Additional Observations on the Nerve-Elements of the Embryonic Lobster.

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In Vol. III., No. 3, p. 208, of this Journal, a summary was given of certain observations made in the Plymouth Laboratory on the nerve-elements of the embryonic lobster. A more detailed description of these elements, with figures, appeared in the *Quarterly Journal of Microscopical Science*, vol. 36, 1894. The observations have since been extended, and the following summary of the additional results may not be without interest.

In the detailed paper a pair of elements (Element B) was described occurring in the ganglia Thorax II., Th. V., and Th. VIII., each of which consisted of a cell lying in the lateral mass of ganglion cells, which gave off a fibre decussating with its fellow of the opposite side, and then running forward to the brain. Before leaving the ganglion in which the cell lay, the fibre gave off a pair of branches, one going to the ganglion immediately in front, the other to the ganglion immediately behind, the branches breaking up in the neuropile of each of these ganglia. Thus Element B, in Th. II., sent a branch to Th. I. and to Th. III.; Element B, Th. V., sent branches to Th. IV. and Th. VI.; Element B, of Th. VIII., sent branches to Th. VII. and Th. IX., the main fibres running forward to the brain.

A precisely similar element has since been found in Th. XI., sending branches to Th. X. and Abd. I., so that the series is now complete for the thorax, and each of its ganglia appears to be influenced by these elements, the fibres of which arboresce in a particular region of the brain.

A number of additional motor fibres, which cannot well be described without drawings, have also been observed in the thorax, some of which resemble those figured in the former paper, whilst others differ from

them in essential details. Some of these motor elements send their fibres out of the cord through the anterior nerve roots, others through the posterior.

The motor elements previously described are all characterised by the fact that the fibre leaves the central nervous system through one of the roots of that ganglion in which the cell attached to it is situated. The portion of the element which lies within the central nervous system is therefore entirely confined to one ganglion. In a number of elements, which have since stained, whilst the cell lies in one ganglion, the fibre passes out of the cord by the nerve-root of some other ganglion. In one such element, the cell lies in the anterior portion of the central mass of ganglion cells of Th. VII., and gives off a fibre which runs outwards and then upwards, to Th. VI., where it passes out by the posterior root of the ganglion. The fibre gives off a stout arborescent branch in Th. VII., and a straight transverse branch in Th. VI., which passes across to the opposite side of that ganglion.

Of elements belonging to new types, perhaps the most interesting are those which, taking origin in a single cell, have two or more branches, which pass out of the central nervous system by the nerve-roots of different ganglia. For example, a cell lying in the anterior portion of the lateral mass of ganglian cells of Thorax VIII., gives off a moderately fine fibre, which very soon bifurcates, one branch passing immediately out of the ganglion through the anterior nerve-root, whilst the other runs forwards along the ganglionic cord. The forward branch pursues a perfectly straight course until it reaches Th. III., where it gives off a branch, which passes out through the posterior root of that ganglion. After giving off this branch the fibre continues to Th. II., where it turns and leaves the ganglion through the posterior root. Hence this element, the cell of which lies in Th. VIII., supplies fibres to at least three nerve-roots of different ganglia, namely, the anterior nerve-root of Th. VIII., the posterior root of Th. III., and the posterior root of Th. II., and all these fibres have their origin in a single cell.

In the *Abdominal Ganglia*, staining of nerve elements can be obtained in two ways. In the case of embryos in the early or medium stage, fibres which have taken up the methylene blue in the thorax, often continue to absorb the colouring matter in the abdomen, and the cells with which they are connected are thus brought to light. The best results for the abdominal ganglia can, however, be obtained by special preparation of embryos, which are very near the hatching point. In such embryos the abdominal ganglia may be dissected out from the surrounding tissue by careful manipulation with needles. Special care

must be taken not to injure or stretch the ganglia, and their continuity with the ganglia of the thorax should be maintained. If the embryo, thus prepared, be placed with the dorsal surface uppermost in very dilute methylene blue, satisfactory staining of many of the elements of the abdomen will soon take place.

The elements of the abdomen belong to types similar to those described for the thorax.

In each ganglion a pair of elements exists, taking origin in two ganglion cells lying upon opposite sides. Each cell gives off a fibre, which after decussation with its fellow, passes to the opposite side of the ganglion, and gives off a branch to the neuropile. It then turns forward and runs along the cord to the brain. In this way each of the ganglia of the abdomen is placed in direct communication with the brain.

In the sixth abdominal ganglion two pairs of elements of this type occur, thus pointing to the composite nature of the ganglion.

A considerable number of motor elements, consisting of a cell in one of the ganglia, and a fibre which passes out of the central nervous system, have stained in the abdomen. These are of two kinds; first, those in which the element is confined to a single ganglion, the fibre passing out through one of the roots of the ganglion in which the cell lies, and secondly, those in which the fibre leaves the central nervous system by a nerve-root of a ganglion other than that in which the cell lies. These will be described in detail in a later paper.

Further observations have also been made on the sensory nerve elements, which have their origin in cells lying outside the central nervous system. These fibres, on entering a ganglion, make a characteristic Y-shaped bifurcation, sending one branch forwards and the other backwards along the cord. These branches have been traced for considerably greater distances than was previously possible, the forward one having been seen to pass through at least nine or ten ganglia. In all probability, all these forward branches go in every case to the brain. The backwardly directed branch has never been actually traced through more than two or three ganglia, and no indication has been obtained as to the locality or nature of its termination.

A detailed account of the observations here recorded will be published in the *Quarterly Journal of Microscopical Science.*