Reports and Letters

Alkaline Phosphatase in the Kidneys of Aglomerular Fish

Renal tubular alkaline glycerophosphatase has been demonstrated histochemically in most vertebrate species examined. Perhaps the only exceptions are those reported by Wilmer (*1*), who was unable to find the enzyme in the kidneys of the aglomerular toadfish, *Opsanus tau,* the spotted salamander, *Amblystoma maculatum,* and the snapping turtle, *Chelydra serpentina.* The widespread occurrence of this enzyme has justified the belief that it plays some fundamental role in kidney function (*2*). Because the aglomerular kidney does not have occasion for resorptive activity and is apparently incapable of excreting sugars (*3*), Wilmer provisionally interpreted the alleged absence of alkaline phosphatase in the tubule of the toadfish kidney as valid evidence of the relation of the tubular enzyme to glucose transport (*1*). His hypothesis has gained considerable acceptance (*2, 4, 5*).

Danielli has cast some doubt on the validity of this idea by incidental references to unpublished studies by Lorch and himself revealing the presence of tubular alkaline phosphatase "in a number of species of aglomerular fishes" (*6, 7*). The present communication calls attention to this finding and reports my own demonstration of tubular alkaline phosphatase in the three particular species reported negative by Wilmer.

Freshly caught specimens of *Opsanus tau, Amblystoma maculatum,* and *Chelydra serpentina* were obtained locally in season (*8*), and the kidneys were removed as soon as possible after capture. Fixation was carried out in 65-percent alcohol for 24 hours. After the specimens were imbedded and sectioned, alkaline phosphatase was demonstrated according to the method of Gomori.

Five specimens of *Opsanus tau* were examined. Although the kidneys were removed for fixation as soon as the fish was taken from the water, the results were distinctly variable, but strong local tubular activity was demonstrated in most tissue blocks (Fig. 1). Activity tended to be least at the centers of the blocks, suggesting a fixation artifact arising from an unusual lability of the tubular alkaline phosphatase in this animal. No difficulty was encountered in demonstrating vigorous tubular activity in kidneys of two *A. maculatum* and one *C. serpentina.*

The evidence of enzyme lability noted in the toadfish seems to offer a reasonable explanation of Wilmer's negative findings. Although he does not state the source of the *A. maculatum* or *C. serpentina* examined by him, the *O. tau* had been for a long time in an aquarium. It is suggestive that Grafflin (*9*) has remarked on the lability of renal function in fishes in captivity. In addition to the experience related with toadfish, I have sometimes found it impossible to demonstrate alkaline phosphatase in the renal tubules of box turtles (*Terrapine carolina carolina*) that have been kept in the laboratory, although freshly caught specimens are well supplied with it. In any event, it is clear that acceptable evidence of the absence of this enzyme in any species can be based only on wide experience.

The general conclusions that arise from the distribution of tubular alkaline phosphatase among vertebrate species are altered by these findings and those cited by Danielli. Although the possibility cannot be excluded that this enzyme survives in aglomerular fishes as a vestigial characteristic inherited from their glomerular ancestors (*10*), its presence argues, barring this, *against* its involvement in glucose resorption. Conclusions with respect to the possible functional importance of tubular alkaline phosphatase based on its general distribution are reinforced by the reduction of the list of excepted species to none. The fact that individual animals under certain conditions can apparently exist without it does not necessarily contradict this estimate. Instead it may be that its function is of sufficiently general nature that alternative mechanisms exist which, in case of necessity, can accomplish a corresponding and vitally sufficient result.

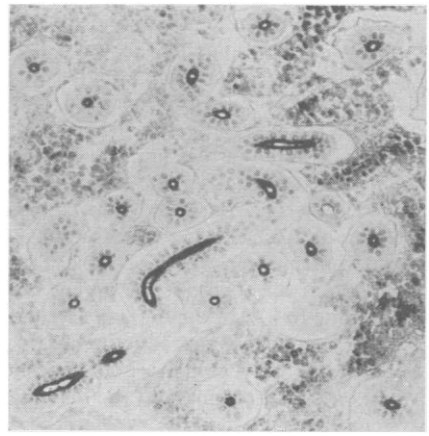

Fig. 1. Gomori alkaline phosphatase reaction in renal tubules of *Opsanus tau.* (× 150)

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References and Notes

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Ultraviolet Irradiation of Pyrimidine Derivatives

The substances identified up to the present as products of the ultraviolet irradiation of pyrimidine compounds include ammonia, urea, oxamide, parabanic acid (*1*). These clearly arise by more or less extensive disruption of the pyrimidine ring. However, in 1949 Sinsheimer and Hastings (*2*) reported that uracil, uridine and also cytidylic acid, after brief irradiation with light of wavelength 254 mμ lost their characteristic ultraviolet absorption band and yielded a product that, on treatment with acid, spontaneously regenerated the original compound. More detailed information about this reaction has been reported recently by Sinsheimer (*3*). Since this reversible photoreaction may constitute an initial step in the more drastic photodecompositions it seemed to us important to know the structure of the "reversible" product.

A survey of variously substituted pyrimidine derivatives disclosed that 1,3-