that in plasma. If this is assumed to hold during severe hypoxia, then it is demonstrable that glycolysis could account for a considerable part of the energy deficit in this condition.

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Temperature regulation in the white rhinoceros. By D. B. ALLBROOK, A. M. HARTHOORN, C. P. LUCK and P. G. WRIGHT. *Departments of Anatomy, and of Human and Veterinary Physiology, Makerere College, Kampala, Uganda*

The white rhinoceros, *Ceratotherium simum*, is the second largest land mammal; the adult probably weighs about 3000 kg. Its natural habitat includes intensely hot parts of Africa and the manner of its temperature regulation is of some interest. A male and a female of this species (*C.s. cottoni*), taken from the Uganda–Sudan border, were investigated. They were allowed to wander freely during the day, grazing on short grass with no appreciable cover from the sun. Although they had free access to marsh ground, many hot days would lapse without their frequenting it. At night they were herded in a paddock without cover or windbreak, and would sleep fully exposed to cold winds.

Rectal and skin temperatures were taken with thermistors. The rectal temperature was taken at a depth of not less than 22 cm, skin temperature was recorded from a thermistor strapped to the skin. The thermistor element was attached to a thin copper plate 25 mm in diameter, to give a secure area of contact.

The pulse rate was counted at the caudal artery.

Meteorological observations included cloud:sky ratio, air velocity, relative humidity, mean temperature of the surroundings in sun and shade and the air temperature.

The animals' rectal temperatures at sunrise were about 34·5° C, rising throughout the day if the animal grazed in the sun to 37·5° C by sunset with the air temperature around 25° C and a relative humidity of 75%.

When kept in the shade all day the rectal temperatures remained at 35·2° C. On returning from a wallow the rectal temperature was 35·4° C. The night ambient temperature during the investigation fell to 5° C for five or 6 hr, but 33·6° C was the lowest rectal temperature recorded.

The skin is well adapted for temperature regulation, having an epidermis about 1 mm thick, with a well-developed subjacent vascular bed. The dermis, about 2 cm or more thick, is dense, collagenous and relatively avascular, pierced at intervals by vessels to the epidermis. Beneath the epidermis lie large and numerous sweat glands with well-developed myo-epithelial cells. Under the thermal conditions prevailing no signs of sweating were observed

with the quinizarin-sodium carbonate-starch method. After prolonged exertion sweat is however said to appear.

The pulse rate at rest varies from 30 to 40 pulses/min, the higher figures being found in the afternoon.

A comparison of these studies with those of Benedict (1936) on the elephant show that the rhinoceros has a greater diurnal temperature variation, the elephant varying little from a mean rectal temperature of 35·9° C by day or night; Benedict does not mention the environmental temperature but remarks that his elephant tolerated cold.

We wish to thank Mr Carr Hartley and his intrepid herdsman for making this study possible, and Gus and Mitzi for their patient co-operation.

REFERENCE

Benedict, F. G. (1936). *The Physiology of the Elephant.* Washington: Carnegie Institution.

The discharge mechanism of the electric cat-fish. By M. V. L. Bennett, H. Grundfest and R. D. Keynes. *Department of Neurology, College of Physicians and Surgeons, Columbia University, New York*

As recalled in recent reviews (Grundfest, 1957; Keynes, 1957), the discharge of *Malapterurus electricus* differs in polarity from that of all other electric fishes. Contrary to Pacini's rule, the innervated (caudal) faces of the electroplates become positive instead of negative. Fritsch (1887) believed the cells

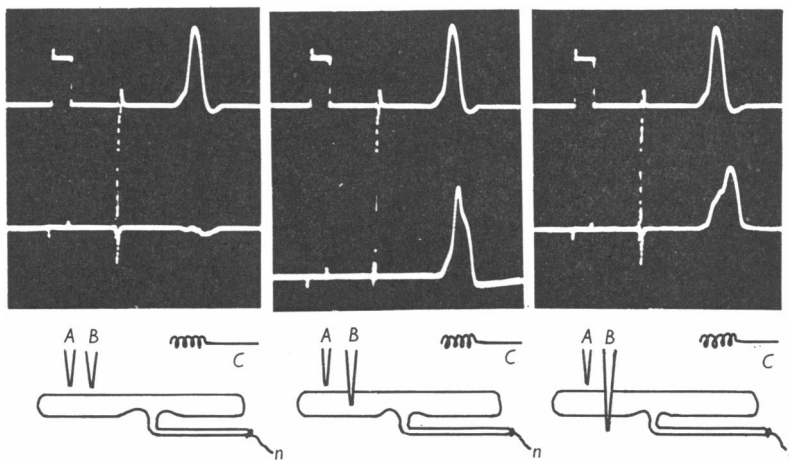

Fig. 1. Discharge of a small piece of electric organ, stimulated via the attached nerve (*n*). Upper trace: potential at *A*, relative to distant reference electrode (*C*). Lower trace: electrode *B*, differential with respect to *A*. Note resting potential in middle record. The electroplate penetrated by *B* was firing slightly later than most of the others. Temperature about 23° C. Calibration pulse 50 mV and 1 msec.