In view of the demonstrations that colchicine interferes with axoplasmic transport in a variety of preparations[5,6,13], including the cockroach nervous system[12], we favour the second possibility mentioned above, namely, that the present findings are the result of axoplasmic transport blockage by colchicine. In this regard, at least 3 rates of protein transport (1, 24 and 72 mm/day) have been shown in the cockroach[14]. Whether any of these proteins are involved in the synaptic changes described is not yet known; further studies are in progress in order to elucidate the problem.

Resumen. La facilitación de transmisión sináptica en un ganglio de cucaracha se puede inducir mediante hiperuso de reflejos anti-gravitatorios. La inyección intraganglionar de colchicina inhibe reversiblemente la modificación sináptica sin alterar la conducción nerviosa. Este resultado puede explicarse considerando que la colchicina bloquea el proceso de progresión axoplasmática.

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Responses to Osmotic Concentration Changes in the Lobster Antenna

It is well known that stenohaline Crustacea reside in an environment with limited variability of concentration and that they avoid unsuitable osmotic conditions. Although the presence of osmoreceptor is presumed, a specific organ sensitive to changes in osmotic pressure has not been identified. Motor responses have been studied in a marine crab when the antennule is stimulated with various concentrations of sea water[1]. Chemoreceptor responses in Decapods have been reported by many authors[2–4], but water responses, such as are described in vertebrate chemoreceptors[5,6], have not been observed. This paper communicates afferent responses to osmotic concentration changes of various solutions in the lobster antenna.

Material and methods. The antenna of the lobster *Panulirus japonicus* consists of stout basal segments and a long flexible flagellum. Recordings of afferent impulses from antennal nerves were performed on the isolated flagellum of about 5 cm in length. Two recording electrodes (silver wire covered with a glass capillary except for the wire tip) were introduced into the lumen from both the cut ends respectively. Impulses were picked up on the tip of electrode and displayed on a cathode-ray oscilloscope through a CR amplifier (time constant, 0.01 sec). Among chemicals tested were NaCl, choline-Cl, sucrose and glycerol. These test solutions were made up in the pure water of various concentrations. A small amount of the test solution (0.2 ~ 0.4 ml) was applied to the cuticular surface of the antenna by means of a small glass pipette. After stimulation, the material was washed with sea water. All the experiments were carried out at room temperatures (20 to 22 °C).

Results and discussion. The application of pure water gave rise to a high-frequency volley of impulses for several seconds. The water sensitive organ was found to be a small seta with many hairs on its tip found in great numbers distributed over the exoskeleton of the flagellum.

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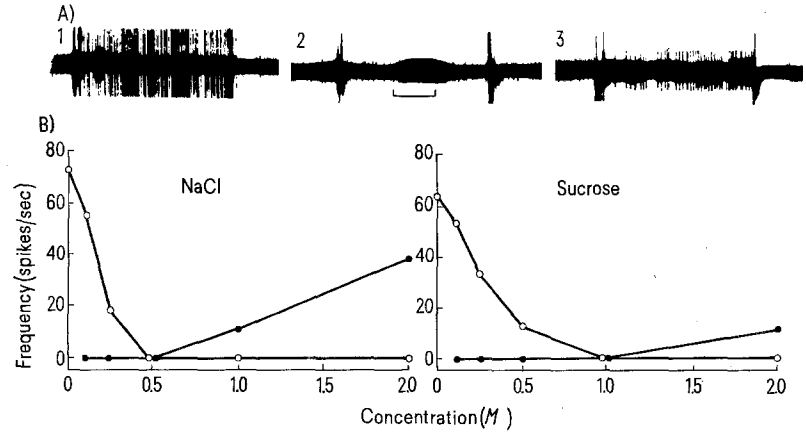

Responses to osmotic concentration changes. A) electrical recordings of responses to stimuli of NaCl solutions. 1. 1/8 *M*; 2. 1/2 *M*; 3. 3.1 *M*. 1/2 *M* NaCl is osmotically equivalent to sea water. Large and small units were evoked at hypotonic and hypertonic concentrations, respectively. Large deflections of traces before and after the responses indicate stimulus and wash artifacts. Calibration: horizontal bar, 1 sec. B) responses partly shown in A were plotted with frequency against concentration of NaCl or sucrose. Open circle, large unit; solid circle, small unit.

A series of test solutions with ascending concentration were dropped on the cuticular surface where a number of setae stood out. An example of the response is illustrated in Figure A. Two distinct responses were evoked at concentrations below and above $^1/_2M$ NaCl respectively. Responses to varying concentrations of NaCl and sucrose are shown in the graphs of Figure B. While response magnitude shown as impulse frequency decreased with increasing concentration of hypotonic solutions, it increased with increasing concentration of hypertonic solutions. These responses disappeared in $^1/_2M$ NaCl or $1M$ sucrose which was the isotonic concentration for marine Decapods. Similar response characteristics were observed with other solutes, choline-Cl and glycerol. Since the solutes tested were electrolyte and non-electrolyte, it is unreasonable to think that a specific substance elicited the effect on the receptor. The water sensitive setae did not respond to tactile and chemical stimulations. Although mechanoreceptor impulses also appeared for a brief period just when test solutions were applied, the discrimination between the two responses was made by differences in their time course and impulse amplitude. Mechanical stimulation given to individual hairs revealed that mechanoreceptor responses came from other hair sensilla and adapted rapidly. These sensilla were not sensitive to water. It is unlikely, therefore, that mechanosensory hairs respond to osmotic concentration changes.

The result suggests that the setal organ on the antenna is an osmoreceptor because a parameter of the test solutions correlated to the response is osmotic pressure.

The water receptors in the cat[5] and frog[6] are not associated with osmotic sensitivity, and the water sensitive receptor in the blowfly[7] does not behave as an osmoreceptor to salts or non-electrolytes other than sucrose. The responses described in the present study are different in nature from the water responses in the organs mentioned above. It is considered that the two receptor cells sensitive to changes in osmotic pressure may occur in a single seta because two types of response took place at hypotonic and hypertonic concentrations respectively. The activity of individual setae should be further studied for clearing this point.

Zusammenfassung. Es wurden an den grossen Antennen des marinen Hummers, *Panulirus japonicus*, die afferenten Antworten auf Änderungen in der osmotischen Konzentration von verschiedenen elektrolytischen und nichtelektrolytischen Lösungen untersucht. Die Borstenorgane der Antennen scheinen Änderungen des osmotischen Druckes der Badeflüssigkeit wahrzunehmen.

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Determination of the Biliary Dead Space Using ^{14}C-Taurocholate as a Marker

Whereas organ structure and its relation to function has been extensively explored for the kidney[1], relatively little is known about such relationships in the liver. Clearance measurements with easily diffusible solutes, like erythritol, have allowed to differentiate between canalicular and ductular bile formation. By contrast, knowledge concerning the dimensions and the functional importance of the biliary spaces is scarce. About 10 years ago Barber-Riley[2] introduced a method to measure the volume of the biliary tree by determining the washout volume of bile after rapid i.v. injection of BSP. However, as demonstrated by Sicot et al.[3], this method permits at best rough approximations, and probably overestimates the true value. The limitations of such measurements arise from the unknown transit time of the marker between its injection and appearance in bile. These transit times have been neglected in previous studies. The use of a marker substance which signals its appearance in bile by producing an increase of bile flow should permit us to eliminate these variables. An approach using ^{14}C-taurocholate as a marker substance was therefore employed to determine the biliary dead space.

Materials and methods. Male Sprague-Dawley rats weighing 280 to 370 g, maintained under standard laboratory conditions, were used. The common bile duct was cannulated under pentobarbital (Nembutal®) anesthesia (5 mg/100 g body wt. i.p.) with PE 10 polyethylene tubing just below the bifurcation. The body temperature was maintained between 36.5 and 37.5 °C by using a warming lamp and a heated operating table. After a control period of 15 min, sodium-24-^{14}C-taurocholate[4] (8 µmoles/100 g body wt., 37.5 µCi/mmole) dissolved in a volume of 0.3 ml of saline was rapidly injected in 15 rats via a jugular catheter and flushed with 0.3 ml of isotonic saline. Bile was collected in 20 sec periods up to 300 sec and in 1 min periods up to 480 sec and weighed. Thereafter 5 ml of Instagel® were added and radioactivity was measured in a Packard Tricarb liquid scintillation counter. The counting efficiency was determined by the channel ratio method employing an external standard.

The volume of the biliary dead space was calculated in 2 ways: *Method I: Calculation according to* Barber-Riley *as modified by* Sicot[3]. By this approach the biliary dead space is calculated as the volume of bile collected between i.v. injection and appearance of a marker in the collected bile. Since the marker does not appear in bile as a flat concentration front, the volume of the biliary dead space (BDS) is calculated in the following way:

$$\mathrm{BDS} = \mathrm{Vol}_{max} - \sum_{i=1}^{i\mathrm{C}_{max}} \frac{\mathrm{C}_i}{\mathrm{C}_{max}} \cdot \mathrm{Vol}_i - \mathrm{Vol}_{catheter}$$

Vol_{max} stands for cumulative volume of bile collected from the time injection until maximal concentration (C_{max}) of the marker in bile is reached. $i=1$ denotes the first sample after injection and $i\mathrm{C}_{max}$ the sample in which C_{max} is reached. C_i represents the concentration of the marker in the single sample i, and Vol_i the volume of sample i.

Method II: Modified approach for calculation of biliary dead space using a choleretic marker substance. This approach is based on the assumption that the increase of bile flow, which follows the administration of tauro-

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