PATHOLOGICAL ILLUSTRATIONS OF THE LOCALISATION OF THE MOTOR FUNCTIONS OF THE BRAIN.*

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CASE V. *Adhesion of the Pia Mater to and Softening of the Middle Third of the Left Ascending Parietal Convolution, Portion of the Ascending Frontal, and Edges of the Gyrus Supramarginalis and Gyrus Angularis; Paralysis of the Right Hand and Arm.*—W. J., male, aged 38, was admitted into the Cork District Lunatic Asylum on December 3rd, 1876, suffering from general paralytic dementia. The patient, a Welshman, was a discharged soldier, and his illness, of eight months' duration, was attributed to a fright he received while serving as pointsman on the railway near Mallow, County Cork. It is needless for my present purpose that I should enter into the minute details of his history or condition; suffice it to say that he had the uncertain gait, the trembling muscles, the hesitating speech, the jerky movements of the tongue, and the unequal pupils (the left being the larger), physically characteristic of this fatal malady. Mentally, he was dull, stupid, and demented, with occasional vivid hallucinations of sight; but never developed any of the delirious conceptions or ideas of grandeur which mark this disease from the mental point of view. During his residence in the asylum, every function slowly but surely deteriorated; he became more and more helpless bodily, but without any distinct paralysis, and demented mentally; the power of speech and of protruding the tongue diminished, and the muscular tremblings and twitchings increased, while he lost all control over the bladder and rectum.

On April 29th, 1877, the following report was made. "Since March 13th, when the last note was recorded, the unfortunate man has been steadily growing worse, and is now a pitiable object to look at. Though kept out of bed in an arm-chair, he has become quite incapable of walking unsupported; he can, however, move the arms and legs freely. For the past two or three days, he appears to be unable to protrude the tongue, and has not spoken; when pressed to do so, he makes feeble efforts with the facial muscles, which twitch convulsively. The general muscular tremor has increased, the irregularity of the pupils still exists, but to a less degree than before; he is greatly emaciated, the muscular groups being apparently generally and equally wasted. He now takes his food readily when fed. Urine and feces are passed involuntarily. This morning, he was found to have become during the night quite unconscious. The attendant reports that he had no noticeable fit of any kind. He lies on his back with his eyelids closed, his eyes fixed, the conjunctivæ being quite insensible to the touch of the finger. The pupils are equal in size, contracted and fixed. The arms are flexed across the chest, and, when raised, require some force to straighten them, the muscular groups being very rigid; the lower limbs are to a less extent in a similar condition. Tactile sensation appears dulled, no outward manifestation being made when the skin is sharply pricked with a pointed probe. Reflex excitability is increased, the feet moving convulsively when the soles are tickled. Respiration is unaffected."

April 30th.—The comatose condition had passed away; he was to-day brighter; had opened his eyes, and looked around him, appearing to partially recognise those about him, and was able to swallow liquid food. The pupils were larger, and the inequality was again observable, the left being of greater diameter than the right. The features were much sunken; there was a tendency to diarrhœa.

May 1st.—He was in much the same condition as yesterday; diarrhœa was less; there was decided loss of power in the right hand and arm. Bed-sores were commencing over the lower portion of the sacrum.

May 2nd.—He was somewhat more sunken than yesterday. The right hand and arm were to-day completely paralysed; when raised, the muscles were in a state of tonic rigidity; but, when let go, the hand and limb dropped powerless, and could not be moved by any voluntary effort. The back of the hand was swollen and puffy; the epidermis between the forefinger and thumb was raised into a large irregular-shaped bleb containing yellowish-brown serum, surrounded by an erythematous zone. The fingers were flexed and rigid, the nails pressing on the palm of the hand; they were straightened with difficulty, and, when released, returned at once to their former position.

On the posterior aspect of the second phalanges of the fore-middle and third fingers were elongated ovoid bullæ of fluid, which had appeared since yesterday. The power of movement of the left hand and arm was but little affected; the grasp was still, comparatively speaking, strong; when he got anything into the hand, he clutched it so firmly that it was difficult to disengage it. The muscles of this limb were atrophied to a considerable extent, especially the interossei, the back of the hand forming a strong contrast to its swollen fellow. The man did not emit the slightest sound or noise of any kind. When the mouth was forcibly opened, the tongue could be seen moving about in the buccal cavity, the organ being atrophied, red, and glazed. Cutaneous sensibility seemed to be almost extinguished over the entire surface of the body. Reflex excitability was diminished, especially in the right leg. Farado-muscular contractility was weakened in the lower limbs, but persistent in the upper limbs, especially in the left arm and facial muscles. He lay on his back, with the legs drawn up and the pelvis rotated towards the left side. Across the junction of the sacrum and buttocks was a large eschar surrounded by an erythematous zone; and there was a commencing bed-sore midway on the left iliac crest.

May 4th.—For the past two days, the patient had been sinking, and he died this morning at 5.30 A.M.

May 5th.—*Necropsy*, thirty hours after death. Rigor mortis was strongly marked. The body generally was much emaciated. Over the lower portion of the sacrum, and extending across the left half of the buttocks, was a black eschar of a quadrilateral shape, about five inches in length, surrounded by the remains of an erythematous zone. The surface of the abdomen was flattened and of a blue colour. The bullæ above mentioned still existed on the fingers and hand. The scalp was thin, and considerable force had to be exercised to strip it from the bone. The cranial outline was asymmetrical, the right hemisphere being more prominent than the left, the fronto-parietal regions of the latter being flattened and sloping. The consistence of the bone under the saw was normal. The inner surface of the calvarium was of a slaty-blue colour. On the left frontal eminence was what appeared to be the remains of an old fracture, to which the scalp was firmly adherent. There was no corresponding mark on the inner surface. The outer surface of the dura mater over the vertex of the hemispheres appeared normal. Laterally over the left hemisphere, it was covered with a thin layer of clear gelatinous material readily scraped off with the scalpel. On cutting through the dura mater, between two and three ounces of non-sanguineous turbid sero-purulent fluid escaped; on raising the membrane, it was found adherent beneath at each side of the longitudinal cleft, and also connected over the hemispheres with the arachnoid by filiform bands; its inner surface covering the fronto-parietal convolutions of the left hemisphere was lined with a soft layer of yellow gelatinous material easily removable. The corresponding surface of the arachnoid was similarly coated, the coating extending anteriorly over the membrane covering the three tiers of frontal convolutions, and reaching posteriorly across the ascending frontal and parietal convolutions, as far as the edges of the sulci bounding the postero-parietal and portion of the inferior parietal lobules. The gelatinous deposit existed also over the upper tiers of the temporo-sphenoidal lobe, the occipital and annectent gyri being almost entirely free. The pia mater was, in the regions specified, thickened and opaque, especially that bridging the various sulci, where were scattered here and there numerous small spots of a greenish-yellow exudation. The Pacchionian bodies along the median cleft, where the dura mater had been attached, were shaggy, rough, and eroded. The membrane covering the convolutions of the right hemisphere was free from any of the gelatinous material; where it bridged the sulci, however, it was thickened and opaque, but to a less extent than at the left side. The fronto-parietal region of the left hemisphere was flattened, the individual convolutions appearing to be attenuated and angular. In removing the brain from the skull, about four ounces of sanguineous fluid escaped from its base and the upper portion of the spinal canal; the osseous configuration was normal; from the anterior and middle fossæ of the left side, a thin layer of gelatinous material could be scraped. The arteries at the base of the brain were delicate-looking and nowhere atheromatous; the basal ganglia were normal, the crura cerebri being somewhat diminished in consistence to the touch. The entire brain, previous to draining, weighed 1555.209 grammes; the cerebellum, pons, and medulla 138.8 grammes. The hemispheres were carefully divided into equal halves; the left weighed 641.5 grammes, the right 684.2 grammes, giving a difference of 42.2 grammes in favour of the right hemisphere. The ventricles and central ganglia were normal in appearance. The left hemisphere was placed in nitric acid solution (one to five of water). After macerating for thirteen days, the pia mater was removed, the membrane separating readily, leaving the portions where it was adherent to the cortex distinctly localised and eroded with ex-

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cavated and irregular margins. The portions thus affected were a small portion of the middle of the ascending frontal, the middle third of the ascending parietal convolution, extending farther below than above, the anterior edge of the gyrus supramarginalis, and a little piece of the gyrus angularis where it joined with the gyrus supramarginalis adjoining the ascending parietal. Not only was the membrane adherent to the cortex in these situations, but the latter was softened and pulpy, especially the portion of the ascending parietal, the tissue being broken down for a depth considerably greater than its own thickness and extending into the white matter subjacent. The pia mater was also adherent to the posterior portion of the superior frontal convolution on its inner aspect, and to small spots on the middle and posterior third of the inferior frontal, together with a few little patches on the posterior folds of the gyrus angularis. These adhesions were confined to the summits and sides of the gyri, the membrane stripping readily from the bottoms of the sulci; the latter were wide, especially that between the ascending parietal and gyrus supramarginalis.

The patches of softening and the adhesions are mapped on this diagram (fig. 5), the hemisphere of the brain preserved in the nitric acid

Fig. 5.—Adhesion of Pia Mater to, and Softening of the Middle Third of, the Left Ascending Parietal Convolution, Portion of Ascending Frontal, and Edges of the Gyrus Supramarginalis and Gyrus Angularis.

solution being also before you; the changes, owing to the shrunken condition of the tissue from the action of the acid, are not so well marked now as when seen in the fresh state: the organ, however, has been preserved from the action of the air, and has not, therefore, firmly hardened or changed colour.

Microscopical examination showed the surface of the pia mater to be covered with densely crowded free nuclei. The walls of the vessels were somewhat thickened and similarly overlaid with nuclei; in some instances, so closely packed that it was difficult to make out the boundaries of the coats of the vessels; where the latter were seen, the muscular coat was tolerably distinct, regular in outline, and unaffected. Scattered over the surface of the membrane and on the vessels were aggregations of clear circular disc-like bodies slightly or not at all tinted by carmine, forming clusters, rosettes, or irregular groups, varying in size from a minute dot to a disc as large again as a blood-corpuscle. These appear to me to be free fat or oil-globules, the result of degenerative processes which have taken place. Teased preparations of the fresh brain-tissue stained with aniline blue black showed the larger pyramidal nerve-cells, in the great majority of instances, to be destitute of their basal processes, the angles being eroded or rounded, and the protoplasm loaded with granules, the nuclei being invariably present. Aggregations of globules quite similar to those observed in the pia mater were present here also, and, in several specimens from the apices of the ascending parietal and ascending frontal convolutions (right hemisphere), the so-called "giant-cells" at once arrested attention by their superior size and close resemblance to the multipolar bodies of the anterior cornua of the spinal cord. Prepared sections showed the vessels to be somewhat thickened and excessively nucleated, and surrounded by dilated perivascular spaces (?). The larger ganglion-cells were in different stages of pigmentary degeneration, and the neuroglia was coarse and molecular.

The importance in general paralysis of the localised adhesions of the pia mater, in the fronto-parietal regions, as a pathognomonic mark of the disease, has been lately discussed by Dr. Crichton Browne in the sixth volume of the *West Riding Asylum Reports*; and, more recently, the relations between the cortical lesions resulting therefrom and the various motor symptoms occurring in the course of this fatal malady, have been treated of at some length by Dr. Achille Foville in the

Annales Médico-Psychologiques. As the result of his observations, the latter concludes that, in general paralysis, the cortical lesions of the fronto-parietal convolutions are the direct cause of the motor troubles, and that on the localisation and intensity of these lesions depend the localisation and intensity of the various ataxic, spasmodic, and paralytic accidents which may occur. In the present instance, we have a paralysis confined to the right hand and arm, with spastic contraction of the muscles coming on towards the close of a case of the disease in question, the necropsy revealing localised cortical lesions resulting from adhesions of the pia mater occupying portions of the ascending frontal and ascending parietal convolutions, and of the inferior parietal lobule. Granting, then, that these localised cortical lesions and the partial paralysis stood to each other in the relation of cause and effect, which the absence of other lesions leaves no reason to doubt, we have here an interesting verification pathologically of the results obtained experimentally in this region. Ferrier, as is now well known from the phenomena produced both by electrical irritation and circumscribed destruction of the cerebral cortex in monkeys, localised the centres for the movements of the arm and hand in the ascending frontal and the ascending parietal convolutions, the regions which were here chiefly affected; and, although the localisation of the diseased patches is more circumscribed than that which produced similarly extensive symptoms experimentally in the monkey's brain, yet, from the nature of the pathological process causing the cortical lesions, it is more than probable that the irritation from the specially diseased foci spread to neighbouring centres in the same convolutions, thus leading to their involvement and the loss of voluntary motor power in the muscular groups they govern. The spastic contraction of the muscles, as an indication of irritation of the nerve-centres, would, I think, appear to favour this view.

The presence of the visual hallucinations with the disease in the angular gyrus, together with the fact that the prominent cerebral lesions were at the same side as the dilated pupil, and about the regions which have been found experimentally to govern its motility, are interesting points in this case. The rapid formation of the bullæ on the paralysed hand and the acute bed-sore are also noteworthy. It is to be remarked that the latter was primarily sacral, and the side of the buttock to which it subsequently extended was the opposite to that of the paralysed limb: a fact contrary to the statement of M. Charcot, that, when an acute bed-sore forms in cases of cerebral hemiplegia, it is invariably at the same side as the paralysed limbs. I may add here that the spinal cord presented no gross lesions; the histological alterations I shall detail elsewhere, as well as those in the medulla oblongata.

CASE VI. *Softening of the Lower Two-thirds of the Left Ascending Parietal Convolution; "Foyer" of similar Softening in the Central White Matter of the Hemisphere; Right Hemiplegia.*—For the history of this case, and for the opportunity of being present at the *post mortem* examination and subsequently investigating the condition of the organs, I am indebted to my friend Dr. Cremen, Physician to the Union Hospital, Cork.

M. R., female, aged 68, was admitted under Dr. Cremen's care on March 4th, 1877. The patient, a fish-vendor, had always been a hard-working woman of tolerably temperate habits, and, up to three years since, had been in the enjoyment of general good health. About that time past, she began to feel oppressed after exertion, and experienced a sensation of giddiness, noises in the head, and failure of memory. These symptoms gradually increased, and finally she had to seek admission to hospital, when she presented the following appearance and symptoms. The skin was sallow; pulse hard and full, not intermittent; urine slightly albuminous, specific gravity 1017; contained a large quantity of phosphates; memory impaired; gait unsteady; she complained of occasional transient diplopia and constant pain in the forehead. On examining the heart, a rasping *bruit* was heard at the base, accompanying the second sound, and extending along the course of the aorta. With the exception of a few mucous *râles*, no indications of any morbid condition of the lungs was detected. The diagnosis arrived at was general atheroma, with probable softening of the brain. When about a fortnight in hospital, whilst walking along the ward, she suddenly fell down, and, when taken up by one of the assistants, was found to have lost power over the right side. She was not unconscious, but had partly lost the power of speech. When seen on the next day, her condition was as follows. There were complete paralysis of the right side (limbs, face, and tongue), dilatation of the left pupil, and a well marked flush on the left side of the face, which persisted until her death. When spoken to, she seemed to understand everything that was said, reached out her left hand when requested to do so, and protruded her tongue, which deviated laterally. The power of speech, however, was much affected. She seemed to improve for a couple of days, but then gradually sank into a stupor, from which she could be

roused with difficulty. Gradually, a typhoid condition came on, in which she remained for some days, and then sank.

Necropsy.—On removing the scalp and sawing through the calvarium, the diploë in the frontal region was found to be completely absent, the space between the tables of the skull being hollowed out into several thin-walled cavities extending upwards and downwards, and quite empty. The dura mater was healthy; on its removal, a small quantity of fluid distended the pia mater posteriorly. On removal, the configuration of the brain was normal; five ounces of blood and sanious serum escaped during its removal, draining chiefly from the base of the skull and spinal canal. The arteries at the base of the organ were slightly enlarged; their coats of a whitish colour, but not materially thickened. The middle division (the anterior parietal of Duret) of the arteria fossæ Sylvii of the left hemisphere, at its breaking up into two branches, was blocked, a transverse section under the microscope showing it to be filled with granular detritus; the arteries at the right side were normal. The various cranial nerves appeared healthy; the third nerves were, however, very easily detached. The pons, medulla, and cerebellum appeared normal. On examining the hemispheres, the left ascending parietal convolution, for two inches and three-quarters of its length, extending from one inch below the longitudinal fissure into the fissure of Sylvius beneath, was completely softened and broken down into a whitish pulp throughout its entire thickness, the pia mater being adherent to the surface and incapable of being stripped without bringing with it portions of the brain-substance (fig. 6). Beyond a general wasting

Fig. 6.—Softening of Lower Two-Thirds of the Left Ascending Parietal Convolution; "Foyer" of Softening in the Central White Matter of the Hemisphere.

and separation of the convolutions by wide and shallow sulci, no further cortical lesions, either on this or on the right hemisphere, existed. On cutting into the brain, a "foyer" of softening, circular in outline, and with a diameter of two inches, occupied the centrum ovale of Vieussens of the left hemisphere, commencing two inches and a quarter behind the apex of the left frontal lobe and terminating three inches and one-eighth anterior to the apex of the occipital lobe. This region of softening extended from above the level of the corpus callosum, right through the white matter of the hemisphere, and was continuous with the softened ascending parietal convolution. The intraventricular portions of the opto-striate bodies and the basal ganglia appeared normal. Microscopical examination showed the softened tissue of the cortex to contain numerous granular bodies and broken down nerve-fibres. Many of the ganglionic corpuscles had, however, still retained their normal appearance. A prepared section through the third left frontal convolution revealed a pigmented and granular condition of the nerve-cells and a widely dilated state of the perivascular canals, many of which contained globular débris of nervous disintegration; the majority of the vessels under observation were contracted and shrivelled; their coats were not morbidly thickened. Spots of miliary sclerosis were present in great numbers both here and in a section through the left crus cerebri. The heart was enlarged, the walls of the left ventricle being much hypertrophied and covered with a layer of fat. The mitral valves were not apparently diseased; the aortic were puckered and thickened at the edges, and on one curtain was a minute vegetation. The aorta was dilated, and its lining membrane studded with atheromatous patches and cicatrices; the coronary arteries were enlarged and atheromatous; both kidneys were granular on the surface. Microscopic examination revealed hypertrophic thickening of the walls of the arterioles, with a circularly arranged layer of connective tissue externally. The epithelial lining of the tubules was generally present, filling the latter, of a yellowish colour, clouded and granular. Many of the Malpighian bodies appeared to be shrunken and broken. The

condition of the brain in this case was without doubt due to embolic softening of the region included within the area of distribution of the middle division of the arteria fossæ Sylvii (anterior parietal of Duret), aided probably by the general changes in the walls of the vessels. The cortical lesion was strictly located in the left ascending parietal convolution; but, as I have said, the softening was not confined to the cortex, the white matter of the centrum ovale beneath the fronto-parietal convolutions being also involved; and to this must, in all probability, be attributed the extent of the paralysis, though Charcot, indeed, has shown that destruction of a single convolution in the motor zone is sufficient to account for a loss of power in the hand, arm, and leg. Here the localised *ramollissement*, by interrupting the continuity of the conducting fibres passing from the cortical centres to the ganglia beneath, over a wider area than the cortical lesion itself extended, virtually destroyed the activity of motor centres not themselves affected, causing a cessation of function, and, as a result, paralysis of the region which they motorially governed. Softening may exist in certain portions of the white matter of the centrum ovale, without producing paralysis, if such be situated beneath or outside the course of the conducting fibres passing from the cortical motor centres to the ventricular ganglia. Such in all probability was the condition in the case recorded by Dr. Keblell in the *Lancet* for May 5th, 1877, where a tubercular cavity extending for a distance of three inches and a half through the anterior and middle lobes of the hemisphere existed without any motor derangement being present, this softening being probably beneath the level of the conducting fibres to which I have alluded.

These six cases, gentlemen, which I have now related, in all of which localised lesions of the convolutions, either in the non-motor or motor regions, existed, and which were accompanied by negative or positive symptoms, according to the seat of the disease in the non-motor or motor zones, tend, in a greater or less degree, to support pathologically the fundamental doctrines of cerebral localisation, and as a slight contribution to this *questio vexata* of modern medical science, are, I trust, worthy of being placed on record.

MENSTRUAL FLUID RETAINED IN THE LEFT FALLOPIAN TUBE, SIMULATING OVARIAN TUMOUR; ABDOMINAL SECTION DURING ACUTE PERITONITIS.

By LAWSON TAIT, F.R.C.S.,
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MISS M., aged 38, was sent to me in the beginning of 1877 by my friend Mr. Alfred Freer of Stourbridge. In November 1876, she had an ill-defined illness, during which she had obscure pelvic pains accompanied by fever. Previously to this illness, she had been in good health and had menstruated regularly. After it, she had severe pain during the whole period of menstruation, and she gradually increased in size until Mr. Freer discovered a pelvic tumour in February last. I found the tumour to be pear-shaped, quite movable, attached to the uterus at the left cornu, evidently unilocular, and about the size of an infant's head. I diagnosed it as a cyst of the parovarium, and advised that it should be tapped after it had increased in size sufficiently to warrant interference. She returned to me in May, with the tumour increased so as to be felt above the umbilicus. I advised her to come again in a month. She came, however, before the expiry of that period, on account of a sudden accession of serious symptoms; and when I saw her on June 20th, there could be no doubt she was suffering from peritonitis. Her pulse was 130; the temperature was 38.4 deg. C. (101.12 deg. Fahr.), and rose to 39.6 deg. C. (103.28 deg. Fahr.) in the evening; and there was excessive pain all over the abdomen, with considerable flatulent distension. I administered opium freely, and applied counterirritation over the epigastrium.

On the morning of the 21st, she was easier, but the temperature and pulse had not fallen. I therefore had her placed under the influence of ether by Dr. A. H. Carter, and proceeded to open the abdomen, assisted by Mr. Priestley Smith. The tissues of the abdominal walls were extremely vascular, and it was necessary to use a large number of ligatures to arrest the bleeding. The peritoneum was found to be intimately adherent to the tumour; and, as soon as the latter had been laid bare for a short distance, it became evident that it was not an ovarian tumour, but presented the red muscular appearance of the uterus. Passing the forefinger of my left hand down as deeply as I could in front of the tumour, with that of my right hand in the vagina, I made out distinctly enough that my original conception of the relations of the tumour to the uterus were perfectly correct.