

EXPLANATION OF PLATE XV.

FIG. 1.—“The inner surface of the dura mater (right half) is covered with a pseudo-membrane which is colored a pale red in some parts, a dark red in others, and which clings firmly to the dura. On the left side there is presented an irregularly shaped yellowish-green deposit which rests upon an older layer of organized exuded material of a dark red color and infiltrated with blood. The explanation of these conditions is this: An infectious fibrino-purulent inflammation has, in this case, been grafted upon an older proliferative process, a complication which is observed only in rare instances. The pseudo-membrane, which is applied quite uniformly over the inner surface of the dura mater, is composed of a fibrous connective tissue which in some parts is rich in cells and everywhere is liberally supplied with blood-vessels (*pachymeningitis vasculosa*). In many places throughout the layers of newly formed tissue there may be seen hemorrhagic exudations, some of older and others of more recent date. It is safe to assume that these hemorrhages have come from the imperfectly developed new blood-vessels, through a process of *diapedesis*.” (Bollinger.)

FIG. 2.—*Apoplexy of the Right Hemisphere of the Brain (nucleus caudatus and nucleus lentiformis; capsula interna)*. “In the right cerebral hemisphere, at a point corresponding to the location of the nucleus lentiformis, and extending from this outward as far as to the capsula interna, is an irregularly shaped cavity, somewhat larger than an English walnut, which is filled with dark, reddish-brown masses of clotted blood. Its walls in some places show a rusty red discoloration. Some bloody serum is present in the right lateral ventricle. The rest of the cerebral parenchyma is tough, the brain as a whole being atrophic (it weighs 1,220 gm.). The large arteries at the base of the brain are in a condition of marked atheromatous degeneration; the *arteria pro fossa Sylvii* is obliterated.

“Among the other pathological conditions found in this woman, who was sixty-nine years of age, the following may be mentioned: Chronic interstitial nephritis and hypertrophy of the heart (both ventricles), which weighed 475 gm. (the normal weight being from 250 to 300 gm.).” (Bollinger.)

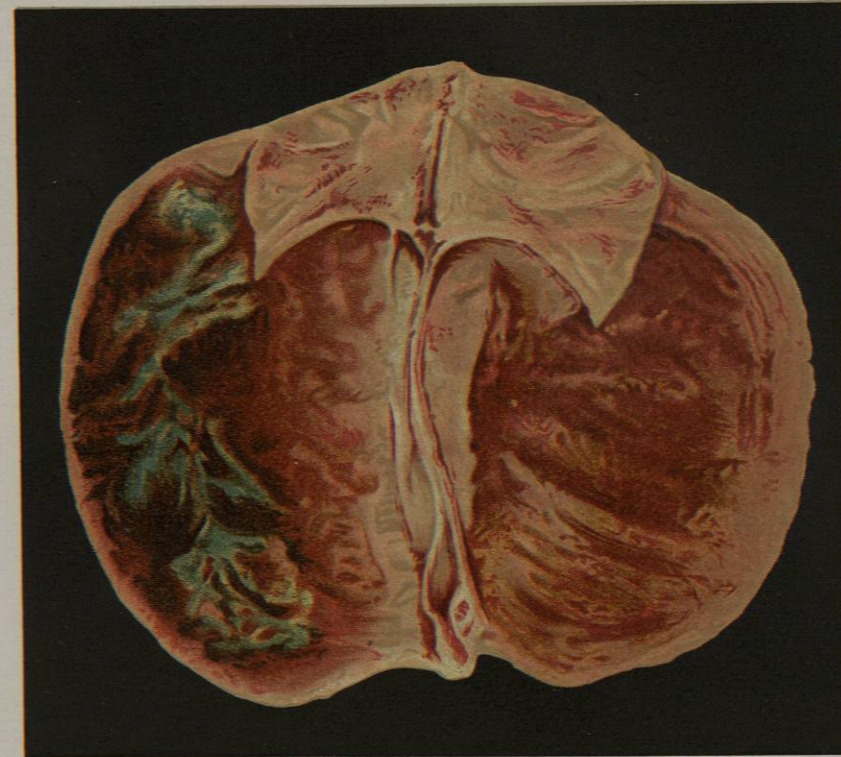


FIG. 1.

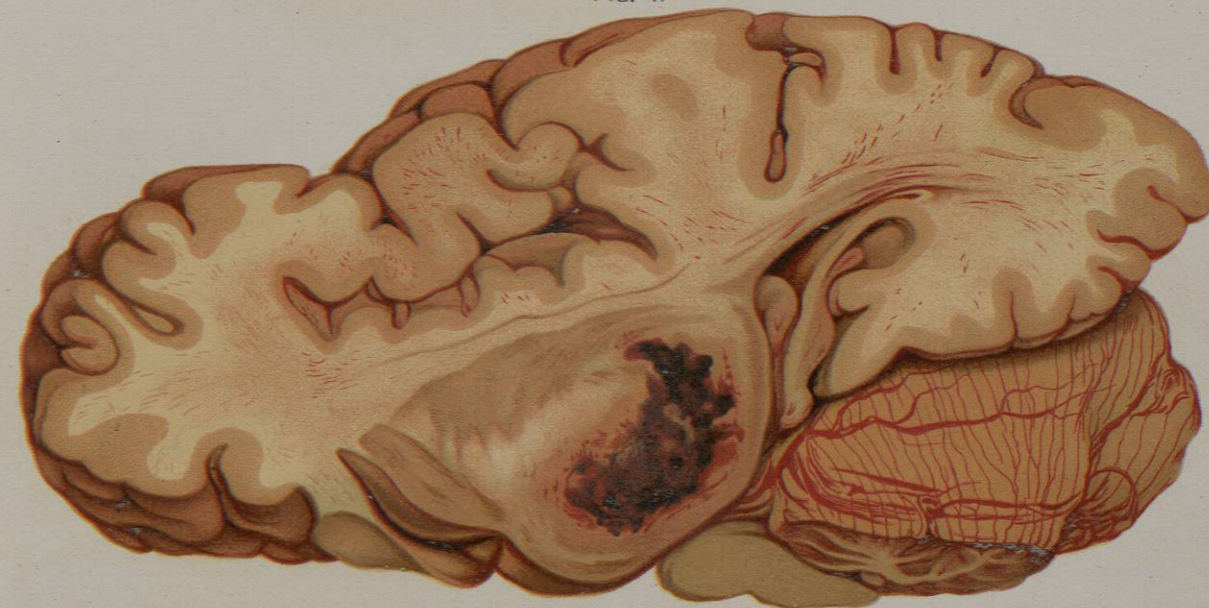


FIG. 2.

Intracranial Pathological Conditions. (After Bollinger)

Fig. 1. Pachymeningitis Interna Hæmorrhagica.

Fig. 2. Apoplexy of the Right Hemisphere of the Brain.

days. When consciousness is restored the paralysis present is more clearly defined and is found to consist usually of hemiplegia of motion, frequently associated with aphasia when situated on the right side of the body.

In a considerable proportion, perhaps the majority, of cases it is found, when the patient returns to consciousness, that sensation is also somewhat impaired on the paralyzed side. In addition it is not rare to find that hemianesthesia of the special senses, associated with hemiplegia, is also present. Gowers thinks that the latter symptom can be detected, in the majority of cases, during the first period after the attack. We have verified this observation in a number of instances. As a rule, the sensory disturbances disappear almost entirely within one or two weeks, though exceptionally they continue permanently, while the motor symptoms clear up in great part or entirely.

In the majority of cases improvement continues uninterruptedly after the restoration of consciousness until a certain definite degree of paralysis is left over. In a small proportion of cases, however, symptoms of cerebral irritation, probably owing to the development of encephalitis around the clot, make their appearance at the end of a week or ten days, sometimes as early as two or three days, after the occurrence of the hemorrhage. The patient then complains of severe headache, the temperature again rises, irritability, and even delirium may supervene. These symptoms may increase in severity and a fatal termination ensues, or, after lasting for a week or more, they may gradually disappear, leaving the patient in about the same condition as before the relapse. In some cases, rigidity or contractures develop during this condition, and subside with the other symptoms.

Acute decubitus (bedsore) may also develop during the early period of the attack. If this occurs, it will be found usually, from the second to the fourth day, that an erythematous patch appears upon the middle of the gluteal region of the paralyzed side, followed rapidly (usually the next day) by the formation of bullae, and then by rapid sloughing of the parts. According to Diprat, the acute bedsore is sometimes observed upon the healthy side. Charcot states that death almost always occurs in such cases.

Vaso-motor symptoms may also be noticed from the very onset of the attack. The paralyzed side is then warmer to the feel than the non-affected side, and is covered with more profuse perspiration; sometimes the radial pulse is fuller on the hemiplegic side; slight oedema of the skin on this side is also often noticed. These symptoms disappear in proportion as the coma subsides, and, at a later period, may give place to vaso-motor symptoms of a different character, which will be mentioned later.

After the immediate effects of the hemorrhage have passed off, the patient may live for years without a recurrence. Subsequent attacks usually occur, however, unless the patient dies from an intercurrent disease.

The hemiplegia left over after an ordinary attack of cerebral hemorrhage presents the following characteristics:

The paralysis is not so well marked, as a rule, in the face as in the limbs. There is less expression and power of motion in the lower half of the paralyzed side of the face than on the opposite side, the naso-labial fold is partly or entirely effaced, and the angle of the mouth droops and sometimes is drawn closer to the median line. The frontalis and orbicularis palpebrarum usually act as well as those on the non-paralyzed side, though careful observation often shows that they do not contract quite as vigorously as normally. This is particularly noticeable if the patient be directed to close only the eye of the paralyzed side. The paralysis of the lower half of the face becomes more noticeable during voluntary movements, while in laughing both sides of the face may contract to an equal degree. Some difficulty in mastication may arise from the accumulation of food between the teeth and cheek of the affected side; more rarely there is slight disturbance of deglutition. The tongue,

when protruded, may deviate to the side of the paralysis on account of the unopposed action of the genioglossus muscle on the healthy side. It must be remembered, however, that this deflection of the tongue may be more apparent at times than real, and that it may be owing to the closer approximation of the angle of the mouth on the paralyzed side to the median line. If the hemiplegia has occurred in early childhood it is commonly found after the lapse of a few years (the interval being shorter the earlier the age at which the hemorrhage occurred) that the bones of the skull and face on the paralyzed side are slightly smaller than those on the opposite side. The muscles are also atrophied to a slight extent.

Apart from aphasia, the discussion of which will be found in Vol. I., speech is usually not affected very much, though sometimes there is considerable thickness and slowness of speech from the diminished mobility of the tongue and lips, or perhaps from the impairment of mental power.

The upper limb is usually paralyzed to a greater extent than the lower limb, *i.e.*, the latter recovers much more rapidly and thoroughly than the former. The upper limb, as a rule, is partially flexed in all the joints, and the arm drawn alongside the chest. The power of executing coarse movements returns first, the delicate manipulations of the fingers being restored last. The tendon reflexes at the bend of the elbow and the wrist are increased.

In walking the lower limb drags along the ground, and there is an evident effort in propelling it along. It is swung more at the hip, and the pelvis is raised higher upon the paralyzed than upon the non-affected side in order to allow the drooping toes to clear the ground.

As an almost invariable rule in adults the paralyzed limbs do not undergo any noteworthy atrophy, although the paralysis may have lasted for years; the subcutaneous adipose tissue may disappear to a considerable extent. In rare cases, however, rapid atrophy takes place, sometimes even within a few months, and is more marked in the upper limb. It is supposed that this peculiar feature is owing to the implication of the anterior gray horns as a secondary result of the descending degeneration of the lateral columns. In one case under our observation the diagnosis of this secondary change in the cord was verified by the post-mortem examination.

In hemiplegia of early childhood marked atrophy of all the tissues of the paralyzed limbs always takes place, or, at least, their growth does not correspond with that of the healthy side. Sometimes this atrophy is so marked as to look, at the first glance, like that resulting from acute infantile paralysis.

The paralyzed limbs are usually cool to the feel, and the skin may present a dusky, mottled appearance from impaired circulation; not infrequently the radial pulse is smaller than on the other side.

In addition to these vaso-motor disturbances, trophic changes may also occur, and are more marked in the upper limb. The integument sometimes seems to be thinned and atrophic, in other cases it appears thicker than normal. The nails may become discolored, lose their gloss, and become rough from excessive development of longitudinal striations. The joints, particularly the shoulder, hip, and fingers, not infrequently become affected. The joint affection is very rarely acute in its origin. When this does occur, phenomena not unlike articular rheumatism are developed. This form usually begins in from two to four weeks after the apoplectic attack. Much more frequently, however, chronic, slowly progressing changes arise. The articular ends of the bones then appear to enlarge, and at the same time a certain amount of atrophy appears in the muscles surrounding the joint. No exudation can be detected, but the joint is very tender on pressure, and may be so painful on movement that the mobility is interfered with out of all proportion to the actual loss of muscular power. This condition is extremely obstinate, and frequently resists all forms of treatment.

Late rigidity, or contracture, is a very frequent sequel

of hemiplegia. The upper limb is involved to a much greater extent than the lower limb. As a general rule the fingers are strongly flexed, sometimes bent forcibly into the palm of the hand; the wrist is flexed upon the forearm, and the latter is pronated and at the same time slightly flexed on the arm. Contracture of the pectoralis major muscle draws the arm against the chest. In the lower limb the contracture is confined chiefly to the muscles of the calf, which draw up the heel.

It is very often found, even in advanced cases, that the contracture disappears in great part when the patients awake in the morning. Then the fingers, which could not be extended previously without a very great effort on the part of the physician, are relaxed spontaneously, and the patient may even be able to execute voluntary movements. In a little while, however, the *status quo ante* is restored. This condition is always attended by a marked increase of all the tendon reflexes, and sometimes by increased mechanical excitability of the paralyzed muscles. It is generally believed that this form of contracture is due to descending degeneration of the lateral columns, but this view is not well founded. We have seen one case in which the contracture was absent, although well-marked descending degeneration was found at the autopsy. Were this theory true, the symptom in question should be present in all cases of hemorrhage or other lesion affecting the pyramidal tracts, but in reality it is not infrequently absent under such conditions.

The phenomenon known as "associated movements" is also observed quite often in hemiplegia, particularly when it occurs in childhood. As a rule, strong voluntary effort on the part of the non-paralyzed limbs is associated with an involuntary movement of the paralyzed parts. Much more rarely a vigorous attempt to move the paralyzed muscles is attended with an involuntary movement of the healthy side.

Post-hemiplegic chorea is another peculiar phenomenon, allied perhaps to the associated movements just referred to. It occurs with greatly preponderating frequency in the hemiplegia of childhood, but is observed not very rarely in adults. The period of its development varies greatly, but it never occurs until a very considerable amount of improvement has taken place. This symptom is also found to be much more pronounced in the upper than in the lower limb.

The movements are manifold in character. Sometimes they can be distinguished in no respect from ordinary chorea; and, as in the latter disease, in some cases the movements are increased on effort, in others they are diminished.

More rarely tremor is produced like that seen in paralysis agitans, or the movements may be coarser. Some cases have been observed in which the movements were of an ataxiform character, and it is even claimed that true ataxic disturbances may be produced. There is very little doubt that athetosis (slow, constant alternation of flexion and extension of the fingers, with corresponding movements, perhaps, in the upper portions of the arm, more rarely in the lower limb, particularly the toes) is merely a variety of post-hemiplegic chorea, though it may also occur independently of cerebral hemorrhage.

In children, in whom post-hemiplegic chorea is of very frequent occurrence, this symptom often becomes complicated with epileptiform convulsions, affecting at the onset only the paralyzed side, but later spreading usually to the other side.

DIAGNOSIS.—The recognition of cerebral hemorrhage is often attended with great difficulty, and indeed may be impossible. The disease is most frequently mistaken for cerebral embolism, since the symptoms of both affections may be identical. In such cases a provisional diagnosis can be made only from attendant circumstances. Embolism is usually associated with cardiac valvular disease, thrombosis of the heart, or aneurism of the arch of the aorta. As a matter of course, however, the existence of these lesions does not preclude the occurrence of

cerebral hemorrhage. If the coma occurs with great suddenness, it is due more probably to embolism than to hemorrhage, and this is also true if the patient recovers, within a week, a considerable amount of power in the paralyzed side. Again, embolism is comparatively more frequent before the age of forty, though, as we have seen above, hemorrhage may also occur at any age, even in infancy and childhood. The determination of the coexistence of chronic interstitial nephritis favors the diagnosis of hemorrhage, on account of the vascular lesions so often present in the former disease. On the other hand, it must be remembered that the mere presence of albumin in the urine during an apoplectic attack possesses no significance whatever.

Cerebral hemorrhage must also be distinguished from cerebral thrombosis. In the latter affection, the comatose condition, if it develops at all, is usually much slower in its onset, though it must also be remembered that exceptionally the symptoms of thrombosis occur with great suddenness. The disease is peculiarly an affection of old age, and the radial, temporal, and other superficial arteries are generally found to be very atheromatous. When the thrombosis is the result of a syphilitic affection of the vessels, it is almost always preceded by another train of symptoms, a discussion of which will be found under the head of syphilitic lesions of the cerebral vessels.

Hemorrhage into the pons may also be mistaken for opium poisoning, if it is attended, as is usually the case, with strongly contracted pupils. In the former affection, however, the pulse and respiration are not so notably retarded as in the latter, and the coma is more profound. Epileptiform convulsions, also, are not an infrequent accompaniment of pons hemorrhage, and do not form a part of the history of opium poisoning. Of course the obscurity is cleared up if the patient recovers consciousness.

When the hemorrhage occurs during infancy or childhood, the disease must also be differentiated from tuberculous meningitis. This affection may also be attended with unconsciousness and sometimes distinct hemiplegia, even in cases in which the autopsy shows a tolerably uniform distribution of the lesion over both hemispheres of the brain. Meningitis, however, is attended with more marked prodromal symptoms than cerebral hemorrhage; the hemiplegia, if present, is not very profound, and is variable in degree at different times, as are also the other symptoms of the disease. In adults meningitis rarely simulates the history of cerebral hemorrhage.

But however careful we may be in the observation of the symptoms and of the attendant circumstances, very many cases will be encountered in which the diagnosis remains doubtful or is only cleared up by a post-mortem examination. Indeed, as was remarked in the paragraph on the pathological anatomy of the disease, even a post-mortem examination, if made long after the attack, may fail to decide the nature of the affection.

Even if a diagnosis of cerebral hemorrhage has been made, it is extremely difficult to localize the lesion accurately with any degree of certainty until the general pressure symptoms have cleared up, leaving only those which are due to the local lesion.

In the large majority of cases the most that can be done during the comatose stage is to determine the side on which the hemorrhage has occurred. The paralyzed side of the body is usually more relaxed than the non-paralyzed side, is often warmer, and the reflexes are entirely abolished; if conjugate deviation of the eyes and head is present, it is directed usually toward the side of the lesion. After the coma and the general pressure symptoms have subsided, localization of the lesion must be determined according to the principles laid down in this HANDBOOK under the headings, *Brain: Diagnosis of Local Lesions*, and *Brain: Functions of Cerebral Cortex*.

If the coma is very profound, and rigidity or convulsions make their appearance at the onset, together with serious respiratory and circulatory disturbances, the hemorrhage has probably occurred into the lateral ven-

tricles (from surrounding parts). Hemorrhage into the pons is frequently attended by marked contraction of the pupils and profound coma, and when the paralysis can be determined, it is usually found to be alternate, *i.e.*, the face is paralyzed on one side, the limbs on the opposite side.

PROGNOSIS.—This varies according to the size and situation of the hemorrhage. Other things being equal, life is more endangered the larger the hemorrhage. However, even hemorrhages of small size, if situated in the pons Varolii or medulla oblongata, are apt to prove rapidly fatal, and hemorrhages in the latter locality very rarely terminate in recovery. The fatal event is due to direct interference with the functions of respiration and circulation. Cheyne-Stokes respiration is an extremely unfavorable symptom, and is almost always a precursor of impending dissolution.

Large hemorrhages into the hemispheres, or those which rupture into the ventricles, also prove fatal, usually by direct or indirect pressure on the centres of the pons and medulla. The more sudden the development of coma, the smaller the chances of recovery. Acute decubitus, which occurs during the comatose stage, is almost invariably followed by death. The coexistence of Bright's disease is also a very unfavorable complication.

As regards the extent of recovery from the paralysis, very little can be foretold in the first period of the disease. In the large majority of cases the sensory disturbances disappear in great part and very rapidly.

Power of motion is usually restored much more quickly in the lower than in the upper limb. When the reverse obtains, it has been generally held that an unfavorable termination will ensue, but this opinion does not appear to be well substantiated.

The occurrence of late rigidity must be regarded as an unfavorable symptom, inasmuch as it interferes, in the first place, directly with the power of motion, and, in the second place, improvement in the latter usually ceases with the appearance of the former. This also holds good of post-hemiplegic chorea.

Symptoms of mental deterioration are usually permanent, and indeed, in many cases, are steadily progressive. As a rule, however, it is only after repeated attacks that a condition of mental impairment, amounting even to imbecility, develops. In very exceptional instances, epilepsy follows cerebral hemorrhage.

TREATMENT.—Prophylactic treatment is practically nil. If the prodromal symptoms are prolonged, the patient should be kept as quiet as possible, mentally and physically, and care taken that the bowels be kept thoroughly open. When the onset of a hemorrhage has been suspected, I have been in the habit of putting my patient to bed for a week, giving bromide of potassium in fifteen to thirty grain doses, *t.i.d.*, and a mild laxative or enema daily.

If the hemorrhage has taken place or is occurring at the time the physician is called, very little, if anything, can be done to check it. Drugs given internally for this purpose do more harm than good. The most that should be done is to keep the head slightly elevated, and if the carotids and temporals are pulsating strongly, apply cold applications to the head or leeches to the forehead. If the pulse continues strong during the comatose stage, nothing more need be done. When evidences of heart failure arise ammonia and stimulants are indicated.

When the stationary stage of paralysis has developed, treatment is useless until after the lapse of a considerable period. The natural tendency of the paralysis is toward improvement (though complete recovery hardly ever occurs), and until this tendency becomes manifest, we may rest satisfied either that motor fibres are cut across or that pressure is still exerted at the site of the lesion, thus interfering with nervous conduction.

Almost the only means at our command to hasten recovery is the use of electricity. This may be employed in two ways, either to the brain itself or directly to the paralyzed parts.

The former method has been very little used hitherto,

and, indeed, it is not probable that much good can be expected from it. The galvanic current alone is employed for this purpose. The positive pole is usually applied to the side on which the hemorrhage took place, the negative pole on the opposite side of the head. The current should be mild, and must never be strong enough to produce vertigo; the sittings should not exceed from two to five minutes in duration.

The ordinary method (and the one which promises by far the best results) of employing electricity in hemiplegia is the direct application of the faradic current to the paralyzed muscles. It has generally been held that this measure should not be employed until at least two or three months have elapsed since the occurrence of the hemorrhage, for fear of causing a recurrence of the disease. There is very little reason, however, to doubt that this fear is entirely unfounded, and that it is perfectly safe to begin the treatment within two or three weeks after the stationary period has begun.

The strength of current employed should be merely sufficient to produce distinct contraction of the paralyzed muscles; the sittings may be held every other day, and their duration may vary from five to fifteen minutes.

In a few cases an astonishing degree of improvement occurs after the first two or three applications, after which very little, if any, progress is made. As a rule, however, improvement, if it occur at all, is very gradual, and the treatment must be continued patiently for months.

When contractures of the paralyzed limbs have developed, another method should be employed. The one usually adopted is the application of the stable galvanic current through the nerves and muscles (nervo-muscular current) of the flexor aspect of the limbs (the parts in which the contracture is usually situated) and the faradic current to the antagonists. Warm baths and massage are also useful for this purpose.

In some cases painful swelling of the joints is extremely annoying to the patient, and this complication is very intractable to treatment. It is best combated by the use of a strong stable galvanic current passed directly through the joint, with the addition of repeated small blisters over the site of pain.

Iodide of potassium, in doses of from five to ten grains *t.i.d.*, is usually administered as a matter of routine, but it is more than doubtful whether this drug exerts any beneficial effect.

In our hands ergot has never given good results, no matter in what stage of the disease it has been employed. Careful attention should always be paid to the condition of the bowels, particularly as the patients are apt to be constipated for a long time after the attack.

Leopold Putz.

BRAIN: CEREBRO-SPINAL FLUID.—(Synonyms: *celiolymph*; Ger., *Cerebrospinalflüssigkeit*; Fr., *liquide céphalo-rachidien*; Lat., *liquor cerebrospinalis*.)

ANATOMY.—The cerebro-spinal fluid is found in the encephalic and myelic ventricles, and in the subarachnoid and subdural spaces. It varies in amount from 60 to 200 c.c., increasing somewhat with age. It is not lymph and is sufficiently characteristic in its reactions to be distinguished from other serous fluids. The subarachnoid space is the interval between the arachnoid and the pia, very narrow on the upper and lateral aspects of the encephalon, crossed by numerous bands of arachnoid tissue, but enlarged in certain regions at the base, above the corpus callosum and over the optic lobes, called the *cisternæ subarachnoidales*.

These are in communication with one another and have as tributaries the clefts along the great fissures (flumina), which themselves have as tributaries the spaces along the secondary and tertiary fissures (*rivi* and *rivuli* of Duret). There are prolongations of this space around the optic, olfactory, and auditory nerves, and a connection with the lymph spaces around the other cranial and spinal nerves. Communications with the lymphatic vessels of the nasal mucous membrane and deep vessels