evoked pigment release initially, and finally suppressed all spontaneous movement. Fragments left in the weak solutions eventually recovered.

Saliva lot *B* can be taken as an example. At 4/1,000 there was an immediate release of pigment and increased waving of spines. In three minutes the response to shading was lost in concentrations of 4/1,000, 2/1,000, 1/1,000, and 0·5/1,000. The response to prodding disappeared in 6 min at 4/1,000, in 38 min at 2/1,000, and was not lost at 1/1,000. In another series, saliva (lot *A*) decreased the response of fragments to shadow and touch in dilutions as great as 4/10,000. There was a questionable depression at 3/10,000. By means of small doses it was not possible to block the light response alone. The effect of the toxin at any effective dilution progressed and then declined, so that a level state at any one stage of inhibition was not attainable.

The spontaneous recovery of fragments under supposedly continuous exposure was subjected to further analysis. Such fragments transferred to fresh solutions were again affected. Untreated pieces placed in the old solution were inhibited little, or not at all. Dilutions in sea-water left at room temperature retained their activity, however, if not in contact with *Diadema*.

Cassis tuberosa has large paired salivary glands comprising a large hyaline posterior portion from which a duct passes through the smaller brown opaque anterior lobe. An aqueous brei of these glands inactivates *Diadema*, so the gland is indicated as the source of the toxin. The other two species of *Cassis* on Bimini, *C. madagascarensis* and *C. flammea*, also have large paired bilobed salivary glands with toxicity comparable with the glands of *C. tuberosa*.

The helmet conch is supplied with a poisonous saliva capable of incapacitating the surface organs of the black urchin and thereby decreasing his mobility and the effectiveness of his spines. It would now appear that the play of the proboscis among the spines of the urchin, as described by Schroeder[2], serves to deliver the poison to the body surface, where it is most effective.

The saliva blocks response to touch and to all the different responses to light: spine convergence on a shaded area, inhibition of spine movement under steady illumination, and increased movement under increased light[3].

The active principle of the saliva would appear to be a neurotoxin, since it first inactivates the sensory receptors or their afferent nerves. Receptors cannot be distinguished morphologically from nerves, but the physiological evidence points to a sequence of events in the receptor-effector arc[4]. The systems responding separately to mechanical and actinic stimulation[3] are separately affected by the toxin. It can block photoreception temporarily without interfering with the tactile sense, or with transmission of the impulse throughout the body. Below a damaging level, the effect is reversible, even when it has proceeded to the extent of eliminating all response and all spontaneous movement. Immobilized pieces placed in fresh sea-water regain activity in a few minutes. The urchin, or even a piece of the body wall, can inactivate the poison. Ascribing this inactivation to bacterial decomposition would appear unjustified, since the saliva is antibiotic, and solutions allowed to stand at room temperature maintain full toxicity for 24 h. Loss of activity is accompanied by a drift towards neutrality (the saliva is strongly acid), but saliva initially neutralized retains its paralysing properties.

IVOR CORNMAN

Hazleton Laboratories, Inc.,
Falls Church, Virginia, and
Lerner Marine Laboratory,
Bimini, Bahamas.

[1] Moore, D. R., *The Nautilus*, **69**, 73 (1956).
[2] Schroeder, R. E., *Sea Frontiers*, **8**, 156 (1962).
[3] Millott, N., *Phil. Trans. Roy. Soc.*, B, **238**, 187 (1954).
[4] Yoshida, M., *J. Exp. Biol.*, **39**, 589 (1962).

Long-distance Migration of Atlantic Salmon

IN recent years reports have appeared[1–4] of Atlantic salmon bearing English or Scottish tags being caught on the west coast of Greenland, and Atlantic salmon tagged in Canada[5] have also been caught in the same area.

Two further records are now to hand, both in respect of salmon tagged as smolts at this Ministry's research installation on the River Axe, south Devon.

The first, a male, was tagged on April 20, 1960, and was recaptured off Sukkertoppen (65° 20′ N., 53° 00′ W.) on October 26, 1961, length 73 cm and weight 4 kg. The second, a female, was tagged on April 11, 1961, and was recaptured near Kangerdluarssorujak (60° 40′ N., 45° 45′ W.) in the Julianehaab District of west Greenland on November 19, 1962. It was then 94 cm long and weighed 4·7 kg.

The minimum distance travelled by the first fish (the longer journey) was approximately 2,300 miles from the point of tagging to the point of recapture.

Nielsen[2] states that the duration of the freshwater life, before migration as smolts, of the west coast of Greenland salmon catch indicates that these salmon are, for the most part, of more southern, non-Greenlandic origin. As increased numbers of smolts were tagged in English and Welsh rivers last year further recaptures off Greenland of British-tagged fish are anticipated this autumn.

We thank the Ministry for Greenland, Charlottenlund, Denmark, for sending details of the recaptures.

I. R. H. ALLAN
M. J. BULLEID

Salmon and Freshwater Fisheries Laboratory,
Ministry of Agriculture, Fisheries and Food,
Whitehall Place, London, S.W.1.

[1] Menzies, W. J. M., and Shearer, W. M., *Nature*, **179**, 790 (1957).
[2] Nielsen, J., *Meddelelser om Gronland* (Copenhagen), **159** (8) (1961).
[3] Swain, A., Hartley, W. G., and Davies, R. B., *Nature*, **195**, 1122 (1962).
[4] Swain, A., *Nature*, **197**, 923 (1963).
[5] Kerswill, C. J., and Keenleyside, M. H. A., *Nature*, **192**, 279 (1961).

Hexagonal Patterns in Cell Membranes

Dourmashkin, Dougherty and Harris[1] demonstrated a hexagonal pattern on some viral and mammalian membranes treated with saponin. They took the view that the pattern was revealed by the removal of certain lipid components and suggested that their observation supported the mosaic structure proposed for cell membranes by Parpart and Ballentine[2] in which lipid cylinders, 90 Å in diameter and spaced at 150 Å centre to centre, are enclosed in a protein mesh. Muir[3] has produced the same effect in the plasma membrane of rat intestinal epithelium by *in vivo* treatment with saponin.

Kavanau[4] has proposed, on the basis of other evidence, a new theory of membrane structure and function based on the concept of a hexagonal mosaic arrangement of the lipid component in discrete bimolecular leaflets which can transform to a more open arrangement of cylindrical columns under prescribed conditions.

Bangham and Horne[5] and Glauert, Dingle and Lucy[6], however, have shown that patterns like those of Dourmashkin *et al.* can be induced in monolayers of cholesterol and in mixtures of cholesterol and lecithin by treatment with saponin. These authors suggest that their figures are formed by the insertion of saponin molecules into the film. Husson and Luzzati[7] also, using X-ray diffraction techniques, have shown that in saponin-treated red cell membranes a hexagonal lattice of 165 Å spacing can be detected, whereas only a lamellar structure is shown in cell membranes prepared by the use of hypotonic phosphate. They conclude that their results argue against an intrinsic pattern in the normal membrane.

In a recent investigation[8] of the fine structure of the marine protozoan *Gromia oviformis* we were unable to find a normal cell membrane. Instead, we found at the cell