Salt Transport By Eel Gill Epithelium
II. Attempts To Define The Site Of Active Transport

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In general, the transport properties must be different at the two surfaces of secretory cells which are normal to the direction of secretion. These experiments are part of an attempt to define these differences in the salt secreting cells of the gill epithelium. In order to characterize ion transport across each surface of a cell, it is necessary to know the electrical potential difference across each surface. Therefore, preliminary measurements were made of the electrical potential difference between the fluid bathing the outside of the gills and the inside of the cells, as well as between blood stream and gill cells in eels anesthetized with MS 222 (Sandoz). The intracellular potentials were recorded with Ling-Gerard glass microelectrodes (tip diameter less than 1 micron) filled with 3 M KCl and connected via a silver-silver chloride electrode to a very high impedance electrometer (Cary). The indifferent silver-silver chloride electrode made contact via a catheter filled with KCl agar either with the fluid outside the gills or with the mesenteric artery. When .15 M NaCl bathed the outside of the gills, the average cell potential was -15 mV to the outside solution and -17 mV to the blood. When the outside of the gills was bathed with .005 M NaCl, the average cell potential was -30 mV to the outside solution and -50 mV to the blood. When the outside of the gills was bathed with sea water, the average cell potential was -10 mV to the outside solution and -5 mV to the blood. Marked variation in the potential recorded in successive punctures suggested that the potential is not the same in all cells of the gill epithelium.

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Salt Transport By Eel Gill Epithelium
III. The Role Of Blood Pressure And Flow In Salt Transport In The Perfused Eel Gill

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In order to evaluate the role of filtration in producing the high ratios of NaCl outflux to influx noted in the previous report, the experimental setup was modified by replacing the heart with a constant frequency variable stroke pump which maintained a constant output independent of the pressure into which it was pumping. A similar pump produced a constant flow of fluid over the outside surface of the gills. The temperature of the perfusion fluids on both the outside and the inside of the gill membrane were maintained at 12°C by an appropriate cooling system. The fluid perfusing the outside of the gill membrane flowed through a vial placed in a

wellscintillation counter so that the Na^{22} concentration in the outside solution could be monitered continuously by a rate meter throughout the experiment. With this preparation, it was shown that the sodium outflux was directly proportional to the blood flow in the range of flow from 0.6 to 4.7 ml/min. Doubling the blood flow (with consequent doubling of sodium outflux) was associated with an increase in ventral aortic pressure of 6 mm Hg. Increase in the dorsal aortic pressure by 6 mm Hg produced only a 10% increase in sodium outflux. The removal of colloid (6% Ficol) from the blood perfusion fluid caused a marked increase in sodium outflux. These results emphasize the importance of controlling blood flow, capillary pressure and colloid osmotic pressure before attempting to approach the problem of active sodium chloride transport by the gill membrane.

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Salt Transport By Eel Gill Epithelium IV. The Effect Of Sodium Concentration On Sodium And Water Transport In Perfused Gills From Fresh And Salt Water Adapted Eels

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The experiments described in this report were directed toward the physiological role of the salt and water transport by eel gills. The experiments were performed on the perfused eel gill preparation described in a previous report. The perfusion rate was kept constant in each experiment. The fluid perfusing the blood vessels of the gills contained 6% Ficol in all experiments. When gills taken from fresh water adapted eels were perfused with fresh water (5 mM/1 NaCl) on the outside and 115 mM/1 NaCl on the inside, the outwardly secreted fluid contained 96 mM/1 NaCl. The net outward secretion of sodium was 75 μEq/min. while the outward water flow was 0.78 ml/min. In the same preparation, when the concentration of sodium in the fluid perfusing the blood vessels was increased to 240 mM/1, the concentration of sodium in the secreted fluid rose to 231 mM/1. The net outward movements of sodium and water were 383 μEq/min. and 1.66 ml/min. respectively. When gills taken from eels adapted to sea water for at least ten days were perfused with sea water (540 mM/1NaCl) on the outside and 240 mM/1 NaCl on the inside, the outwardly secreted fluid had a sodium concentration of 563 mM/1. The net outward movements of sodium and water were 17 μEq/min. and 0.03 ml/min. respectively. In this preparation, reduction of the sodium concentration in the fluid perfusing the blood vessels to 115 mM/1 produced a net inward movement of sodium of 5.1 μEq/min. while the water movement remained outwardly directed at a value of .14 ml/min. These data are consistent with the view that both fresh and salt water adapted eels filter salt and water outwardly across the gill epithelium but that in the salt water adapted form an out-