the syphilitic virus. There are certain forms of lead encephalopathy which resemble general paresis, and, considering the association of plumbism with arterio-sclerosis, it is not unlikely that the anatomical substratum of the disease may result from this poison.

Prognosis.—The disease rarely ends in recovery. As a rule the progress is slowly downward and the case terminates in a few years, although it is occasionally prolonged ten or fifteen years.

Treatment.—The only hope of permanent relief is in the cases following syphilis, which should be placed upon large doses of iodide of potassium. Careful nursing and the orderly life of an asylum are the only measures necessary in a great majority of the cases. For sleeplessness and the epileptic seizures bromides may be used. Prolonged remissions, which are not uncommon, are often erroneously attributed to the action of remedies.

VII. TUMORS OF THE BRAIN.

The following are the most common varieties of new growths within the cranium:

(*a*) *Tubercle*, which may form small or large growths, usually multiple. They are most frequent early in life. Three fourths of the cases occur under twenty, and one half of the patients are under ten years of age (Gowers). Of 299 cases of tumor in persons under nineteen collected from various sources by Starr, 152 were tubercle. They are most numerous in the cerebellum and about the base.

(*b*) *Syphiloma* is most commonly found in the hemispheres or about the pons. The tumors are superficial, attached to the arteries or the meninges, and rarely grow to a large size. They may be multiple.

(*c*) *Glioma and Neuroglioma.*—These vary greatly in appearance. They may be firm and hard, almost like an area of sclerosis, or soft and very vascular. They persist remarkably for many years. Klebs has called attention to the occurrence of elements in them not unlike ganglion-cells. Tumors of this character contain "the spinnen" or spider cells; enormous spindle-shaped cells with single large nuclei; cells like the ganglion-cells of nerve-centres with nuclei and one or more processes; and translucent, band-like fibres, tapering at each end, which result from a vitreous or hyaline transformation of the large spindle-cells.

(*d*) *Sarcoma* occurs most commonly in the membranes of the brain and in the pons. It forms some of the largest and most diffusely infiltrating of intracranial growths.

(*e*) *Carcinoma* not infrequently is secondary to cancer in other parts. It is seldom primary. Occasionally cancerous tumors have been found in symmetrical parts of the brain.

(*f*) Other varieties occur, such as fibroid growths, which usually develop from the membranes; bony tumors, which grow sometimes from the falx, and psammoma and cholesteatoma. Fatty tumors are occasionally found on the corpus callosum.

(*g*) *Cysts* occur between the membranes and the brain, the result of hæmorrhage or of softening. Porencephalus is a sequence of congenital atrophy or of hæmorrhage, or may be due to a developmental defect. Hydatid cysts will be referred to in the section on parasites.

Symptoms.—(1) **General.**—The following are the most important: *Headache*, either dull, aching, and continuous, or sharp, stabbing, and paroxysmal. It may be diffused over the entire head or limited to the back or front. In the former case it may extend down the neck, and in the latter be accompanied with neuralgic pains in the face. Occasionally the pain may be very localized and associated with tenderness on pressure.

Optic Neuritis.—This occurs in four fifths of all the cases (Gowers). It is usually double, but occasionally is found in only one eye. A growth may develop slowly and attain considerable size without producing optic neuritis. On the other hand, it may occur with a very small tumor, more commonly in a growth at the base.

Vomiting.—This is a common feature, and with headache and optic neuritis makes up the characteristic symptom group of cerebral tumor. An important point is the absence of definite relation to the meals. It may be very obstinate, particularly in growths of the cerebellum and the pons.

Giddiness.—This is often an early symptom. The patient complains of vertigo on rising suddenly or on turning quickly. *Mental Disturbance.* The patient may act in an odd, unnatural manner, or there may be stupor and heaviness. The patient may become emotional or silly, or symptoms resembling hysteria may develop. *Convulsions*, either general and resembling true epilepsy or localized (Jacksonian) in character.

(2) **Localizing Symptoms.**—(*a*) *Central Motor Area.*—The symptoms are either irritative or destructive in character. Irritation in the lower third may produce spasm in the muscles of the face, in the angle of the mouth, or in the tongue. The spasm with tingling may be strictly limited to one muscle group before extending to others, and this Seguin terms the *signal symptom.* The middle third of the motor area contains the centres controlling the arm, and here, too, the spasm may begin in the fingers, in the thumb, in the muscles of the wrist, or in the shoulder. In the upper third of the motor areas the irritation may produce spasm beginning in the toes, in the ankles, or in the muscles of the leg. In many instances the patient can determine accurately the point of origin of the spasm, and there are important sensory disturbances, such as numbness and tingling, which may be felt first at the region affected.

In all cases it is important to determine, first, the point of origin, the *signal symptom;* second, the order or march of the spasm; and third, the subsequent condition of the parts first affected, whether it is a state of paresis or anæsthesia.

Destructive lesions in the motor zone cause paralysis, which is often preceded by local convulsive seizures; there may be a monoplegia, as of the leg, and convulsive seizures in the arm, often due to irritation in these centres. Tumors in the neighborhood of the motor area may cause localized spasms and subsequently, as the centres are invaded by the growth, paralysis occurs. On the left side, growths in the third frontal or Broca's convolution may cause motor aphasia.

(*b*) *Prefrontal Region.*—Neither motor nor sensory disturbance may be present. The general symptoms are often well marked. The most striking feature of growths in this region is mental torpor and gradual imbecility. In its extension downward the tumor may involve on the left side the lower frontal convolution and produce aphasia, or in its progress backward cause irritative or destructive lesions of the motor area.

(*c*) Tumors in the *parieto-occipital lobe* may grow to large size without causing any symptoms. There may be word-blindness and mind-blindness when the angular gyrus is involved, and paraphasia.

(*d*) Tumors of the *occipital lobe* produce hemianopia, and a bilateral lesion may produce blindness. Tumors in this region on the left hemisphere may be associated with word-blindness and mind-blindness.

(*e*) Tumors in the *temporal lobe* may attain a large size without producing symptoms. In their growth they involve the lower motor centres. On the left side involvement of the first and second gyri may be associated with word-deafness.

(*f*) Tumors growing in the neighborhood of the *basal ganglia* produce hemiplegia from involvement of the internal capsule. Limited growths in either nucleus of the corpus striatum do not necessarily cause paralysis. Tumors in the thalamus opticus may also, when small, cause no symptoms, but increasing they may involve the fibres of the optic radiation, producing hemianopia and sometimes hemianæsthesia. Growths in this situation are apt to cause early optic neuritis and, growing into the third ventricle, may cause a distention of the lateral ventricles. In fact, pressure symptoms from this cause and paralysis due to involvement of the internal capsule are the chief symptoms of tumor in and about these ganglia.

Growths in the *corpora quadrigemina* are rarely limited, but most commonly involve the crura cerebri as well. Ocular symptoms are marked. The pupil reflex is lost and there is nystagmus. In the gradual growth the third nerve is involved as it passes through the crus, in which case there will be motor oculi paralysis on one side and hemiplegia on the other, a combination almost characteristic of unilateral crus disease.

(*g*) Tumors of the *pons* and *medulla.* The symptoms are chiefly those of pressure upon the nerves emerging in this region. In disease of the pons the nerves may be involved alone or with the tract. Of 52 cases analyzed by Mary Putnam Jacobi, there were 13 in which the cranial nerves were involved alone, 13 in which the limbs were affected, and 26 in which there was hemiplegia and involvement of the nerves. Twenty-two

of the latter had what is known as alternate paralysis—i. e., involvement of the nerves on one side and the limbs on the opposite side. In four cases there were no motor symptoms. A tumor growing in the lower part of the pons usually involves the sixth nerve, producing internal strabismus; the seventh nerve, producing facial paralysis; and the auditory nerve, causing deafness. Conjugate deviation of the eyes to the side opposite that on which there is facial paralysis also occurs.

Tumors of the *medulla* may involve the cranial nerves alone or cause in some instances a combination of hemiplegia with paralysis of the nerves. Signs of irritation in the ninth, tenth, and eleventh nerves are usually present, and produce difficulty in swallowing, irregular action of the heart, irregular respiration, vomiting, and sometimes retraction of the head and neck. The gait may be unsteady or, if there is pressure on the cerebellum, ataxic. Occasionally there are sensory symptoms, numbness, and tingling. Toward the end convulsions may occur.

(*h*) Tumors of the *cerebellum* constitute by far the most important affection of this part. There may be no symptoms whatever if the tumor is confined to one hemisphere and does not involve the middle lobe. When this portion is affected the symptoms are very characteristic, consisting of:

Vertigo, which is more constant in this than in affections of any other region of the brain. This may be due, some believe, to the central relations of the semicircular canals with the cerebellum. The giddiness may be of the most distressing nature.

Headache.—In the analysis by Mary Putnam Jacobi of symptoms in tumors in various parts of the brain headache was relatively much more frequent in tumors of the cerebellum than in any other region.

Cerebellar Ataxia.—The gait is irregular and staggering. In attempting to walk the patient reels to and fro like a drunken man. There may be a tendency to fall to one side, backward, or, less commonly, forward.

Other less constant but suggestive symptoms are the optic neuritis; nystagmus; neuralgic pains in the region of the neck and occiput; pressure symptoms on the medulla, causing vomiting; distention of the lateral ventricles, causing in children hydrocephalus; and, lastly, bilateral rigidity from pressure on the motor paths (Sharkey).

Diagnosis.—From the general symptoms alone the existence of tumor may be determined, for the combination of headache, optic neuritis, and vomiting is distinctive. The localization must be gathered from the consideration of the symptoms above detailed. Mistakes are most likely to occur in connection with uræmia, hysteria, and general paralysis; but careful consideration of all the circumstances of the case usually enables the practitioner to avoid error.

Prognosis.—Syphilitic tumors alone are amenable to treatment. Tuberculous growths occasionally cease to grow and become calcified. The gliomata and fibromata, particularly when the latter grow from the membranes, may last for years. I have described a case of small, hard

glioma, in which the Jacksonian epilepsy persisted for fourteen years. Hughlings Jackson has reported cases of glioma in which the symptoms lasted for over ten years. The more rapidly growing sarcomata usually prove fatal in from six to eighteen months. Death may be sudden, particularly in growths near the medulla; more commonly it is due to coma in consequence of gradual increase in the intracranial pressure.

Treatment.—(*a*) *Medical.*—If there is a suspicion of syphilis the iodide of potassium and mercury should be given. Nowhere do we see more brilliant therapeutical effects than in certain cases of cerebral gummata. The iodide should be given in increasing doses. In tuberculous tumors the outlook is less favorable, though instances of cure are reported, and there is post-mortem evidence to show that the solitary tuberculous tumors may undergo changes and become obsolete. A general tonic treatment is indicated in these cases. The headache usually demands prompt treatment. The iodide of potassium in full doses sometimes gives marked relief. An ice-cap for the head or, in the occipital headache, the application of the Paquelin cautery may be tried. The bromides are not of much use in the headache from this cause, and, as the last resort, morphia must be given. For the convulsions bromide of potassium is of little service.

(*b*) *Surgical.*—Tumors of the brain have been successfully removed by Macewen, Horsley, Keen, and others. The number of cases for operation, however, is small. Four fifths at least of all the cases are probably unsuccessful, or of such a nature as to render an operation fatal. The most advantageous cases are the localized fibromata growing from the dura and only compressing the brain substance, as in Keen's remarkable case. The safety with which the exploratory operation can be made warrants it in all doubtful cases.

VIII. CHRONIC HYDROCEPHALUS.

Definition.—A condition, congenital or acquired, in which there is a great accumulation of fluid within the ventricles of the brain.

The term hydrocephalus has also been applied to the collection of fluid between the cortex of the brain and the skull, known in this situation as *h. externus* or *h. ex vacuo*, a condition common in cases of atrophy of the brain substance, and perhaps caused also by meningeal cysts. A true dropsy, however, of the arachnoid sac probably does not occur.

The cases may be divided into two groups, congenital or infantile, and secondary or acquired.

(1) **Congenital Hydrocephalus.**—The enlarged head may obstruct labor; more frequently the condition is noticed some time after birth. The cause is unknown. It has occurred in several members of the same family.

The anatomical condition in these cases offers no clew to the nature of

the trouble. The lateral ventricles are enormously distended, but the ependyma is usually clear, sometimes a little thickened and granular, and the veins large. The choroid plexuses are vascular, sometimes sclerotic, but often natural-looking. The third ventricle is enlarged, the aqueduct of Sylvius dilated, and the fourth ventricle may be distended. The quantity of fluid may reach several litres. It is limpid and contains a trace of albumen and salts. The changes in consequence of this enormous ventricular distention are remarkable. The cerebral cortex is greatly stretched, and over the middle region the thickness may amount to no more than a few millimetres without a trace of the sulci or convolutions. The basal ganglia are flattened. The skull enlarges, and the circumference of the head of a child of three or four years may reach twenty-five or even thirty inches. The sutures widen, Wormian bones develop in them, and the bones of the cranium become exceedingly thin. The veins are marked beneath the skin. A fluctuation wave may sometimes be obtained, and Fisher's brain murmur may be heard. The orbital plates of the frontal bone are depressed, causing exophthalmos, so that the eyeballs cannot be covered by the eyelids.

Convulsions may occur. The reflexes are increased, the child learns to walk late, and ultimately in severe cases the legs become feeble and sometimes spastic. The mental condition is variable; the child may be bright, but, as a rule, there is some grade of imbecility. The congenital cases usually die within the first four or five years. The process may be arrested and the patient may reach adult life. Cases of this sort are not very uncommon. Even when extreme, the mental faculties may be retained, as in Bright's celebrated patient, Cardinal, who lived to the age of twenty-nine, and whose head was translucent when the sun was shining behind him. Care must be taken not to mistake the rachitic head for hydrocephalus.

(2) **Acquired Chronic Hydrocephalus.**—This is stated to be occasionally primary (idiopathic)—that is to say, it comes on spontaneously in the adult without observable lesion. Dean Swift is said to have died of hydrocephalus, but this seems very unlikely. It is based upon the statement that "he (Mr. Whiteway) opened the skull and found much water in the brain," a condition no doubt of *h. ex vacuo*, due to the wasting associated with his prolonged illness and paralysis. In nearly all cases there is either a tumor at the base of the brain or in the third ventricle, which compresses the venæ Galeni. The passage from the third to the fourth ventricle may be closed, either by a tumor or by parasites. More rarely the foramen of Magendie, through which the ventricles communicate with the cerebro-spinal meninges, becomes closed by meningitis. These conditions, occurring in adults, may produce the most extreme hydrocephalus without any enlargement of the head. Even when the tumor begins early in life there may be no expansion of the skull. In the case of a girl aged sixteen, blind from her third year, the head was not unusually large, the ventricles were