

between these two extremes. The most common among existing species is the *Amphistegina gibbosa*, which is very extensively diffused through the tropical ocean, and which, though generally of small size, acquires in the Philippine region dimensions nearly equal to those of the fossil *Amphistegina* of the Vienna and other tertiary deposits. But Mr. Cuming's Philippine collection contains another and far larger species, which is distinguished by the extraordinary thinning-out of the last whorl; and it is remarkable that in this species the canal-system is highly developed, although completely absent in *A. gibbosa*,—a difference of structure, which, going along with very close resemblance in external aspect and general conformation, seems only to be accounted for on the supposition that the difference in size requires a difference in the arrangement of the nutrient apparatus.

XXI. "Further Researches on the Grey Substance of the Spinal Cord." By J. LOCKHART CLARKE, Esq., F.R.S.
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(Abstract.)

In this communication it is proposed, for reasons assigned, to divide each lateral half of the posterior grey substance into two portions:—1. The *caput cornûs posterioris*; 2, the *cervix cornûs posterioris*. The *caput* consists of the broad or expanded extremity of the cornu, and is separated from the *cervix* by an imaginary line drawn across from the opposite anterior extremities of the gelatinous substance; the *cervix* comprises the remaining anterior portion of the cornu.

The *caput cornûs* consists of two different portions:—1. an outer and comparatively transparent portion, the *gelatinous substance*; 2. an inner and more opaque portion, or base.

1. The outer portion or gelatinous substance consists of,—
 - A. Nerve-fibres, transverse, longitudinal, and oblique.
 - B. Nerve-cells, large, small, and intermediate.
 - C. Blood-vessels, and connective tissue, with numerous nuclei.
2. The inner or more opaque portion of the *caput cornûs* is continuous with the grey substance of the *cervix*, and surrounded

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behind and on each side by the gelatinous substance, with which it varies in shape at different regions of the cord. In addition to blood-vessels and connective tissue, it consists of,—

A. Nerve-fibres, transverse, longitudinal, and oblique.

B. Nerve-cells, both large and small.

A. The longitudinal fibres form bundles of various sizes, and are broader and coarser than those of the *gelatinous substance*, which, however, they immediately adjoin.

The transverse and oblique fibres are continuous with the posterior roots of the nerves, and partly with the longitudinal fibres, which they also cross in a great variety of ways.

About the middle of the dorsal region, in the spinal cord of the higher vertebrata, the posterior cornua are united in a single mass. The inner or median half of each *cervix cornûs* is occupied by a remarkable longitudinal column, which is cylindrical or oval,—the *posterior vesicular column*. This consists of a cylinder of fibres interspersed with and surrounded by cells and thin processes. The fibres are derived from the posterior roots of the nerves, and interlace with each other in an intricate manner. The cells are oval, fusiform, and variously stellate, and differ considerably in size, but the largest are equal to those of the anterior cornu. They are elongated with thin processes transversely, longitudinally, and obliquely, and are continuous with fibres in the same direction, including the posterior roots.

At the lateral border of the grey substance, between the anterior and posterior cornua, is a small and somewhat triangular tract, which is more transparent than the rest, and projects more or less into the lateral column. This tract, which was pointed out by the author in 1851, and is named the *tractus intermedio-lateralis*, consists of oval, fusiform, and triangular cells, which are smaller and of more uniform size than those of the surrounding substance. Some of them are elongated transversely and longitudinally,—transversely both in a lateral and antero-posterior direction,—and send their processes on the one hand to the transverse commissure, and on the other to the anterior and posterior cornua.

In receding from the dorsal to the cervical region, the central portion or cylinder of each posterior vesicular column is reduced in size and less completely circumscribed. In the middle of the cervical

enlargement it entirely disappears, but the whole inner half of the *cervix cornûs* is still interspersed with numerous cells of various shapes, and traversed by the posterior roots and the fibres of the transverse commissure. At the origin of the third pair of cervical nerves, a darker mass reappears in the same situation, but gradually diminishes as it ascends to the medulla oblongata.

The *tractus intermedio-lateralis* is larger in the upper part than in the middle of the dorsal region, and projects further into the lateral column. As it ascends, however, through the cervical enlargement, it gradually diminishes, and at length disappears; but the lateral portion of the grey substance contains numerous branched and elongated cells, amongst which are a few that resemble those of the *tractus intermedio-lateralis*; it is traversed by the anterior and posterior roots, and by the lowest roots of the spinal-accessory nerve on their way to the anterior cornu. In the region of the first pair of cervical nerves, a distinct vesicular tract reappears at the lateral part of the grey substance. It is traversed by the roots of the spinal-accessory nerves, and partly by those of the spinal nerves. Its cells are elongated transversely and longitudinally. Ascending the medulla oblongata, this vesicular tract makes its way inwards to the space behind the central canal, where it forms the nucleus of the upper roots of the spinal-accessory nerve.

In descending the cord from the dorsal region, the grey substance undergoes a series of changes nearly similar to those which are observed in ascending to the cervical enlargement. But in the upper part of the lumbar enlargement, the posterior vesicular columns are much larger than in any other region of the cord, and contain more large cells. Through the rest of the lumbar enlargement the number of large cells diminishes; but they are still traversed and surrounded by the posterior roots of the nerves, and by the transverse commissure.

In the spinal cord of Man, the form of the grey substance differs in some respects from that in Mammalia. Throughout the whole of the dorsal region the posterior cornua stand completely apart. The posterior vesicular columns are oval, but in structure resemble those in the Ox. In the middle of the cervical and lumbar enlargements, their cells, in connexion with the posterior roots, are very small, but numerous.

The *tractus intermedio-lateralis* in Man presents nearly the same appearance as in Mammalia, and contains the same kind of cells. In the lumbar region it is still prominent at the side of the grey substance, but its cells are less numerous than in the dorsal region. In the upper part of the cervical region a similar tract reappears, which is traversed by the roots of the spinal accessory, and those of the spinal nerves.

In Birds, as in Mammalia, the posterior cornua are united in a single mass, both in the dorsal region and lower part of the *conus medullaris*; and the gelatinous substance extends uninterruptedly across from side to side. There are no dark masses corresponding to those of the posterior vesicular columns of mammalia, although numerous cells are scattered through the same space. There are no traces of any distinct *tractus intermedio-lateralis*. In Reptiles it is only in the *conus medullaris* that the posterior cornua form a single mass. A distinct stratum of small fusiform cells, in connexion with the fibres of the posterior roots, extends diagonally from the point of each cornu to the transverse commissure.

In the Ox and Sheep the epithelium of the canal consists, not of cylindrical, but of fusiform cells arranged in close apposition. The fibres proceeding from them are precisely similar in appearance to those of the connective tissue which surrounds the cord, and, like those fibres, they are in connexion at intervals with minute nuclei; in the *filum terminale* the author has satisfactorily traced them *through* the grey substance to the surface of the cord. In the *filum terminale*, where the nerve-cells and nerve-roots entirely disappear, the canal, and consequently the number of epithelium-cells, are much greater than in the cervical or lumbar enlargement, where the nerve-cells and nerve-roots are abundant. These facts are opposed to the statements of those observers who profess to have traced their connexion with nerve-cells and nerve-fibres.

The white columns of the cord are traversed by a network of connective tissue, which abounds with nuclei and small cells precisely similar to those found in the grey substance.

In the *conus medullaris*, the author has distinctly seen some of the anterior roots of the nerves form loops around the group of stellate cells, instead of terminating in them.