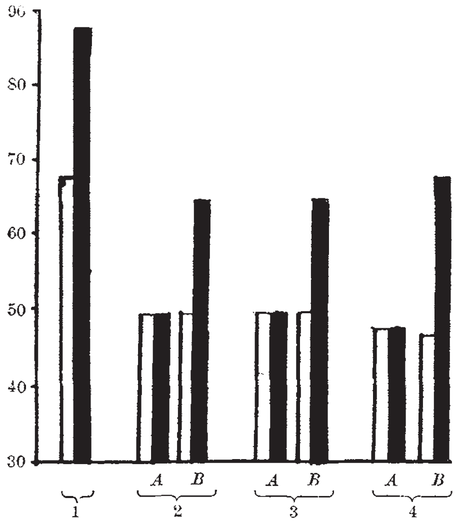
Effect of High Environmental Temperature on the Oxygen Consumption of Thyroidectomized, Hypophysectomized and Methylthiouracil-treated Rats and the Related Action of Thyroxine

It is well known that oxygen consumption increases if the temperature of the environment is raised above the neutral zone (28°–30° for the rat). Normal rats, in a chamber saturated with water vapour, invariably respond to a temperature of 35° C. with a marked rise in oxygen consumption.

We have failed to observe a similar rise, at this temperature, in most thyroidectomized and hypophysectomized rats, and in rats receiving thiouracil over a long period. In these animals oxygen consumption either remained unchanged or was diminished in spite of hyperthermia, and, in most instances, a rise in oxygen consumption failed to appear even at environmental temperatures of 37–38° C. or higher, and with body temperature approaching or often exceeding 40° C. If a few micrograms of thyroxine is administered subcutaneously to these animals, they behave as do normal rats, in that high environmental temperature, producing hyperthermia, now causes raised oxygen consumption (see diagram). This observation not only demonstrates that thyroxine plays an essential part in the metabolic response to hyperthermia but also confirms, in a conveniently reproducible way, our earlier observation of an acute action of thyroxine in physiological dosage[1-4].

The absence of a rise in oxygen consumption, in spite of hyperthermia, as referred to above, demonstrates that the rise in normal animals is not based simply on the van't Hoff effect. The increase in oxygen consumption without change in hyperthermia,



Oxygen consumption of the rat in various circumstances.
(1) Normal rat : ▯ at 29° C., ▮ at 35° C. environmental temperature.

(2) Thyroidectomized rat : ▯ at 29° C., ▮ at 36° C. environmental temperature : (*A*) before thyroxine, (*B*) after 5 μgm. of thyroxine. Body temperature (in an environment at 36° C.) before thyroxine 38·8° C., after thyroxine 38·8° C.

(3) Hypophysectomized rat : ▯ at 29° C., ▮ at 35° C. environmental temperature : (*A*) before thyroxine, (*B*) after 5 μgm. thyroxine. Body temperature before thyroxine (environment 35° C.) 38·3° C., after thyroxine 38·5° C.

(4) Thiouracil-treated rat : ▯ at 29° C., ▮ at 37° C. environmental temperature : (*A*) before thyroxine, (*B*) after 10 μgm. thyroxine. Body temperature (environment 37° C.) before thyroxine 39·3° C., after thyroxine 39·3° C.

which occurs after thyroxine, indicates that this metabolic response is not due, as is widely assumed, to the activation of thermo-regulatory mechanisms serving heat loss. Details of this work will be published elsewhere[5].

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A New Method of Age Determination for Mammals

For estimating the age of mammals such widely differing characters as coat colour, size, skull proportions and sutures, ossification, numbers of corpora albicantes, changes in the lens of the eye, etc., have been used ; but such methods are laborious and frequently yield only an approximate result. While working on the elephant seal (*Mirounga leonina*) in 1949, a new and accurate method of determining age, depending upon cyclical variation in the rate and manner of calcification of the teeth, was developed. This makes possible determination of age, to within a month, up to at least twenty years in the male, and thirteen years in the female.

The permanent canine teeth of the elephant seal erupt within a few days of birth and grow throughout life ; the pulp cavity remains open and attrition is negligible. The other teeth cease to grow at an early age. In this species the yearly cycle is remarkable in that in the adult there are two periods of complete or partial fasting, corresponding to the mating season and to the annual moult. In younger animals there are three or more short periods of fasting. These fasts appear to be correlated with changes in the general metabolism and are represented in the structure of the canine teeth throughout life. Microscopic examination of thin ground sections of elephant seal canines shows a stratification of alternating zones of 'columnar' and marbled[1] dentine. The former are more dense than the marbled zones and are visible macroscopically as light-coloured rings which vary in thickness and are arranged in a definite pattern. The simplest pattern consists of an outer, first formed, light ring, then a narrow region of darker dentine followed by a light ring. The average thicknesses of these zones in a male canine are 330 μ, 200 μ and 168 μ respectively. They are separated from the next set by a zone of marbled dentine about 312 μ thick. It is believed that the three rings represent the breeding season, a period at sea, and the moult, while the wide dark ring represents the winter at sea. The annual increments of dentine may be considered as a series of superposed hollow cones, and a discontinuity in the rate of growth in length of the tooth results in a series of annular ridges on the root, which, by deposition of cementum, become progressively obscured. This is markedly so in teeth of the hooded seal (*Cystophora cristata*), which have very clear rings in cross-section,