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CROSSOCEPHALUS ZEBRAE, N.SP.

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This nematode was present in considerable numbers in the collections made from the intestine of six zebrae (*Equus burchelli*) shot by one of us in Northern Rhodesia, 1912.

SIZE AND SHAPE. It is a moderately small species, the female being slightly larger than the male. Four sexually mature males and ten females were measured. The males were from 7.6 mm. to 8.3 mm. in length, average 8.0 mm.; the females from 7.4 mm. to 9.4 mm., average 8.6 mm.; the greatest breadth averaged, males 440 μ , females 498 μ . The anterior extremity is truncated; the posterior extremity of the male is inrolled ventrally and that of the female straight and tapering.

THE HEAD. The anterior end of the body tapers very slightly to the head, which is sharply truncated; there is no definite neck (figs. 1 and 2).

Lips. The mouth is surrounded by three lips (one dorsal and two sub-ventral), each lip, on its oral aspect, being sub-divided into three portions, and having a finely serrated edge (fig. 5).

Head papillae. There are numerous (fifteen) head papillae having a complicated arrangement as shown in figs. 1-5. The lateral papillae (*a*) are very prominent; there are four sub-median papillae (*b*) just projecting beyond the surface of the lips; there is also an additional papilla (*c*) situated at the middle of each lip; and finally there are three pairs of small papillae (*d*) arranged so that one papilla lies on each side of the junctions of the three lips.

There is no chitinated mouth capsule, but there are three pairs of pectinated laminae situated in the anterior end of the oesophagus (figs. 1 and 2). Each of these laminae bears from eight to eleven pointed teeth, the points being directed backwards when the mouth

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FIG. 1. *Crossocephalus zebræ*.Anterior extremity, ventral view, mouth closed. $\times 360$.

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FIG. 2. *Crossocephalus zebræ*.Anterior extremity, dorsal view, mouth closed. $\times 360$.

is closed. The mouth is, however, capable of being everted, in which condition the lips are folded back over the anterior end of the worm, the papillae being directed backwards; the anterior portion of the oesophagus then forms the anterior end of the worm, the six pectinated laminae being erected and their teeth directed forwards (figs. 3 and 4). Eversion is probably to a considerable extent brought about by the action of certain prominent longitudinal muscles which are shown in figs. 1 and 2.

The duct of the *dorsal oesophageal* gland opens into the mouth (fig. 5. *g*).

OESOPHAGUS. The length of the oesophagus in seven female worms, in which the mouth was closed, varied from $1,016\mu$ to $1,085\mu$, the average being $1,045\mu$. When the mouth is open there is an apparent shortening of the oesophagus to the extent of about

FIG. 3. *Crossocephalus zebrae*.
Anterior extremity, ventral view, mouth everted. $\times 360$.

FIG. 4. *Crossocephalus zebrae*.
Anterior extremity, dorsal view, mouth everted. $\times 360$.

FIG. 5. *Crossocephalus zebrae*.
End-on view of head, mouth slightly everted, shewing position of the various papillae; *a* = lateral papillae, *b* = sub-median papillae, *c* = papillae on middle of each lip, *d* = paired papillae, *g* = duct of dorsal oesophageal gland. $\times 360$.

FIG. 6. *Crossocephalus zebrae*.
Transverse section through oesophagus at level of cervical papillae. $\times 360$.

100 μ , showing the extent to which eversion of the anterior end of oesophagus proceeds. In three males, the oesophagus varied in length from 1,002 μ to 1,020 μ ; average 1,013 μ ; the apparent shortening of the oesophagus in worms with the mouth open was here also about 100 μ . The ratio of the length of the oesophagus to that of the worm is about 1 to 8.

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FIG. 7. *Crossocephalus zebrae*.

Anterior end showing oesophagus, ventral view. $\times 60$.

A series of yellow club-shaped bodies, possibly of a glandular nature, occur in the wall of the oesophagus; these commence about 220 μ from the anterior extremity of the worm, and they extend backwards for a distance of about 70 μ . The bulb of the oesophagus contains a valvular arrangement consisting of three ridges projecting into the lumen. The appearance of the above structures is shown in fig. 7.

EXCRETORY PORE. This is situated about twice the length of the oesophagus from the anterior extremity. In ten females the distance of the excretory pore from the anterior end of the worm varied from $1,866\mu$ to $2,110\mu$; average $2,041\mu$; and in four males from $2,027\mu$ to $2,172\mu$; average $2,110\mu$.

The pore presents the appearance of a transverse slit, and is surrounded by a pallisade-like structure consisting of cuticular ridges (fig. 8).

FIG. 8. *Crossocephalus zebræ*.
Excretory pore. $\times 240$.

CERVICAL PAPILLAE. These are small, nipple-like projections lying very close to the anterior extremity of the worm (figs. 1 to 4).

POSTERIOR EXTREMITY OF MALE. The posterior extremity of the male is markedly inrolled, ventrally. The tail tapers to a point and is furnished with three pre-anal and five post-anal papillae, as is shown in fig. 10. There are no membranous expansions.

Spicules. The spicules are unequal in size, the larger being almost exactly twice the length of the smaller. In eight worms the length of the larger varied from 295μ to 353μ ; average 330μ , and the smaller from 145μ to 176μ ; average 165μ . The larger spicule exhibits fine transverse striations; the smaller is not striated (fig. 11). The testes and ejaculatory duct are limited to the posterior third of the worm, and are shown in fig. 9.

POSTERIOR EXTREMITY OF FEMALE. The end of the female is straight, the tail tapering to a point. In nine worms the distance from the anus to the vulva varied from 170μ to 255μ , average 195μ ; and the distance of the anus from the tip of the tail from 488μ to 617μ , average 551μ (fig. 12).

There is a single tubular ovary the anterior extremity of which lies about 300μ behind the excretory pore. The oviduct runs forward for a short distance and then dilates into a receptaculum seminis. The uterus is a thin-walled sac and reaches nearly as far

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FIG. 9. *Crossocephalus zebrae*.
Posterior extremity of male. $\times 45$.

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FIGS. 10 and 11. *Crossocephalus zebrae*.

Fig. 10. Posterior end of male. $\times 120$.

Fig. 11. Spicules. $\times 360$.

posteriorly as the vulva; in gravid worms it contains one or more fully formed larvae which attain to a length equal to about half that of the parent worm; the larvae exhibit clearly the six pectinated laminae. In the posterior part of the uterus developing larvae can be seen. The vagina commences as a thick muscular tube and exhibits a beaded appearance due to numerous dilatations, it runs first posteriorly, and then anteriorly for a short course, and then directly posterior to the vulva (fig. 13).

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FIGS. 12 and 13. *Grossocephalus zebrae*.

Fig. 12. Posterior extremity of female. $\times 120$. Fig. 13. Diagram of female genitalia.

DIAGNOSIS

This worm is probably closely related to the worm described by Von Linstow (1899) under the name *Pterocephalus viviparus*, and which was subsequently re-named *Crossocephalus* by Railliet in 1909, as the genus *Pterocephalus* was already occupied. We infer this from an examination of Von Linstow's figures rather than from a study of his written description of the worm. The six pectinated laminae of our worm obviously correspond to the '6 aufrichtbare Flügel' described and figured by Von Linstow. Other points in which the worms agree are the possession of two unequal spicules, the character of the tail in the male, and the fact that both are viviparous. These points appear to us to be sufficient to establish the identity of the genus. As regards the minute anatomy of the structure of the head, Von Linstow's description, and some of his figures, appear to us so extraordinary that we can hardly believe that they are correct; indeed, this is the view held by Gedoelst (1906), who found a number of females of what he believed to be *Crossocephalus viviparus* in the intestine of a zebra from Katanga. Apart from the minute anatomy of the head and from certain minor characters, such as the number of papillae on the tail of the male, Von Linstow's worm presents one most striking difference from ours, viz., the position of the vulva. This structure, according to Von Linstow, is situated a short distance behind the middle of the body, whilst in our specimens it was invariably placed immediately in front of the anus; this was also the case in Gedoelst's worm. The description and figures of the head given by Gedoelst differ markedly from ours in certain respects, notably in the arrangement of the papillae. Moreover, Gedoelst's description is of necessity incomplete, as the material at his disposal was limited to females, and to specimens in which the mouth was closed.

We have, then, to deal with three worms all presenting certain morphological similarities, all coming from the same host, and yet all differing in detail. The head of the worm is extremely complicated and possibly the differences may be due to faulty interpretations, and the worms may really all be the same species. But this hypothesis can hardly explain the position assigned to the vulva by Von Linstow. Unfortunately we have been unable to

examine Von Linstow's co-types, and so cannot offer a definite opinion on the matter. It appears to us, therefore, that the proper procedure is to act on the assumption that the description given by Von Linstow is correct, and to regard our worm as a new species, *Crossocephalus zebrae*.

Attention might be drawn to the fact that Baylis (1919) has recently given the name *Crossocephalus longicaudatus* to a closely allied species found in a rhinoceros from the Malay Peninsula.

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