SENSORY DISTURBANCES OF CEREBRAL ORIGIN

CONSIDERATION OF TYPES AND OF DIAGNOSTIC ELEMENTS *

ALFRED GORDON, M.D.

PHILADELPHIA

The character of sensory disturbances caused by cerebral lesions has always been a subject of considerable scientific interest because of its importance from the standpoint of localization. In one of my former studies¹ an attempt was made to investigate cerebral sensory disorders from an extensive clinical material. Although some of the conclusions reached then did not coincide with those of some workers in the same field, nevertheless the facts observed were sufficiently suggestive to question the views of those writers who considered their conclusions as definitely established.

Throughout the present work it has been my aim to approach the problem of sensory disturbances of cerebral origin on an anatomic basis. In order to be able to draw more stable conclusions, I submitted my patients, during several years of observation, to a rigorously uniform investigation. That is, every one of the patients was examined and reexamined repeatedly by the same methods and same procedures with regard to all forms of superficial and deep sensibilities. Every one of the cases came to necropsy. The uniformity of investigation was so strictly observed that some definite diagnostic inferences are permissible.

The forms of sensations which I have investigated are tactile sensibility, the sense of superficial pain, the thermic sense, the power of localization, the muscular sense, especially in passive movements, the sense of weight, the spacing sense, orientation sense, and stereognostic sense.

Tactile sensation was tested with absorbent cotton, which, in my judgment, is the best of all methods, as it enables one to detect the least impairment. The sense of pain was tested with my precision esthesiometer.² The thermic sense was tested with extreme heat and cold, usually very hot water and ice. The power of localization was tested by having the patient tell the spot touched while his eyes were closed (naming procedure) or by having him point out the touched spot after his eyes had been closed during the touching and after the impress made on the skin had disappeared (looking procedure). The

* Submitted for publication July 3, 1916.

1. Gordon, A.: *Jour. Nerv. and Ment. Dis.*, March, 1903, xxx, 144.

2. Gordon, A.: *Jour. Am. Med. Assn.*, 1909, lli, 1257.

muscular sense was tested only for passive movements. The patient's eyes being closed, extension, flexion and rotation of each segment of the fingers, of the arm, forearm, thigh, leg and foot were performed. The orientation sense was tested either with the finger-to-nose movements or with the Blix method. The latter consists of the following procedure: The patient is either sitting or standing, with his back against an immovable object. With a pencil in the hand to be examined, he touches a mark made on paper, which is placed in front of him. This is repeated several times with open and with closed eyes. The pencil leaves a mark each time it touches the paper. The distance between these marks and the fixed point will determine the degree of the error. The spacing test consists of touching with two points of the compass or with one point after another in close succession. In the first case the distance between the two points will determine the degree of ability or inability to recognize two points. In the second case, while one point is in contact with the skin, the other is rapidly brought down on the skin. The appreciation of a double contact is thus determined. The sense of weight was determined by placing light and heavy objects on the parts of the body to be examined. Cork, pieces of lead and coins were the objects used and comparisons were drawn between the appreciation of various weights on the sound and affected sides. The stereognostic sense was tested by asking the patient to recognize the form, consistence, also the material of which objects placed in the hand were made, finally the nature and their names. The same kind and number of objects were used in all the nine cases.

CASE REPORTS

CASE 1.—A man, aged 43, gave a negative Wassermann reaction. At necropsy a tumor was found (mixed cell sarcoma) in the left basal ganglia (Fig. 1). There had been characteristic general symptoms of intracranial pressure, namely, persistent headache, vertigo, vomiting and later in the course of the disease optic neuritis. There was also a hemiparetic condition on the right side, with an increased knee-jerk and doubtful Babinski, but a certain paradoxical reflex on the same side. Objective sensations on the affected side showed marked diminution of sensibility to touch, but pain and temperature senses presented an interesting peculiarity. If with a pin one attempted to provoke pain, the response of the patient was entirely out of proportion to the degree of stimulation. The reaction was excessive, the patient flinched considerably and complained of much pain. When a similar stimulus was used on the other side, the response was by far less marked. If, on the other hand, a mildly warm object was applied to the paretic side, a very pleasurable sensation was experienced by the patient on the tested surface. If a cold object was applied, the patient complained of a very disagreeable sensation. It was therefore evident that in spite of the affected side being anesthetic, there was hyperreaction to the sense of pain and temperature.

The deep sensibilities were markedly affected and among them especially posture, passive movements and pressure. The position in which various portions of the right arm and leg were placed was not recognized correctly by the patient; gross errors were made. Passive movements with the arm and legs

were also not accurately executed. Weights placed on the arm and leg were equally not correctly recognized. Astereognosis was also present in the right hand, probably because of the defect in the other deep sensibilities.

Subjectively, the patient complained of a constant pain in the right arm and leg, which was so persistent that it would not yield to the usual remedies. At times the pain was sharp and lancinating in character. To sum up, there was the "syndrome thalamique," such as described originally by Dejerine.

Fig. 1.—Tumor of left basal ganglia (Case 1).

CASE 2.—A man, aged 38, a laborer, gave a negative Wassermann reaction. At necropsy (Fig. 2) softening of the entire left internal capsule, including its very posterior portion, also of the lenticular and caudate nuclei and of the adjacent portion of the optic thalamus. During life there was a total right hemiplegia, with aphasia, and conjugate deviation of head and eyes to the left.

There was a distinct diminution of the cutaneous sensibility to touch, pain and temperature over the entire paralyzed side. This condition was present not only shortly after the apoplectic insult, but also before the patient died. It is interesting to observe that the sense of pain was more affected than

the sense of touch and temperature, and this was alike over both arm and leg, while on the paralyzed side of the face all three superficial sensations were equally but slightly involved. The deep sensibilities were not involved, with the exception of the muscular sense, which was only slightly impaired. When one or two fingers or the entire hand of the paralyzed side were placed in a certain position, the patient sometimes (not always) made errors. When told of the error he soon corrected it. The involvement of the muscular

Fig. 2.—Softening of entire left internal capsule (Case 2).

sense was only distal, as this sense for the forearm, arm and shoulder remained intact. All other deep sensibilities, including the stereognostic sense, were normal. In view of the destruction of the carrefour sensitif in this patient, it is interesting to note that there was no contraction of the visual field or amblyopia on the affected side.

CASE 3.—A man, 44 years of age, gave a negative Wassermann reaction. At necropsy there was found a gliomatous tumor in the left hemisphere,

involving the supramarginal gyrus, angular gyrus and the posterior third of the first and the second temporal convolutions, also a very small portion of the occipital lobe. On section the mass was shown to extend posteriorly into the occipital lobe and mesially as far as the posterior cornu of the lateral ventricle. The very posterior portion of the internal capsule and the corona radiata were involved by the tumor (Figs. 3 and 4).

Fig. 3.—Glioma in left hemisphere, involving supramarginal gyrus, angular gyrus, posterior third of the first and the second temporal convolutions (Case 3).

During life the patient presented verbal amnesia, alexia, paraphasia and paragraphia, also retinal hemorrhages with choked disk. The motor power and reflexes were normal and equal on both sides.

Fig. 4.—Same as Figure 3.

Sensations, superficial as well as deep, were normal on both sides during the entire time of the patient's illness. At no time was astereognosis observed. The destruction of the posterior portion of the internal capsule did not produce sensory disturbances. It is also significant that in spite of the marked involvement of the inferior half of the parietal lobe and in spite of consider-

able pressure on the upper portion of this lobe, the stereognostic sense was not disturbed.

CASE 4.—A boy, 16 years of age, died from a tumor (round-cell sarcoma) wedged in between the frontal lobe and the insula of the left hemisphere and extending into the lateral ventricle in its anterior and lateral horns, compressing, displacing and destroying largely the surrounding tissue. Among the latter the lowest portions of the ascending frontal and parietal convolutions suffered considerably (Fig. 5).

Fig. 5.—Tumor (round-cell sarcoma) wedged in between the left frontal insula and the temporal lobes, penetrating the lateral ventricle (Case 4).

During life the patient presented headache, vomiting, vertigo, choked disk in both eyes, loss of knee-jerks and Achilles tendon reflexes on both sides, but Babinski and paradoxical reflexes were present on the right side. The face was slightly deviated to the left, and with this exception there was no paralysis or paresis on the right side.

On the entire right side there was a diminution of superficial sensations of all three forms, namely, touch, pain and temperature. There was no astereognosis or any other disturbance of the deep sensibilities.

CASE 5.—A man, 38 years of age, had a history of syphilis at the age of 23. Necropsy showed softening of the entire left internal capsule, lenticular nucleus, head and tail of caudate nucleus and the external capsule. The left optic thalamus was much paler than the right, and the part of it adjacent to the capsule also was softened (Fig. 6).

Fig. 6.—Softening of the entire left internal capsule (Case 5).

During life the patient presented a right hemiplegia with all the typical symptoms. Besides a partial alexia and partial verbal amnesia, which will not be described here, there was a decidedly marked diminution of sensations for touch, pain and temperature, also for localization. It is interesting to note that the pain sense was more involved than the touch and temperature senses, that the decrease of all sensations was more marked in the hand and foot than in the forearm and leg, and that in the latter two the diminished

sensibility was more pronounced than in the arm and thigh. The latter condition was parallel with the degree of loss of motor power in the corresponding segments of the affected limbs. The disturbance of the localization was more marked in the foot than in the hand, but an irregularity of this sensation was observed in the other parts of the right side. Thus, a touch on the right cheek was referred by the patient to the trunk, and a touch on the leg to the upper part of the thigh. Evidently the direction of pointing by the patient was toward the least-affected sensation.

Fig. 7.—Tumor of hypophysis; crura compressed; pons and medulla displaced (Case 6).

It is also interesting to observe that in spite of the destruction of the very posterior portion of the internal capsule the visual fields were not contracted, there was no amblyopia and no other special sense was involved.

CASE 6.—A man, 31 years of age, had a diagnosis made of tumor of the pituitary body. The postmortem findings showed a large vascular tumor at the base of the brain extending backward as far as the foramen magnum and

forward to the sphenoidal fissure. The tumor consisted of two portions, the anterior being the smaller, the posterior the larger. Both covered the basal portion of the brain between the orbital lobes and the pons in the middle line. It pressed backward and disfigured enormously the pons and the structure of the posterior portion of the medulla, which could be seen also on microscopic sections. The crura cerebri were compressed and deformed. Microscopic sections showed, besides the angiosarcomatous character of the

Fig. 8.—Extensive hemorrhage over right parietal lobe (Case 7).

hypophysis, also a unilateral involvement of the pyramidal tract below the cerebral peduncles and spinal cord, but not in the internal capsule. In the posterior portion of the medulla and pons all the elements were hardly distinguishable; they were displaced and deformed (Fig. 7).

The patient showed a clinical history of headache and vertigo, right exophthalmia, bitemporal hemianopsia, optic atrophy in left eye and optic neuritis in the right eye, attacks of unconsciousness, glycosuria, obesity, and infantile genitalia. Gradually a left descending hemiplegia developed and convulsive

attacks made their appearance on the paralyzed side. Soon difficulty of swallowing set in.

On the left side there was a sensory dissociation of almost syringomyelic type. The tactile sense was very slightly diminished, but the sense of pain was totally abolished. The senses of heat and cold were also dissociated, the sense of cold being entirely absent, so that ice felt warm while extreme heat was taken for tepid. Astereognosis was present in the left hand, patient

Fig. 9.—Extensive hemorrhage over right frontal lobe, encroaching on both rolandic convolutions (Case 8).

being unable to recognize the nature, shape and consistence of objects. Localization and pressure were but slightly involved. The above-mentioned diminution of the tactile sense was parallel with the loss of motor power, which was more marked in the distal than in the proximal segments of the limb and gradually decreased in intensity from the former toward the latter.

CASE 7.—A boy, aged 17, with a diagnosis of cortical hemorrhage following trauma, came to necropsy. There was a large hemorrhage over the parietal

region of the right hemisphere. The overlying portion of the meninges was thickened (Fig. 8).

The clinical history showed that the boy fell down from a third story window. He was unconscious for five hours. There was no bleeding from the facial cavities. He was found lying on his right side. Twelve hours later, when consciousness had totally returned, he was examined. There was a slightly paretic condition of the left leg and arm, more of the first than of the latter. The left knee-jerk was slightly more marked than the right and the paradoxical sign was distinct and easily obtainable on the left. The Babinski was absent.

Fig. 10.—Subdural abscess over right frontal lobe, encroaching on the rolandic convolutions (Case 9).

There was a slight hemianesthesia of the left arm and leg to touch, pain and temperature. The deep sensibilities were considerably involved. Astereognosis was absolute for the left hand. The patient was unable to recognize the nature, consistence, form and material of objects placed in the left hand. Localization was markedly deficient in the left arm, hand and entire leg. Passive and active movements were equally inaccurate in the left arm and leg. Pressure, position and compass measurement were also involved, but less than the other deep sensibilities. Ataxia was distinct in his left hand, which could be demonstrated by the finger-to-nose movements and by the Blix method. The patient refused to be operated on. During his five weeks of life several examinations were made and the above sensory disturbances were found unaltered. The patient gradually developed fever and died in coma.

CASE 8.—A man, aged 32, a fireman, was injured while on duty. He was unconscious and a diagnosis of intracranial pressure in the right sensorimotor area was made.

At necropsy a large hemorrhage was found at the level of the right frontal lobe, encroaching also on the lower portions of both rolandic convolutions (Fig. 9). The patient lived two weeks. Operation was refused. He was conscious for ten days. The symptoms observed were headache and a paretic condition of the left arm and face. There was no abnormal reflex in the left leg, but the biceps and triceps reflexes of the left arm were exaggerated. The left lower face was slightly deviated to the right.

The cutaneous sensibility to touch, pain and temperature was unaltered. A slight ataxia was present in the left hand, especially in the finger-to-nose movements. Pressure, localization and compass measurements were decidedly defective in the hand, wrist and lower half of the forearm. The patient died in coma.

CASE 9.—A girl, aged 16, died from septic cerebral thrombophlebitis (pneumococcus) and abscess following an operation.

At necropsy a subdural abscess was found over the entire frontal region of the right hemisphere, encroaching on the rolandic convolutions (Fig. 10).

During life following the attack of influenza the patient developed headache, rigors, a temperature of 105, rigidity of the neck, abscess of the right upper lid and evidences of frontal sinusitis. A paretic condition of the left face, arm and leg was evident.

The sensations of touch, pain and temperature were all very slightly diminished. The left arm was ataxic and dysergic which could easily be seen in the finger-to-nose movements. Astereognosis was absolute, the patient being unable to recognize not only the form, shape and consistence but also the nature of the most ordinary objects. Position and muscular sense were defective. Other deep sensibilities, namely localization, compass measurements and pressure were all intact.

ANALYSIS OF THE CASES

Sensory Disturbances from Cortical Lesions.—In Case 4 there was a tumor pressing considerably on the lowest portions of the left ascending frontal and parietal lobes. While there was no paralysis of the right arm and leg, nevertheless there was a slight deviation of the lower portion of the face toward the left and the toe phenomenon was present. As to sensations, only the superficial ones were diminished on the entire right side. Here is an example of simultaneous involvement of the motor and sensory areas. In Case 7 a cortical hemorrhage occupied the right parietal lobe, with the result that the superficial sensations were but slightly involved, but all the deep sensibilities were strikingly affected. Among the latter the stereognostic sense especially, also the localization, muscular and orientation senses were particularly affected. Pressure, position and spacing senses were also, but to a lesser degree, involved. In Case 8 there was a hemorrhage over the right frontal lobe encroaching also on the lower portions of both rolandic convolutions. The superficial sensations were intact. Among the deep sensibilities, orientation, position, pressure, localization and spacing senses were defective in the left hand, wrist and lower half of the forearm. In Case 9 there was a subdural abscess

over the right frontal lobe encroaching on the rolandic convolutions. The superficial sensations on the left toe were very slightly diminished. Among the deep sensations, astereognosis, ataxia and dysergia were all marked on the left side; appreciation of position and muscular sense were defective, but localization, spacing and pressure were all intact.

Analysis of sensory disturbances produced by cortical lesions in these four cases demonstrates the fact that the superficial sensibilities were but slightly involved (Cases 4, 7 and 9) or not at all (Case 8); that tactile, painful and thermic senses usually run parallel in occurrence and intensity. The deep sensibilities were most constantly and always markedly affected (Cases 7, 8 and 9). Only in Case 4, in which a tumor pressed on the very lowest portions of the rolandic convolutions, the deep sensations alone were not involved. In all the three cases in which the deep sensations were defective position and muscular sense were invariably involved. Localization was intact only in one case out of three. Evidently the localization test is not always dependent on the power of an affected limb. The spacing sense was involved in but two cases. It is interesting to note that this sense runs parallel with the localization sense. In Case 9 the localization and the spacing senses were equally unaffected, but in Cases 7 and 8 they were equally affected. Astereognosis was present in two out of three cases and in both cases it was present, together with defects of some other deep sensibilities.

In considering the cortical sensory disturbances in their relation to motor phenomena we observe that in Case 4 the tumor pressed on the lower portions of both rolandic areas. Hemihypoesthesia was present, but with the exception of the left face, arm and leg, there was no motor paralysis, although Babinski's sign was present. In Case 7 motor and sensory hemianesthesias were simultaneously present. In Case 8 a hemiparetic condition was accompanied by disturbances of deep sensibilities on the same side. In Case 9 motor and sensory disturbances, superficial and deep, were equally present on the same side. We consequently find that in two cases disturbed superficial sensibility accompanied motor disorders, that in one case deep sensibilities were involved, together with the motor power, and in one case the superficial sensations were disturbed in the arm and leg, which had no loss of motor function, but there was loss of sensory and motor functions in the face. The question arises, have these findings any bearing on the sensory-motor localizations in the cortex? Do they contradict or confirm the generally accepted present view regarding the separate functions of the two ascending convolutions? In Case 4 both convolutions were compressed in their lowest portions. The tumor, being wedged in between the frontal lobe and the insula, was

located nearer the precentral than the postcentral convolutions. In spite of this the cutaneous sensibility was more involved than the motor power; there was no paralysis of the arm and leg, but a total hemianesthesia. In Case 8, on the contrary, a hemorrhage over the frontal lobe encroached also on the lower portions of both rolandic convolutions, a hemiparetic condition coexisting, with impairment of the deep sensibilities. In Case 9 there was a similar pathologic condition and sensorimotor disturbances were present. In this case all forms of sensation were involved. In these three cases both ascending convolutions were involved, consequently the problem of separate functions of the central convolutions cannot be decided from these findings. But Case 7 stands isolated from this point of view. Pathologically we find a hemorrhage covering the right parietal lobe close to the ascending parietal convolution, consequently at a distance from the ascending frontal. Clinically there were present, besides disturbed deep sensibilities, also a hemiparesis and a hemianesthesia. Moreover, the degree of the loss of both kinds of function was parallel. Here the pressure on the cortex was superficial, as sections of the affected part of the brain failed to reveal any changes in the subcortical tissue of the involved area as well as of the ascending frontal convolution. To reconcile the clinical findings in this exceptional case with the generally admitted view concerning the separate function of each rolandic convolution is quite difficult. A similar difficulty is experienced in the interpretation of many similar cases reported by competent authors. I mention at least the well-known case of Horsley (1909), in which extirpation of the ascending frontal convolution was followed by sensorimotor disturbances.

If we turn our attention to the deep sensibilities, we find in Case 7 all deep sensibilities disturbed. Pathologically the parietal lobe proper was involved. In Case 7, in spite of involvement of the lower portions of the ascending convolutions, the superficial sensations were intact and some of the deep sensibilities suffered, namely, orientation, position, pressure, localization and spacing senses. In Case 9 the pathologic condition was identical with that of Case 8 and we find a slight hemianesthesia, but a pronounced disturbance of some of the deep sensibilities, including the stereognostic sense. It is evident that all deep sensibilities are affected in cases of a lesion in the parietal lobe (Case 7), but some of them may be affected in cases of lesion in cortical areas other than the parietal, such as the frontal lobe and the two central convolutions. As far as astereognosis is concerned, we are in possession of a large number of facts, all tending to prove that the parietal lobe is not the only cortical region controlling the stereognostic function. Cases 8 and 9 are also striking examples of this contention. As to the point of view of stereognosis being a faculty

dependent on the integrity of other sensibilities, it is not tenable, as there are cases on record in which the stereognostic faculty was disturbed or abolished and other sensations were intact.³

Sensory Disorders from Capsular Lesions.—In Case 2 there was an extensive softening of the entire left internal capsule, also of the adjacent portion of the optic thalamus. The superficial sensibilities were involved over the entire paralyzed side. Among the deep sensations, only the muscular sense was slightly impaired, the others being intact. In Case 3 a gliomatous tumor involved in the left hemisphere the supramarginal gyrus, angular gyrus, and the posterior third of the first and the second temporal convolutions. On a transverse section we see the posterior portion of the internal capsule destroyed by the tumor. Apart from the special manifestations corresponding to the involved special centers, there were no sensory or motor disturbances whatever. It is also interesting to note that in spite of considerable pressure on the parietal lobe there was no trace of symptoms referable to the deep sensibilities, including the stereognostic sense. In Case 5 there was a softening of the entire left internal capsule and of the adjacent portion of the optic thalamus. The patient presented a right hemiplegia and hemianesthesia for touch, pain and temperature and also for localization. The degree of sensory diminution corresponded to the degree of diminution of the motor function, although the impairment of the localization sense was more marked in the foot than in the hand.

An analysis of these three anatomoclinical cases shows that in Cases 2 and 5 sensory and motor disturbances were concomitantly present on the same side; that in both cases the superficial sensibilities almost alone were affected; that very few of the deep sensibilities were involved, namely, muscular sense in one case and localization in the other case; that in both cases the posterior portions of the internal capsule were affected and that in both cases the adjacent portion of the thalamus was involved. In Case 3 the lesion was cortical as well as capsular. Curiously enough, the cortical lesion (parietal lobe) did not disturb the deep sensibilities and the capsular lesion (posterior limb) did not produce sensory symptoms. If, in accordance with the teaching of Charcot concerning the *carrefour sensitif*, we are to expect hemianesthesia of the cutaneous and deep sensibilities and disturbance in the domain of the special sensorium, particularly contraction of the visual fields with amblyopia on the anesthetic side, the three observations recorded speak decidedly against the alleged function of the *carrefour sensitif*. In Cases 2 and 5 there was only hemianesthesia of the superficial sensations and no involvement whatever of the

3. Gordon, A.: *Rev. Neurol.*, Sept. 30, 1910, p. 301.

special senses, and in Case 3 the posterior portion of the internal capsule was destroyed and sensory manifestations of any kind were conspicuously absent. The three cases seem to favor strongly the contention that while the internal capsule possesses a sensorimotor function, its very posterior portion does not possess the exclusive sensory function, as advocated by Türck and Charcot. This is particularly seen from Case 3. The concomitance of a lesion in that portion of the thalamus which is adjacent to the internal capsule is very significant, as it leads to the possibility if not probability that the sensory disturbances accompanying motor paralysis are due to the involvement of the corticopetal or thalamocortical fibers, which, together with the projection fibers, enter into the formation of the posterior segment of the internal capsule.

Sensory Disturbances from Lesions of the Optic Thalamus.—In Case 1 (tumor in basal ganglia in left hemisphere) there was a hemiparesis and sensory disturbances on the same side. Touch sense was diminished, but pain sense was increased (hyperalgesia); warmth produced a pleasurable sensation, cold a disagreeable sensation. On the same side some of the deep sensibilities were involved, namely, position, muscular sense, stereognostic sense and pressure. Gross errors were made by the patient at each repeated test. There was also considerable subjective pain in the right arm, which was unusually persistent.

The striking peculiarity about this case is the dissociation of the superficial sensibilities and the excessive response to painful stimuli and to cold. The existence of hyperalgesia on the anesthetic side is unusual, although sensory disorders of this character in lesions of the lateral zone of the optic thalamus have been reported by Edinger⁴ and Roussy.⁵ The pleasurable sensation to warmth and disagreeable sensation to cold form another peculiarity in this case. The fact that these phenomena, together with the above-mentioned hyperalgesia, have been totally absent in all the other cases of my series renders the condition quite suggestive, inasmuch as it may be considered characteristic of thalamic lesions.

In addition to these manifestations the marked involvement of several forms of deep sensibilities and the spontaneous pain on the anesthetic side constitute a separate group of sensory phenomena which are not encountered in cortical or capsular lesions. They are therefore pathognomonic of the thalamic syndrome originally described by Dejerine.

4. Edinger: Deutsch. Ztschr. f. Nervenhe., 1891, i, 262.

5. Roussy: Neurol. Rev., 1909, xvii, 301.

Sensory Disturbances from a Peduncular Lesion.—In Case 6 a tumor of the pituitary body disfigured the crura and all the elements in the posterior portions of the pons and medulla. The superficial sensations on the hemiplegic side presented a dissociation of a syringomyelic type with regard to touch and pain and also a thermic dissociation, the sense of cold being absent and extreme heat being taken for tepid. Among the deep sensibilities, the stereognostic sense was markedly impaired. Localization and pressure were but slightly involved. There was no crossed hemiplegia or crossed hemianesthesia. The cranial nerves were not invaded by the tumor. The pressure by the latter backward was such that it disfigured and displaced the crura and the pons, but did not completely destroy them. In this case we have, therefore, a conspicuous sensory symptom dissociation in the superficial sensibilities, with marked disturbances in the deep sensibilities. The latter were more pronounced than the former. The sensory disturbances were present on the side on which the motor function was impaired.

DIAGNOSTIC DEDUCTIONS

A review of the forms of impaired sensibility in various cerebral lesions demonstrates the fact that the superficial sensations are to a greater or lesser extent involved in all the lesions of the brain considered here. The capsular lesions give the most pronounced and the most persistent disturbances in the touch, pain and temperature senses. The least involvement is seen in the cortical cases. The three senses run parallel in degree and extent. A distinct dissociation is seen in the peduncular lesions and this dissociation is analogous to the syringomyelic type. In the thalamic cases there is also a dissociation, but of a special kind, namely, a diminution of touch sense, pleasant feeling from warmth and disagreeable feeling from cold. Disturbances in the deep sensibilities were found in all varieties of lesions considered here. The most constant and most extensive variety was the cortical one. Next in order of degree of involvement is the thalamic kind. Among all forms of deep sensibilities position and muscular sense were most frequently affected. These were disturbed in all except in the peduncular variety. The localization sense was found altered next in frequency. Astereognosis comes next in order of frequency.

In spite of this apparent regularity in sensory impairment, certain exceptions were nevertheless present. Special emphasis is laid on Case 3, in which an involvement of the parietal lobe and a destruction of the posterior portion of the internal capsule gave no sensory disturbances of any sort. In capsular lesions in which the superficial sensibility is so conspicuously involved there was also impairment of some deep sensibilities. In the peduncular variety the deep sensibilities were

more involved than the superficial ones. Astereognosis, which has been looked on as a symptom of a lesion in the parietal lobe, was present here, not only in the cortical, but also in the thalamic and peduncular, variety.

On the other hand, in Case 3 the lesion of the parietal lobe gave no disturbance of the stereognostic sense. Similarly, in the case reported by me⁶ in 1908 a bullet entered the left parietal region and subsequently an operation with extensive destruction in the same area did not cause a loss of the stereognostic sense or of any other form of sensations. Among other authors, Verger and Abadie,⁷ for example, published in 1900 the history of a case in which a sarcoma of the dura compressed the entire parietal lobe so that the cortex was markedly flattened and still the general sensibility and the stereognostic sense remained intact. In connection with these clinical irregularities, which are usually called exceptions, it may not be superfluous again to call attention to Case 7, in which a cortical hemorrhage strictly confined to the parietal lobe, but close to the ascending parietal convolution, gave place not only to an impairment of the superficial sensibilities, which was to be expected, but also to a motor hemiplegia, although the hemorrhagic area was far removed from the anterior central convolution.

The problem of sensibility of cerebral origin, as studied from a clinical standpoint but verified by means of anatomic material, establishes the existence of types of sensory disorders more or less distinct from each other. The nine anatomoclinical cases described here corroborate in a general way the findings of some authors, yet the exceptional features are sufficiently conspicuous to emphasize the fact that certain conservative reservations must always be made when diagnostic inferences present themselves. Literature is abundant with examples which militate against the generally adopted views. Exclusivism is a method which may be damaging to diagnostic investigations.

1812 Spruce Street.

6. Gordon, A.: *Med. Rec.*, New York, April 18, 1908, lxxiii, 648.

7. Verger and Abadie: *Bull. Soc. d'anat. de Bordeaux*, April 30, 1900, p. 347.