1964 #7

HISTOPHYSIOLOGY AND FINE STRUCTURE OF REGULATORY EPITHELIA

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A physiological, histochemical and electron microscopic approach to comparative studies on epithelia of marine organisms which play a significant role in regulatory processes. Principal attention has been devoted to saline secretions and this work has provided the first descriptions of the fine structure of the nasal salt glands of marine birds and the rectal salt gland of elasmobranchs. Initial studies were on the so-called chloride cells of the gills of marine fish and later studies have been concerned with the structure of the respiratory tree in holothuria, the haemal rete in holothuria and with the alkaline gland of the male skate. The glands studied are all noted for the production of highly concentrated solutions of sodium salts. In the other epithelia principal emphasis has been devoted to the cytology of specialized cells and the mucoid elements of the basement membranes. The following papers have been published on the work done on these materials.

W. L. Doyle. 1960. Principal Cells of the Salt Gland of Marine Birds. Exp. Cell Res., 21. 386.

_____ and Donna Gorecki. 1961. The so-called chloride cell of the fish gill. Physiol. Zool., 34, 81.

_____. 1962. Tubule cells of the rectal gland of Urolophus. Am. J. Anat., 111, 223.

_____. 1964. Fine structure of the respiratory tree in Cucumaria. Quart. J. Micr. Sci., 105, 7.

It is proposed to extend these primarily morphological studies in order to provide experimental physiological and histochemical evidence for the significance of the cytological aspects which relate to the special function of these epithelia. Work in progress is concerned with epithelia forming physiologically significant barriers in a variety of marine organisms and includes further work on gills of elasmobranchs and on the formation of the basement membranes in primitive vascular systems.

1964 #8

THE ROLE OF URICOLYSIS IN THE PRODUCTION OF UREA BY FISHES AND OTHER AQUATIC VERTEBRATES

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The activity of the uricolytic pathway (uric acid → urea) was assayed in slices prepared from livers of teleost fishes. The rate of conversion of uric acid to urea ranged from 5 μmoles urea/g hr in the goosefish (Lophius americanus) to 23 μmoles urea/g hr in the winter flounder (Pseudopleuronectes americanus). Allantoin and allantoic acid were also converted to urea at approximately the same rate as uric acid.

Allantoicase was found to be present in the livers of eighteen species of teleosts indicating

the widespread occurrence of this enzyme in these fishes. The range of enzyme activity was 22-225 μmoles urea/g hr.

Liver slices from other aquatic vertebrates such as bullfrog (Rana catesbeiana) tadpoles, small adult but not large adult bullfrogs and Necturi (Necturus maculosus) also catalyzed the conversion of urate to urea.

1964 #9

ANION SUBSTITUTION: COUPLING OF H AND Cl ION ACTIVE TRANSPORT BY DOGFISH GASTRIC MUCOSA

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Bathed in vitro by Cl-saline, gastric mucosae of Squalus acanthius do not generate a potential difference because H and Cl ion active transport proceed together. Likewise anion (A-media) substitution for Cl by sulfate, isethionate or glucuronate did not produce a significant potential difference; .4 ± .5 mV. H ion secretion decreased with a time constant of .48/hr over 5 hr and was 1.3 μEq/g/hr at 2.75 hr. Fate of mucosal Cl was followed by exposing mucosae to Cl-36 in Cl-saline for 3 hr and eluting for 2.75 hr into either A-media or Cl-saline. Bathed by A-media, the luminal Cl flux had a time constant of .55/hr and was 2.2 μEq/g/hr at 2.75 hr. Correspondence of the magnitude and time course of H ion secretion and Cl luminal flux indicates that anion substitution does not uncouple H and Cl transport. The fraction of Cl-36 transferred across the luminal border at 2.75 hr was .26/hr into A-media and .35/hr into Cl-saline. The lesser fraction transferred from cell into mucosal A-media suggests that a locus of "exchange diffusion" is at the luminal border.

1964 #10

GILL PERMEABILITY IN Squalus acanthias*

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We measured the net movement of tritiated water and C-14 urea from fish to sea water using the in vivo gill perfusion system previously described. From these values the permeability coefficients were derived in terms of millimoles crossing membrane per unit of time, gill area and concentration gradient.

Average permeability to water during 15 periods in 7 dogfish was 7.66×10^{-6} cm/sec. Urea in 3 intervals each for 2 fish averaged 7.5×10^{-8} cm/sec. Comparable figures for toad bladder (Maffly, et al., J. C. I. 39:630) are 90 and 260×10^{-8} cm/sec for water and urea respectively.

With the exception of Phagiothecium denticulatum (3.6 cm/sec x 10^{-8} for urea) no published data which we can discover describes a biological membrane of comparable impermeability to the dogfish gill.

*Supported by National Science Foundation Grant #G-13047.

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