

THE DEVELOPMENT OF THE STOMACH IN THE EU-  
PHONIAS.

BY ALEX. WETMORE.

THE stomach of the small brightly colored Tanagers known as Euphonias has long been noted as one of the most anomalous in the avian group, but to my knowledge no explanation for its peculiarities has been attempted. During recent field work in Porto Rico for the Biological Survey, and in subsequent laboratory investigations, it has been my fortune to examine critically 51 specimens of the Porto Rican Euphonia (*Tanagra sclateri*) and on these examinations the following observations are based.

In the long array of species forming the order Passeriformes the stomach is composed ordinarily of two parts; a smaller, constricted glandular portion, the proventriculus, connected with the œsophagus, and a larger, more or less muscular division the ventriculus, which opens into the duodenum by the constricted pyloric orifice. In the Euphonias, however, a different development is encountered. The glandular proventriculus is large and well developed while the stomach proper is indicated by a thin, transparent, membranous band or zone which passes over without lessening in size into the dilated end of the small intestine, lined internally with projecting villi. In addition the passage from the œsophagus down is direct, without apparent cardio-pyloric flexure, a combination of peculiarities that stamps this group of species as unique among their feathered kindred.

Attention was drawn to the intestinal tract of the Euphonias by Lund in 1829 but he was misled into describing a lateral diverticulum of the zonary portion, which he considered as the rudimentary ventriculus. For fifty years his discussion and plates were quoted and reproduced by other zoölogists so that they are found in many of the standard texts published during that period. The eminent English ornithotomist W. A. Forbes reviewed these facts before the Zoölogical Society of London in 1880, disproving the presence of Lund's ventricular diverticulum, but was unable to assign any reason for the aberrant structure which he found.

In my work in the field I soon learned that the Euphonias fed eagerly on mistletoe-berries of the genus *Phoradendron*, clumps of which were locally common in tree growth. This habit was well known to the Porto Ricans and has been reported from various islands in the Lesser Antilles where these birds are known as "mistletoe birds." From their restless activity in the tree tops I was led to believe that they were feeding on insects as well but in the critical examination of the stomachs, seeds of three species of *Phoradendron* and one other of an allied Loranthaceous genus were encountered alone with absolutely no trace of animal matter. The globular berries of these mistletoes have a moderately tough skin containing a seed surrounded by a yellowish-green transparent fluid, gelatinous in appearance and exceedingly viscid. In feeding the Euphonias break this outer skin with their bills and swallow the single seed surrounded by its adhesive pulp. The seeds pass through the intestinal canal wholly undigested and the whole mass is excreted in apparently the same condition as when it was swallowed, as the faeces are amorphous and exhibit practically none of the white nitrogenous renal matter commonly noticed in other birds.

Though the adhesive pulp surrounding the seed is apparently unchanged by the processes of digestion yet we know that some part is taken from it. A large per cent of it is composed of viscin — or as it is popularly called bird lime — and several gums, and these act as a vehicle for various salts of potash, lime and magnesia, vegetable acids and oxide of iron a highly tonic purgative combination.

Arabine present in the gums is readily dissolved, furnishing grape sugar, other nutritive matter is contained and with the various salts, of the highest importance to the body, is readily assimilated. Thus mistletoe apparently furnishes a highly nourishing food from which the nutritious elements are easily separated by the digestive juices without preliminary grinding and trituration. A considerable amount of bassorin which is contained in the bird-lime is insoluble in ordinary fluids while in water it becomes viscous which accounts for the lack of change in appearance of the food in passing through the alimentary canal. In captivity this bird thrives on a diet of over-ripe banana, a food which, like the mistletoe berries, can be assimilated readily without mechanical comminution. In a wild state however it eats only the mistletoe berries.

The outcome is readily seen. Through a long period of subsistence on a peculiarly specialized food the ordinary form and musculature of the stomach has been lost through disuse and specialization until it has been changed to the simple membranous sac connecting the œsophagus and duodenum, now characteristic of the Euphonias, a digestive tract which is so arranged as to permit the rapid and unobstructed passage of food through the entire length of the canal.

The Euphonia, furthermore is enabled to increase its own food supply as the seeds unharmed by digestion are excreted and cling by their adhesive coating to the limbs of the trees, starting new plants which, when mature, produce a new crop of berries. Though in some parts of the United States, notably Louisiana and Texas, mistletoe plants increase until the tree host is killed, in Porto Rico they cause little apparent damage and no effort is made to keep them down. They were noticeably more abundant on the dry south coast, where the air soon hardened the gum surrounding the seeds, than they were on the rain swept north slopes of the mountains, where seeds dropped by the birds are liable to be washed off before germination and attachment.

Some forms of the family Dicæidæ notably *Dicæum hirundinaceum* of Australia are called mistletoe birds, and are said to feed extensively on the berries, but I can find no satisfactory description of their stomach. The Robin, Bluebird, Cedar Waxwing and others which occasionally feed on mistletoe berries in the United States do so locally or rarely and use this food merely to supplement their ordinary diet. In my studies I have been restricted to the investigation of the Porto Rican Euphonia, through lack of other material but as parasitic plants of the family Loranthaceæ, belonging to either the genus *Phoradendron* or to others more or less closely allied, are found all through tropical America in the range of the Euphonias we may suppose that they are utilized as food by these species as by the bird which I have studied. This habit sufficiently accounts for the peculiar stomach found in the group as a whole.

To recapitulate, the Euphonias have long been noteworthy for the aberrant form of the stomach. In studying the species found on Porto Rico it has been found that it feeds entirely on the berries of mistletoe (*Phoradendron* spp.) a food readily assimilated and one

not requiring a muscular stomach for its digestion. In consequence we have a degeneration of the ventriculus into a thin membranous band and a straightening of the stomach to facilitate the passage of food no cardiac or pyloric constriction being necessary to hold matter in the ventriculus for digestion as the process of conversion is carried on wholly by the secretions of the alimentary canal.

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## ANATOMICAL NOTES ON TROCHALOPTERON AND SICALIS.

BY HUBERT LYMAN CLARK.

THROUGH the kindness of Mr. Outram Bangs, I have recently had the opportunity of examining freshly-killed specimens of the 'Chinese Thrush' (*Trochalopteron canorum*) and the 'South American Yellow Finch' (*Sicalis flaveola*). There is no other reason for associating these two species in this brief paper than that they happened to come into my hands at about the same time. So far as I can ascertain no species of either genus has ever been examined with reference to either its pterylosis or internal anatomy. This is my warrant for publishing these meagre notes.

### TROCHALOPTERON.

When the plucked carcass of this bird (*T. canorum*) is compared with that of a Robin (*Planesticus migratorius*), the most striking difference is in the width of the feather-tracts. The body of *Planesticus* is about one fourth longer than that of *Trochalopteron* and proportionately heavier but the feather-tracts are two to four times as wide. Thus in *Trochalopteron*, the upper cervical tract where narrowest is 2 mm. wide, the dorsal diamond-shaped tract is 13 mm., the dorsal tract posterior to the diamond is 3 mm. and the sternal tract, where widest, is 5 mm. across. In *Planesticus*,