heat.

When mental excitement exists, all cutaneous stimulants or irritants are to be avoided, as they are said to increase the pain and restlessness. Under these conditions opiates often act well, better probably than chloral, which has also been recommended by good authorities.

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BRAIN AND NERVES, CHEMISTRY OF.—The proportion of water in the nervous tissues varies at different ages and in different parts. It is more abundant in the gray than in the white matter and in early than in adult life. In the gray matter of the adult it forms about eighty-five per cent. of the total constituents, in the nerves about sixty-five per cent.

The solids comprise the following:

1. Proteids, including nucleo-proteids, globulins, and, according to some, albumins.
2. Substances rich in combined phosphoric acid: nuclein, protagon, lecithin.
3. Complex nitrogenous substances, yielding a carbohydrate on decomposition and known as cerebrosides.

4. Cholesterin, a complex alcohol (C₂₇H₄₆OH).
5. Neurokeratin, a substance resembling ordinary keratin (from hair, etc.) and found in neuroglia and the medullary sheaths.
6. Extractives: Kreatin, xanthin, hypoxanthin, inosit, lactic acid, uric acid.
7. Inorganic salts.

Several of the above call for a brief note.

Nuclein is a compound formed by the union of a proteid with nucleic acid. Nucleic acid is phosphoric acid, P₂O₅, combined with a member of the purin group (xanthin, hypoxanthin, adenin, guanin).

Protagon, discovered in 1865 by Liebreich, was stated by Hoppe-Seyler and others not to be a definite substance but a mere mixture. Recently, however, its existence has been confirmed by numerous workers. Gamgee and Blankenhorn suggest C₁₆H₃₀N₂PO₃ as its empirical formula, but others claim that it may be found in several closely related varieties. On decomposition it yields one of the cerebrosides and the decomposition products of lecithin (fatty acids, glycerophosphoric acid, and cholin). It may be obtained as a loose, white powder. It dissolves in eighty-five per cent. alcohol at 45° C., but separates on cooling as a snow-white, flaky precipitate consisting of balls or groups of fine crystalline needles.

The **Cerebrosides** are complex nitrogenous substances, yielding among their products of decomposition fatty acids and a carbohydrate (galactose). A number of varieties have been described, among which the best recognized are cerebrin, homocerebrin, and encephalin. Kossel and Freytag give the formula of cerebrin as C₇₀H₁₄₀N₂O₁₅, and of kersin or homocerebrin as C₇₀H₁₃₈N₂O₁₂.

The relative proportions of the above-mentioned substances vary in different parts of the nervous system, but the following figures are probably approximately correct.

The total solids vary from 10 to 40 per cent. and are made up as follows: Of the total solids: Proteids, 25 to 55 per cent.; nuclein, 1 per cent.; protagon, 5 to 10 per cent.; lecithin, 10 to 30 per cent.; cerebrosides, 0.5 to 10 per cent.; cholesterin, 10 to 50 per cent.; neurokeratin, 3 to 6 per cent.; salts, 0.5 to 2 per cent.

The proteids are most abundant in the gray matter, cholesterin and the cerebrosides in the white matter. The salts are given as follows by Geoghegan in parts per 1,000 of brain:

Total ash.....	2.9 to 7.1	Chlorine.....	4 to 1.2
Potassium.....	6 to 17	PO ₄	9 to 2.0
Sodium.....	4 to 11	CO ₂	2 to .7
Magnesium.....	.0 to .07	SO ₄1 to .2
Calcium.....	.005 to .02	Fe (PO ₄) ₂01 to .09

The reaction of the central nervous system, especially the gray matter, has been stated by many writers to be acid during life, but according to Halliburton it does not become so till shortly after death.

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William S. Morrow.

BRAIN, ANEURISM OF ARTERIES OF.—Aneurisms of the cerebral vessels (independently of the military aneurisms which are treated of in the discussion of Cerebral Hemorrhage) are comparatively rare, though Coats makes the surprising statement that, "in persons under forty years of age cerebral hemorrhage is due to the rupture of aneurisms in the great majority of cases."

These aneurisms are situated commonly on the arteries of the circle of Willis, and, according to Lebert, the vessels are affected in the following order of frequency: basilar, middle cerebral, internal carotid, and posterior communicating, and the artery of the corpus callosum. The middle cerebral and basilar are involved in more than half the cases. The other vessels are only exceptionally the site of this lesion. Robertson reports a case in which an aneurism had burst into the right lateral ventricle. It was situated on a branch of the right middle cerebral artery, and had hollowed out a bed for itself in the substance of the corpus striatum and optic thalamus.

According to the majority of writers, the vessels of the left side appear to be affected more frequently than those of the right side, but in Coats' eleven cases all were situated on the vessels of the right side of the brain. The male sex seems to furnish a much larger proportion of the cases than the female sex.

The anatomical structure of cerebral aneurisms is entirely similar to that of similar lesions in other vessels of the body, and therefore need not be discussed here. They vary from the size of a pea to that of a hen's egg, though tumors of the latter dimensions are extremely rare. As a rule, they do not exceed the size of a hazelnut.

The immediate causes of the origin of this lesion have not been ascertained very clearly, but there appears to be little doubt that it does not bear such close relations to atheromatous degeneration as aneurismal dilatation of other vessels of the body. In a considerable proportion of cases the aneurism is the result of embolism, and this explains its comparative frequency at an early age (endocarditis, heart disease). Imperfect closure of the vessel by the embolus leads to inflammatory changes in the walls of the vessel, and, as the lumen is still partly open for the passage of blood, the weakened walls yield to the blood pressure and an aneurism is gradually produced.

Syphilis acts in a similar manner by weakening the walls of the vessels.

The lesion has also been attributed to the effects of injury to the head.

The aneurism produces various local effects. When situated in the circle of Willis it may cause erosion of the bones at the base of the skull. As a matter of course, it also produces pressure on adjacent soft parts, and as the circle of Willis is usually involved, the various cerebral nerves are mainly subject to compression, then the medulla oblongata, pons Varolii, and crura cerebri. Klippel reports a case in which an aneurism of the right posterior communicating artery, as large as a walnut, had compressed the adjacent brain substance from the edge of the pons to the right optic nerve. During life the patient had suffered from ptosis of the right side and complete immobility of the right eye, with disturbance of vision on both sides.

The aneurismal sac may also press upon adjacent vessels and give rise to thrombosis, with its usual train of sequences. In other words, the pressure effects are very similar to those of other forms of tumor situated at the base of the brain. An aneurismal murmur has been heard in a few cases, on auscultation of the skull. In still rarer cases this murmur has been heard by the patient himself.

When the aneurism is situated upon the basilar artery it is apt to give rise to hemiplegia. According to Lebert, this occurred nine times in thirty-one cases. Schmidt reports a case in which a diagnosis of cerebral hemorrhage had been made:

A man, aged fifty-seven, had an apoplectic attack with unconsciousness, left hemiplegia, including the facial nerve; the pupils were sensitive to light; sensibility was intact. The condition of the lower limb improved considerably, the arm became contracted. Death occurred two years later from pneumonia.

The autopsy disclosed a cylindrical aneurism of the basilar artery, extending from the lower end of the pyramids on the left to the corpora candiantia on the right. There was a depression of the pyramids in the medulla oblongata, and its edges were softened; also a depression in the pons, chiefly on the right side. There was distinct gray degeneration of the left lateral column of the cord and median bundles of the right anterior column.

Although, as I have stated above, the symptoms of cerebral aneurism are usually very similar to those of other kinds of tumors situated at the base of the brain, it differs from them in the fact that choked disc is a very rare symptom in the history of the former affection. In this respect it is somewhat similar to cerebral abscess, and, like the latter, it may also remain latent until the occurrence of a sudden apoplectiform attack, due to the rupture of the vessel. In quite a number of instances it has been