THE STRUCTURE OF THE MOUTH-PARTS OF PANGONIA LONGIROSTRIS
IN RELATION TO THE PROBABLE FEEDING-HABITS OF THE SPECIES.

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(PLATE VI.)

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The present research was carried out in the Department of Agricultural Entomology at Manchester University, under the direction of Dr. A. D. Imms. I am greatly indebted to him both for giving me the insects upon which this research was prosecuted, and also for much help at the University, and afterwards in looking over my paper and aiding its publication.

I. Habits and Economic Significance of the Genus *Pangonia*.

Pangonia longirostris is one of the Orthorrhapha Brachycera, of the family TABANIDAE and sub-family PANGONINAE. This fly was first described by Hardwicke in the Transactions of the Linnaean Society of 1825 from specimens taken in Nepal. His description is as follows :—

“*P. villosa flava*, thorace ferrugineo, abdomine nigro-brunneo: segmentorum marginibus flavis, alis immaculatis.

“Rostrum about twelve times longer than the head. Antennae approximated at the base, short, consisting of three pieces, the two lowest of which are very small, the upper one long, tapering to a point, and composed of eight small articulations. Eyes large, very prominent. Head and thorax very hairy both above and beneath, longer under the throat; of a bright yellow beneath, brownish above. Wings longer than the body, hyaline; costal nervures brown. Body black; the margins of each segment shining, the sides hairy. Halteres short, having the shafts yellow and the knobs ovate, black.

“Length of the insect from the base of the rostrum to the apex of the abdomen ten lines ; and of the rostrum two inches and a half.”

This species was redescribed by Röder in 1881.

Fig. 1. *Pangonia longirostris*, Hardw., ♂ ($\times 2$).

The geographical distribution of the genus *Pangonia* is a wide one, species being found in Spain, Southern France, Russia, throughout a large part of Africa, in India, Australia, New Caledonia, Chili, Brazil and Canada. In this genus there is

to be found a series beginning with those types that have a proboscis that hardly extends beyond the head, and ending with *Pangonia longirostris* in which it extends to a distance greatly exceeding the length of the body. The precise economic importance of the family TABANIDAE seems to be doubtful at present. Austen (2) in 1909 says that it has not been proved or even seriously suggested that any species of *Pangonia* is the regular transmitter of any micro-organism pathogenic to animals or man. According to Fantham, Stephens and Theobald (5) in 1916, Martoglio says that the trypanosome disease of dromedaries known as salaf is "transmitted" by TABANIDAE, especially *Pangonia magretti* and *P. beckeri*, in Italian Somaliland.

In addition to this, the same three authors state that *Haematopota* can carry *Trypanosoma evansi* (causing surra in horses) and that *Chrysops* conveys *Filaria loa* in Southern Nigeria, and in Algeria Dr. E. Sergent has proved that a species of *Tabanus* can transmit three forms of animal trypanosomiasis.* From this it is evident that the TABANIDAE are of importance from an economic view, and further investigation may show this importance to be greater than has been demonstrated at present. It is one of the characteristics of the family to which *Pangonia* belongs that the males are without mandibles, and do not feed on blood to anything approaching the same extent that the females do; they seem to feed chiefly on the nectar of flowers. In the genus *Pangonia* are many species with a very long proboscis, and Lutz (quoted by Austen) thinks that this points to a liquid diet other than blood. From his own observations Lutz doubts whether species in which such an organ exists bite and suck blood on the wing. This agrees with the view of Mr. Ll. Lloyd who writes that "the long proboscis in the PANGONINAE is used to extract the nectar from flowers which they do while hovering, much in the manner of many Sphingid moths." The experience of Dr. Imms in India with *Pangonia longirostris* is that they are found on the borders of forests towards the end of the rainy season, feeding on flowers of the orders Scrophulariaceae and Labiatae by thrusting their proboscis into them, poisoning themselves in the air during the process. He has never seen them attacking man or cattle, and in an experiment which he carried out by enclosing his arm in a loose gauze sleeve containing a female of this species, he found that the insect showed no inclination to use its mouth-parts. This experiment, Dr. Imms informs me, cannot be regarded as conclusive, as the insect had not full freedom for hovering on the wing.

Various species of *Pangonia* have been found attacking man or cattle in different parts of the world, and their methods of attack differ considerably in the experience of the observers. This fact appears to me to be natural owing to the variation in the relative lengths of the labium and the other trophi.

Westermann [quoted both by Westwood (20) and Austen (2)] found *Pangonia rostrata* a very troublesome species to domestic animals at the Cape, but says that this species seems to prefer the flowers of *Pelargonium*. He held the view that, owing to the length of the proboscis, it can bite only when on the wing. In the opinion of Westwood (20) *P. longirostris* could not use its lancets, except by

* [M. B. Mitzmain has demonstrated the transmission of surra by *Tabanus striatus*, F., in the Philippines.—ED.]

detaching them from the labium and holding the latter at a wide angle from the other parts of the mouth. Bates found, on a southern tributary of the Amazon, a *Pangonia* with a proboscis half an inch long and sharper than the finest needle; this insect settled on the backs of his party and pricked them through their clothing. Sharp (16), speaking of the genus *Pangonia*, says that "The proboscis in the females of some of the species is three or four times the length of the body, and as it is stiff and needle-like the creature can use it while hovering on the wing, and will pierce the human body even through clothing of considerable thickness."

I will not comment on this at present except to say that the implied difference in length of proboscis between the male and female is not mentioned, so far as I can find out, in any species of *Pangonia*, and does not apply to *Pangonia longirostris*, as will be seen from the table of the lengths of the mouth-parts of the two sexes of this insect. According to Patton and Cragg (13) "there is evidence that some of these flies, notwithstanding the great length of the proboscis, feed on mammalian blood . . . while hovering near by, making sudden darts. . . . Such a habit is apparently exceptional in the genus, as in the majority of cases the mandibles and maxillae are shorter than the labium, and cannot, therefore, be employed in making a wound." Austen (2) considers that the fact that, in such species as *P. rostrata* and *P. gulosa* (of Africa) there occurs the great extension of the proboscis beyond the piercing stylets, would obviously offer a mechanical obstacle to the piercing of the skin of a mammal by these flies. He thinks it possible that when such flies appear to be attacking animals, they are merely sucking up the blood flowing from wounds caused by other TABANIDAE.

In two more instances taken from Austen (2), the methods of blood-sucking are given. *Pangonia rupelli* was seen attacking horses in Northern Nigeria; it did this by sucking blood on the wing, and darted away after feeding. Dr. Old (12) says of *P. oldii* that it "hovers for a few seconds, alights, and then deliberately punctures, like a needle, with its extraordinary proboscis."

Neave (11) also mentions that individuals of this species were inclined to enter tents and the females occasionally attacked the bare skins of the natives.

Wesché (19), writing in 1904, remarks that "In *Pangonia* is found an extraordinary development in the length of the labium without the geniculation that usually accompanies this character. This enables these insects to pierce through clothing to the skin."

In 1916 Prof. Poulton exhibited at the Entomological Society of London a specimen of what was probably a form of *P. oldii*, Aust. (vide *Proc. Entom. Soc.* 1916, p. lxxii) and read some notes written by Dr. G. D. H. Carpenter, who had conducted some observations in German East Africa. The latter wrote, "I was bitten one day [16th June 1916] in this locality [30° 55' E., 2° 5' S.] by a *Pangonia*, the first I have met. I heard its hum (an unmistakable Tabanid hum), and looking towards the sound saw what I thought was a fine Bombyliid hovering at my bare forearm sucking up moisture from the skin, as Syrphids often do. The proboscis seemed to me to be laid along the surface. I could not quite reconcile the Tabanid hum with the Bombyliid appearance, and was interested to notice that the proboscis was

shrinking, *i.e.*, its tip had penetrated, but obliquely and so gradually that I had not felt it. So it seems that this species feeds on the wing. I send the specimen. I had always wondered how *Pangonia* managed its long proboscis."

A little later in the same year Prof. Poulton exhibited another *Pangonia* which had been identified by Austen as *P. varicolor*, Wied., and was captured by W. J. Burchell at Uitenhage on 27th Nov. 1813 (vide *Proc. Entom. Soc.* 1916, p. xc). Burchell had added in a manuscript catalogue, under the same number which the specimen bears, "The fly that sucks the oxen without settling upon them."

Prof. H. Maxwell Lefroy (who has kindly allowed me to use the information) has observed *Pangonia* attacking cattle in India. He says that they make wounds with the mandibles, turning up the proboscis as an elephant does its trunk. They then back a little and suck up the blood by means of the proboscis. They are walking and not hovering at the time.

This description agrees with one given by Roubaud (15) in an account of an experiment he carried out in Senegal-Niger, West Africa, with a *Pangonia*; the species was undetermined, nor does he mention the sex, but I take it to be a female. The insect was confined in a muslin cage and this was placed on the author's bare arm to see if the *Pangonia* would bite, but beyond the testing of the skin with the labella, there was no result. A piece of sugar soaked in water was placed in the cage, and after leaving the insect feeding on it for a quarter of an hour, the cage was replaced on the author's arm. This time blood-sucking started at once, and continued without a break for 7-8 minutes at a temperature of 23-25° C., when the insect was fully fed. This experiment seems to show that a meal of nectar would precede any blood-sucking.

M. Roubaud concludes his account thus:—"These observations show the biting rôle and the manifest blood-sucking habits of *Pangonia*. There is no doubt that by reason of the large size of the wounding apparatus, tropical pathology and biology must henceforth reckon with these curious TABANIDÆ."

From the above descriptions it will be seen that the possible processes of blood-sucking in the species of *Pangonia* may be classed as follows:—

1. The insect punctures and sucks up the blood through the proboscis alone, while on the wing.
2. The insect alights and punctures with its proboscis.
3. The insect alights, punctures with its other trophi, and then sucks up blood through its proboscis.

I shall return again to this subject after giving a description of the mouth-parts in both sexes of *Pangonia longirostris*.

I am indebted to Dr. A. D. Imms for supplying me with the two pairs of insects upon which this research was carried out. These were preserved in alcohol and were taken by him at Bhowali, in the Kumaon Himalaya, at an altitude of about five thousand feet, on 7th August 1912.

II. Mouth-parts of the Female (text-fig. 2).

(1). *Mandible* (Pl. vi, fig. 2).—A strong chitinous blade 10 mm. in length, with the greatest width (near the base) of .53 mm., and tapering gradually towards the apex; the width half-way along its length being .30 mm. At .2 mm. from the apex, it narrows more abruptly to a sharp point, which is more strongly

Fig. 2. Lateral view of the head of *P. longirostris*, ♀ ($\times 5$): *a*, antenna; *e*, eye; *h*, hypopharynx; *l*, labium; *le*, labrum-epipharynx; *m*, mandible; *mx*, maxilla; *p*, maxillary palp. Owing to its great length only the proximal portion of the labium is shown.

chitinised than the rest of the blade. Very small teeth are found on both sides of the apex; those on the inner side extend to a distance of .1 mm., but the outer ones occur as far down as 3.2 mm. from the tip of the mandible, and then become minute (text-fig. 3).

Fig. 3. Apex of left mandible of ♀ greatly enlarged.

The inner edge of the mandible is produced proximally into a strongly chitinised rod which articulates with a second much shorter rod. From the proximal end of the outer edge there arises another short, curved and pointed rod, which, together with the projection from the inner edge, forms a horseshoe-shaped end to the mandible, in which the inner end of the horseshoe is prolonged beyond the outer one. To this outer projection the abductor rectus muscle is attached.

(2). *Maxilla* (Pl. vi, fig. 3).—This is composed of a cardo, stipes, lacinia, galea and palp. Of these, the cardo is articulated with the head skeleton at a point

which lies internal to, and further back than, the articulation of the mandible ; it is spindle-shaped, .74 mm. long, and has a strongly chitinised ridge running down its length.

The *stipes* cannot be distinctly separated off from the galea. It articulates with the distal end of the cardo, and from here to the base of the palp it is strongly concave outwards, but then curves in the opposite direction and merges into the galea

The *lacinia* is a curved projection from the base of the inner edge of the galea ; it has a pointed end directed towards the base of the head.

The *galea* is a long narrow chitinous rod, of the same length but not as broad as the mandible, the greatest width being .35-.37 mm. Its basal portion is evenly chitinised throughout its breadth, but more distally the chitin is concentrated into a narrow darker band, which runs to the apex. The latter is rounded and covered with numerous rows of teeth, which point backwards (text-fig. 4). The teeth are deep basally, but are produced into thin flattened or pointed ends. On the outer edge of the galea the teeth continue only for a short distance, hairs arising part of the way down and then continuing down towards the base beyond the point where the teeth disappear. Teeth are found on the inner edge to a point further down than the

Fig. 4. Apex of left maxilla (galea) of ♀ ; greatly enlarged.

outer edge, but they gradually become less numerous and then are no longer evident. Some of the more distal of these teeth point inwards. Following a small gap, hairs arise and are continuous down to the base.

Maxillary palp.—This consists of two joints, and arises from the soft membrane on the external border of the base of the galea, and not from any chitinous part. The proximal joint of the palp is expanded at the base, and passes forward as a long rod, slightly curved outwards and of uniform width ; its edge is deeply chitinised and corrugated. At the junction with the second joint it expands slightly, and from this region two rows of stiff hairs arise at the edge and converge, passing for some distance down the first joint. The second, or distal, joint is swollen near the base and then tapers to a blunt end, being about three-quarters of the length of the first joint. Both joints of the palp are covered with hairs ; at the base of the first joint are a few long, slightly pigmented setae, in addition to a continuous covering of short hairs ; higher up are a few more darkly pigmented hairs of medium length, each arising from a conspicuous rounded base. On the proximal part of the second joint is a thick clothing of short stiff darkly-pigmented hairs or spines ; hairs are also found to the extremity of the joint, the stiff ones being succeeded by others which are finer and more transparent. In addition to

these, there are a number of very dark long hairs scattered irregularly over the surface, and on this joint is an oval area of circular thick-walled cells.

Wesché has laid down the rule that "the maxillary palpi when present in Diptera are always in contact with the stipites and cardines of the maxillae," and in the *Journal of the Royal Microscopical Society* for 1904 he gives a figure of a dorsal view of the mouth-parts of a male of *Pangonia longirostris*, in which he marks the palp as maxillary palp. The assumption from this would be that the palps are in contact with the basal joints of the maxillae, but I did not find this to be the case in the specimens I dissected, the palps arising, as stated above, from the soft membrane adjoining the external border of the base of the galea. If Wesché's rule be accepted, the palps should, in my opinion, be called the labial palps, but it seems more likely that, from their close association with the maxillae, they are really not labial palps, but maxillary.

(3). *Labrum-epipharynx* (Pl. vi, fig. 5).—Strong, deeply chitinised in its basal third, broad at the base and gradually tapering distally until, at a short distance from the apex, it narrows more abruptly. It then widens out again, and again

Fig. 5. Apex of labrum-epipharynx of ♀;
greatly enlarged.

narrows, forming a somewhat blunt extremity. I have not been able to separate the labrum from the epipharynx, but in the preparations I have made I can see clearly that there is a central portion which is directly continuous with the fulcrum, and this I take to be the epipharynx, as described by Cragg in the case of *Haematopota pluvialis*. The basal external corners of the labrum articulate with two strong curved rods, which lie in the wall of the head. The apex (text-fig. 5) is covered with numerous rounded teeth which are directed backwards, and on the outer edges of its base there are three ridges on each side, which run diagonally from the edge towards the centre. Behind these ridges the teeth are continued for a short distance on the edges of the labrum-epipharynx, but in the centre they pass gradually into rows of minute hairs, which continue for some way down. A strengthening of the

apex is effected by a strong chitinisation of the central portion forming a straight rod. This structure tapers slightly distally, and divides at the base into two rods, each of which passes to the edge of the labrum-epipharynx. The sides of the whole organ are hairy, starting from a point which is half-way down the chitinous rod and continuing towards the base, the hairs decreasing in size. Ventrally a channel is formed by the downward extension of the edges of this organ.

(4). *Hypopharynx* (Pl. vi, fig. 4).—A slender tapering rod, but swelling out near the apex, which is broad and notched in the centre. The salivary duct runs along the whole length and opens near the extremity (text-fig. 6).

Fig. 6. Apex of hypopharynx of ♀ from ventral aspect; greatly enlarged.

(5). *Labium*.—The most noticeable feature of this species is the labium, which forms the long proboscis giving the insect its specific name. The organ lies ventral to all the other trophi and is loosely attached to the head, its base being enclosed in a basal membrane, the conjunctive membrane of Meinert (10). The labium extends directly forwards in front of the head, and is grooved on its dorsal surface, the other mouth-parts lying within this groove. It is a rather broad organ, and stiff, its surface being strengthened at intervals by transverse bands of brown chitin. At its distal end are the two labella, each of which is so situated that it forms a right or left half of the apex of the labium. The two labella are flattened from side to

Fig. 7. One of the spine-like processes of labellum of ♀ ($\times 830$).

side, and not horizontally as in the rest of the proboscis. They are united at their bases, but are separate distally; they are convex externally and concave internally, and each contains within it a number of pseudotracheae.

The external surface of each labellum (Pl. vi, fig. 1) has a honeycombed appearance, and bears some short, fairly strong spines projecting outwards from it (text-fig. 7). As stated above, Dr. Imms has found this species only on flowers belonging either to the order Scrophulariaceae or to the Labiatae, in both of which the flowers are tubular. In view of this observation, I would suggest that the use of these spines is to steady the insect somewhat when feeding on nectar. Having inserted its

proboscis into the flower, the insect would naturally make the two labella diverge so as to suck up the nectar; this would have the effect of making the spines project into the sides of the flower and would give the insect a slightly firmer hold while it was hovering. Such an arrangement would, I think, be a help, considering the great length of the proboscis.

III. Mouth-parts of the Male.

(1). *Mandibles*.—Absent.

(2). *Maxilla* (text-fig. 8).—Differs very strikingly from the maxilla of the female in the method of its connection with the head. In the female, as stated above, the base of the maxilla is inserted well inside the head. In the male there is no articulation, but the whole organ, with its palp, lies in a membranous area situated within a hollow. The latter is formed firstly by the forward prolongation of the central anterior region of the submentum, and secondly by the hollowing out of the

Fig. 8. Basal portion of right maxilla of ♂ ($\times 44$): *g*, galea; *l*, rudiment of lacinia; *p*, maxillary palp; *st*, stipes.

parts of the genae lying on either side of this process of the submentum. Thus it will be seen that the maxilla in the male is not nearly so firmly welded to the head as it is in the female. The maxilla consists of stipes, lacinia, galea and palp.

Cardo.—Absent.

Stipes.—A broad, very deeply chitinated rod, and slightly curved. It has a distinct articulation with the galea, and is not continuous with it as in the female. The articulation is straight, but faces obliquely towards the middle line.

Lacinia.—A small projection from the inner basal corner of the galea, slightly hooked at its extremity, and pointing towards the head. Its inner edge is stronger than the outer one, as it has a ridge running down it. A straight line, running parallel to the edge of the galea, can be seen separating it off from the latter piece.

Galea.—Approximately of the same length as in the female. It is slightly curved outwards at the base, but the remainder is straight until close to the apex, where it narrows. The inner edge commences to narrow before the outer one. The galea is more deeply chitinated at the base than elsewhere, the chitin decreasing over the

general surface to the apex, which is weak and practically colourless. There is, however, as in the female, a rod of deeper chitin going down the galea, but it gradually disappears before the apex is reached. The two galeae would, when brought together, form a circular tube of which each piece would form one side, up which the liquid food could be sucked.

The apex (fig. 9) is covered with two series of hairs, in one of which the hairs are long and point outwards and slightly forwards, those in the other (along the inner edge) being shorter and pointing inwards and more forwards. The two series

Fig. 9. Apex of right maxilla (galea) of ♂; greatly enlarged.

approximate near the apex, but are more widely separated further down. Hairs are found down to the base of the galea, but are not nearly so numerous as at the apex, and further down the blade they lie in the centre in a direction parallel with its edges.

Maxillary palp.—Of the same length as in the female, but the comparative lengths of the two joints are different, the second one being just over half as long again as the first one, instead of being only three-quarters of its length. In addition to this, the second joint is more uniform in width, ending more bluntly and not being so drawn out as in the female. There are the same different types of hairs as are found on the female's palp.

(3). *Labrum-epipharynx* (text-fig. 10).—The most essential difference between this organ and its counterpart in the female is found in the character of the apex. The

Fig. 10. Apex of labrum-epipharynx of ♂; greatly enlarged.

base of the blade is as strongly chitinated as in the female, but the rest of it has not the same strength, as the chitin decreases, the apex being only feebly chitinated. In contrast to the apex of the labrum-epipharynx in female, that of the male bears no teeth, unless some serrations along the edges can be so called. It is, however,

hairy, more pointed than in the female, and has no central strengthening rod of chitin. Its breadth is covered with rows of minute hairs or spines which lie in a direction perpendicular to the edge of the blade. On either side of the apex is an area free from hairs (fig. 10), in which lie the curved rod-like structures shown in the figure.

(4). *Hypopharynx* (text-fig. 11).—This has the apex much broader than in the female, and it ends abruptly and does not taper. The salivary duct runs down the middle and opens at a distance of .4 mm. from the apex.

Fig. 11. Apex of hypopharynx of ♂ ; greatly enlarged.

(5). *Labium*.—Similar to that of the female, except that the teeth on the pseudo-tracheae of the labella seem to be rather more slender as a rule, but the difference is very slight.

IV. Measurements, in Millimetres, of the Mouth-parts of both Sexes.

	<i>Labium</i> .		<i>Mandibles</i> .		<i>Maxillae</i> .				<i>Hypo-pharynx</i> .		<i>Lbr-epi-pharynx</i> .	
	♂	♀	♂	♀	♂		♀		♂	♀	♂	♀
Length . . .	47	49	—	left 10 right 10	left 9.5 right 9.5	left 9.8 right 9.6	9.5	9.5	9.5	9.3		
„ . . .	42.5	42	—	— —	— —	— —	— —	— —	— —	— —		
Greatest width	—	—	—	.53 .54	.24 .30	.35 .37	.40	.40	1.04	.66		
Width in middle . .	—	—	—	.30 .30	.14 .16	.18 .13	—	.10	.58	.46		

V. Conclusions as to the Feeding-habits of the Species.

From an examination of the mouth-parts of both sexes of *Pangonia longirostris* it will be seen that the sexual differences are :—

- (1) That mandibles are completely absent in the male (as in all other male TABANIDÆ), but are present in the female as strong organs toothed at their apices.
- (2) The maxillae of the male are loosely attached to the head, lying in a membranous area and with no articulation with the head skeleton, and are hairy to the apex ;

those in the female are firmly attached to the endo-skeleton of the head and are hairy over a portion of their length only, the apices being naked and armed with strong teeth.

(3) The labrum-epipharynx of the male has a weak chitinated apex and is hairy; in the female it has a firm apex, strengthened by a median band of chitin, and is armed with strong teeth and not hairy.

(4) The hypopharynx of the male differs from that of the female only in being broader at the apex.

(5) The labium is similar in the two sexes, and the pseudotracheal teeth are found in both male and female.

I conclude from these observations that the male could only suck blood which was flowing from a wound already present on an animal, such as might be caused by the bite of a female Tabanid. I mention this as a possibility, but do not think it is at all likely to occur, as I have been unable to find any reference to a male Tabanid sucking blood. They are always found sucking up the nectar of flowers.

The female is quite competent to suck blood, but can at any time suck up also the juices of flowers through her proboscis.

The most natural way in which the former process would be carried out seems to me to be the third of the three different methods I have enumerated above on p. 257. The female alights, punctures with her stylets and then sucks up blood through the proboscis, either while settled or on the wing. It is possible, however, that certain species feed only while hovering and others only when settled on the skin, but further observations are greatly needed.

The idea that *Pangonia longirostris* could pierce the skin with its proboscis seems to me quite untenable, as the apex of this organ is not pointed and could only be thrust into anything by the close apposition of the two labella. In this case, all possible value that the pseudotracheal teeth might have as piercing organs would be lost, seeing that they would be enclosed inside the labella. There are, too, some short but rather stout spines projecting outwards from the outer edge of the labella, which would hinder any attempt to thrust in the proboscis. As pseudotracheal teeth are found on the labella of such a purely flower-haunting family as the Bombyliidae, and as they are also present in the male *P. longirostris*, I do not consider that their presence has any significance in deciding whether an insect is a blood-sucker or not. According to Dimmock (4) the Bombyliidae use these teeth to scratch the surface of flowers, and no doubt their presence in *Pangonia* can be explained in the same way.

Dr. Imms states that in the living insect the apex of the proboscis is flexible and has not the rigidity usually associated with piercing organs.

VI. Comparison of the Mouth-parts with those of other Tabanidae.

The other TABANIDAE with which *Pangonia longirostris* will be compared are species of *Tabanus*, *Chrysops*, *Haematopota*, and other species of *Pangonia*. The only literature that I have found which deals with the mouth-parts of the males of this family are the writings of Hansen (7), Meinert (10), both of whom give figures of various TABANIDAE, and Wesche (18), who gives a figure of a male *Pangonia*

longirostris without any description. For the mouth-parts of the female I have used a mounted preparation of *Chrysops coecutiens*, and consulted the figures and descriptions of Hansen (7), Meinert (10), Patton and Cragg (13), Cragg (3), and Alcock (1).

Mouth-parts of the Female.

The apices of the mandible of *Pangonia longirostris*, in common with those of *P. sorbens* and *P. depressa*, as figured by Hansen (7), differ from those of species of *Tabanus*, *Chrysops*, and *Haematopota*, in having teeth on both edges of the blade. In *Tabanus* all the teeth are very small and directed backwards, in *Haematopota* there is "a regular row of extremely fine serrations" (Cragg, 3), and in *Chrysops coecutiens* there are a number of large teeth followed by smaller ones; in all these three genera teeth are found only on the inner edge of the blade.

The apices of the maxillae of *Tabanus* are armed with stout rasp-like teeth which are set closely together on the whole of the surface. These teeth continue for some distance on the inner side, and all point towards the base of the blade. In *Chrysops coecutiens* the apical teeth are not so numerous as in *Pangonia longirostris*, but teeth are found further down the blade than in the latter species.

In the maxillary palp of *Tabanus*, *Chrysops* and *Haematopota* the second joint is larger or much larger than the first, but in the female of *Pangonia longirostris* it is smaller, and larger in the male.

The apex of the labrum-epipharynx in *Pangonia longirostris* differs from the condition found in *Tabanus*, *Chrysops* or *Haematopota*. In these three genera teeth are found only at the extreme apex, which is more strongly chitinised than the rest of the blade, and in none of them do they occur so far down. In the case of *Chrysops coecutiens* no hairs are found on the labrum-epipharynx as in *P. longirostris*, though they occur in *Tabanus sudeticus*.

The hypopharynx does not differ from that found in other TABANIDAE.

The labium is considerably more elongate than in *Tabanus*, *Haematopota* or *Chrysops*.

The mouth-parts of the female resemble those found in *Tabanus* more closely than they do those of *Chrysops* or *Haematopota*.

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EXPLANATION OF PLATE VI.

Mouth-parts of the female of *Pangonia longirostris*.

- Fig. 1. Apex of the left labellum seen from the inner side. $\times 180$.
2. Left mandible. $\times 22$.
3. Left maxilla : *c*, cardo ; *g*, galea ; *p*, palp ; *st*, stipes. $\times 22$.
4. Hypopharynx. $\times 22$.
5. Labrum-epipharynx. $\times 22$.
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Mouth-parts of *Pangonia longirostris*, Hardw.