in the right middle cerebral artery just beyond the first two branches (temporal). The central portion of the hemisphere was swollen and œdematous. The right anterior cerebral was greatly dilated, and by measurement its diameter was found to be nearly three times that of the left.

Treatment of Cerebral Hæmorrhage.—The patient should be placed with the head high, and measures immediately taken to reduce the arterial pressure. Of these the most rapid and satisfactory is venesection, which should be practiced whenever the arterial tension is much increased. With a small pulse of low tension and signs of cardiac weakness it is contra-indicated. The chief difficulty is in determining whether the apoplexy is really due to hæmorrhage, or to thrombosis or embolism, since in the latter group of cases bleeding probably does harm. As a rule, however, in middle-aged men with arterio-sclerosis, an accentuated aortic second sound, and hypertrophy of the left ventricle, bleeding is indicated. Horsley and Spencer have recently, on experimental grounds, recommended the practice, formerly employed empirically, of compression of the carotid, particularly in the ingravescent form; or even, in suitable cases, passing a ligature round the vessel. An ice-bag may be placed on the head and hot bottles to the feet. The bowels should be freely opened, either by calomel, or croton oil placed on the tongue. Counter-irritation to the neck or to the feet is not necessary. When dyspnœa, stertor, and signs of mechanical obstruction are present, the patient should be turned on the side, as recommended by Bowles. This procedure also lessens the liability to congestion of the lungs.

Special care should be taken to avoid bed-sores; and if bottles are used to the feet, they should not be too hot, since blisters may be readily caused by much lower temperature than in health. In the fever of reaction, aconite may be indicated, but should be cautiously used. Stimulants are not necessary, unless the pulse becomes feeble and signs of collapse supervene.

The treatment of *softening* from thrombosis or embolism is very unsatisfactory. Venesection is not indicated, as it lowers the tension and rather promotes clotting. If, as is often the case, the heart's action is feeble and irregular, stimulants and small doses of digitalis may be given with, if necessary, ether or ammonia. The bowels should be kept open, but it is not well to purge actively, as in hæmorrhage.

In the thrombosis which follows syphilitic disease of the arteries, and which is met with most frequently in men between twenty and forty (in whom the hemiplegia often sets in without loss of consciousness), the iodide of potassium should be freely used, giving from twenty to thirty grains three times a day, or, if necessary, larger doses. If the syphilis has been recent, mercurials are also indicated. Practically these are the only cases of hemiplegia in which we see satisfactory results from treatment.

Operative treatment has been suggested, and when the diagnosis of

subdural hæmorrhage can be made it is justifiable. An attempt to reach a central hæmorrhage in the neighborhood of the internal capsule would only increase the damage to the brain-substance. Very little can be done for the hemiplegia which remains. The damage is too often irreparable and permanent, and it is very improbable that iodide of potassium, or any other remedy, hastens in the slightest degree Nature's dealing with the blood-clot.

The paralyzed limbs may be gently rubbed once or twice a day, and this should be systematically carried out, in order to maintain the nutrition of the muscles and to prevent, if possible, contractures. After the lapse of a fortnight the muscles may be stimulated by the faradic current; but when contractures develop, electricity is useless, and the passive movements and frictions are alone indicated.

In a case of complete hemiplegia, the friends should at the outset be frankly told that the chances of full recovery are slight. Power is usually restored in the leg sufficient to enable the patient to get about, but in the majority of instances the finer movements of the hand are permanently lost. The general health should be looked after, the bowels regulated, and the secretions of the skin and kidneys kept active. In permanent hemiplegia in persons above the middle period of life, more or less mental weakness is apt to follow the attack, and the patient may become irritable and emotional.

And, lastly, when hemiplegia has persisted for more than three months and contractures have developed, it is the duty of the physician to explain to the patient, or to his friends, that the condition is past relief, that medicines and electricity will do no good, and that there is no possible hope of cure.

Aneurism of the Cerebral Arteries.

Miliary aneurisms are not included, but reference is made only to aneurism of the larger branches. The condition is not uncommon. There were twelve instances in my first eight hundred autopsies in Montreal.* This is a considerably larger proportion than in Newton Pitt's collection from Guy's Hospital, nineteen times in nine thousand inspections.

Etiology.—Males are more frequently affected than females. Of my twelve cases seven were males. The disease is most common at the middle period of life. One of my cases was a lad of six. Pitt describes one at the same age. The chief causes are (*a*) endarteritis, either simple or syphilitic, which leads to weakness of the wall and dilatation; and (*b*) embolism. As pointed out by Church, these aneurisms are often found with endocarditis. Pitt, in his recent study of the subject, concludes that it is exceptional to find cerebral aneurism unassociated with fungating

* Canada Medical and Surgical Journal, vol. xiv.

endocarditis. The embolus disappears, and dilatation follows the secondary inflammatory changes in the coats of the vessel.

Morbid Anatomy.—The middle cerebral branches are most frequently involved. In my twelve cases the distribution on the arteries was as follows: Internal carotid, 1; middle cerebral, 5; basilar, 3; anterior communicating, 3. With the exception of one case they were saccular and communicated with the lumen of the vessel by an orifice smaller than the circumference of the sac. In the 154 cases which make up the statistics of Lebert, Durand, and Bartholow the middle cerebral was involved in 44, the basilar in 41, internal carotid in 23, anterior cerebral in 14, posterior communicating in 8, anterior communicating in 8, vertebral in 7, posterior cerebral in 6, inferior cerebellar in 3 (Gowers). The size of the aneurism varies from that of a pea to that of a walnut. The hæmorrhage may be entirely meningeal with very slight laceration of the brain substance, but the bleeding may be, as Coats has shown, entirely within the substance.

Symptoms.—The aneurism may attain considerable size and cause no symptoms. In a majority of the cases the first intimation is the rupture and the fatal apoplexy. Distinct symptoms are most frequently caused by aneurism of the internal carotid, which may compress the optic nerve or the commissure, causing neuritis or paralysis of the third nerve. A murmur may be audible on auscultation of the skull. Aneurism in this situation may give rise to irritative and pressure symptoms at the base of the brain or to hemianopsia. In the remarkable case reported by Weir Mitchell and Dercum an aneurism compressed the chiasma and produced bilateral temporal hemianopsia.

Aneurism of the vertebral or of the basilar may involve the nerves from the fifth to the twelfth. A large sac at the termination of the basilar may compress the third nerves or the crura.

The diagnosis is, as a rule, impossible. The larger sacs produce the symptoms of tumor, and their rupture is usually fatal.

Endarteritis.

In no group of vessels do we more frequently see chronic degenerative changes than in those of the circle of Willis. The condition occurs as:

(*a*) *Arterio-sclerosis*, producing localized or diffused thickening of the intima with the formation of atheromatous patches or areas of calcification. In the later stages, as seen in elderly people, the arteries of the circle of Willis may be dilated, stiff, or almost universally calcified.

(*b*) *Syphilitic Endarteritis.*—As already mentioned under the section of syphilis, gummatous endarteritis is specially prone to attack the cerebral vessels. It has in itself no specific characters—that is to say, it is impossible in given sections to pick out an endarteritis syphilitica from

an ordinary endarteritis obliterans. On the other hand, as already stated, the nodular periarteritis is never seen except in syphilis.

Thrombosis of the Cerebral Sinuses and Veins.

The condition may be primary or secondary.

Primary thrombosis of the sinuses and veins is rare. It occurs (*a*) in children, particularly during the first six months of life, usually in connection with diarrhœa. It has, in my experience, been a rare condition. I have never seen an example of spontaneous thrombosis of the sinuses in a child, and only two instances, both in connection with meningitis, in which the cortical veins contained clots. Gowers believes that it is of frequent occurrence, and that thrombosis of the veins is not an uncommon cause of infantile hemiplegia.

(*b*) In connection with chlorosis and anæmia. Brayton Ball has recently called attention to this interesting association, and has reported one case and collected ten or eleven others from the literature. All were in girls with anæmia or chlorosis.

(*c*) In the terminal stages of cancer, phthisis, and other chronic diseases thrombosis may gradually occur in the sinuses and cortical veins. To the coagulum developing in these conditions the term marantic thrombus is applied.

Secondary Thrombosis is much more frequent and follows extension of inflammation from contiguous parts to the sinus wall. The common causes are disease of the internal ear, fracture, compression of the sinuses by tumor, or suppurative disease outside the skull, particularly erysipelas. In these cases the lateral sinus is most frequently involved. Of 57 fatal cases in which ear-disease caused death with cerebral lesions, there were 22 in which thrombosis existed in the lateral sinuses (Pitt). The thrombus may be small, or may fill the entire sinus and extend into the internal jugular vein. In more than one half of these instances the thrombus was suppurating. The disease spreads directly from the necrosis on the posterior wall of the tympanum. It is not so common in disease of the mastoid cells.

Symptoms.—Primary thrombosis of the longitudinal sinus may occur without exciting symptoms and is found accidentally at the post-mortem. There may be mental dulness with headache. Convulsions and vomiting may occur. In other instances there is nothing distinctive. In a patient who died under my care, at the Philadelphia Hospital, of phthisis, there was a gradual torpor, deepening to coma, without convulsions, localizing symptoms, or optic neuritis. The condition was thought to be due to a terminal meningitis. In the chlorosis cases the head symptoms have, as a rule, been marked. Ball's patient was dull and stupid, had vomiting, dilatation of the pupils, and double choked disks. Slight paresis of the left side occurred. An interesting feature in her case was

the development of swelling of the left leg. In the cases reported by Andrew, Church, Tuckwell, Isambard Owen, and Wilks the patients had headache, vomiting, and delirium. Paralysis was not present. In Douglas Powell's case, with similar symptoms, there was loss of power on the left side. Bristowe reports a case of great interest in an anæmic girl of nineteen, who had convulsions, drowsiness, and vomiting. Tenderness and swelling developed in the position of the right internal jugular vein, and a few days later on the opposite side. The diagnosis was rendered definite by the occurrence of phlebitis in the veins of the right leg. The patient recovered.

The onset of such symptoms as have been mentioned in an anæmic or chlorotic girl should lead to the suspicion of cerebral thrombosis. In infants the diagnosis can rarely be made. Involvement of the cavernous sinus may cause œdema about the eyelids or prominence of the eyes.

In the *secondary thrombi* the symptoms are commonly those of septicæmia. For instance, in over seventy per cent of Pitt's cases the mode of death was by pulmonary pyæmia. This author draws the following important conclusions: (1) The disease spreads oftener from the posterior wall of the middle ear than from the mastoid cells. (2) The otorrhœa is generally of some standing, but not always. (3) The onset is sudden, the chief symptoms being pyrexia, rigors, pains in the occipital region and in the neck, associated with a septicæmic condition. (4) Well-marked optic neuritis may be present. (5) The appearance of acute local pulmonary mischief or of distant suppuration is almost conclusive of thrombosis. (6) The average duration is about three weeks, and death is generally from pulmonary pyæmia. The chief points in the diagnosis may be gathered from these statements.

Pitt records an interesting case of recovery in a boy of ten, who had otorrhœa for years and was admitted with fever, earache, tenderness, and œdema. A week later he had a rigor, and optic neuritis developed on the right side. The mastoid was explored unsuccessfully. The fever and chills persisting, two days later the lateral sinus was explored. A mass of foul clot was removed and the jugular vein was tied, after which the boy made a satisfactory recovery.

III. AFFECTIONS OF THE SUBSTANCE.

I. Topical Diagnosis.

A majority of the lesions of the nervous system which permit of a local diagnosis have as an important part of their symptomatology disturbance of muscular action, and as our knowledge of the mechanism governing the movements of muscles is comparatively exact, we shall take this system as a basis for local diagnosis.

The motor system is made up of two segments, each consisting of groups of nerve-cells, and their prolongations into nerve-fibres. The *upper segment* comprises the motor cortex and the pryamidal fibres; and the *lower segment* the motor cells in the medulla and cord and the nerve-fibres arising from them, forming the peripheral nerves distributed to the muscles, which may themselves be considered as part of this segment.

The nerve-cells are so arranged that when thrown into action, by whatever cause, a definite movement is the result, and the same combination of nerve-cells always causes the same movement, or, in other words, every movement of the body is represented in the nervous centres by combinations of the nerve-cells, or, as we say, is localized.

Movements are localized both in the cells of the lower segment and in those of the upper, and we have consequently spinal localization and cerebral localization.

Spinal Localization.—In the lower motor segment the muscles are represented in their simplest movements, and different sections of the cord have been found to represent the movements of different muscles. Our knowledge of this localization is by no means complete, but enough has been learned to aid us materially in determining the site of a spinal lesion.

The cells of the lower segment are found in the motor nuclei of the medulla, and in the anterior gray horns of the spinal cord. They are connected with the muscles by the axis cylinder processes, the anterior nerve-roots (roots of motor cranial nerves), the peripheral nerves, and the end organs by which they are brought into intimate relation with the protoplasm of the muscle fibre itself.

The following table prepared by Starr gives in detail our knowledge on this subject:

Localization of the Functions of the Segments of the Spinal Cord.

Segment.	Muscles.	Reflex.	Sensation.
II and III C.	Sterno-mastoid. Trapezius. Scaleni and neck. Diaphragm.	Hypchondrium (?). Sudden inspiration produced by sudden pressure beneath the lower border of ribs.	Back of head to vertex. Neck.