

the saline solutions were not fully equilibrated with the gas mixtures.

Because of these findings additional experiments were carried out, incubating single tubule fragments with 100% O<sub>2</sub> as the gas mixture. When tubules were incubated without perfusion, the Diobrast<sup>131</sup>I content after 1 hour was more variable than in the earlier studies, some tubules having a concentration of radioactivity only 1 to 2 times as great as the medium. Mean concentration ratio was 30 (range 1.-100., 21 tubules). Experiments incubating tubules with oil in the lumen and with stop-flow microperfusion were carried out but have not been completely analyzed yet.

Kidneys from several other species were dissected (fundulus, sculpin, pollack, skate, and dogfish) and all appeared to be satisfactory for use in similar experiments.

#### CONCLUSION:

A method has been developed for measuring directly concentration gradients of radioactive substrates between cells, lumen, and outside bathing solutions in fragments of flounder renal tubule in vitro. It seems likely that the same method can be applied to other marine species. Using this method it should be possible to investigate the kinetics of organic acid transport, correlating transport rates with the transport steps at the cell borders.

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1965 #10

#### RENAL CAPACITIES TO MANIPULATE ELECTROLYTE IN THE SPINY DOGFISH, Squalus acanthias\*

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The capacity of the kidney of the spiny dogfish to handle various electrolytes has been poorly explored, but is obviously important in understanding the pattern of this fish's adjustment to its marine environment. Simultaneous inulin-electrolyte clearances were run on normal dogfish and on fish loaded with magnesium chloride and sulphate; calcium chloride; and monosodium phosphate. Inulin urine-plasma ratios ranged from 2-15 with urine flows of 0.12-1.2 ml/kg/hr. The higher ratios (8-15) are uncommon. Thus there is always a reabsorption of filtered fluid, but a hypotonic urine. Chloride-inulin clearance ratios ranged from 0.038-0.455 (12% over 0.29). Evidence indicates that the supra-plasma urine chlorides which occur frequently result from no capacity of the kidney to concentrate chloride, but from an obligatory binding to other excreted

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cations. A salt gland (rectal gland) is charged with the duty of specifically excreting chloride.

Magnesium-inulin clearance ratios were always over one (total range, 1.45-34), and were lowered with magnesium loading. This ion seems to be always secreted, and there is always a net loss of it vis à vis plasma. Calcium-inulin clearance ratios were always below one (total range 0.115-0.95), rising on loading. This ion is always reabsorbed, but there may be a net urinary conservation or loss. Phosphate-inulin ratios ranged from 1.02-21.7, rising on loading. As indicated by others, this ion is secreted. Comparisons of plasma and centrifuged filtrates of plasma indicate that only calcium is markedly plasma-bound.

1965 #11

#### NET SODIUM FLUXES IN THE SPINY DOGFISH, Squalus acanthias

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Previous measurements of salt and water excretion in urine and rectal gland fluid from the dogfish suggested that this elasmobranch normally takes up saline solution and not merely water as might be supposed from the hypertonicity of the blood compared with sea water. This postulate was tested directly by measuring Na influx at the head end of the dogfish and total Na efflux. The head end only of two unrestrained dogfish was immersed in a sea water bath to which Na<sup>22</sup> was added. The fish had no open wounds. The bath was aerated and kept under 14°C. After a period in the bath, a blood sample was withdrawn through a previously implanted arterial catheter. The fish was returned to running sea water. Na<sup>22</sup> was then injected arterially to determine the sodium space. Finally, arterial samples were taken over a two day period to determine sodium loss. After the efflux data had been collected, the urinary papilla was catheterized for urine collections. It was not feasible in these initial experiments to catheterize the rectal gland.

Using sodium figures of 440 mM/l for sea water, and 250 mM/l for plasma, and taking the minimal (1 hour) sodium space, the net influx of sodium into the head was: Fish 1, 1.0 mmoles/kg/hr; Fish 2, 0.89 mmoles/kg/hr. This is roughly equal to an uptake of 2 ml/kg/hr of sea water. These data do not define the site or sites of uptake.

The net loss of sodium was: Fish 1, 0.92 mmoles/kg/hr (first 18 hour period); Fish 2, 0.87 mmoles/kg/hr (14.5 hour period). Urinary loss varied from 15 to 42% of total sodium lost. It is noted that the net influx and efflux figures taken at different times are quite similar, indicating that the fish were in approximate sodium balance. It is clear that the dogfish takes up Na and not merely water.