

ance of spores of low resistance in dilute buffer solution. For example, the heat resistance of *Cl. botulinum* type *E* was increased about 30,000 times by equilibration at 25° C. to an a_w of about 0.8. The same treatment increased the heat resistance of spores of *B. megaterium* and *B. stearothermophilus* by factors of about 3,000 and 10 respectively. In the dilute buffer solution, the resistance of spores of *B. stearothermophilus* was some 30,000 times the resistance of spores of *Cl. botulinum* type *E*, but after controlled drying this ratio was reduced to about 10.

For each type of spore there was a range of a_w at which the resistance to heat was appreciably greater than in the phosphate buffer. Qualitatively, this situation is well known, as spores have long been known to be more readily destroyed by 'moist' heat than by 'dry' heat. It may be noted, however, that the most rigorous drying, namely, storage over phosphorus pentoxide, did not cause the greatest increase in heat resistance. In general, the greatest heat resistance was found with spores equilibrated at about a_w 0.8–0.9, the maximum resistance being 10–100 times the value obtained with the very dry spores. For *Bacillus megaterium* the resistance increased steadily as a_w increased from zero to about 0.9. For *B. stearothermophilus* and *Cl. botulinum* type *E* there was a fairly wide zone between a_w 0.2 and 0.85 in which the resistance did not change greatly.

These results support the hypothesis that the heat resistance of bacterial spores in dilute solution is largely dependent on the maintenance of some part of the spore contents in a relatively dry state.

Further details of these results, together with a discussion of some of the implications relevant to an understanding of heat resistance, will be published elsewhere.

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¹ Robinson, R. A., and Stokes, R. H., "Electrolyte Solutions", Appendix 8, 11 (Butterworth, London, 1955).

Embryology of X Organs in *Crangon allmanni*

RECENTLY, I have shown the presence of true paired frontal organs in species of Decapoda Natantia where the sensory pore X organ¹ was simultaneously well developed². Consequently, the supposed homology between the paired frontal organs of lower Crustacea and the sensory pore X organ and eye papilla can no longer be accepted, and interest in the derivation of the X organs is renewed. As information on their ontogeny is scanty and mostly refers to late stages^{3,4}, investigations on embryological material of *Crangon allmanni* were carried out.

Both the cells of the sensory pore X organ and those of the medulla terminalis ganglionic X organ¹ are derived from neuroblasts in the anterior wall of the medulla terminalis ganglion layer. The first onion body¹ appears approximately simultaneously with the compound eye pigment. This agrees with observations made on *Birgus* by Orlamünder³; but nothing emerged in support of his view that the sensory pore X organ is induced by the wandering

in of an ectodermal gland cell. The first onion body lies immediately below the integument surrounded proximally and laterally by cells of the sensory pore X organ which are rather well provided with cytoplasm and probably form a syncytium⁵. I could not trace the course of the axons concerned with the formation of these very early onion bodies. The cells of the future medulla terminalis ganglionic X organ at this stage are of a neuroblastic type with large vesicular nuclei and very little cytoplasm. Staining reactions with Gomori hæmatoxylin and phloxin and with the Gabe paraldehyde fuchsin give no indications of neurosecretory activity in these cells. The sensory cells of the sensory pore cannot yet be identified but the mantle cells⁶ begin to appear early and are closely connected with the interstitial tissue between the medulla interna and externa and between the medulla interna and terminalis. When the sensory cells begin to appear in late embryonic stages they are derived from the medulla terminalis ganglion layer. In the free-swimming larva the organization of the X organs and the sensory pore complex is essentially similar to that found in the adults.

The investigation throws light on the discussion of the derivation of neurosecretory cells from nerve cells or vice versa^{7,8}. The neuroectoderm forming the medulla terminalis ganglion layer also produces the cells of the hypodermis of the corresponding region of the eye-stalk and part of the mantle cells mentioned above. The neurosecretory cells are formed from neuroblasts which have already wandered in. But they are not formed directly from neuroblasts; the latter first develop into young nerve cells the axons of which are formed and could in many cases be traced to the medulla terminalis before any signs of neurosecretory activity in the cytoplasm became evident.

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Lund. Dec. 12.

¹ Knowles, F. G. W., and Carlisle, D. B., *Biol. Rev.*, **31**, 396 (1956).

² Dahl, E., *K. Fysiogr. Sällsk. i Lund Förh.* (in the press).

³ Orlamünder, J., *Z. Wiss. Zool.*, **155**, 280 (1942).

⁴ Pyle, R. W., *Biol. Bull.*, **83**, 87 (1943).

⁵ Carlisle, D. B., and Passano, L. M., *Nature*, **171**, 1070 (1953).

⁶ Hanström, B., *Zool. Jahrb. Anat.*, **56**, 387 (1933).

⁷ Hanström, B., *K. Fysiogr. Sällsk. i Lund Förh.*, **24**, 1 (1954).

⁸ Clark, R. B., *K. Fysiogr. Sällsk. i Lund Förh.*, **26**, 1 (1956).

The Australasian Barnacle, *Elminius modestus*, in France

THE Australasian barnacle *Elminius modestus* Darwin has been recently recorded from several localities in northern France¹. In September 1954, we carried out independent surveys along the whole of the Channel and Atlantic coasts of France to define the limits of distribution of this immigrant species. The observations made show that *E. modestus* was established over two large areas of the French coast. These extend from the Belgian frontier to Cap de la Hague and from the estuary of the Jaudy to the Rade de Brest (Fig. 1).

In the first of these areas much of the coastline is characterized by gently sloping sandy or shingle beaches, but *E. modestus* could be found wherever there were suitable surfaces for settling and was almost as common on the open coast as in the sheltered harbours and estuaries. It was notably abundant at Le Havre, Trouville, Omaha Beach