1964 #26

CARBONIC ANHYDRASE INHIBITION AS A MODEL FOR GAS TRANSPORT IN Squalus acanthias

E. D. Robin, H. V. Murdaugh, Jr., and J. E. Millen, University of Pittsburgh, Pittsburgh, Pa., and University of Alabama, Birmingham, Ala.

Theoretical analysis of gas transport dictates that passive diffusion of respiratory gases across the gill in aquatic forms will produce $PaCO_2$'s less than 5 mmHg. One mechanism which would permit a higher $PaCO_2$ is the establishment of a positive steady state CO_2 gradient between arterial plasma and expired sea water, a positive K_2 (see Robin and Murdaugh, this issue). It has been established that carbonic anhydrase inhibition in the dogfish is capable of producing $PaCO_2$ greater than 10 mmHg. Therefore the effect of a potent carbonic anhydrase inhibitor, acetazolamide, on K_2 was studied in 14 dogfish. K_2 was calculated from the following relationship:

$$K_2 = PaCO_2 - P_ICO_2 + \left(\frac{\text{cardiac output}}{\text{gill water flow}}\right)\left(\frac{1}{CO_2}\right)\left(C\bar{v}_{CO_2} - Ca_{CO_2}\right)$$

In all studies K_2 values were greater than 5 mmHg and quantitatively accounted for $PaCO_2$'s greater than 10 mmHg. This study verifies the ability of steady state CO_2 gradients to produce high values of $PaCO_2$ in the face of relatively high PaO_2's.

1964 #27

ENERGY EXCHANGE DURING DIVING IN THE SEAL, Phoca vitulina

E. D. Robin, H. V. Murdaugh, Jr., J. E. Millen, and C. D. Hearn, University of Pittsburgh, Pittsburgh, Pa., and University of Alabama, Birmingham, Ala.

The ability of the seal to tolerate prolonged diving, over 20 minutes, makes the seal an excellent model for studying oxygen depletion. With seals that have been trained to dive under laboratory conditions and to undergo expired air collections one may readily quantitate the control resting oxygen consumption in the animal. A face mask was designed that could be quickly placed over the face of the animal and expired air collected using Rubens Valve and a Douglas Bag. The oxygen debt incurred during diving could be quantitated by multiplying diving time by the control oxygen consumption. Carbon dioxide surplus could be quantitated in a similar manner. Ten studies were performed in 6 seals. It was found that following diving there was an incomplete repayment of oxygen debt. Increase in oxygen consumption over control values following the dive averaging less than 50% of the calculated debt. There was, however, an overshoot of carbon dioxide excretion that averaged approximately 160% of the calculated carbon dioxide surplus accumulated during diving.

This apparent discrepancy with the Law of Conservation of Energy, may be related to several possible mechanisms that include depression of metabolism during diving, variable oxygen binding to some tissue components, increased efficiency of energy utilization during diving, a slow repayment of oxygen debt that could not be detected operationally, or alterations of the ki-