

DISCUSSION

THE DIVING HABITS OF THE BEAVER

THERE are many interesting accounts of the habits of the beaver, but we have not yet seen any report of a critical examination of the behavior of beavers during submergence. During a recent visit to Algonquin Park, Ontario, through the courtesy of Mr. F. A. Macdougall, superintendent, we were enabled to make some observations on a living animal. The beaver was caught by ranger George Heintzman in a live trap near Opeongo Lake. It was in excellent condition and weighed about 40 pounds.

Its movements were slow and deliberate, but when it once reached the water it swam and dived violently. When returned to an open-topped box it soon became quiet. Within fifteen minutes one of us had firmly placed one hand on the nape of the beaver's neck and with the other hand could feel the heart beating regularly and strongly at 100 per minute.

The box was then placed at the edge of the lake, so that the animal was just awash. With its nostrils just above the water, the heart-beat after a half hour of rest was 50 and irregular, while respiration went on regularly and gently at about 16 per minute. This was the usual resting condition of heart and respiration.

The head of the beaver was then pressed under water. There was no resistance, and as soon as the head was immersed the animal relaxed and lay with its head resting on the bottom. It made no effort to raise its head until about five minutes had passed, when, after some brief struggling, it was impossible to hold it down longer. Upon emerging, the breathing movements were only slightly increased in amplitude and frequency. The observation was repeated four more times at intervals.

While the beaver was submerged the heart-beat could not be detected, although the position of the animal's thorax was not altered. It is unlikely that the heart entirely stopped, but it certainly diminished greatly in vigor. It is known that in the duck, seal and muskrat the heart is slowed during apnoea.

The docility of our beaver also allowed us to observe the animal's heart while one of us compressed the animal's trachea with his hands. After respiratory movements had completely ceased, from 6 to 10 normal heart-beats were distinctly felt, and then no further movement within the thorax. This observation, which was repeated three times, showed that there was no change in the thorax during apnoea, which made it impossible to detect the normal heart-beat, and that the inhibition of cardiac activity was a regular accompaniment of apnoea.

When it is considered how violent the struggles of

an asphyxiated land animal are and how savagely even man combats interference with his process of respiration, it is remarkable that the wild beaver should have submitted so readily to forced submergence and violent closure of its trachea. The observed muscular relaxation and the inhibition of the action of the heart are probably part of the physiological adjustment of the beaver to submergence, as Paul Bert and Richet demonstrated them to be in the duck.

Apparently metabolism is by no means suspended during diving, for after the five-minutes apnoea the beaver's heart beat more strongly at from 75 to 90 per minute during several minutes. It was evidently repaying the oxygen debt which was incurred during the period of apnoea. That the heart showed such a slight acceleration after 5 minutes of asphyxia suggests that the limit of its endurance had by no means been reached. We received reports from three experienced rangers who had observed beavers resting on the bottom while submerged for 15 minutes, and we feel convinced that the capacity of the beaver for resisting asphyxia is exceptional when contrasted with the ability of a land mammal.

LAURENCE IRVING
M. D. ORR

UNIVERSITY OF TORONTO

LATEX TEST FOR MATURITY OF
PAPAYA FRUITS

THE immature fruit of the papaya (*Carica papaya*) contains the enzyme papain.¹ The concentration of this enzyme in the juice reaches its maximum when the green fruit is fully grown in size, and then decreases as the fruit matures, apparently disappearing when full maturity is reached.² As the papaya fruit matures the following changes are readily apparent—the color of the flesh and placenta changes to orange or peach pink, depending on variety character, the seeds turn black, the flesh softens and its sweet taste increases with a decrease in effective acidity (increase in pH). The color of the juice also changes with maturity. When the immature green fruit is punctured a milky juice is exuded. The milkiness of the juice becomes less and less as maturity proceeds until the stage is reached when the fruit matures on the tree and the juice exuded is colorless and finally ceases to exude at all. When fruits capable of exuding juice are cut in half, the exudation following puncture

¹ A. Wurtz and E. Bouchut, *Compt. Rend. Akad. Sci. Paris*, 89: 425-429, 1879.

² Ellis Thomas and V. A. Beckly, *Jour. Dept. Agric. So. Africa*, 6: 357-360, 1923. F. A. Stockdale, *Dept. Agric. Ceylon. Leaflet*, 44, 1926. V. A. Pease, "Papaya and Papain." (A mimeographed publication of the Bur. Chem. and Soils, U. S. Dept. of Agric.) 1933.