Feeding of the Common Toad

THE accompanying photographs of the feeding of the common toad (*Bufo vulgaris*, Laurenti) supply, I believe, for the first time an accurate description of the tongue movement in an Anuran. The movement in the frog is similar, but I have not so far obtained such satisfactory photographs of it. Most modern text-books assume that protrusion of the tongue is accomplished by lymph pressure. The

Fig. 1.

TOAD FEEDING: FROM SIDE. RECONSTRUCTED SERIES; NOS. 1, 4, 6 and Nos. 2, 5, 7 ARE CONSECUTIVE FRAMES OF TWO SHOTS. FIG. 2 WAS TAKEN SIMULTANEOUSLY TO THE LAST OF THESE SHOTS. THE PREY IN ALL CASES IS A WOODLOUSE.

Fig. 2.
TOAD FEEDING: FROM ABOVE.
TONGUE FULLY EXTENDED.

evidence for that theory is slight¹, and these photographs argue against it and in favour of a muscular mechanism, because (1) the time of protrusion is shown to be so short (sometimes less than 1/20 sec.); (2) the tongue and floor of the mouth show no signs of inflation; (3) there is a distinct constriction at the base of the tongue when viewed from above in the fully extended position (see Fig. 2). These features, and others, suggest a muscular mechanism similar to that proposed by Gaupp² on anatomical grounds; with the probability that purely intrinsic

muscles play a larger part than he thinks, especially in the unrolling of the tongue and in the first part of retraction. It is still possible that lymph pressure may play a subsidiary part.

The entire movement occupies little more than 1/10 sec., divided nearly equally between protraction and retraction. The dorsal surface (at rest) is here only elongated to about eight sevenths of its length at rest, though other photographs show that it can be elongated slightly more than that. In its other dimensions there is very little change, except that it is slightly narrower when seen from above. The length of the protruded tongue in this female, which measures 3 in., is 8/10 in., from the tip of the lower jaw. Fig. 1, No. 5, shows from the legs of the prey that the tip of the tongue is rotated through 180° at the beginning of retraction.

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¹ Hartog, M., *Ann. Mag. Nat. Hist.*, 7, 7 (1901).

² Gaupp, E., *Anat. Anz.*, 19 (1901).

Response to Colour in Birds

APART from some experiments by Marples¹, little work appears to have been done on the colour awareness of birds in their wild state. By colour awareness is meant the ability to detect and react to light of widely differing wave-lengths. The possibility that such recognition may, in birds, involve merely the detection of different intensities of a single shade has not been overlooked, but is contra-indicated by the experiments described here. These experiments have been carried out by utilizing the instinct of nest-sanitation whereby most birds, and especially those of the Passerine order, keep their nests free from contamination by the excrement of the young. This instinct has been shown by Smith² to be of the same order of strength as that to feed the young, and the provision at the nest of artificial faeces of various colours gave a ready means of testing the response to colour in certain species. These artificial faeces were made from 'Plasticine' moulded into the shape and size of a faecal sac, and spectroscopic analysis of the samples employed gave the data shown in Table 1.

TABLE 1.

Colour	Brightness factor	Hue wave-length (μ.)	Saturation
White	0.586	578	0.156
Yellow	0.362	578	0.448
Green	0.222	549	0.348
Red	0.134	492C	0.228
Purple	0.116	566C	0.006

(C = complementary colour.)

The colours are thus far from pure, but this was to be expected from a substance like pigmented 'Plasticine'.

The artificial faeces were placed on the rim of the nest, in a similar position to that used by the nestlings. Their arrangement was quite random, and was changed for each trial. Observation of the order of removal of the artificial faeces was made from a 'hide' in close proximity to the nest. If birds were colour-blind, the order of removal would be in the order