Krauss (W. C.)

Symptomatology of Cerebellar Disease; Clinical Analysis of a Hundred Cases, with Report of Four Personal Cases.

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SYMPTOMATOLOGY OF CEREBELLAR DISEASE;

CLINICAL ANALYSIS OF A HUNDRED CASES, WITH REPORT OF FOUR PERSONAL CASES.*

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The most important addition to our knowledge of cerebellar physiology in recent times is the able monograph of Luciani, published in Florence in 1890. Luciani was first attracted to this field in the summer of 1882, he having in that year completely extirpated the cerebellum of a dog and succeeded in keeping the animal alive.

The fact that this was a possibility, and considering the chaotic condition in which cerebellar physiology existed, induced him to make a minute study of the subject, casting aside all theories and hypotheses, and plunging into the very beginning of the work just as if cerebellar physiology had never been thought of.

After eight years of observation and study, he brought his labor to the light of day, and a comparison of his re-

* Read before the Medical Society of the State of New York at its eighty-ninth annual meeting.

sults with the results obtained by other experimenters, and a comparison of these with the symptoms of cerebellar disease, will be the purpose of this paper.

The pioneer of cerebellar physiology depends upon whether the compiler resides in England, Italy, or France. If in England, then Willis is considered the father; if in Italy, then Rolando; and if in France, then Flourens is considered the founder. Willis was undoubtedly the first to lend attention to the cerebellum, although his work was more anatomical than physiological or experimental. Rolando essayed the solution of cerebellar action and experimented upon animals, especially young pigeons, turtles, etc. His technique was faulty, and the animals experimented upon lived but a short time after the removal of the cerebellum. As a result of his experiments he found that slight injuries to, or partial destruction of, the cerebellum influences muscular movements, while complete destruction annihilates the nerve activity, the abolition of which occasions complete paralysis.

Supporting these deductions he cites the clinical cases of Bianchi, Larrey, and Bertini.

In Bianchi's case, abscess of the right lobe of the cerebellum produced paralysis of the right side of the body; in Larrey's case, injury to the right lobe was followed by right hemiplegia; and Bertini's diagnosis of cerebellar disease was based on the uncertain, irregular muscular movements of his patient, resembling the antics of a drunken man.

Although mistaken regarding the presence of paralysis, which is nothing more than a loss of sthenic tone, Rolando proved that the cerebellum exerted some influence over the correlation of muscular forces, and that an insult to one side of the cerebellum was manifested by some disorders on the corresponding side of the body.

Flourens, the brilliant young French experimenter, in 1822 addressed to the Royal Academy of Sciences a memoir on cerebellar physiology, which stands to day for all that is accurate and positive regarding cerebellar action from an experimental standpoint. Three of his experiments, which are quoted by all writers on this subject, may not be amiss in this paper:

"I extirpated the cerebellum of a pigeon by successive layers. During the removal of the first layers only slight feebleness and want of harmony in the movements were noticed.

"At the middle layers an almost universal agitation was manifested, but without convulsions; the pigeon executed sudden and disordered movements; hearing and vision remained intact. On the removal of the last layers the faculty of jumping, flying, walking, and maintaining the erect position was lost entirely. Placed on its back, it was not able to recover itself, and became vainly and continually agitated, but it never moved in a firm and definite manner."

The entire removal of the cerebellum, then, in a pigeon results in volition, sensation, and perception remaining intact. The possibility of making general movements persists, but the co-ordination of the movements in regular and definite acts of locomotion is lost.

The second experiment relates to partial removal of the cerebellum in a young cock. The animal immediately lost all stability, all regularity in its movements, and its tottering and bizarre mode of progression reminded one entirely of the gait in alcoholic intoxication.

Four days after, the equilibrium was less disturbed, and the progression was more firm and assured.

Fifteen days after, the equilibrium was completely restored.

Partial destruction of the cerebellum, then, means a temporary loss of muscular co-ordination.

Flourens fell into an error regarding the influence of the cerebellum as crossed instead of direct, each hemisphere exerting its influence over the corresponding half of the body. With this exception, the experimental results of this astute observer remain unchallenged to this day, even though there may be difference of opinion as to his deductions regarding the functions of the cerebellum.

Magendie, another French physiologist, followed closely upon the work of Flourens, and repeated the almost forgotten experiments of Pourfour du Petits—that of cutting the cerebellar peduncles and observing the animal rotate on its longitudinal axis toward the right or left, according to the side on which the peduncle was cut. He also observed what Fodera von Palermo had previously noticed—that injuries to the cerebellum were accompanied by an uncontrollable inclination to lean or even fall backward.

Serres (1826), through faulty experimentation, taught that the action of the cerebellum was crossed; he also observed the tendency of animals to recoil, to incline the head backward, and was the first to call attention to the fact that the cerebellum exerts powerful influence over the extremities, more particularly the inferior or posterior. This is shown nicely in the experiments upon pigeons, where, after extirpation of the cerebellum, on being thrown into the air they are able to fly, but, on trying to rise from the ground, they are unable to use their feet, because, as Serres says, they are paralyzed.

Gall, the father of phrenology, in the early part of the century taught that the cerebellum was the seat of the sexual desires. This doctrine was combated by Bouillaud (1827), who, studying many clinical cases, asserted that the cerebellum had no connection whatever with the sexual in-

stincts. Bouillaud followed Flourens's experiments, and tried to prove that the cerebellum presided over acts of equilibrium, of station, and of progression.

Andral, in 1833, published the first series of cases of cerebellar disease, and was able to collect ninety-three cases, of which six were under his personal observation. Of these cases, only one, according to Andral, tended to confirm the opinion of physiologists that the cerebellum was the organ that regulated the co-ordination of muscular movements. Longet (1842), in his *Anatomy and Physiology of the Nervous System*, says, in view of Andral's results, we must be extremely reserved in calling the cerebellum the co ordinator of voluntary muscular movements. Andral's analysis seems to have precipitated a merry war between the experimental school and the pathological school. The former, following Flourens and Bouillaud, regarded the cerebellum as the organ of co-ordination, while the latter lent it no such functions.

Flint, in his text book on physiology, page 712, makes a scrutinizing analysis of Andral's cases, and comes to the following very sound conclusions:

"Of Andral's ninety-three cases, eighty-five may be thrown out altogether, leaving but eight; and of these eight cases, five are so imperfectly described and the disorganization of the cerebellum is so restricted that they may also be disregarded. The ninety three cases are thus reduced to three. Of these three cases, in two it is uncertain whether or not there were deficiency of co-ordinating power, and in one the difficulty in equilibrium or co-ordination was distinctly noted." This criticism does not show that Andral's cases are opposed to the Flourens doctrine.

Following Andral's publication, there seems to have been a lull in the study of cerebellar physiology, for noth-

ing important was published until the year 1860, when Brown-Séquard, in his lectures on the central nervous system, taught that the inco ordination was not due to the loss of function of the cerebellum, but that it was due to irritation of neighboring parts of the brain carried through the cerebellar peduncles.

Schiff studied carefully the effects of cutting the cerebellar peduncles and was the first to explain one of the elements of cerebellar ataxia—namely, that it was due to incomplete fixation of the vertebral column, the result of paralysis of the vertebral muscles.

Wagner, Dalton, Lusanna, and Renzi, in their experiments on pigeons and birds, added little that was not known of cerebellar physiology, their findings taking more the character of negative rather than positive phenomena.

Dalton, however, found that the greater the extirpation of the cerebellum the more pronounced would be the motor disturbances, and these would disappear, leaving nothing but a certain general muscular weakness. After the disappearance of the inco-ordination, the result of an irritative lesion, there remains the general muscular weakness, the result of the deficiency lesions.

The inco-ordination he believed to be due to the sudden injury to the cerebellum as a whole, rather than the simple loss of a part of its substance.

Renzi asserted that the cerebellum was the seat of memory, while Lusanna set up the hypothesis that the muscle sense resided in the cerebellum.

Other observers, especially Foville and Pinel-Grandchamp, thought that the cerebellum stood in close relation with the posterior white columns, and therefore presided over general sensation.

Leven and Ollivier (1862–'63) rejected the Flourens

doctrine, but made the same error as Flourens in thinking the action of the cerebellum crossed instead of direct.

Luys (1864) undertook to resuscitate the Rolando doctrine, and regarded the muscle weakness following extirpation of the cerebellum not paralytic but asthenic.

Weir Mitchell came practically to the same results obtained by Dalton, Leven-Ollivier, and Luys, regarding the weakness following extirpation of the cerebellum, and considered it as one of the great centres of force development for voluntary and perhaps involuntary motion. Its loss leaves finally no functional defect save some incapacity for prolonged muscular activity.

Nothnagel in 1876 emitted the theory that to the middle lobe alone belonged the functions commonly ascribed to the cerebellum, and that on lesion of this lobe, directly or indirectly, the symptoms of cerebellar disease exclusively depend.

Ferrier, in his experiments on monkeys, found that when the cerebellum has been totally removed the animals exhibit the most tumultuous disorders of equilibrium, so that station and locomotion are for the time altogether impossible. Gradually these tumultuous disorders subside, so that the animal can sit up, but is so tottering that it falls over on the slightest disturbance or excitement. A persistent feature is the astasia or unsteadiness of the head, trunk, and limbs.

If only one of the lateral lobes is removed the sprawling, ungraduated action of the limbs and the astasia are confined to the same side as the lesion.

If the middle lobe is destroyed the symptoms are essentially of the same character as those which follow destruction of the whole organ, but they do not affect one side more than the other and are more pronounced in the head and trunk than in the limbs. These symptoms are less persistent,

and in a few months almost entirely disappear. If one of the peduncles is cut the symptoms have the same character as those following destruction of the lateral lobe, and are confined to the limbs on the side of the lesion.

Ferrier concludes that the cerebellum is the organ presiding over the equilibrium of the body or the location of the body in space.

Stefani (1877) regarded the cerebellum as Ferrier the organ of maintaining the equilibrium; Bechterew is also of this opinion, but regards the olivary bodies, the semicircular canals, and the gray matter of the third ventricle as associated with the cerebellum in the performance of this function.

Bianchi succeeded in keeping alive for some time a dog which had the greater part of its cerebellum removed, which showed no sign of inco-ordination, but simply a loss of muscular power.

The results obtained by experimental physiologists previous to Luciani's publication may be summed up as follows:

First, as concerns the negative phenomena, all observers are practically agreed that the cerebellum plays no part whatever over the mind, instinct, intelligence, sensibility, or special senses; these functions belong to the cerebrum alone, and remain unaffected even in the most severe of cerebellar accidents.

That the sexual instinct resides in the cerebellum, as advocated by Gall, has found no supporter, and must be dismissed from further consideration.

The teaching of Rolando, Serres, and others, that paralysis follows cerebellar extirpation must likewise be modified so as to mean loss of tone or simply weakness, which may disappear or persist according to the extent of injury to the cerebellum.

The positive phenomena following complete or partial extirpation are more difficult to enunciate, and any attempt to make generalizations will be met by stern rebukes and demurrers. As Vulpian has aptly said, the problem of the functions of the cerebellum is still far from being definitely solved. However, this much we do know:

1. That lesions of one side of the cerebellum produce symptoms on the corresponding side of the body.

2. That after partial removal of the cerebellum muscular weakness follows, which disappears almost entirely after a lapse of a few months.

3. That after complete removal of the cerebellum in animals the movements of the lower or inferior extremities become tangled, and they refuse to obey the impulses which try to guide their action.

4. That the cerebellum has some function over the regulation of muscular movements, either co-ordinative or compensatory; the weight of opinion seems to favor the former.

5. That lesions of the middle lobe seem to affect both sides of the body, while lesions to the lateral lobes or peduncles affect the corresponding side of the body only.

To Summarize.—The cerebellum, as a centre, according to the majority of observers up to 1890, presides over the co-ordination of muscular movements, the effects of which would be to maintain the equilibrium of the body, the guidance of locomotion, and the maintenance of body station.

Luciani's labors in the field of cerebellar physiology deserve the highest encomiums, and his views merit most respectful consideration. It is gratifying to know that which the cerebellum does not do, even if we dispute the things that it does do. Luciani has virtually decided for all time that complete extinction of the cerebellum produces neither

partial nor general paralysis of the mind, perception, volition, intuition, muscular movements, or the appetites. Removal of the cerebellum produces, first, irritative phenomena; secondly, ataxic phenomena. The irritative phenomena follow closely upon the destruction of the cerebellum, and are indicated by such symptoms as opisthotonus and pleurothotonus, rotation round the longitudinal axis, squinting, or deviation of the optic axis. The ataxic phenomenon or cerebellar ataxy is due to three principal conditions—asthenia, atonia, and astasia—due to the loss of a sthenic tone and static influence which the cerebellum normally exerts on the apparatus of movements, and which is the essence of its function. A trophic influence is also exerted by the cerebellum direct on the efferent tracts which spring from it, and indirect on the nutrition of the body.

According to Luciani the cerebellum is an end organ directly or indirectly related to certain peripherical sensory organs, and in direct efferent relationship with certain ganglia of the cerebro spinal axis, and indirectly with the motor apparatus in general. It is functionally homogeneous, each part exercising the functions of the whole, but having special relations to the muscles on the corresponding side of the body.

Now turn from the physiologico-experimental to the clinico-pathological and see how the facts obtained from experiments upon animals harmonize with the symptoms of cerebellar disease.

From 1880 up to the present time, the era of greatest scientific progress that medicine has ever enjoyed, I have been able to collect ninety-seven cases * of cerebellar dis-

* The cases reported by American observers in this list are those of Eskridge, *Journal of Nervous and Mental Disease*, 1885, No. 12;

ease in which the diagnosis was verified by the necropsy.

This does not embrace cases of mental defect or aberration with such lesions as atrophy or absence of the cerebellum, but, with one or two exceptions, only those cases where a diagnosis was surmised *intra vitam*. To this number I can add three of my own which I will report later on in this paper. These cases have been studied with a view of establishing a syndrome of cerebellar disease based upon the labors of clinicians the world over.

Of these one hundred cases the pathological finding in the cerebellum is as follows: Sarcoma in twenty-two cases, tubercles in twenty-two, glioma in eighteen, abscess in ten, tumor (character not specified) in thirteen, cyst in seven, and one case each of softening, endothelioma, cyst and sarcoma, cancer, gumma, fibroma, and hæmorrhage. The procreative faculty of the cerebellum for neoplasms of various kinds is here well illustrated, being particularly partial toward tuberculosis and the sarcomata.

The left lobe of the cerebellum was found to be the seat of lesion thirty-two times, the right lobe thirty-two times, the middle lobe seventeen times, both right and left six times, right and middle lobes three times, left and middle lobes twice.

Turning to the clinical manifestations, we find that

Wilkins, *Canada Medical and Surgical Journal*, 1886, No. 4; Seguin, *Journal of Nervous and Mental Disease*, 1887, No. 4; Preston, *Journal of Nervous and Mental Disease*, 1889, No. 4, and 1892, No. 4; Booth, *Journal of Nervous and Mental Disease*, 1889, No. 3, and 1890, No. 10; Knapp, *Journal of Nervous and Mental Disease*, 1892, No. 2; Knapp, *Intracranial Growths;* Dercum, *Transactions of the American Neurological Association*, 1893; Starr, *Brain Surgery;* Amidon and Weir, *Annals of Surgery*, 1887; Wyman, *Medical News*, 1890; Bullard, *Boston Medical and Surgical Journal*, 1890; Angell, *Buffalo Medical and Surgical Journal*, 1894, No. 9.

headache was present in eighty-three cases, absent entirely in six cases, and in twelve cases its presence or absence was not reported.

Vomiting occurred in sixty-nine cases, was absent in nine cases, and not reported in twenty-three cases.

Optic neuritis was found in sixty-six cases, was absent in twelve, and not reported in twenty-three.

Vertigo was present in forty-eight cases, absent in nine, not reported in forty three.

These four symptoms are generally considered characteristic of intracranial growths, and their frequency in this series of cases shows that whether the tumor resides in the cerebrum or cerebellum the "big four" must ever be regarded as pathognomonic, especially when all of them or even three are present at the same time.

Of the symptoms which we are in the habit of designating distinctly cerebellar, we find that occipital pain and tenderness were present in forty-five cases, doubtful in thirty-nine, absent in eight, and not reported in eight.

Ataxia—and by this I mean the disturbances of motion, especially of the inferior extremities—was noted in fifty-eight cases, absent in nine, and not reported in thirty-two.

Asthenia, or the lack of sthenic tone in the muscles as evidenced by weakness, erroneously termed paralysis or paresis, was present in forty-eight cases, absent in fourteen, and not reported in thirty-eight. It would have been interesting to determine whether the muscular asthenia always occurred on the same side as the lesion, as was found in the experiments upon animals, but the clinical histories were very faulty in this particular, and hence no data could be obtained to form any conclusion, although it is generally admitted that such is the case. Convulsions, either partial or general, were present in thirty cases, absent in fourteen, and not reported in fifty-six.

Inclination to go to one side or the other has sometimes served as an index for determining the lobe affected, the rule being that the patient walks toward the side bearing the lesion. Of thirty-five cases where inclination was reported the following results were obtained: Where the lesion was situated in the right lobe, six inclined to the right, two to the left, two backward, and one forward. Where the lesion was situated in the left lobe, four inclined to the left, one to the right, and three backward. Where the middle lobe was affected, four inclined to the left, two to the right, and one backward. In eight cases there was no inclination either to the right or left. These results seem to bear out the rule enunciated that the patient moves from the well to the diseased side.

The tendon reflexes were reported normal in ten cases, exaggerated in twelve, and diminished or absent in twelve cases.

Disturbances of the general sensibility were so rarely noted, and the reports so incomplete, that any careful consideration is out of the question.

The symptom astasia, so often quoted by Luciani, which is the counterpart of the tremors, oscillations, instability of the body in station and motion, has been partly considered under the head of inclination. The tremors which were so often noticed in animals, sometimes compared by writers to the intention tremor of multiple sclerosis, were recorded in only two or three of the one hundred cases collected.

Polyuria and glycosuria were likewise so infrequent, and the cause so hypothetical, that they may be dismissed from the list of primary cerebellar symptoms.

Another important group of symptoms arising chiefly from pressure of the tumor mass upon the floor of the fourth ventricle, producing paralysis of the fifth, sixth

seventh, eighth, ninth, and tenth pairs of cranial nerves, or the blocking up of the venæ Galeni and the consequent dilatation of the lateral and third ventricles, are only secondary, but concomitant with the primary symptoms help to localize more accurately the seat of the lesion in the cerebellum. The sudden death so often observed in cerebellar disease may be due to the effects of pressure upon the nucleus of the vagus nerves.

Marked changes in the sexual desire, the appetites, or the mental states were not discoverable.

To summarize, the symptoms of cerebellar disease arranged according to their frequency in this series of cases would be headache, vomiting, optic neuritis, vertigo, ataxia, asthenia, occipital pain and tenderness, inclination to turn toward the side of lesion, convulsions, and such secondary symptoms as nuclear paralyses, polyuria and glycosuria, tremors, and sudden death. The negative symptoms would comprise the disorders of the sexual desire, of the mind, of sensation, and the variability of the tendon reflexes.

The following cases* of cerebellar disease have come under my observation. Cases I and II having been previously published, Cases III and IV, seen by me during the past year, are reported here for the first time:

Case I. *Clinical Diagnosis: Tuberculosis of the Cerebellum; Autopsy; Anatomical Diagnosis: Miliary Tuberculosis, with Implication of the Cerebellum.*—In January, 1888, Willy L., a child of two years, appeared for the first time in the polyclinic for nervous diseases of Professor Mendel and Professor Eulenburg (Berlin), where I had the opportunity of studying the case.

* Case I. *Tuberkel Knoten des Kleinhirns.* Inaugural Dissertation. William C. Krauss, M. D., University of Berlin, August 8, 1888. Case II. *Journal of the American Medical Association*, Chicago, November 30, 1893.

The child was emaciated, thin, pale, and showed, in general, a scrofulous disposition. The father had always been a healthy man. The mother, with the exception of being an alcoholic, had always enjoyed good health. The mother relates the following history:

For some time past the child had been subject to attacks, regular in appearance, occurring every five minutes. During these attacks, which may be regarded as epileptoid, clonic contractions appear on the right side, particularly involving the right arm; the head is drawn backward and is rigid. During these paroxysms the patient is not in an unconscious condition, nevertheless the mental faculties are somewhat blunted. Movements of the orbits, general convulsions, tonic and clonic, and paresis of the sphincters are wanting. The mother reports that the child complains frequently of headaches, during the night is restless, and sleep is much disturbed. During the past week the child has become quiet and apathetic. The mother also relates that four children have died of similar attacks.

Status Præsens.—The child is in a state of apathy, paying no attention to surrounding objects; is indifferent during the examination. The head is easily moved; no rigidity at the back of the neck. The movements of the eyeballs are normal; the pupils react readily, and show no difference in their size. An examination of the fundus of the eye was not undertaken. The tongue is protruded easily, shows no deviation, shows no appearance of scars either recent or former. The face shows no dissimilarity of the two sides. An examination of the extremities reveals no paresis or paralysis. The general sensibility is not affected.

The child, in attempting to walk, shows a staggering gait, with a tendency to fall backward, so that it is impossible to make any progress without support. The reflexes are all normal.

An examination of the lungs shows consolidation in both upper lobes, with fine bronchial râles.

The heart sounds are distinct; no murmurs appreciable. The pulse is not retarded. The examination of the remaining organs gives a negative result.

The diagnosis is that of an affection of the brain—or the cerebellum—based upon the epileptoid convulsions, headaches, staggering gait, dizziness, nocturnal cries, and semi-comatose condition. With reference to the age, constitution, and condition of the lungs it is plausible to infer that the affection is of a tubercular nature.

Ten days later death occurred, and the report of the autopsy is as follows:

The body gracile, emaciated; shows a slight amount of rigor mortis. The cranium is easily removed; no adhesions of the dura. The dura presents nothing of interest. The pia is clear, easily removed; no adhesions to the cortex. Blood-vessels are not engorged.

In attempting to remove the brain from the cranium the left hemisphere of the cerebellum offers resistance, being firmly adherent to the dura. By using some force the adhesions are overcome, but there remains attached to the dura a round, somewhat regular mass of about the size of a hazelnut. The left hemisphere of the cerebellum shows a cavity with irregular walls, corresponding to the tumor attached to the dura.

The cerebrum presents a smooth surface, with no perceptible resistance. Cross sections reveal nothing abnormal. The surface of the cerebellum shows, with the exception of the cavity above referred to, nothing abnormal. A closer examination, however, reveals distinctly the presence of six round, hard tumors, the size varying from a bean to a hazelnut, and a number of smaller ones less distinct in the substance of the cerebellum. Cross sections show the tumors to be distributed in the superior and inferior vermiform processes and the inferior lobes of the right and left hemispheres.

A section of the tumors shows them to be grayish white, of a distinct concentric formation. The centre shows a soft, degenerated caseous mass. The surrounding tissues are œdematous.

The examination of the thoracic cavity reveals the pleura pulmonalis covered with numerous yellowish points of about the size of a pin's head. Sections through the lungs reveal in great number the same deposits. The mediastinal glands are swollen

and present the same caseous consistence as the tumors in the cerebellum. The heart shows nothing abnormal.

By request of the parents, the examination was limited to the cranial and thoracic cavities.

Anatomical Diagnosis.—Miliary tuberculosis, especially characterized by the formation of tubercular deposits in the cerebellum.

The nodule to which I will pay special attention is a tumor having the size and form of a hazelnut, with a diameter of ten millimetres. It is situated in the inferior-posterior lobe of the right hemisphere, occupying the greater portion of this lobe. A longitudinal section through cerebellum and nodule shows it to extend upward into the region of the corpus dentatum. The grayish coloration of its external layers permits it to be easily separated from the surrounding tissue, while its centre presents two large, opaque caseous masses surrounded by an amorphous structure not possessing the caseous character of the former, being less opaque and of a greater consistence. The central masses are surrounded by a zone having a concentric laminated structure of a light-gray color. The transition into the normal tissues of the cerebellum is not a sharp one, the gray coloration of the external zone of the nodule gradually disappearing. During the section-cutting the nodule shows the following microscopic changes: Gradually diminishing in size, and in the centre several small, opaque, irregular masses appear. Laterally another group of small nodules appear, increasing in size gradually, conglomerating, forming a new nodule laterally and posterior to the one first described. The lobus inferior posterior of the right hemisphere, therefore, possesses two tumors of about equal size;

FIG. 1.—Case I (natural size).—*nd*, nucleus dentatus; 2, lobus cuneiformis; 3, 4, lobus posterior inferior, with nodule; 5, lobus posterior superior; 6, 7, 8, lobus lunatus posterior.

the one situated mesad and anteriorly, the other laterally and posteriorly.

Case II. *Clinical Diagnosis: Neoplasm of the Right Lobe of Cerebellum; Autopsy; Anatomical Diagnosis: Cyst of Right Lobe of Cerebellum.*—For the history of this case and the pleasure of having made the observation I am indebted to my friend Dr. Linus T. McAdam, of Buffalo, N. Y.

Jacob M., aged thirty-six years; height, five feet seven inches; weight, a hundred and seventy pounds; complexion, fair; constitution, robust; well developed. Antecedents, nothing of particular note was elicited; family history good.

Early History.—The patient passed through infancy and adolescence without any serious illness; never contracted syphilis or gonorrhœa. Some years ago he suffered a slight attack of insolation from which, however, he seemed to have fully recovered.

Present Condition.—On October 23, 1892, the patient consulted Dr. McAdam for pain in the back of the head, dizziness, nausea, peculiar revolving sensations in his head, and on standing or while walking an inclination to be drawn backward. So strong were these last sensations that while the patient was in bed he would be compelled to turn on his right side, his head deep in the pillow, or while working in a stooped position he would suddenly fall backward, and on several occasions received quite severe knocks on his head. Along with these symptoms there coexisted a subnormal temperature, slow pulse, furred tongue, loss of appetite, sallow complexion, discoloration of the conjunctivæ, and constipation. The patient was given hepatic stimulants, but without obtaining any alleviation of the distressing symptoms. A few days after this first visit he again consulted his physician, and complained of great thirst and gave a history of polyuria. On examination, the urine was found to contain sugar in abundance, and on measuring the urine it was found that he passed sixty to seventy ounces daily. About this time (November 7, 1892) he experienced considerable difficulty in walking, and was obliged to discontinue all work and remain at home. With assistance he was still able to walk about the

house, but his gait was unsteady, staggering, with a marked tendency to fall backward and to the right.

With the exception of the glycosuria and polyuria, which subsided under careful treatment, the remaining symptoms gradually became more and more severe, and a consultation was held. The disease was diagnosticated as of cranial origin, but no definite diagnosis was reached. All methods of treatment proving unavailing, and, Dr. McAdam being desirous of further counsel, the writer was called to see the case on January 17, 1893, with his family physician.

The patient was found lying upon a couch, complaining of intense occipital pains radiating toward the vertex. On sitting up he felt dizzy, nauseated, and as if his head were being pulled backward. On attempting to walk his gait was staggering, with a desire to fall to the right and backward, and on walking across the room with assistance he would continually veer to the right.

Psyche.—His mind seemed to be clear and unaffected; sleep, fair.

Motility.—The strength of the muscles of the extremities was diminished, but no more than the inactivity to which he was subjected would warrant; the muscles of the right side were, however, weaker than those of the left.

Tendon Reflexes.—The patellar tendon reflexes were slightly exaggerated. Other superficial and deep reflexes were normal.

Sensation.—There existed no disturbance of the sensory nerves; trophic and vaso-motor disturbances were likewise wanting.

Special Senses.—Unfortunately, the fundus of the eye was not examined, due perhaps to the fact that no ophthalmoscope was at hand. An ophthalmoscopic examination was, however, promised, but failed eventually to be performed. No abnormities whatever of the special senses were discernible; no loss of sexual power was admitted.

To me it seemed clear that we had to deal with some cerebellar neoplasm, but what its nature or origin I could not say. The characteristic symptoms of cranial tumor—such as intense cranial pain, obstinate vomiting, vertigo, coupled with symp-

toms which we are wont to denominate cerebellar, as staggering, ataxic gait, inclination to fall backward, occipital tenderness, etc.—warranted the diagnosis arrived at.

Not receiving the desired promise of speedy and certain recovery, the patient sought other advice, and the history of the course of the disease was unfortunately interrupted. On the evening of March 15, Dr. McAdam was hastily called, and arrived in time to see the fatal termination. Inquiry elicited the fact that for two or three weeks previous the patient had been attacked with a slight fever with occasional chills. No convulsions had been noticed at any time.

An autopsy was made on the following day by the writer, assisted by Dr. McAdam, with the following results: The cal-

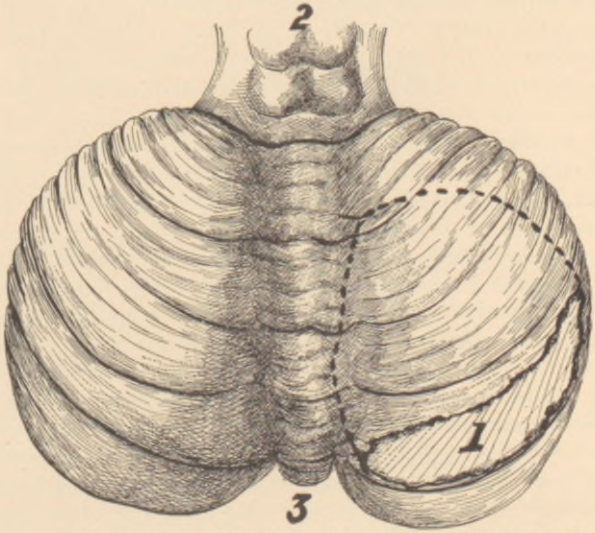

FIG. 2, Case II.—1, opening of cyst cavity (the dotted line shows the size of the cyst); 2, the corpora quadrigemina; 3, the vermis.

varium was rather thick, dura somewhat adherent. The pia was clear; vessels not markedly injected; Pacchionian bodies

small and sparse. The convexity of the brain appeared healthy, the convolutions were not flattened, and the fissures were of usual depth. The cerebrum was removed; beginning cephalad, the basilar structures were carefully severed, and, on cutting the right side of the tentorium cerebelli, a clear, amber-colored fluid flowed into the cerebral cavity. The cerebellum was carefully removed, and in the inferior-occipital fossæ was found about an ounce to an ounce and a half of amber-colored fluid. On closer examination the right lobe of the cerebellum was found to be flattened, boggy, and considerably smaller than the left lobe. This condition was quickly explained by the presence of a large cavity in the right lobe, the walls of which had collapsed, and the fluid had escaped during the removal of the cerebellum. The entire right lobe appeared to have been undermined, and virtually was nothing more than the walls of the cyst. During the dissection and examination of the cerebellum the undertaker thoughtfully and thoughtlessly sponged the cranial cavity, thus depriving us of any of the cystic fluid for a more careful microscopic examination. It is therefore impossible to say just what the character of the cyst was: whether it was the result of hydatid disease, or of inflammatory or hæmorrhagic origin.

Case III. *Clinical Diagnosis: Abscess of Left Lobe of Cerebellum; Autopsy; Anatomical Diagnosis: Abscess of Left Lobe of Cerebellum.*—S. S., aged forty-two years, kindly referred to me by Dr. C. W. Bourne, of Hamburg, N. Y.; height, five feet five inches; weight, two hundred and eleven pounds; constitution strong, healthy; complexion dark; married and father of children; occupation, salesman; family history shows no trace of any hereditary or constitutional disease.

Early History.—When four years old he had an attack of brain fever and was sick ten days; otherwise he has always been a healthy, robust man, of good habits, moderate in his appetites, ambitious, striving to attain success in everything he undertook.

During the latter part of November, 1893, he slipped on an icy sidewalk and struck on the back of his head. He complained of a numb feeling, but did not experience much pain. It only made his head "feel queer," as he stated, and in a few

days he felt no further effects of the fall. The following week he was taken sick with the "*grippe*," according to his family physician. He complained of a general malaise, drowsiness, dizziness, pain in the ears, but no otorrhœa. He was not confined to his bed, but did not leave the house for two weeks. He returned to his work, but after a week's trial was compelled to abandon it because of the ear trouble, which caused him much pain and dizziness. He experienced a dull, heavy feeling just back of the ears—would tire easily.

About February 1, 1894, he again resumed his work, and soon thereafter had a second fall on an icy sidewalk, striking the back of his head with considerable force. He was stunned for a few moments and complained of much pain about the occiput. After treating the head with liniments and applications for a few days, he was once more able to go on the road. On March 17, 1894, he complained for the first time of a severe headache at the back of the head, and referred to it as "just as if something were trying to burst his head open." The pain was excruciating, its greatest intensity being over the left occipital region. Pressure upon the occiput alone would relieve it. About midnight of the same day he began to vomit, apparently on the least exertion, without any warning; no nausea, and the vomited material would be forced from his mouth (projectile vomiting). He was unable to retain anything on his stomach, expelling it immediately, and vomited much watery fluid. The least movement of his head or body would precipitate a spell of vomiting. He complained of much dizziness and vertigo. His gait was staggering, loggy, and he could not rise from the chair alone because of the dizziness and inclination to fall backward. His condition grew gradually worse, and in a few days he was unable to leave his bed. His head would be drawn down into the pillows, and he seemed to have lost the power over the movements of the head. I was summoned to see him in consultation with his family physician on March 29, 1894, and found the *status præsens* as follows:

A strong, well-nourished, heavily built man of about forty years of age, lying upon a bed with his head drawn backward, the posture of spinal meningitis. On hearing the history of

vomiting, localized headache, dizziness, associated with a fall, the backward displacement of the head, I surmised some cerebral disorder. His mind was at times clear—always clear, the family reported; but to me he appeared semi-conscious, would reply tardily to questions put to him, and made considerable effort to make known his wants.

Motility, although impaired somewhat by the long sickness and inability to retain food, was not limited to any special extremity or side; face and tongue were regular on both sides; eyeballs moved lazily; pupils dilated and responded to light. The eyes were dull and heavy. I did not carry an ophthalmoscope with me and so unfortunately could not examine the optic discs.

The tendon and muscular reflexes were exaggerated. Patellar reflexes considerably increased, but no definite ankle-clonus. Apparently no disorders of sensation, although the semi-stupor which he was in may have influenced this examination. He evinced great pain when the head was turned or when the occiput was percussed, but did not feel any other painful sensations.

Pulse was full, regular, uniform, ranging from 78 to 85 per minute.

Temperature, 98·7° F.

Urine contained neither sugar nor albumin and was not increased in quantity.

Bladder and rectum performed their functions normally, and up to March 17, 1894, there was no change in his sexual power.

My suspicions of a cerebral growth were satisfied, and taking into consideration the fall on the occiput, with a history of a preceding attack of *grippe*, I ventured the diagnosis of *cerebellar abscess*. He was in no condition for an operation and palliative measures were resorted to.

A troublesome hiccough set in a few days after my visit, also a paresis of the left arm and leg; both of these symptoms increasing in severity from day to day.

Incontinence of urine, necessitating catheterism, and constipation also made their appearance. He was conscious up to the last, and at intervals would make inquiries about local

affairs. On awakening from sleep he would be flighty for a few seconds, then would be calm and composed.

He died on April 11, 1894, and on the following day I was telegraphed for to perform an autopsy.

The head only was examined, as it was deemed unnecessary to make a complete examination.

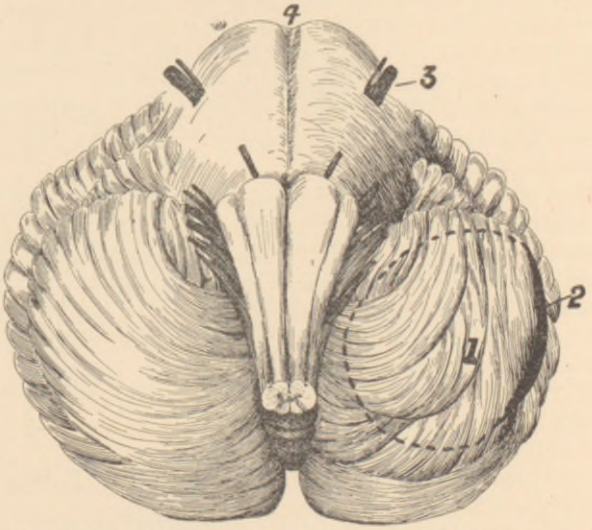

FIG. 3, Case III.—1, abscess, denoted by the dotted line; 2, opening of the abscess; 3, trigeminus nerve; 4, pons.

The scalp was quite thick and bound quite firmly to the skull. No hæmorrhages or discolorations could be detected over the occipital region, the result of the previous falls.

The calvaria was somewhat thicker than normal; not adherent to the dura. The sinuses were engorged with venous blood, and the pial vessels were markedly injected, but not abnormally so. The pia was easily removable; there were no opacities, and the Pacchionian bodies were not enlarged.

The cerebro-spinal fluid was clear, amber-colored, and of the usual quantity. The cerebrum was carefully removed from the

fossa, and on cutting the tentorium and attempting to roll out the cerebellum so as to cut the spinal cord, a thick, creamy fluid burst through the lateral walls of the left cerebellar hemisphere.

The brain was carefully placed on a platter and sections cut through the cerebrum, longitudinally and transversely. A small quantity of fluid was found in the lateral ventricles; no hæmorrhages, no inflammatory conditions, and no diseased condition of the cerebral arteries could be detected. The cerebellum, however, was of more interest.

The right side was firm and elastic to the touch, while the left hemisphere was boggy, and on the slightest pressure a thick, creamy pus exuded from a large longitudinal opening in the lateral wall of the lateral lobe. The opening was perhaps one inch in length, and opened into an irregular cavity about the size of a small hen's egg. The walls of the abscess cavity were roughened, irregular, and had a reddish hæmorrhagic appearance indicative of a former congestion or capillary hæmorrhage. The pus was not examined bacteriologically and its bacterial contents can not therefore be given.

Analyzing this case briefly, we find present the three cardinal symptoms of brain disease: localized headache of the bursting variety, dizziness, and cerebral vomiting—*i. e.*, vomiting without nausea, without warning, and forced from the mouth (projectile). The other cardinal symptom of brain disease—tumor, choked disc, or optic neuritis—was unfortunately not sought for, and must therefore be left out of consideration.

The history of two severe falls upon the occiput, with symptoms of pain and numbness for a few days following, the staggering gait, tenderness and rigidity of the neck muscles, with head drawn backward, pointed to some cerebellar affection.

The gradual implication of the left side of the body, semiparesis, consciousness up to the end, and the behavior of the reflexes, strengthened the theory of cerebellar disease. The diagnosis of abscess was made upon the theory that as, prior to the falls, he had been sick with an infectious disease, and as septic processes are liable to be lighted up consequent to such injury, the idea of abscess seemed to me both plausible and pos-

sible. Trauma is recognized as one of the most prolific ætiological factors of brain abscess, the shock seeming to tear and bruise the tissues directly under the seat of injury, causing hæmorrhage, inflammation, disintegration, and finally necrosis of the nerve elements. The presence of pyogenic bacteria in the system, and the cordial invitation which such a focus of softening and dissolution extends to the gallant germs, results in the speedy formation of a suppurating abscess.

Case IV. *Clinical Diagnosis: Tuberculosis; or else Abscess of Cerebellum.*—L. L., female, unmarried, aged twenty-three years; height, five feet four inches and a half; weight, one hundred and twenty-four pounds; complexion, dark; constitution, delicate.

Antecedents.—Father and mother both living and healthy, aged forty-six and thirty-eight years respectively; three brothers and two sisters likewise healthy.

Paternal grandparents: Grandfather living and healthy, aged seventy-four; grandmother died of typhoid fever, aged sixty-one years.

Maternal grandparents: Grandfather died of paralysis, aged seventy-two; grandmother died of cirrhosis of the liver, aged fifty-seven years.

No history of tuberculosis among near or distant relatives could be elicited.

Early History.—When a child she had measles, chicken-pox, diphtheria, scarlet fever, and malarial fever. When nine years of age she fell over suddenly and injured her back, a large bunch appearing over the lumbar region a little to the right of the spinous processes. She was unconscious for twenty-four hours, and suffered great pain. Curvature of the spine developed, and for a year she was unable to walk about. Was vaccinated when fourteen years old, and immediately her back grew worse, the deformity increasing until a right scoliosis was well marked. She wore braces for some time and improved in general health, so that the spinal irregularity was scarcely noticeable. When nineteen years of age she had a severe attack of pneumonia, and every winter since then has had heavy colds with cough, expectoration, symptoms of fever, and periods

of extreme weakness. At the same time she began to notice a dull, heavy ache over the occiput extending down the spine, accompanied with vomiting spells and dizziness; was taken with fever which ended suddenly, and began to improve and increase in weight (winter of 1891). The following winter she again had the occipital headaches, but without vomiting or dizziness. In January and February, 1893, the same familiar headaches reappeared and as quickly subsided, leaving her in comparatively good health for the remainder of that year. On July 4, 1893, she weighed one hundred and thirty-six pounds. The week before Christmas of 1893 she was taken with a slight attack of the then prevalent *grippe*.

Her present sickness she dates back to January 1, 1894, when, without any warning whatever, she would vomit forcibly a watery, stringy fluid. She narrates that while going through the figures of a quadrille one evening in January, 1894, a convulsive act of vomiting overtook her on the dancing floor. Headaches, confined mostly to the occipital region and extending down the spine to the middle of the back, made their appearance, sharp and piercing at first, then would gradually wear away. Along with the headaches she would have dizzy, staggering spells, and on rising from a chair would feel like falling backward. On walking she would constantly pitch to the left side, and would put out her left hand to save herself. On several occasions her left knee and leg would give way, precipitating her to the ground. Accompanying these symptoms she would experience, two or three times daily, a feeling of extreme heat come over her which would be followed by light chills. Her face would redden, flush, perspiration would break out, and in a short time she would complain of the room being too cold. The headaches, vomiting, and vertigo growing more intense, she was referred to me by Dr. C. C. Frederick on April 21, 1894, for special treatment.

Status Præsens.—April 21, 1894, I found her a fairly well developed, bright, intelligent, and active girl, with no indications of any mental disturbance.

Head.—Not painful on percussion except over the occiput, and when pressure is exerted over the left occipital region she

complains of severe pain, just as if something were crushing her head, or as if the back of her head were falling out. Her hair, which is long and beautiful, is coming out rapidly, and many gray hairs have appeared within the past year. Her face when she entered the office was cold, pale, and anæmic, and before leaving it was hot, flushed, and feverish.

Eyes.—No disturbances of motility, but when they are fixed to the right or left she experiences a pain over the occiput. Pupils react to light and accommodation, and are dilated. No nystagmus and no appearance of any optic neuritis (choked disc).

Ears.—A buzzing noise has been heard at times, and she has sometimes experienced an itchy feeling in both ears. No deafness.

Nose and Mouth.—Nothing abnormal about the sense of smell or taste. The tongue protrudes without deviation and is not coated.

Appetite poor.

Motility.—A staggering, uncertain gait is manifest, and her mother reports an inclination of wheeling to the left, and has repeatedly chided her for the unladylike way in which she walks. Standing with her eyes closed, she tends to fall backward. Inco-ordination of the hands or legs can not be detected.

Right-hand grip, as measured with the dynamometer, 50; left, 48. Muscles are rather flabby.

Sensation.—No distinct abnormities of sensation can be detected.

Reflexes.—Somewhat, though slightly, increased, especially the patellar tendon; no ankle-clonus. Superficial reflexes not exaggerated.

Internal Organs.—Heart and lungs appear undisturbed. Pulse, 80, regular and uniform; temperature, 37·8° C.

Bowels regular. Urine, high specific gravity; no albumin, but shows presence of sugar.

General Symptoms.—She sleeps very poorly because of the pulsation in her head. When she turns over she feels as if something heavy had turned over in her head with a thump.

Menses irregular; flows profusely for eight or nine days. She has lost much in weight since January 1, 1894, her clothes all becoming too loose and baggy. Her hands and feet are generally very cold and covered with cold perspiration, and yet her face will be hot and flushed.

The severe headaches, projectile vomiting, and vertigo, along with occipital pain and tenderness, inclination to fall backward, and of veering to the left, the sudden giving way of the left leg, ataxic gait, with general sensibility and reflexes but little if at all disturbed, indicated some cerebellar growth, seated in all probability in the left lobe. The slow growth, previous history of the patient, and fever phenomena suggested to me the presence of a tubercular nodule undergoing softening and disintegration.

Without disclosing my diagnosis to the patient or her parents, I put her on a palliative and constructive treatment, which seemed to relieve and benefit her for about five weeks. The symptoms became suddenly more severe, and feeling pretty confident that if an operation could be secured an abscess cavity would be found, I entreated the parents to yield to what seemed the only procedure that would offer any hope of saving the daughter's life. Consent was obtained provided the operation would not be performed unless it was reasonably certain that it would bring relief, and the patient was transferred to the Sisters of Charity Hospital. A thorough examination made June 19, 1894, revealed the following additional facts:

She feels as if her chin were being elevated and the head drawn backward. At night the head digs deep into the pillows. Pressure over the occiput provokes a feeling of nausea.

Sensation.—Some slight disturbances of sensation have presented themselves, as delayed sensation over the forehead and areas of hyperæsthesia about the face and hands, which perhaps arise from the state of mind occasioned by her surroundings. Her eyes were tested to-day by Dr. A. A. Hubbell, whose report is here appended:

"R. and L. hypermetropia, 0·75 D.; no optic neuritis; esophoria, 3°; abduction, 8°; adduction, 25°, one trial, which can

be brought up to 40° or 45°. There is nothing here to account for symptoms."

Measurements of the arms and legs give the following results:

Circumference of left arm:	Distance from internal condyle of humerus:	Circumference of right arm:
9 inches.	9 inches.	9 inches.
8½ "	6 "	8⅝ "
8¼ "	3 "	8⅜ "
Left forearm:		Right forearm:
8 inches.	3 inches.	8 inches.
6⅞ "	6 "	6¾ "
5½ "	9 "	5⅝ "

Circumference of left thigh:	Distance from internal condyle of femur:	Circumference of right thigh:
15⅝ inches.	6 inches.	15⅝ inches.
13⅝ "	3 "	14 "
Left leg:		Right leg:
12⅜ inches.	3 inches.	12⅝ inches.
12⅛ "	6 "	13⅛ "
12⅜ "	9 "	13 "

Strength of hands: Right, 40; left, 40. The strength of the legs, as measured with the pedo-dynamometer, shows: Right leg, 30; left, 36.

The temperature has ranged from 38·5° C. to 40° C. Pulse, 70 to 85 a minute. Urine shows now no trace of sugar.

The surgeon in charge, Dr. H. Mynter, desired to keep her in the hospital for a few days before operating and to watch her closely, so that in case she should fail rapidly an operation could be performed at once. To our surprise, instead of failing she seemed to improve, the vomiting was less frequent, the head less painful, appetite improved, the fever symptoms were less marked, and her general health was gaining. Encouraged by this change in her symptoms, the parents removed her to their home and all thoughts of any operation are now relegated to dreamland.

My diagnosis and mode of relief, so nicely planned and specified, have provoked some twitting remarks, but neverthe-

less I am positive that the diagnosis was correct, and the operation would have sustained me.

I have seen the patient several times since she left the hospital, and still find left occipital tenderness, unsteadiness of gait, vomiting and vertigo. Her general physical condition is below par; she is pale, anæmic, and still complains of feelings of heat and cold.

I have at no time observed any manifestation of hysteria or any type of malarial fever, and am confident that her cerebellum harbors a latent tubercular nodule.

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