fossa (Fig. 17 B). These fossæ represent those termed retro-cæcal by some anatomists. They are, however, not deserving of a special name. They are rare, are most variable, and evidently more or less accidental. Some appear as mere shallow grooves, while others are large enough to take a bantam's egg. They can hardly be demonstrated, unless the cæcum be put upon the stretch. It may be noted, however, that these retrocæcal folds have much to do in keeping the cæcum in position. Folds are also often found at right angles to the long axis of the gut, and passing from the colon near the cæcum, transversely across the iliacus muscle. These folds are very irregular, and can often be more or less entirely obliterated by displacing the large intestine. They do not merit anatomical recognition.

(To be continued.)

ABSTRACT OF THREE LECTURES ON THE MUTUAL RELATION OF THE GREY MASSES OF THE CEREBRO-SPINAL SYSTEM, AND THEIR CONNECTIONS WITH PERIPHERAL NERVES.

Delivered at the Royal College of Surgeons of England.

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Lectures I and II.—The Central Grey Tube, and the Involuted Parts of the Cerebral Cortex.

Were it possible to unravel the cerebro-spinal system, it would probably be found to consist of an association of simple combinations of nerve-fibre and nerve-cell, simple as to the number of elements entering into the formation of each combination, but complex as to the connections between them. The object of our study is to trace the fibres of nerves, the functions of which we know, back to their ultimate terminations in cells, and to determine further the connections of the various cell-groups with one another. The mere topography of the system, although, in the history of the subject, necessarily the first to be studied, is of no interest until we have some notion of the meaning of the different regions. So difficult, however, is the investigation of the structure of the cerebro-spinal system, whether carried out by the microscope or by methods of dissociation, that exceedingly discrepant results are obtained by different observers; and it is necessary, in order to obtain a general conception of the plan upon which this system is built up, to have recourse to fundamental morphological and physiological considerations.

Formed as an involution of the epiblast, the central nervous system retains, throughout its whole extent, its tubular character. This tube, at first uniform, undergoes a differentiation into three concentric layers, of which the internal constitutes the epithelium of the spinal canal, the middle the grey matter, and the peripheral the white matter of the cord, and of its continuation throughout the basal part of the system. It is with the grey matter alone that we have any further concern; this, owing to the lozenge-shaped section of the primitive central canal, is constricted into four columns, which subsequently become the two anterior and two posterior cornua, united above and below the central canal by the anterior and posterior commissures. The anterior and posterior roots of the spinal nerves are connected with their respective cornua. Within the grey matter, we find three distinct kinds of cells: 1, large motor cells (measuring from 67 to 135 μ) with distinct process of Deiters, collected in two separate groups in the anterior and lateral horns respectively, except in the cervical and lumbar enlargements, where these groups fuse together; 2, a dorso-mesial group of cells (Clarke's column) resembling the cells of the anterior horn in form, but not in size, their diameters varying from 40 to 90 μ; 3, spindle-shaped cells, of an average length of 18 μ, apparently devoid of an axis-cylinder process. These cells are diffused through the matrix of the posterior horns.

It must be remembered that the above mentioned groups of cells constitute continuous columns, presenting, nevertheless, a distinctly metameric arrangement. Birge has shown that, in the frog, the number of motor cells in the spinal cord equals the number of large motor fibres in the anterior roots; and, further, that the number of cells in each metamer equals the number of large motor fibres in the anterior root leaving that metamer. Although there are certain difficulties in carrying out this investigation which should make us hesitate in accepting the exact numerical equivalence as proved, Birge's results are strongly confirmatory of the opinion that every motor fibre is connected with a nerve-cell immediately before its exit from the cord. The variation in size of the posterior cornu, and consequently in the number of spindle-shaped cells which it contains, indicates that a similar connection obtains of the fibres of the posterior roots with nerve-cells of their own metamer.

Gaskell has, quite recently, called particular attention to the white rami communicantes (rami advehentes of Remak) of the sympathetic system, composed of the smallest medullated (leucenteric) fibres; and has further remarked that the number of cells in Clarke's column in any particular region appears to vary as the number of leucenteric fibres derived from that region. As the result, therefore, of Gaskell's researches, this column, hitherto so anomalous in position, in the character of its cells, and in its pathological alterations, falls into place as containing the primary centres of the visceral nerves; and we are justified in considering the central grey tube of the cerebro-spinal system as composed of metameric groups of three varieties of cells, well defined as to their histological characters, and severally connected with three kinds of nerve-fibres, equally distinct as to their anatomical and physiological relations.

As the spinal cord passes into the medulla, its central canal opens out into the fourth ventricle. The posterior columns, previously separated only by the median fissure, become widely divergent, and the posterior cornua are consequently displaced outwards. The physiological reason for this change is to be found, as it appears to the lecturer, in the peculiar needs of the nervous system with regard to the circulation. Subject to rapid exaltation and depression of functional activity, it demands a correspondingly variable nutrient supply. A very slight alteration in the pressure upon the nerve-cells would be injurious; and yet, since it forms a solid parenchymatous mass, local turgidity must produce pressure upon, and displacement of, neighbouring regions. To prevent such pressure, and to remove rapidly all products of action (a function of the lymphatic system not sufficiently recognised), every nerve-cell and fibre swims in a little bath of lymph. Where, however, the grey centres reach a certain size and functional importance, they are brought into contact with a sea of lymph, by which their alternating pressures are widely distributed, and their products of action rapidly removed.

With the displacement of the posterior column outwards, the anterior column of cells is brought up into the floor of the fourth ventricle close to the median line, where it constitutes the nucleus of the hypoglossal nerve. The lateral column is isolated by the crossing fibres of the pyramid, as the antero-lateral nucleus of Clarke, and the nucleus ambiguus. Clarke's column, the cells of which retain the same characters as in the cord, swells out into the nucleus of the vagus, the great leucenteric nerve of the thoracic viscera. From it also arise fibres of the glosso-pharyngeal nerve, which Vulpian has shown to possess a vaso-dilator influence upon the back of the tongue; and into its anterior part Duval has traced the pars intermedia of Wrisberg, ramus visceralis of the seventh pair, from which the chorda tympani vaso-dilator nerve of the submaxillary gland is derived. The sensory part of the glosso-pharyngeal nerve probably terminates in the spindle-shaped cells of the grey matter of the medulla, homologous with the posterior cornu of the cord. In the pons Varolii we find the abducens arising from the anterior, the facial from the lateral, and the auditory passing into the posterior cell-columns.

The motor nucleus of the fifth nerve appears to belong to the lateral column, the sensory to the posterior column, of the whole hind and mid-brain. In the mid-brain, the grey matter resumes its tubular arrangements; indeed, this part, the region of the corpora quadrigemina, preserves, to a greater extent than any other part of the central nervous system, its primitive form. From the ventral (motor) part of the grey tube arises the third nerve; the fourth arises from its dorso-lateral part.

The optic thalamus and corpora striata are usually associated together as "basal ganglia," and constitute the second node in Meynert's projection scheme. They are considered to be of a higher value than the grey matter of the spinal cord, to constitute, as it were, an intermediate office or *bureau* between the cord and the cortex, exercising a censorship over all messages received from and forwarded to the front, and capable, in the absence or somnolence of their chief, of re-directing and returning them. The lecturer believes that this scheme was based originally upon Carpenter and Todd's classification of reflex actions. Intermediate centres were required to carry out the kind of reflex they termed "ideo-motor." But neither two nor twenty serially ascending centres would suffice for the proper allocation of such official work. Every gradation of reflex action is possible, from a simple twitch carried out by a limited portion of the cord, to the imitation of speech and gesture exhibited by a hypnotised person. The character of the action depends not upon the particular group of cells by which it is reflected, but upon the extent of the connection between the primary centres of the sensory nerve, up which the afferent impulse passes, with other sensory and motor centres. Everywhere throughout the grey matter, nerve-cells communicate with one another by a fret-work of processes, and it would appear that there is less resistance to the passage of impulses up sensory tracts than to their immediate transference from sensory to motor ones. Only when the road is blocked does this transference take place. This is, in many instances, the meaning of inhibition; as long as the sensory connections are open, the impulse travels up this tract instead of being reflected across to the adjoining motor cells. As in the well known experiment of dangling three frogs, from the first of which the cerebral hemispheres, from the second the corpora bigemina, and from the third these structures and the medulla also have been removed, with their feet in sulphuric acid, the farther the sensory impulses have to travel, the longer the time that elapses before they are reflected, and the greater the possibility of their being directed to motor cells other than those which will remove the injured foot from the acid.

The fact that the complexity and the purposeful character of reflex action is more marked the less the nervous system has been mutilated, depends, not upon its being carried out by higher centres, but upon the more extensive connections of the primary receptive cells. Physiologically, the conception that the basal ganglia serve as intermediate projection-areas, does not in any way facilitate the explanation of the different varieties of reflex action. Nor is it justifiable to place the optic thalami and corpora striata together in a division by themselves on anatomical grounds. They are developed from different cerebral vesicles, and grow in a somewhat different way. More distinctive, however, is the fact, that the nucleus caudatus remains permanently connected by its head and tail with the cortex, of which it seems justifiable to regard it, with Wernicke, as forming an involuted part. The nucleus lenticularis is inseparably connected with the nucleus caudatus, and, therefore, if Wernicke's view be correct, also a part of the cortex system. The correctness of this view has been strongly impressed upon the lecturer by a careful examination of the nucleus amygdaleus, which, with the claustrum, although almost everywhere separated from the cortex by white fibres, is always regarded as forming a part of this system.

Dr. Alex. Hill then observed that he proposed to lay before his audience evidence of an entirely new kind in proof that the corpora striata cannot possibly be middle-men between the cortex and the cord. In a microhydrocephalic brain (the anatomical report of which the lecturer proposed to publish in conjunction with Mr. De Lisle's clinical notes) he had particularly examined these ganglia, with a view to determining if there was any alteration in their size coincident with the diminution of the cortex. The whole brain, after soaking in spirit, only weighed 10½ ounces, and since it was not put into spirit until some days after death, it could not, the lecturer thought, have weighed more than 15 or 16 ounces when fresh (as against 49 ounces, the normal weight). The cortex was reduced to not more than one-fifth of its normal size. The brain was cut, by means of a specially constructed macrotome, into sections one-sixteenth of an inch thick. At the same time, a normal brain, similarly hardened, was cut up with the same machine. Dr. Hill also used the photographs in Luys' *Iconographie* for comparison.

Without entering into details as to the method of measurement, he stated that the head of the nucleus caudatus was a trifle larger than in his control brain; the nucleus lenticularis was almost identically the same size. Both were a little smaller than in Luys' photographs, owing to the contraction produced by the spirit. This result is the more remarkable, inasmuch as all the cranial nerves, the crura, and the spinal cord, were considerably reduced in size. Except for the remote possibility of the corpora striata exercising vicarious functions, it is inconceivable that they can be normally connected with the cortex by the fibres of the corona radiata, and yet not diminished in size when the cortex is congenitally deficient.

The optic thalami, on the other hand, appear to the lecturer to belong to the central grey tube, with the sensory part of which they agree, with certain modifications, in the manner of development, in minute structure, and in connections. Anatomically, it is impossible to distinguish them from the rest of the grey matter surrounding the third ventricle. Their prominence and comparative isolation depend upon the absence of motor nuclei in this region. Unless they belong to the æsthesodic part of the central grey tube, it is impossible to find primary metameric centres for the optic and olfactory nerves, a result for which neither the development of these nerves (Marshall has shown that, in the chick, the olfactory nerves arise, like any other, from the dorsal ridge of the fore brain before the budding out of the cerebral vesicles), nor what we have already learnt of the mechanical construction of the central nervous system, justifies us in anticipating.

THE POST-MORTEM APPEARANCES IN A CASE OF DEATH FROM THE ACTION OF ELECTRICITY.

By MARMADUKE SHEILD, M.B., F.R.C.S., and SHERIDAN DELÉPINE, M.B., B.Sc.

(For permission to publish this case we are indebted to Dr. Cavafy.)

A HEALTHY strong man, aged 21, engaged at the electrical department of the Health Exhibition, was observed to suddenly fall back insensible from a machine which he was manipulating. He was at once brought to St. George's Hospital, on the evening of September 27th, 1884, and was found to be quite dead on admission. No alteration was perceptible in the texture of his clothes or the metallic substances on the person.

The necropsy was performed forty hours after death. The body was that of a muscular healthy man; rigor mortis well marked. Great cutaneous congestion was present, curiously limited to the head, neck, upper part of the chest, and arms. On the outer aspect of the left index finger was a small elongated blister, about half an inch in length by one-eighth of an inch wide. This had the appearance of a burn, but there was no congestion of the skin round it, and no smell of charred epidermis.

On opening the body, the muscles of the thorax were noted to be very firm and resistant to the knife. All the internal viscera, with the brain and spinal cord, were, to the eye, perfectly healthy. A striking feature in the investigation was the extreme fluidity of the blood; there was not a trace of a clot even in the right side of the heart. The viscera were much engorged with dark fluid blood; the heart was large and muscular, but quite uncontracted. Under the microscope, the fibres were normal in appearance. The blood was also examined with the microscope, but nothing abnormal could be discovered. The median nerve, and portion of blistered skin, were submitted to prolonged and careful microscopical investigation.

Nothing of importance could be discovered in the median nerve; this, however, does not exclude the idea that some abnormal coagulation, or other changes, may have been present, but these were of such a nature as not to be revealed by the methods of observation used.

DESCRIPTION OF THE MICROSCOPICAL APPEARANCES OBSERVED IN TRANSVERSE SECTIONS THROUGH THE SKIN OF THE LEFT INDEX FINGER IN THE REGION OF THE BLISTER.

One part of the specimen was hardened in osmic acid, and another in chromic acid and spirit.

The sections were cut in a plane perpendicular to the surface of the skin and to the long axis of the blister.

A. EXAMINATION UNDER LOW POWER.

The epidermis is raised from the cutis vera in the portion of skin corresponding to the blister; thus a small elongated cavity is formed, which, at the time it was opened, contained no fluid.

The roof of the cavity is depressed in the centre, this depression corresponding to a longitudinal groove, observed on the surface of the blister, and running in the direction of its long axis. On cutting through this raised epidermis, it is noticed that it is very brittle and hard, generally breaking in the region of the median depression; in that region the epidermis is much thinner than elsewhere. The floor of the cavity is almost flat, and the transverse measurement of the cavity, in the middle of the blister, is about ¼ inch, the width diminishing at both ends. The depth of the cavity is from $\frac{1}{30}$ to $\frac{1}{25}$ inch at the sides of the median depression of the roof, but just under that depression it often measures less than $\frac{1}{250}$ of an inch.

For the sake of clearness, it will be necessary to describe the various parts of the epidermis, cutis vera, and subcutaneous tissue in the following regions: 1, the middle of the blister; this will be called the central region, or zone; 2, the border of the blister; this will be called the marginal region, or zone; 3, the immediate vicinity of the blister will be called the external region, or zone.

It must be, however, understood, that there is no sharp line of demarcation between these zones, and, moreover, that if these zones were determined in each layer, according to the degree of intensity of the lesions, they would not have the same extent in each stratum, so