the amount of carbonyl compounds (keto-acids) in the collagen structure can be influenced by the food intake.

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Anti-metabolic Extract from the Brain of *Protopterus aethiopicus*

IT has been suggested that the brain of the aestivating lung-fish might contain an anti-metabolic agent[1], perhaps not unlike the mono-amines secreted in the pons and medulla of cats as active agents in the control of sleep[2].

Large lung-fish (2–6 kg) from Uganda were flown by jet to Denver, then placed in aquaria at Fort Collins, Colorado, in water 4–16 in. deep over specially collected mud. The constant temperature room was maintained at 24°–25° C. When the fish were accustomed to their new environment and were eating well, they were forced to encyst in the underlying mud by simply withdrawing a portion of the water from the aquarium each day until it was quite dry and the mud was caked hard. The fish dug their chambers at the bottom of tunnels, coiled up and entered a state of profound torpor, in every way similar to their behaviour in their normal environment in Africa during the dry season.

After the fish had been immobile for a month to 6 weeks, the mud was chipped away and an attempt was made to kill the fish abruptly without arousal. It is presumed that all fish had reduced metabolism. The oxygen consumption of one was successfully measured. In the resting–active state before encystment, the oxygen consumption was 30·7 ml./h/kg, whereas after 30 days in the mud, the consumption was 4·6 ml./h/kg, a drop of 85 per cent.

The head was severed from the body with a meat cleaver, and the brain immediately dissected from the skull and placed in acetone in a bottle packed in chipped ice. The entire brain was extracted on the same day using the methods described by Guillermin *et al.*[3]. The extract emerged as a buffered solution (*p*H 7·0) of 2 ml. volume.

The extract was injected intravenously into fasting white Wistar rats, contained in a 2 l. dark glass bottle with constant forced ventilation at 200 ml./min. The state of consciousness, rectal temperature, oxygen consumption and carbon dioxide production were monitored. Heat production was calculated from the amounts of oxygen consumed per unit time and the RQ according to the formula: HP (kcals/mol O_2) = 87 + 27 RQ. Readings were continued hourly or at irregular intervals for as long as was deemed desirable.

The following experiments were performed. (*a*) For the controls 2 ml. was injected of: (1) the extracting fluid; (2) and (3) extracts from the brains of two active fish (No. 1 and No. 2); (4) and (5) extracts from the brains of two torpid fish which were aroused and struggled for several minutes before being subdued and killed (No. 3 and No. 4). (*b*) For the protocols 2 ml. was injected of: (6) extract of brain of torpid fish No. 5; (7) combined extracts of brains of fish No. 6 and No. 7. The metabolic data are presented as a family of curves in Fig. 1. Each curve represents observations of 1 h plotted against time for each test animal, numbered as listed here. The "injection period" was variable, but represents the period of time the rat was out of the bottle for the injection procedure.

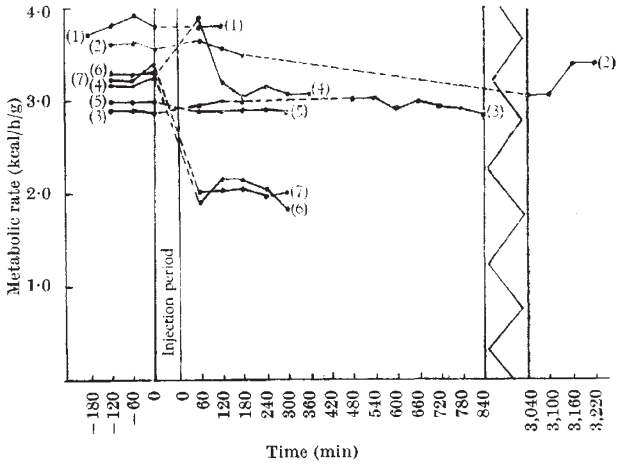

Fig. 1. Curves representing the data obtained from injection of rats.

None of the control extracts affected the injected rat in any observable or measured way. The response to extracts from the brains of fish which had been removed before the animal was aroused from deep torpor was profound and dramatic. The rats became lethargic and did not respond normally to irritating stimuli. They refused food, the body temperature fell 5° C and the measured metabolic rate fell to 65 per cent of the pre-injection fasting level. The respiration quotient did not change significantly (0·80). The effect lasted several hours.

Although the experiments are few in number, all those in which the protocol was successfully completed induced an unequivocal response: lethargy, a 35 per cent drop in metabolic rate and a fall of 5° C in body temperature.

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