

SOME OBSERVATIONS ON THE BIONOMICS OF *TABANUS*
DITÆNIATUS, MACQUART, AND *TABANUS KINGI*,
 AUSTEN.*

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Tabanus ditæniatus, Macq.

The distribution of this Tabanid as given by Austen † is a very wide one. In Africa it occurs from the Transvaal in the south to Egypt in the north, while outside the bounds of Africa it is found in Baluchistan, India, Ceylon, China and Japan. In the Anglo-Egyptian Sudan it occurs fairly commonly in the south, but until this year it had not been recorded from the northern provinces.

The larvæ were taken early in March of this year in a small water channel—locally known as a ‘gadwal’—on the estate belonging to the Sudan Plantation Syndicate Ltd., at Zeidab, Berber Province. The water was for the most part overgrown with a covering of green slime, and if this was cleared away a few larvæ could generally be seen on the surface. On stirring up the mud at the bottom and edges of the water more would appear, while if one waited for an hour or so specimens would continue to rise. They were apparently living in the mud at the bottom of the pools and coming periodically to the surface to breathe. They could be seen rising to the surface by a lashing motion, and if left undisturbed would, after a few seconds, sink out of sight again.

Some forty odd larvæ of various sizes were taken on March 9th and placed in a jar containing water, slime and hollow grass stems; most of these had disappeared by the next morning, the larger ones having devoured their smaller brethren. On March 10th more than a hundred were secured, and, together with the survivors from the previous day, divided among three jars (only three being available), two containing wet mud, and the third water with hollow grass stems and other débris. Earthworms were provided as food, but were not taken very readily; the larvæ seemed to prefer to eat each other. They were brought to Khartoum on March 11th, and the following morning each of the thirty-three which were still living was placed in a separate jar containing clean river sand and water. They fed freely on tiny earthworms, but their numbers steadily decreased until about April 16th,

* A record of research work carried out in the Wellcome Tropical Research Laboratories and published by permission of the Director of Education, Sudan Government.

† Austen, E. E., *African Blood-sucking Flies*, pp. 118, 119.

when the thirteen survivors, having attained maturity, ceased to feed. Up to this stage, if the sand in which they were living was allowed partially to dry out they became very restless until water was given them again, but hereafter they preferred sand which was only slightly damp. In appearance as well as habits they altered considerably at this stage of their existence. While young and growing they possessed well developed pseudopods and conspicuous dark dorsal markings; now, however, their pseudopods became small and in colour they appeared uniform yellowish white.

These thirteen larvæ were left undisturbed until April 26th, when one specimen was washed out and found to have pupated—probably within the previous two days, as the eyes had not begun to show the colour which they acquired later. On the following day, by carefully picking over the sand, two more pupæ were discovered. Prior to pupating the larvæ had made a number of tunnels in the sand, and the pupæ were lying in a more or less upright position in the tunnels and near the surface.

On April 28th the writer left Khartoum, and was absent travelling in the provinces until May 30th, by which date one larva had died and twelve completed their life cycles, producing eight females and four males. The first had emerged on April 29th or 30th, so the period passed in the pupal stage was probably about six days.

Immature larva (fig. 1).—Length 18 mm. Colour yellowish white, with dark markings composed of pubescence. Mandibles dark brown to black, slightly serrated. Anterior margins of the meso- and metathoracic segments dark, except on the venter. A ring of pseudopods, eight in each ring—two dorsal, two lateral, four ventral,—on the anterior third of each abdominal segment

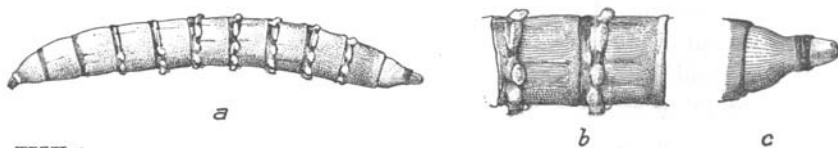


Fig. 1.—Immature larva of *Tubanus ditæniatus*, Macq.

a, lateral view of larva, $\times 3$; b, 3rd and 4th abdominal segments, $\times 6$;
c, 8th abdominal segment, $\times 6$.

except the eighth, well developed (except the dorsal pairs on the first and second segments) and bearing spines or hooks. Spines are also present between the pseudopods on each ring. The rings on the first and second segments edged before and behind with dark pubescence, especially on the dorsum, the pubescence extending between the dorsal and lateral pseudopods, thus enclosing the dorsal pseudopods in a dark ring. On each of the third to the seventh segments inclusive is a patch of dark pubescence between the lateral

and dorsal, and between the dorsal pseudopods,—three patches on each ring—the median patch being conspicuous. To the naked eye these median patches constitute a median dorsal line of black dots. On each of the third to the sixth segments, inclusive, are two patches of dark pubescence immediately anterior to the dorsal pseudopods. The posterior margin of the eighth segment bears dark pubescence. The surface of the larva other than that bearing pubescence is shiny and longitudinally striated.

Mature larva (fig. 2).—Length 25 mm. Colour yellowish white. Mandibles dark brown to black, slightly serrated. Thoracic segments shiny and longitudinally striated, except the anterior margins, which are opaque and pubescent. On the prothoracic segment are five longitudinal grooves—one ventral, two sublateral, two subdorsal—not extending to the posterior border. On the meso- and metathoracic segments are eight such grooves, four on either side. The first abdominal segment bears one pair of ventral pseudopods; the second segment one pair of ventral and one pair of lateral (fig. 2, *b*);

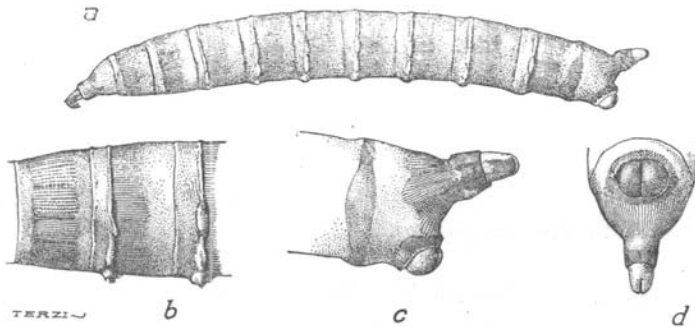


Fig. 2.—Mature larva of *Tabanus ditæniatus*, Macq.

a, lateral view of larva, $\times 3$; *b*, lateral view of 1st and 2nd abdominal segments, $\times 6$;
c, lateral view of anal segment, $\times 6$; *d*, posterior view of same (inverted), $\times 6$.

the third to the seventh, two pairs of ventral and one pair of lateral. Traces of most of the other pseudopods are present, especially of the dorsal pseudopods on the fourth to the seventh segments. The pseudopods bear small colourless spines or hooks, and similar, though smaller, spines are situated between the pseudopods and on the dorsum of the first, second and third segments where the pseudopods are wanting. On the dorsum of the first and second segments these spines constitute a double band. The posterior third of each abdominal segment is shiny and longitudinally striated. The anus is edged with pubescence. The siphon when exerted appears rather shorter than the eighth segment (fig. 2, *c*, *d*).

Pupal case (fig. 3).—Length 17 mm. Colour yellowish brown, thoracic tubercles and abdominal spiracles darker, the former bearing hairs. On the posterior third of the second to the seventh abdominal segments is a ring of backwardly pointing spines, shortest on the second segment and longest on the seventh. The eighth segment terminates in a coronet of six teeth (fig. 3, *b, c*), chestnut brown in colour, darker at the tips, the lateral pair by far the largest, the dorsal and ventral pairs being about equal in size, the former sometimes slightly the larger. The dorsal pair arises from between

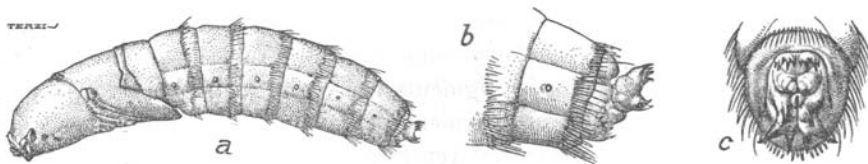


Fig. 3.—Pupa of *Tabanus diteniatus*, Macq.

a, lateral view of pupa, $\times 3$; *b*, lateral view of part of 6th, 7th and 8th abdominal segments, $\times 6$; *c*, posterior view of 8th abdominal segment (inverted), $\times 6$.

the lateral teeth, the four teeth constituting a row. Ventrally placed to this coronet are two rows of similar teeth, each row consisting of from two to five teeth, the two rows together constituting an interrupted transverse row. These teeth are unequal, and vary in size and number in different specimens.

The pupa when first formed is yellow with a greenish tinge, especially on the thorax. Later, as the imago develops, the eyes show as deep maroon and the thorax becomes generally darker.

Tabanus kingi*, Austen.

Khor Arbat (fig. 4), the locality in which this seroot occurs, is situated about 22 miles N.N.W. of Port Sudan, and consists of a stream of slightly brackish water running in a gorge in the rocky hills. On emerging from the hills into the plain the stream loses itself in the sand. In the autumn, during the brief rainy season, it comes down in spate, and is then of considerable size, but in April—the month in which these observations were made—it is, except where pools exist, not more than a few inches in depth. The bed of the stream is stony and there is little or no vegetation growing on its banks.

* For a description and figure of this species, see p. 291.

The female fly deposits her eggs in a rounded mass on a rock rising sheer from the water (fig. 5), generally slightly overhanging, and from 6 inches to 15 inches above water level. Rocks chosen for this purpose overhang comparatively deep pools—from 18 inches upwards—in which the water moves but slowly. Such rocks occur only every here and there; in the mile or so of stream searched by the writer, only three rocks bearing traces



Fig. 4.—View of Khor Arbat, Anglo-Egyptian Sudan; looking up-stream.

of having been used by this Tabanid for purposes of ovipositing were found. On one of them were the remains of several hundred egg-masses lining a small crack in the face of the rock from 2 ft. to $3\frac{1}{2}$ ft. above the water level. As none of the fresh egg-masses found were situated more than 15 inches above water level, these old masses had probably been deposited when that level was higher. Altogether seven females were taken in the act of ovipositing, and several more seen. No particular time of the day seems

to be chosen for the act; one was taken ovipositing at 11.40 A.M. and another at 4.40 P.M., and unlike *T. biguttatus*, Wied., the only other seroot which the writer has observed ovipositing in the field, the female of this Tabanid does not lose her natural wariness while engaged in depositing her eggs. In fact, she is often more difficult to capture than when merely sunning herself on a rock.

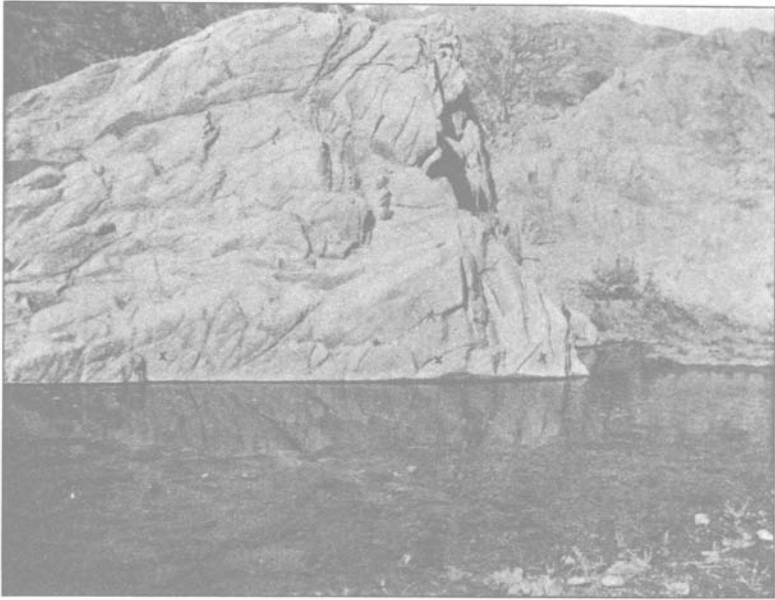


Fig. 5.—A rock at Khor Arbat, showing sites selected by *Tabanus kingi* for ovipositing (indicated by crosses); the three lower crosses represent freshly laid egg-masses.

The egg-masses (fig. 6, *a*) vary in size, and no count of the number of eggs contained was made, but the average mass is believed to consist of about five hundred. When freshly laid the mass is glistening white and can be seen from a considerable distance; but within a few hours it takes on a mottled grey hue, which so closely resembles the colour of the rock that it is not easily detected. While the fly is occupied in laying her eggs, numbers of a tiny Hymenopteron assemble and proceed to add their eggs to the mass, continuing to do so after the fly has gone away. From some twenty egg-masses collected from the rocks about equal numbers of this egg-parasite and of the Tabanid larva were obtained. Specimens have been sent to the Scientific Secretary of the Entomological Research Committee for determination.

One seroot taken in the act of ovipositing completed her egg-laying in a collecting box on the evening of April 13th. These eggs had hatched by the morning of April 19th, the incubation period being therefore about five days. Under normal conditions, exposed to the sun, it may possibly be less. The larvæ from these eggs were allowed to fall from the egg-mass into a basin containing water and stones, and were provided with portions of earthworms and tiny coleopterous and dipterous larvæ obtained from wet moss. They refused to feed however and all perished; probably at this stage of their existence they require brackish running water.

In places, the stream at Khor Arbat is very shallow and ripples over and around stones; under these stones were taken larvæ of various sizes, for the most part nearly mature. Apparently stones which were not quite, or barely, covered with water were chosen by the larvæ in order that they might come up to breathe without losing their hold, and so avoid the danger of being carried away by the current. Usually only a single larva was found under one stone, and in every case where two or three were together a mortal combat was taking place. If a larva was placed on one's hand it would at once endeavour to drive its mouth-hooks through the skin, and where the skin was thin it would succeed in inflicting a sharp pricking pain. Owing to their cannibalistic habits the number of larvæ which could be transported was restricted to the number of vessels available; so though nearly two hundred were taken from the stream, only forty-two were brought alive to Khartoum. There they were placed in jars containing coarse sand, brought from Khor Arbat, and water, and fed on medium-sized earthworms. They took these willingly when hungry, but appeared to need food only once every two or three days. The writer left Khartoum on April 28th, and when he returned on May 30th, the majority of these larvæ were dead; one, however, had completed its life cycle and seven were still living. Six of these seven pupated during the next three weeks, but died as pupæ. The pupal period is probably about six days, for one which pupated on May 5th appeared to be mature on May 11th, when it perished.

One empty pupal case was taken under a stone in the bed of the Khor Arbat stream, and the fly must have crept up the stone through several inches of running water before gaining the air.

Although this Tabanid in its adult form closely resembles *T. tæniola*, Pal. de Beauv., in its larval stage it differs markedly from that species. The larva is admirably adapted for clinging to stones in rapidly running water, its unusually long pseudopods, armed with powerful hooks, being retractile and capable of being used as suckers. None of the other Tabanid larvæ which the writer has seen hitherto has possessed an anal proleg.

Besides the seven specimens mentioned above as having been taken in the act of ovipositing, two or more were caught sucking blood from camels. No males were seen.

Egg.—Length 2 mm. Colour white, becoming darker as the embryo within develops; spindle-shaped.

Mature larva (fig. 6).—Length 35 mm. Colour varying from pale grey through dusky grey to deep chestnut brown. Mandibles dark brown to black, long and powerful, slightly serrated. Anterior margins of meso- and metathoracic segments dark. A smooth shiny pale area on the dorsum of each thoracic segment—on the prothorax this area is concave anteriorly, convex posteriorly and with parallel sides; on the meso- and metathoracic segments it appears to the naked eye diamond-shaped, though sometimes it is actually hexagonal. On the venter of the prothorax are two shiny pale longitudinal areas, each bearing several long black hairs arising from a single pore; a similar but larger area is situated on each of the meso- and metathoracic segments, bearing two similar tufts of hairs. On either side of the meso-

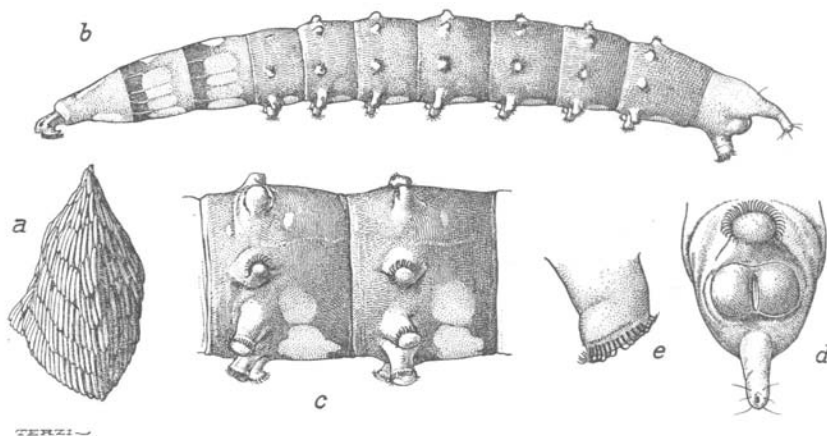


Fig. 6.—Egg-mass and mature larva of *Tabanus kingi*, Austen.

a, egg-mass, $\times 6$; *b*, lateral view of larva, $\times 3$; *c*, lateral view of 4th and 5th abdominal segments, $\times 6$; *d*, posterior view of anal segment (inverted), $\times 6$; *e*, lateral view of anal pseudopod.

and metathoracic segments are three longitudinal areas, not extending to the margins of the segments, longitudinally and deeply striated. On the anterior margins of the meso- and metathoracic segments on either side are four paler lines extending backwards to form the divisions and edges of the three striated areas. On the anterior third of each abdominal segment except the eighth is a ring of pseudopods, eight in each ring,—two dorsal, two lateral, four ventral—except on the first segment where the dorsal pair is wanting. The dorsal pseudopods are never well developed, and with the exception of those on the fifth (fig. 6, *c*), sixth, and seventh segments, are unprovided with hooks. The lateral and ventral pseudopods are very long

and bear at the apices long strong hooks, chestnut brown in colour, some times darker at the tips. On the median pair of ventral pseudopods on the fourth, fifth, and sixth segments these hooks form a complete circle, but on the remaining pseudopods bearing hooks the circle is incomplete. Immediately below these hooks is a row of tiny spines. Immediately behind the ventral pseudopods on the first to the seventh segments is a shiny striated area. On the venter of the eighth segment, anteriorly placed to the anus, is a pseudopod equal in size and similar to the ventral pseudopods on the other segments, and bearing an incomplete circle of hooks (fig. 6, *d, e*). Scattered over the surface of the larva are occasional black hairs. The siphon when exerted is shorter than the eighth segment, and bears a number of black hairs. The dark appearance of the larva is due to tiny dots of pubescence arranged closely together except on the shiny areas mentioned above.

The skin of the larva frequently bears scars of old wounds.

Pupal case (fig. 7).—Length 20 mm. Colour yellowish brown, thoracic tubercles and abdominal spiracles darker, the former bearing hairs. On the posterior third of the second to the seventh abdominal segments is a

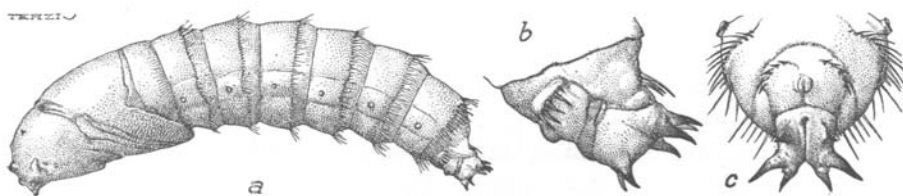


Fig. 7.—Pupal case of *Tabanus kingi*, Austen.

a, lateral view of pupal case, $\times 3$; *b*, lateral view of anal segment, $\times 6$;
c, posterior view of same (inverted), $\times 6$.

ring of backwardly pointing spines, shortest on the second segment and longest on the seventh. The eighth segment terminates in a coronet of six teeth (fig. 7, *b, c*), chestnut brown in colour, darker at the tips, the lateral pair by far the largest, the dorsal and ventral pairs being equal in size. These teeth are arranged roughly in a circle. Ventrally placed to this coronet are two rows of five comparatively thin spines, of varying lengths, together constituting an interrupted transverse row. Dorso-laterally placed to the coronet are two rows of spines similar to the ventral row.

The dorsum of the abdomen is sometimes clothed with black pubescence arranged in four longitudinal stripes. On the sixth and seventh segments these stripes merge, and on the seventh segment the pubescence is confined to the posterior third. The pubescence is wanting on the dorsum of the

eighth segment, but is present on the venter of the seventh, and a small patch is situated immediately below the coronet on the eighth segment.

The pupa when first formed is yellowish. Later, as the imago develops, the eyes appear dark with a greenish tinge, and the thorax becomes generally darker.

The thanks of the writer are due to Capt. W. B. Fry, R.A.M.C., and to Mr. A. Marshall, Laboratory Assistant, for tending these larvæ while he was away from Khartoum.

The drawings are by the well-known entomological artist Mr. A. J. Engel Terzi.