Thyroid Function in Active, Sleeping and Torpid Hummingbirds

HUMMINGBIRDS have been of interest to physiologists for many years due to their small size and high metabolic rate. When it became apparent that these birds could be maintained under laboratory conditions[1] and then studied in regard to various physiological parameters, it appeared of interest to examine the role of the thyroid gland in relation to metabolism. Diurnal torpidity has been demonstrated in two species of hummingbirds[2,3], and recent studies[1] on several other species have quantified the relationship of the active, sleeping and torpid metabolic states to ambient temperature. Although the causes and implications of the torpid state are incompletely understood, it was felt that perhaps the function of the thyroid gland might be related to the metabolic state. Seven hummingbirds that had been maintained under laboratory conditions for nine months were each injected beneath the skin with 1 μc. of carrier-free iodine-131 in a volume of 0·05 c.c. At selected intervals after administration of the isotope, the birds were killed by ether and the thyroid glands removed. The thyroid glands were counted with a probable error not exceeding 1 per cent in a well-type scintillation detector against suitable standards of the original iodine-131 solution. The time of injections was arranged so that the period of accumulation of iodine-131 occurred in birds that were either active, asleep or torpid.

During this period all birds were maintained at 25° C. with access to food and water. Those that were exposed to daylight and artificial light remained active, while those that were kept in the dark were either asleep or torpid. The sex, body-weight, species, and iodine uptake of the birds are given in Table 1.

Table 1

Thyroid uptake of iodine-131 (per cent)	Interval (hr.)	Condition	Genus and species	Sex	Body-weight (gm.)
9·1	2·0	awake	*Calypte costae*	male	3·6
15·7	4·0	awake	*Calypte costae*	male	3·5
25·6	6·0	awake	*Calypte costae*	male	3·6
24·7	6·0	asleep	*Calypte anna*	male	4·6
22·1	12·5	awake	*Selasphorus rufus*	male	3·3
8·6	6·0	torpid	*Calypte costae*	female	3·1
10·4	6·0	torpid	*Archilochus alexandri*	female	3·6

The shape of the iodine-131 thyroid uptake curve based on the four birds that were awake and active resembles the shape of similar curves described for birds and mammals[4]. The maximum uptake of approximately 25 per cent occurring between 6 and 12·5 hr. approximated the findings for other species of birds[5–8]. Although the metabolic studies cited[1] demonstrate a drop in metabolism in sleeping, non-torpid birds, the 6-hr. uptake of the one bird that was asleep, and not active, closely resembled the uptake of the active, awake birds. However, the 6-hr. uptake of the two birds in the torpid state was reduced significantly, when compared with the uptake of non-torpid birds in 6 hr. Perhaps the reduced uptake by torpid birds may be ascribed to the further reduced metabolic activity of the torpid state. A *t*-test comparing the uptake of the two torpid birds to the two non-torpid birds at the 6-hr. interval yields $P > 0{\cdot}91$. It is unlikely that either the sex, or the size, or species differences would influence the thyroid uptake of iodine-131 so drastically[6].

As pointed out by Matthews[9], the factors controlling torpidity are still unknown, but the abruptness of the decline in temperature and metabolic rate suggests that the central nervous system probably controls its initiation and hence the reduced thyroid uptake of iodine-131 observed in the torpid state is, in all probability, a reflexion of the lowered metabolism rather than a cause for the reduced metabolism of torpidity.

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Flimmer-flagellum of the Sponge

THERE is a considerable variation in the morphology of the flagella in the lower plant groups and in the flagellates. The flagellar structures have been used as systematic characters since the pioneering work of Petersen[1] and Vlk[2]. The following five types of flagella are recognized:

(1) One-sided flimmer flagella which have one row of hair-like appendages (called flimmer hairs or mastigonemata or, somewhat misleadingly, cilia). The flimmer hairs are about 3μ long, and the row extends along the entire length of the flagellum on its one side.

(2) Two-sided flimmer flagella which have two rows of flimmer hairs along the entire length of the flagellum.

(3) Whip flimmer flagella which have a demarcated thin end region devoid of flimmer hairs and a main region which possesses two rows of flimmer hairs. The flimmer hairs stand perpendicular to the flagellar axis.

(4) Whip flagella which are devoid of flimmer hairs but have a demarcated thin end region. These flagella are also called lash flagella.

(5) Flagella which lack flimmer hairs and also lack a demarcated end region visible in the light microscope.

These characterizations have been made from fixed specimens at high-magnification light microscopy after certain staining procedures. In some cases it has been possible to confirm the findings by dark-field microscopy on living flagella[2]. Manton[3] and Pitelka *et al.*[4] have been able to confirm and extend these observations by electron microscopy, mainly on whole mounts. Flimmer flagella have also become known under the names ciliated flagella and flagella of a tinsel-type structure.