# The pressure responses of lobster larvae following selective cautery and treatment with surface active substances

E. Morgan[1]

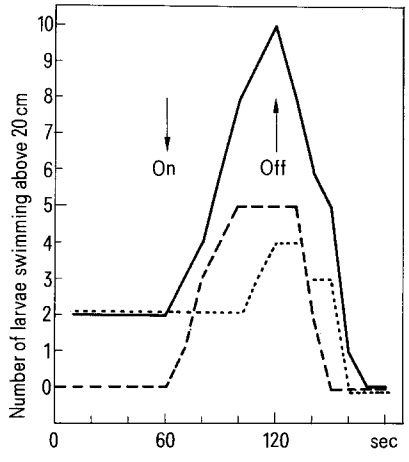
*Department of Zoology and Comparative Physiology, University of Birmingham, P.O. Box 363, Birmingham B15 2TT (England), 24 April 1978*

*Summary.* The pressure responses of phase II larvae of the lobster, *Homarus gammarus,* are not affected by Cetavlon cetrimide, nor by other surface active substances. Amputation of the first and second antennae indicates that these structures, like the embryonic statocyst are essential neither for the perception of the pressure stimulus, nor for the orientation of the response.

Behavioural responses to hydrostatic pressure changes of less than 1 atmosphere have been demonstrated in a number of marine invertebrates[2-5] and Digby[7], has suggested that a thin film of gas located on the body surface may provide the basis of their pressure sensitivity. The presence of a gas layer was inferred from a series of experiments in which he recorded an electro-potential difference across the integument of the prawn *Palaemonetes varians* and found the resulting current flow to be sensitive to changes in pressure. These observations are consistent with the compression of a gas phase but it is unclear from these experiments whether the gas is located on the body surface or on the surface of the electrode itself. Evidence that the gas film was indeed located on the cuticle came from a further series of experiments in which surface active compounds were found to eliminate the pressure responses of mysid and decapod Crustacea[6]. For example Cetavlon cetrimide BP, which forms a positive complex ion in solution was found to abolish the response of the mysid *Praunus flexuosus,* and similar results were obtained with urea and hydrogen peroxide. Changes in salinity or pH have also been found to eliminate the response[6-8], and these observations are consistent with the destruction of a surface layer of hydrogen gas.

Not all pressure-sensitive animals have their ability to respond to pressure changes impaired in this way however. Recent work has shown that the sensitivity of lobster larvae is unaffected by such treatments and these experiments are described here.

*Methods.* Stage-II larvae of *Homarus gammarus* were obtained from captive, ovigerous, lobsters and held in outside tanks of running sea water at the Marine Biological Station, Port Erin, Isle of Man. Their pressure responses were studied in a transparent perspex pressure chamber 61 cm tall with a 6 $cm^2$ cross section. A small air space was left at the top of the vessel and the pressure changed by means of a bicycle pump with a valve attachment. This was connected to a Bourdon gauge and the pressure monitored directly. All experiments were carried out under natural ambient lighting in the laboratory at a temperature of approximately 22 °C.




The responses of 10 stage-II lobster larvae to a 1225 mb pressure pulse of 1 min duration after 10 min (solid line) 20 min (dashed line) and 60 min in a 0.1% Cetavlon/sea water solution. The times of application and release of pressure are indicated by the arrows.

*Results and discussion.* An increase in pressure within the 68–1360 mb range elicits an upward swimming in the lobster larvae, while the subsequent release of pressure is followed by a downward movement[9]. This behaviour pattern is unaffected by treatment with Cetavlon, and the figure shows the response of 10 stage-II larvae to a single pressure pulse of 1225 mb magnitude and of minute duration. The final concentration of Cetavlon in the pressure chamber, 0.1%, was 10 times that required to obliterate the response of *Praunus*[7], and this concentration was found to be lethal to the larvae after a few hours. Even so the animals were still clearly responsive as long as they were able to swim. Similar responses were observed in sea water solutions of urea and hydrogen peroxide, even when these were used in lethal concentrations, although the overall level of swimming activity varied in the different treatments. In mysids an increase in the salinity of the external medium destroyed the pressure responses, presumably by reducing the electro-potential across the integument, but *Homarus* larvae were still responsive in approximately 1.5 strength sea water (SG 1035).

In another series of experiments the first and second antennae of the stage-II larva were removed without noticeably affecting the animals ability to respond to pressure changes, indicating that the embryonic statocyst[10] is not essential either for perception of the stimulus or for the orientation of the response. Moreover the pressure sensitivity of the larvae was not impaired by the abrasive treatment to which they were subjected during the course of these operations although rough handling has been found to obliterate the pressure response of other decapod crustacea and of the chaetognath *Sagitta*[5,11].

It would appear therefore that if cuticular gas is involved in pressure perception by lobster larvae it must be unaffected by rough handling or by the surface active substances used in the above experiments.

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