torcular Herophili (confluens sinuum). The mode in which the veins empty into the sinus—namely, in the direction opposite to that of the blood current in the latter—produces a slowing of the circulation, and thus explains the frequent occurrence of coagula in the veins of the cortex and the sinus. The deep cerebral veins are collected into two trunks, which are known as the veins of Galen. These again unite into one, the vena magna Galeni. They convey the blood from the ventricles to the sinus rectus (perpendicularis), which in its turn empties itself into the torcular Herophili. The blood from the inner ear goes into the cavernous sinus which is situated at the side of the sella turcica; that from the mastoid cells into the lateral sinus, which at the jugular foramen passes into the so-called bulb of the internal jugular vein. The veins themselves anastomose but little with each other, while the sinuses do so freely. It is important to note the communications between the intracranial and the extracranial veins—for instance, of the nasal with the anterior end of the longitudinal sinus, the ophthalmics with the sinus cavernosus and the facial veins, etc.—and the communications made by the venæ diploëticæ, for only then can we understand how pathological processes can extend from the outside of the skull to the inside, and how occasionally we find an external swelling in affections of the sinuses.

Here it is more especially thrombosis with which we have to deal, which may occur in the veins as well as in the sinuses. The distinction is not always easy in life nor even after death, because after death the venous thrombosis may extend into the sinus and be taken for a sinus thrombosis.

If only one vein is affected the mischief may be but slight. Usually, however, it takes in one or two of the larger veins, which become obstructed during the course of exhausting, acute, especially infectious diseases or after an injury, for instance, a blow on the head. The preponderating number of the patients are children, and at times, especially during the hot season, quite young children, in which cases a special ætiological datum can not be found. The symptoms are the following: Hemiplegia, ushered in by convulsions and lasting only a few weeks, is followed by a permanent weakness, not infrequently by occasional spasms in the arm. The development of the child is then usually faulty, for apart from the occasional atrophy in one arm or in one leg or of the whole side, epileptiform convulsions may persist for years, which not rarely have an injurious influence on the mental development of the patiept. In such cases at the autopsy often thrombosis of the longitudinal sinus and of the veins emptying into it is demonstrable. In adults, such a thing as a thrombosis of the cortical veins is extremely rare.

Sinus thrombosis may have one of two causes. Either we have a general disease which favors the coagulation of the blood—as in children profuse diarrhœa, acute infectious diseases, in old people, tuberculous and carcinomatous processes—or neighboring parts, as, for instance, the skull bones or the skin of the scalp are diseased (erysipelas), an extension of the process becoming possible on account of the communications between the extracranial and intracranial vessels above described. We distinguish the true inflammatory thrombosis, which affects the lateral, the petrosal, and the cavernous sinus, from the so-called marantic thrombosis, which often occurs in the superior longitudinal sinus. In both cases the secondary symptoms of engorgement, which are especially marked in thrombosis of the longitudinal sinus and which manifest themselves in so-called meningeal hæmorrhages, are of the greatest importance. Such meningeal hæmorrhages are found in children (post mortem) as thick coagula distributed over the cortical motor centres, where they have in life given rise to a curious combination of paralysis and spasm, the power of spontaneous movements, however, being retained (Gowers). Choreic movements complete the picture which congenital chorea, bilateral athetosis, and double spastic hemiplegia present, cases which are difficult to interpret and still more difficult to diagnosticate. In these patients, too, the mental development remains imperfect, and their irregular movements and contractures (often most marked in the calf muscles) give them the appearance of helpless cripples.

The diagnosis of sinus thrombosis can only be made with any certainty if to the general symptoms (headache, somnolence, paralyses in the distributions of the cranial nerves) signs are added which point to circulatory disturbances peculiar to sinus thrombosis. Thus, for instance, symptoms of engorgement in the ophthalmic veins, manifesting itself by prominence of the eyeball, œdema of the lids, congestion of the retina, etc., point to obstruction of the cavernous sinus; œdematous swellings behind the ear to affections of the lateral sinus, and finally symptoms of passive hyperæmia in the nose—epistaxis, marked fullness in the veins of the temporal region, in small children fullness of the anterior facial veins situated betwen the large

fontanelle and the temples (Gerhardt)—to implication of the longitudinal sinus. Pain and swelling of the corresponding side of the neck may be significant of a jugular thrombosis, etc. All these conditions are, however, but rarely met with, and they are more easily found in the books than demonstrable in the patient. The duration of a sinus thrombosis varies between several days and three to at most four weeks. The prognosis is usually unfavorable and the treatment unsatisfactory and purely symptomatic.

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INFLAMMATORY PROCESSES IN THE BRAIN SUBSTANCE.

1. Purulent Encephalitis—Brain Abscess.

Pathological Anatomy.—Circumscribed pus formations in the substance of the brain, which anatomically differ in no way from pus formations in other organs, are called brain abscesses, and we speak of them as encapsulated and non-encapsulated, according as to whether or not they are definitely separated from the surrounding tissues by sclerotic thickening. In the former, a membrane of connective tissue incloses the abscess, which contains a thick pus; in the latter, disintegrated nerve tissue and crystals of cholesterin are found in conjunction with the frequently very fœtid pus, and the abscess walls are formed by a soft layer of brain tissue infiltrated with pus, and surrounded by areas of yellowish softening and œdema. In the softened areas compound granular corpuscles are found in great numbers. The size of the abscess may vary from that of a pea to that of an apple, and it may even take in nearly the whole hemisphere. The larger the abscess the more marked are the signs of increased intracranial pressure, the more flattened and indistinct the convolutions on the surface of the brain, and the drier and more adherent becomes the pia mater. Should the abscess break through into one of the ventricles, pus may eventually be found in all of them, and the ependyma then appear œdematous. If it reaches the surface of the brain it may give rise to a diffuse purulent meningitis (Wernicke).

Ætiology.—Ætiologically, injury is of the greatest importance, though it need not necessarily have affected the skull itself, but may produce an abscess just as well if confined to the soft parts; in such a case, the inflammation extends through the bone, and the infectious material penetrates into the brain from the flesh wound. If we have no open wound, no break of continuity in the soft parts, then even extensive destructions of the brain substance often do not lead to an abscess formation, just as in the fractures of the skull healing occurs without suppuration provided that the external air is excluded from the injured parts of the brain.

Besides traumatism, suppuration occurring in the neighborhood of the brain may cause a brain abscess; thus, in rare instances, it is a purulent parotitis or suppuration in the nasal cavity, or, more frequently, caries of the petrous portion of the temporal bone or suppuration in the middle ear, which becomes the starting point. For years an otitis media may persist and be attended with a purulent discharge from the external ear without any brain symptoms, but suddenly this running may stop, the pus is retained, and probably gives rise to the caries of the bone, on account of which the petrous portion may become so soft that it can be cut with the knife; a brain abscess then develops either in the temporal lobe or in one of the hemispheres of the cerebellum.

Suppuration in the bronchi, putrid bronchitis, bronchiectasis (Biermer), furthermore, ulcerative endocarditis and pyæmia, may also give rise to brain abscesses, which are then designated as "metastatic" abscesses. Idiopathic abscesses—that is, those in which no ætiological factor could be discovered—have been observed by Strümpell in some cases of epidemic cerebro-spinal meningitis.

Symptoms.—The symptoms of a brain abscess are divided into general and focal. There may, however—and this is of much practical importance—be no sign of brain mischief at all. A man may not complain of anything worth mentioning, save, perhaps, of an occasional headache, and at the autopsy a brain abscess be discovered. Quite a number of these cases are well authenticated, and there can be no doubt as to their existence; to be sure, we ought not to forget to add that the place in which such an abscess is developed must be in a so-called indifferent region.

Among the general symptoms the one most constant and the most distressing to the patient is headache; it can by no means always be localized, but more frequently affects the whole head, and may last with greater or less severity for weeks or even months. Occasionally the torture is such that the patient, incapable of doing anything, is forced to remain quietly in bed, although no other symptoms may be present. Very often, it is true, disturbances of the sensorium may appear after the headache has lasted for a long time; a strange apathy takes possession of the patient, his sleep is disturbed, and his general condition is aggravated if, as is common, febrile movements set in, which may be attended with convulsions, which are mostly unilateral. Attacks of vertigo, sometimes severe enough to cause great anxiety, and sometimes only transient, occur, and not rarely there are spells of vomiting, sometimes lasting for days, and acting very deleteriously on the patient. The ophthalmoscopic examination, as a rule, does not reveal any fundus changes; choked disks are only exceptionally found, certainly much more rarely than in brain tumors. The focal symptoms of cerebral abscess are almost exclusively direct. This is a fact which is easily understood if we consider their mode of origin; they are produced either by a direct destruction of the brain substance or by the preceding œdema and the attendant "preparatory softening" (Wernicke), both of which processes are strictly local. At the same time we must not lose sight of the fact that the part affected by this "preparatory softening" is still capable of regeneration. Indirect focal symptoms have only been observed in cerebellar abscesses; in such, paralyses of the abducens and other nerves have been noted (Wernicke).

How different focal symptoms show themselves, and which are characteristic of lesions of the different parts of the brain, has been discussed above (page 162 *et seq.*); suffice it here to add that abscesses of the so-called motor region produce hemiplegias, which appear in a very characteristic manner—namely, step by step. In abscesses of the occipital lobe hemianopia is the direct focal symptom which, if properly used, may settle the diagnosis. The direct focal symptom of the temporal lobe—the crossed deafness—can only rarely be accurately determined, as the suppuration of the middle ear, which we have shown often to be ætiologically connected with brain abscess, is mostly bilateral, and as testing of the hearing in patients, whose mental activity is somewhat dulled, is very difficult, since they are usually unable to appreciate any decrease in hearing on one side. In general, we must confess that too little attention has been paid to the testing of the hearing, and that the examinations have not been made with sufficient care.

In no one of the few reported cases of abscess of the pons, the medulla oblongata, and the cerebellum have direct focal symptoms been observed, or at least noted with any certainty; the general symptoms, which are mentioned in connection with the abscesses of the cerebellum, must be attributed to pressure produced by the growing abscess.

Course.—The disease may pursue its course in one of three different ways:

(1) It assumes from the onset a tumultuous character, whether it originate from a traumatism or disease of the middle ear. Violent pains—at first local, later spreading over the whole head, and lasting from two to four days—together with marked elevation of temperature and paroxysms of convulsions, are followed by grave disturbances of consciousness. These may last for three, four, even eight days, when the patient, without regaining consciousness, dies in a restless delirium, presenting the picture of one suffering from severe organic disease.

(2) These paroxysmal symptoms lose, after a few weeks, their acute character, and become less and less marked; the patient seems to feel better, and he may, indeed, be free from all trouble for several months. Even the headache seems—at least at certain times—to have vanished. This state of absolute (or relative) latency may be of variable duration, and may by the inexperienced diagnostician be mistaken for complete recovery, but it is doubtful whether this latter ever occurs. It certainly happens much more frequently that after this period

of latency the initial symptoms again make their appearance, this time to continue without intermission until death. The duration of the whole disease comprises then three to six months or more; it is extremely rare that the period of latency lasts for years.

(3) The onset of the disease is insidious and chronic. The patient, who presents slight fever and general symptoms, gradually becomes emaciated. He complains of headache and disturbed sleep, and from time to time, apparently without reason, is taken with chills; he begins to have a cachectic appearance, and bears on his face the imprint of a grave disease. In such, withal very rare, cases our patient is suffering from phthisis and the brain abscess is of a tubercular nature. The duration of this form, as a rule, does not exceed three or four months.

Diagnosis.—In the diagnosis we may have to differentiate between brain abscess, purulent meningitis, meningeal hæmorrhage, and brain tumor. If the course of the abscess is very acute, as has been described above (eight to ten days), then it is often impossible to distinguish it from an acute purulent meningitis, an error which is the more excusable when all direct focal symptoms which often accompany an abscess are wanting. Remissions point rather to the existence of a brain abscess.

From meningeal hæmorrhage, which just as abscess may be the consequence of traumatism, it is also distinguished by its course. Traumatic meningeal hæmorrhages usually give rise to epileptiform attacks, which are to be referred to the effect of the entrance of the blood between the dura and the skull on the motor centres. They are immediately followed by a coma, which lasts until death. In abscesses the insensibility usually lasts only a few hours, and only after a marked improvement has again taken place do alarming symptoms make their appearance.

A brain tumor can be differentiated from an abscess by the fact that in the former febrile symptoms are absent, while on the other hand, in the latter, choked disks, which are a frequent sign in brain tumor, are only exceptionally noted. The course—more especially as regards the remissions, which are well marked and often of long duration—is characteristic of abscess; a tumor usually is steadily progressive. Finally, we are justified in diagnosticating an abscess if after a protracted and varying course the disease suddenly terminates with certain severe symptoms of collapse and death. When this occurs it is probable that an abscess existed which has perforated either into the ventricles or to the surface. In cases of traumatism or in cases in which the cerebral symptoms were preceded by an otitis media we should always think first of brain abscess.

The seat of the abscess can only be determined with any certainty if characteristic focal symptoms—for instance, hemianopia or sensory aphasia—are present. In cases of hemiplegia we can, from the order in which the component monoplegias occur, draw a conclusion as to the point of origin of the abscess. Thus, if at first a paralysis of the leg, together with marked sensory disturbances, are the prevailing symptoms, and only later the arm and facio-lingual region become affected, we may conclude that the abscess is proceeding from behind forward, while if the symptoms occur in the reverse order, then the frontal lobe may have been the starting point and the abscess be extending backward. In cases of traumatism the abscess is to be located in very close proximity to the injury. Where there is a history of otitis media it usually establishes itself in the temporal lobe or the cerebellum. The white matter is, in the cerebrum as well as in the cerebellum, by far the most common seat. In the brain stem it occurs only very rarely, while in this situation, as we have seen, hæmorrhage and softening are more common.

Prognosis.—The prognosis is absolutely bad with regard to recovery and doubtful with regard to life. We can see from what has been said that spontaneous cures, most probably never, therapeutic cures quite rarely, take place. It is well to be very guarded in giving an opinion as to the duration of life, and we should never forget that even during a seemingly excellent state of health suddenly grave symptoms may develop which lead to a rapid termination.

Treatment.—Of an effectual treatment we can only speak in those cases in which an operation is feasible. Since this—trephining of the skull, splitting of the dura, opening of the abscess with the knife—must always, however, even if conducted with the strictest antiseptic precautions, be regarded as a grave undertaking, we should only resort to it when the location of the abscess has been established with some certainty. If this has been done, operative measures are at once indicated, and should be carried out without delay, provided, of course, that the abscess be in a part accessible to the knife,

which, we need not say, is hardly the case in the basal ganglia, the pons, the medulla oblongata, and the cerebellum.

But, unfortunately, an operation is in the greater number of cases not feasible on account of the uncertainty in the topical diagnosis. Then our treatment can only be symptomatic, and we are confined to local bleeding, hypnotics, bromides, etc., which effect but little. For that matter the results of a so-called successful operation are not always lasting either, and repeatedly one, two, or four weeks after the pus has been evacuated an unfavorable outcome has taken place—e. g., in the case of Wernicke-Hahn (cf. lit.).

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2. *Non-suppurative Encephalitis and its Consequences* ("*Athetosis*").

A. IN ADULTS.

There is no question but that inflammatory processes, acute as well as chronic, occur in the brain which show no tendency to suppuration, although our knowledge of their pathogenesis and their symptomatology is very imperfect. These processes take place preferably in quite early childhood, or even during intra-uterine life; only exceptionally may they occur in adults, as a consequence of the abuse of alcohol. They are then circumscribed inflammatory processes, occurring partly in the

cortex, partly in the white matter, which admit of regeneration. If larger areas are affected, the tissue becomes shrunken and of a distinctly firmer consistence, so that it cuts almost like leather. Just how these changes are brought about, in what way the nerve fibres of the white matter waste and the connective tissue increases, which of the two processes is the primary and which the secondary, can not as yet be determined with any certainty. Peculiar disturbances in nutrition in certain areas of arterial distribution may give rise to defects which cause a distinct sinking in of the surface of the brain (Kundrat), "porencephaly" (Fig. 74). At times we find a true

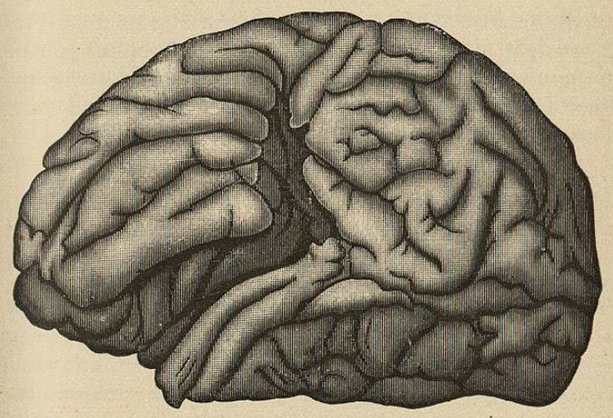

Fig. 74.—PORENCEPHALY.

cicatricial tissue, which characterizes the terminal process of the diffuse cerebral sclerosis. The macroscopic appearance of the brain is similar to that in the "induration cartilagineuse" of Cruveilhier; microscopically, the same histological elements as are seen in all degenerative processes of the gray and white matter of the brain, spider cells, and compound granular corpuscles, are noted (Kast). Marie and Jendrassik (cf. lit.) see in perivascular changes the chief factor which under certain circumstances brings about a lobar atrophy. At times we have to deal undoubtedly with the consequences of a uniform arrest of development which especially takes in one hemisphere, and the anatomical cause for which is not understood. The circumscribed inflammatory foci may also be found in both hemispheres, in which case we speak of a double lobar sclerosis.