UNIVERSITY OF SASKATCHEWAN

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CONTRIBUTIONS TOWARD A REVISION OF THE
GENUS ATRICHOPOGON BASED ON CHARACTERS
OF ALL STAGES (DIPTERA, HELEIDAE)

A Thesis submitted to the Faculty
of Graduate Studies in partial fulfilment
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by

Alwyn Bradley Ewen

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INTRODUCTION

Atrichopogon is a large genus in the subfamily Forcipomyinae of the family Heleidae (= Ceratopogonidae). Systematists have experienced difficulty in identifying species and in splitting the genus into manageable subgenera on the basis of adult characters. Thus in 1913 Kieffer erected the genus Kempia to include those forms which have pubescent eyes and this is still recognized as a subgenus of Atrichopogon by some authors. However, this character is so variable that it is unworkable, some species having the eyes pubescent only above, others only below (Wirth, 1952). Similarly Kieffer's Gymnohelea, based on species which have lost all the macrotrichia of the wings, cannot be maintained (Edwards, 1926). Wirth's subgenus Melohelea, based on species which parasitize meloid beetles and have an unusually upcurved proboscis, can still be maintained although the immature stages of only one species, A. (Melohelea) meloesugans (Kieffer), are known. Only the description of the early stages of more species will confirm the validity of this subgenus.

As pointed out by Edwards(1926), Nielsen (1951) and Wirth (1952), the imagines of the genus Atrichopogon are very difficult to separate, offering no good, clear-cut character, or even combination of characters. The characters that have been used are color, proportions of antennal or tarsal segments, and hairiness of wing or scutellum, all of which exhibit great individual variation. In view of these difficulties we are "in the peculiar situation to be forced to base the taxonomy to a great extent upon the developmental instars" (Nielsen, 1951). The name Atrichopogon

itself is mystifying, for it indicates an impossible situation: a beard ("pogon") without ("a") hairs ("tricho").

All species discussed in this work are from reared larvae. The bulk of the material was collected by Dr. L.G. Saunders in many countries over many years. Five species were taken in localities around Saskatoon, Canada.

Except for A. minutus (Meigen), A. polydactylus Nielsen, A. fuscus (Meigen) and A. (Meloehalea) meloesugans (Kieffer), my endeavours to identify the species failed to find full agreement with any existing descriptions. Hence, each species studied, except for those mentioned above, has been given a new name. I prefer to run the risk of creating a new synonym rather than refer the larva and pupa to the wrong species.

The species are not treated in any special order. Especially, there is no phylogenetic significance to the sequence.

HISTORICAL

Because of their small size, the adults of the family Heleidae received very little attention until 1852, when Winnertz published a monograph on the European species of the genus Ceratopogon. Most of the known American species were described by Coquillett from 1899 to 1905, and like Winnertz, he included all of them in the genus Ceratopogon. The differentiation of the genera was begun by Kieffer, working from about 1899 to 1925, and our present diagnosis of generic limits was published by Edwards in 1926. Malloch (1917) proposed the recognition of the heleids as a distinct family. Until that time they had been considered a subfamily of Tendipedidae (■ Chironomidae).

Besides Kieffer's monograph on the French species (1925) and Edwards (1926) on the British, the most significant contributions on the genus were made by the Belgian worker Goetghebuer (1923, 1933, 1934). Elsewhere,

notable contributions were made by Lutz on the Brazilian species, Tokunaga on the species of the Japanese empire, and de Meillon on the African species. Carter, Ingram and Macfie began their West African studies in 1920. The latter author became internationally known as a specialist on the group, and continued to identify specimens from all over the world until his death in 1948.

North American species have received comparatively little attention until recently, only a few species having been described by Coquillett and Malloch. Johannsen deals briefly with Atrichopogon in his monograph of 1931, but his greatest contribution was his generic synopsis and check list of North American species which appeared in 1943. In 1952 Wirth published a most extensive treatise on the Hyleidae of California and since that time has continued his work on some ectoparasitic forms (1956). Downes (1955) published a description of A. pollinivorus sp. n. in which he has given some account of the food habits of the species. The most recent account on the taxonomy of the family is that published by Lewis (1956).

Little is known of the immature stages of Atrichopogon. In 1923 Goetghebuer described the larva and pupa of A. fuscus (Meigen) and made reference to an earlier description by Müller (1905) of the immature stages of A. mülleri Kieffer. Descriptions of the early stages of three species, A. attenta Johannsen, A. diluta Johannsen and A. pudica Johannsen, were published by Lenz in 1933, and the same author described the larvae and pupae of A. rostratus Winnertz, A. winnertzi Goetghebuer, A. thienemanni Kieffer, A. fossicola Kieffer, A. mülleri Kieffer (= A. trifasciatus Kieffer), A. fuscus Meigen and A. haesitans (Kieffer) in 1934. Thomsen (1937) described the early stages of two American species, A. websteri

(Coquillett) and A. perigrinus Johannsen, and refers to Malloch's (1915) description of A. fuscus (Coquillett). However, these descriptions are very brief. Although they may distinguish the different larvae and pupae, they are of little value from a morphological point of view. The description of the early stages of A. levis (Coquillett) by Boesel and Snyder (1944) is also lacking in morphological detail. Nielsen (1951) has published the most extensive work on the metamorphosis and biology of Atrichopogon, with very excellent and accurate descriptions and figures of eight Danish species.

Unfortunately, some of the above papers were not available to the writer. Reference to them in Wirth's "Heleidae of California" (1952) has made possible their inclusion in this review.

MATERIALS AND METHODS

Larvae occur chiefly in shaded localities which are subject to occasional or periodic flooding: such situations as in algae covering moist soil along the edges of streams or sloughs, on partly submerged wood, in moss growing on wood or soil, or in or above water held in the leaf axils of plants.

Larvae in moss or algae were extracted by means of a Berlese funnel. Those on wood or plants were removed on small slices of their substrate and placed in 1 in. x 3 in. rearing vials containing moistened material from their natural environment. Here they continued their development, pupated and emerged. After emergence the flies were placed in dry vials until they hardened, when their color was recorded. The color of the fresh larvae was also recorded.

Mature larvae were killed in hot water to force out the pseudopods and blood gills. The pupal exuviae were associated with the larvae and imagines and preserved in 75 % ethyl alcohol.

In order to see clearly the morphological features, the larvae were cleared for 12-24 hours in a 10 % KOH solution. The prothoracic pseudopod

was first removed to facilitate the entry of the clearing agent and also to draw. The cleared skin was then washed in several changes of water, stained in an alcoholic solution of Fast Green and stored in creosote oil. This same procedure was carried out on the male genitalia which were first removed from the whole specimen. The larval prothoracic pseudopod, whole female, male, and pupal cast skin were transferred directly from alcohol to creosote oil. The female head was removed to facilitate examination of the maxillary palps. Also, in most cases, one wing was removed from the female and stained in the Fast Green solution.

The specimens were studied in creosote oil under the microscope using the sloping cover slip technique. Drawings were made with a camera lucida and a Bioscope projector. The drawings of the male genitalia were not corrected for symmetry because of the dangers in changing proportions, although more finished drawings would have resulted. The macrotrichia and veins of the female wings have been over-emphasized in order to bring out the more important features. The drawings are not to the same scale or to any constant scale. Because of the great individual variation in size within species, the limitations and inconveniences of preserving a scale would not have been worth while.

Finally, specimens were transferred from creosote oil and mounted on glass slides with Canada balsam as the mounting agent.

The terminology employed in the description of the cuticular processes and appendages of the developmental instars follows closely that used by Nielsen (1951); imaginal terminology is based on Wirth (1952). The wing venation (Fig. 1, B) is after Nielsen (1951).

Genus Atrichopogon Kieffer

The other large genus in the subfamily Forcipomyiinae is Forcipomyia. The adults of Atrichopogon are distinguished from Forcipomyia by the long second radial cell, the absence or great reduction of macrotrichia on the

Figure 1. Atrichopogon spp. A-F, hypothetical representative of genus; G, sp. A. A, male genitalia; B, cells and veins of female wing; C, head and thorax of pupa, dorsal view; D, first and second abdominal segments of larva, lateral view; E, same, dorsal view; F, larval head; G, entire female. a3, third antennal segment; apb, basistylar apodeme; apf, anal process of frons; ar, basal arm of aedeagus; as, antennal socle; ba, basal arch of aedeagus; bst, basistyle; btr, basitarsus; cer, cercus of female; cr, cercus of male; cs, caudolateral shoulder of aedeagus; dop, dorsoanal process; dst, dististyle; ecp, epicranial process; fp, frontal process; fs, frontal suture; hal, haltere; ldp, laterodorsal process; mdp, mediodorsal process; mp, mesal point of aedeagus; pal, maxillary palpus; prh, prothoracic respiratory horn; pro, proboscis; scu, scutellum; sp, spermatheca; sv, secondary vein; tc, tibial comb; a-f, body setae of larva; m1-m6, mesothoracic processes of pupa; pa-pd, sensorial pits of larval head; 1-11, setae of larval head; 9st, ninth sternite.

wings, the large and conspicuous microtrichia and the nature of the fringe on the posterior border of the wing.

The following diagnosis is taken from Wirth's "Heleidae of California" (1952). The passages underlined are modifications made necessary by the inclusion of new species here.

DIAGNOSIS.- Adults: Body short and stout, slightly hairy. Eyes pubescent or bare. Female antennae with last five segments cylindrical, much longer than segments 3-10, which are globular or transverse, last segments usually with terminal style or nipple. Male antennae with weak verticels on segments 11-14, segment 11 not greatly lengthened. Mesonotum bare or with only short hairs. Legs slender with few or no hairs; end of ~~fore~~ tibia usually with a setose anterior lobe; hind basitarsus always at least twice as long as the second segment. Wings broad, anal area more rounded than in Forcipomyia; microtrichia well developed, macrotrichia less dense and finer and more erect than in Forcipomyia and often confined to the wing tip or absent, usually much reduced in male; costa usually reaching to two-thirds of wing length; second radial cell long, usually two to three times as long as the first; a conspicuous intercalary fork or folded fork in cell R_5 ; crossvein nearly perpendicular; median fork with a short stem, lower branch not or scarcely interrupted at base; anal vein straight; allula and squama bare; fringe on posterior border of wing composed of a single row of alternating long and short, simple, straight hairs. Female abdomen sometimes with a median appendage on the sixth or seventh sternite; one or two spermathecae. Male genitalia with short ninth sternite; tergite rounded, without processes; aedeagus usually simple, usually trilobed; parameres (basistylar apodemes) small, usually hook-shaped.

Immature stages: Larva with head capsule present; mouthparts well developed; pharyngeal skeleton with about six combs, pharyngeal angulus

with bristles; anterior and posterior prolegs present; body segments oval in cross section; lateral processes of body at least as long as segments; all body segments with short spines. Pupa with larval exuviae attached to last three segments; respiratory organ short, knob-like; body segments 2-7 dissimilarly bristled; abdomen with branched or setaceous projections on first five segments.

With the present greatly increased number of species available in immature stages, the following more detailed general description of larvae and pupae is possible.

The Larvae: Atrichopogon larvae are small, varying in length from about 1 mm. to about 4 mm. The body is usually flattened owing to the fact that the lateral sides of the segments protrude into processes.

The head is hypognathous. The larval eye is a prominent dome placed anterodorsally on the lateral side of the sclerotized head capsule (Fig. 1, F). Below and slightly behind the larval eye is a flattened, hyaloid dome.

The most prominent appendages of the head are the big, spur-like antennae which rise from upwardly directed antennal socles placed laterodorsally on the head. The frontal suture runs laterodorsally on the head from the posterior margin to a point medial to the antennal socle. The frons thus makes up the greater part of the dorsal surface of the head. Other sutures are not found and the clypeus and distal part of the frons are not separated from the epicranium (Nielsen, 1951). The anterior and lateral surfaces of the head are covered with an irregular sculpture which often appears as fine nodules or ridges. The dorsal surface usually has five longitudinal rows of rounded nodules.

Eleven pairs of setae are found on the head capsule. For the sake of clarity these have been numbered as in Fig. 1, F. Four pairs of sensorial pits are placed on the head as follows: pit a: behind seta 2; pit b: between the larval eye and the frontal suture; pit c: between setae 5 and 8;

pit d: behind seta 6. Below is a comparison given by Nielsen (1951) of the setae and pits of the larval head in Atrichopogon with those described by Saunders (1924) in Forcipomyia: seta 1: x; seta 2: lacking in Forcipomyia? seta 3: t; seta 4: p; seta 5: w; seta 6: u; seta 7: q; seta 8: o; seta 9: v; seta 10: s; seta 11: y; the pit behind seta 2: z; the pit at the larval eye: r; the two lateral pits: lacking in Forcipomyia? However, in Saunders 1956 paper on Forcipomyia it is clear that seta t is much farther forward on the head than is seta 3 in Atrichopogon, and that seta q is not an ocular seta but is often placed on the front of the face. I believe the comparison should be as follows: seta 1: x; seta 2: t; seta 3: q; seta 4: p; seta 5: w; seta 6: u; seta 7: lacking in Forcipomyia?; seta 8: o; seta 9: v; seta 10: s; seta 11: y; pits a and b: pits z and r; pits c and d: lacking in Forcipomyia?

Abdominal segments I to VIII are of nearly uniform shape. The meta- and especially the mesothorax deviate somewhat, the prothorax and especially the ninth abdominal segment very much from this shape.

Abdominal segments I to VIII appear flattened owing to the fact that the lateral sides of each protrude into lateral processes. Three additional pairs of processes may be present on these segments, placed as follows: one mediodorsally and one laterodorsally both slightly anterior to the lateral process, and one dorsoanally at the base of the lateral process (Fig. 1, D, E).

Six pairs of setae are usually found on the dorsal and lateral surfaces of abdominal segments I to VII, placed as follows: seta A: apically on the mediodorsal process; seta B: apically on the laterodorsal process; seta C: dorsally on the laterodorsal process; seta D: apically on the lateral process; seta E: dorsally and subapically on the lateral process; seta F: ventrally and subapically on the lateral process (Fig. 1, D, E). It is possible to homologize these setae with those described by Saunders (1924) in Forcipomyia: setae A and B: a and b; seta C: d; setae D, E and F: c, e and f.

The metathorax is developed as the abdominal segments except that there

are usually only two lateral setae, seta F being lacking. This is also the case on the mesothorax where the lateral process may be much reduced, or even lacking. The dorsoanal process is often lacking on the mesothorax even when it is present on the remaining segments.

On the prothorax a lateral process is always lacking and the three lateral setae are placed at rather great mutual distances above each other. The laterodorsal and dorsoanal processes are usually present. A pair of dark-colored sclerites are often found, placed on the laterodorsal surfaces of the segment. The prothorax also carries a bilobed pseudopod. Each lobe of the pseudopod carries a varying number of backward curved hooklets arranged in two transverse rows; those in the posterior row are brown-colored and stout, those in the anterior row are light-colored and slender.

Setae C and E are usually lacking on the eighth abdominal segment. The dorsoanal process may also be lacking. A pair of dark-colored sclerites may be present, placed as on the prothorax.

Some larvae also have distinctive unpaired, elliptical, smooth areas on the mesothorax and abdominal segments I to VII, placed between the two mediodorsal setae. Nielsen believes that these areas have a respiratory function.

The ninth abdominal segment is cylindrical in shape, with its dorsal surface covered by an unpaired, dark-colored sclerite. The posterior end of the segment carries a pair of protrusible anal blood gills and the anal pseudopod, which bears two transverse rows of hooklets curved forwards and ventrally. Usually there are four pairs of light-colored, slender hooklets in the dorsal row and five pairs of dark-colored, stout hooklets in the ventral row. The chaetotaxy of the segment is very different. There is a backward curved bristle placed laterodorsally and anterior to the middle on each side of the segment. Laterally and ventrally, the posterior margin is surrounded by a semicircular row of setae, seven on each side, of which the two outermost ones are placed on the posterior corner of the dorsal sclerite.

One other pair of setae is placed orally on the ventral surface of the segment.

The ventral surface of the prothorax to seventh abdominal segment usually carries four pairs of setae. The eighth abdominal segment usually has only three pairs of setae on the ventral surface.

With the exception of the sclerites and respiratory areas mentioned above, the body surface of the larva is membranous. The greatest part is covered with slender spinules or nodules, longest on the ventral surface.

The Pupae: Like the larvae the pupae are small, the largest being about 4 mm. long. The body is broad throughout the head and thorax and tapers abruptly towards the posterior end. On the dorsal side of the head and thorax there is a Y-shaped line of weakness in the cuticle. The shaft of the "Y" stretches the full length of the pro- and mesothorax. That part of the "Y" which occurs on the head corresponds to the frontal and coronal sutures (Nielsen, 1951).

On the dorsal side the head is separated from the thorax by a distinct furrow. Proximally the frons carries a pair of setae each placed on a small process. Anally on the frons there is usually a low, unpaired process. On the epicranium a small seta, often placed on a low process, is usually found near the middle of the frontal suture on each side. No boundary is seen between the pro- and mesothorax. However, the large respiratory horn is generally considered as belonging to the prothorax in Nematoceros pupae (Nielsen, 1951). The respiratory horn may appear boot-shaped, flat or cylindrical, depending on the view. It carries a curving row of a varying number of spiracular papillae on the posterior side.

The dorsal side of the mesothorax is furnished with six pairs of cuticular processes, numbered as in Fig. 1, C. On each side these processes are arranged in two oblique rows converging posteriorly towards the median line. The processes decrease in size posteriorly and may vary greatly in shape. Processes 1 and 2 carry an apical, spur-like seta. The metathorax is bisected by the posterior median point of the mesothorax which, however, never overlaps

the first abdominal segment as in most Forcipomyia pupae.

Abdominal segments I to V usually carry a lateral seta on each side, often placed apically on a lateral process. The processes are usually covered with spinules, but may bear branched spines thus forming digitate structures (Fig. 4, E). A small mediodorsal seta is usually found on each side of these segments, often placed apically on a small mediodorsal process.

On the ventral surface, abdominal segments I, II and VIII usually carry a pair of setae. Abdominal segments III to VII usually bear three pairs of ventral setae.

Segments IX terminates with a pair of diverging and tapering processes, highly variable in shape and armature. The sheaths of the male genital appendages are placed ventrally and protrude slightly beyond the tip of the abdomen.

Table 1 lists, for the species treated in the present work, the most important imaginal characters that have been used in the classification of the genus. Length of the adults is measured from the anterior part of the mesonotum to the tip of the abdomen; when the abdomen is curved under, the thorax to the scutellum and the abdomen are measured separately and the lengths are added together. Wing measurements are taken as length from the arculus of the media to the wing tip, and width as the greatest breadth. The tarsal ratio (abbreviated T.R.) is obtained by dividing the length of the hind basitarsus by the length of the second segment. The antennal ratio (A.R.) is the combined lengths of the last five flagellar segments to segments 3-10. The tibial comb is composed of stout, slightly curved spines radiating from the distal tip of the hind tibia. The most anterior spine is distinctly larger than the others and is known as the spike (Lewis, 1956). The spines are measured from posterior to anterior across the distal tip of the tibia. The tibial width (T.W.) is measured from the base of the outermost posterior spine to the base of the spike.

All measurements were made under the microscope with the aid of an

Table 1. Imaginal Characters.

Species	Wing length, mm. ♀	T.R. ♀ left right	A.R. ♀ left right	Empodium ♀ ♂	Proportional lengths of spines of hind tibial comb,
<u>A.</u>	1.1 / 1.2	3.00 3.06 2.60 2.89 2.40 2.28 2.25 2.60	2.19 2.29 2.16 1.76 2.09 ? 2.04 2.00	Simple spinules; tarsal claws bifid, inner smaller.	♀1:17,20,23,21,24,23,23,18;spike,15;T.W.32. ♀r:15,19,20,20,20,20,16;spike,16;T.W.32. ♂1:15,20,23,22,23,21,19;spike,15;T.W.30. ♂r:15,17,20,20,21,20,19;spike,16;T.W.31.
<u>B.</u>	1.4	2.82 2.82 2.82 2.66 2.54 2.92	1.68 1.72 1.96 ? 1.88 1.75	As in <u>species A.</u>	♀1:12,20,22,22,23,22,22,20,?;spike,13;T.W.33. ♀r:15,20,23,25,26,25,23,25,19;spike,13;T.W.32. ♂1:11,13,14,16,20,20,15,17,15;spike,11;T.W.30. ♂r:14,15,18,22,20,20,16,18,13;spike,14;T.W.30.
<u>C.</u>	0.8 / 0.9	3.13 3.57 3.22 3.18 2.20 2.40	2.04 2.13 2.26 2.42 1.91 ?	As in <u>species A.</u>	♀1:17,13,20,18,19,19,13;spike,14;T.W.31. ♀r:19,17,23,21,19,15;spike,16;T.W.30. ♂1:16,18,18,19,20,?,20;spike,16;T.W.27. ♂r:14,19,19,19,21,16,17;spike,15;T.W.28.
<u>D.</u>	0.9	2.88 2.75 2.78 2.89 2.67 2.60	1.74 1.81 1.43 1.50 1.58 ?	As in <u>species A.</u>	♀1:11,11,13,15,16,20,17,19;spike,13;T.W.22. ♀r:12,11,11,15,15,17,15,18;spike,13;T.W.26.
<u>fuscus</u>	1.6 / 1.7	3.14 3.23 2.44 2.50	2.31 ? 2.16 2.36	As in <u>species A.</u>	♀1:20,25,26,23,22,22,21,23;spike,16;T.W.48. ♀r:19,?,28,26,25,26,20,22;spike,20;T.W.46. ♂1:17,23,24,20,24,26,24,22;spike,12;T.W.35. ♂r:18,21,24,23,24,25,25,24;spike,13;T.W.37.

Table 1, continued.

Species	Wing length, mm. ♀	T.R. ♀ left right	A.R. ♀ left right	Empodium ♀ ♂	Proportional lengths of spines of hind tibial comb.
<u>polydactylus</u>	1.7	2.52 2.52 2.63 2.67	2.56 2.51 2.44 2.50	As in <u>species A</u> .	♀ 1:16,19,23,27,25,29,30,25,25;spike,20;T.W.43. ♀ r:19,22,29,33,?,32,33,30;spike,21;T.W.44. ♂ 1:14,15,22,24,25,23,23,24,25,20;spike,22;T.W.34. ♂ r:18,24,27,28,31,34,33,30,25,29;spike,26;T.W.43.
<u>E.</u>	1.1 / 1.3	? 2.43 2.72 2.82 3.00 2.73 2.75 3.00	1.64 1.50 1.62 1.37 1.88 1.84 1.78 1.72	As in <u>species A</u> .	♀ 1:15,20,22,25,21,23,20;spike,17;T.W.28. ♀ r:17,22,22,24,22,22,21;spike,16;T.W.29. ♂ 1:15,18,20,20,18,16;spike,15;T.W.25. ♂ r:13,15,18,16,17,15;spike,15;T.W.23.
<u>minutus</u>	1.1	2.45 2.30 3.34 2.50 2.54 2.33 2.60 2.45 2.50 3.63	2.11 2.00 1.96 ? 2.41 ? 1.92 1.92 2.32 2.36	As in <u>species A</u> .	♀ 1:18,21,23,21,20,22,21;spike,18;T.W.30. ♀ r:18,20,23,21,23,21,20;spike,20;T.W.30. ♂ r:16,20,19,19,16,18,19,16;spike,14;T.W.29.
<u>F.</u>	0.9 / 1.1	2.75 3.00 3.00 2.70 2.80 2.36 2.25 2.41 2.27 2.36	1.86 ? 1.95 1.90 2.00 1.95 1.84 ? 2.08 1.82	As in <u>species A</u> .	♀ 1:14,16,18,17,20,19,20,17;spike,17;T.W.23. ♀ r:14,14,19,19,19,19,18,18;spike,17;T.W.22. ♂ 1:15,20,19,19,23,19;spike,20;T.W.28. ♂ r:15,19,17,18,20,20,17;spike,14;T.W.30.
<u>meloesugans</u>	1.4 / 1.5	2.45 2.14 2.45 2.64 2.05 2.00	2.45 ? 3.19 ? 2.95 3.05	Simple spinules: tarsal claws simple in ♀, bifid in ♂, inner smaller.	♀ 1:16,20,17,15,22,21,22,23,19;spike,15;T.W.30. ♀ r:22,26,18,25,23,25,25,23,23;spike,17;T.W.35.

Table 1, continued.

Species	Wing length, mm. ♀	T.R. ♀ left right	A.R. ♀ left right	Empodium ♀♂	Proportional lengths of spines of hind tibial comb.
<u>H.</u>	1.9 / 2.1	2.73 2.90 2.61 2.50 2.61 2.79 2.48 ?	1.93 2.00 2.13 2.48 1.99 2.00 2.00 ?	As in <u>species A.</u>	♀ 1:?, 30, 36, 31, 35, 40, 38, 37, ?; spike, 33; T.W. 50. ♀ r: 27, 30, 35, 35, 35, 37, 37, 40, 35; spike, 30; T.W. 50. ♂ 1: 22, 25, 29, 27, 35, 36, 35, 30; spike, 27; T.W. 50. ♂ r: 23, 28, 27, 35, 31, 34, 35, 30, 30; spike, 25; T.W. 49.
<u>I.</u>	1.5 / 1.8	2.51 ? 2.60 2.43 2.62 2.55 2.63 3.14 2.65 2.44 2.58 2.45	1.99 2.00 2.11 2.16 2.25 2.39 2.12 2.12 1.95 1.89 1.94 2.06	As in <u>species A.</u>	♀ 1: 16, 19, 19, 28, 28, 29, 31, 30, 31; spike, 24; T.W. 46. ♂ 1: 17, 21, 31, 31, 35, 34, 34, 33, 30; spike, 26; T.W. 43. ♂ r: 18, 20, 27, 34, 35, 33, ?, ?, 30; spike, 25; T.W. 44.
<u>J.</u>	1.5 / 1.7	2.55 2.65 2.55 2.45 2.48 2.84	1.80 1.62 1.84 ? 1.97 1.83	As in <u>species A.</u>	♀ 1: 16, 21, 25, 28, 29, 30, 23, 30; spike, 25; T.W. 47. ♀ r: 15, 15, 19, 23, 22, 22, 25, 25; spike, 23; T.W. 44. ♂ 1: 15, 19, 25, 25, 25, 28, 30, 28, 27; spike, 23; T.W. 42. ♂ r: 16, 18, 22, 23, 25, 26, 27, 28, 26; spike, 22; T.W. 43.
<u>K.</u>	1.5 / 1.6	2.59 2.22 2.58 ?	1.63 ? 1.90 1.74	As in <u>species A.</u>	♀ 1: 16, 19, 22, 30, 29, 30, 35, 31, 32, 32; spike, 27; T.W. 45. ♀ r: 15, 15, 17, 26, 27, 27, 30, 32, 33, 33; spike, 25; T.W. 47. ♂ 1: 15, 16, 20, 27, 27, 28, 27, 27, 22; spike, 23; T.W. 37.

Table 1, continued.

Species	Wing length, mm. ♀	T.R. ♀ left right	A.R. ♀ left right	Empodium ♀♂	Proportional lengths of spines of hind tibial comb
<u>L.</u>	1.0	2.53 2.56 2.78 2.78 2.46 2.50	1.21 1.16 1.26 1.30 1.19 1.60	As in <u>species A.</u>	♀ 1:15, 19, 20, 26, 28, 27, 27, 24, ?; spike, 15; T.W. 31. ♀ r: 17, 20, 20, 25, 24, 24, 25, 25, 23; spike, 15; T.W. 35. ♂ 1: 19, 24, 27, 28, 28, 30, 27, 23; spike, 16; T.W. 35.
<u>M.</u>	0.5 / 0.7	2.78 2.41 2.80 2.50 2.80 2.50	1.73 1.95 1.97 2.27 1.97 2.05	As in <u>species A.</u>	♀ 1: 9, 10, 13, 18, 15, 11; spike, 18; T.W. 20. ♀ r: 7, 9, 11, 12, 13, 9; spike, 18; T.W. 21. ♂ 1: 8, 11, 15, 17, 19, 15; spike, 22; T.W. 20. ♂ r: 9, 11, 14, 18, 20, 15; spike, 19; T.W. 21.
<u>N.</u>	0.9	2.67 2.88 2.72 3.60	1.86 1.82 1.36 1.38	As in <u>species A.</u>	♀ 1: 13, 18, 23, 23, 27, 27, 19; spike, 28; T.W. 30. ♀ r: 12, 17, 21, 25, 26, 27, 19; spike, 25; T.W. 32. ♂ 1: 14, 13, 17, 18, 17, 18, 20; spike, 25; T.W. 31. ♂ r: 12, 12, 16, 16, 18, 16; spike, 25; T.W. 29.

ocular micrometer.

DESCRIPTION OF SPECIES

Atrichopogon species A, n. sp.

Larva.-- Length about 2.8 mm. Body color middle brown, head dark.

Head: eye large, raised above surface, set high: seta 10 developed as a stub, other setae developed as simple bristles: antennal socle moderately long (Fig. 2, E.) Body segments: (Fig. 2, B and C) seta A present on prothorax to eighth abdominal, borne on a short mediodorsal process; setae B and D present on prothorax to eighth abdominal; seta C present on mesothorax to seventh abdominal; setae E and F present on prothorax and abdominal I to VII, seta E lacking on eighth abdominal, seta F lacking on meso- and metathorax; small laterodorsal process present on prothorax to eighth abdominal; dorsoanal process developed on prothorax only; paired dark-colored sclerites present on laterodorsal surfaces of prothorax, similar sclerite on dorsum of ninth abdominal, unpaired; respiratory areas present on mesothorax and abdominal I to VII. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of six hooklets and an anterior row of five (Fig. 2, F); anal pseudopod with a ventral row of five pairs of hooklets and a dorsal row of four pairs. (Fig. 2, D).

Pupa.-- (Fig. 2, H) Length about 2.2 mm. Exuviae pale yellowish.

Frontal and epicranial processes small, setae short, spur-like. Mesothoracic processes 3, 5 and 6 reduced to inconspicuous nodes; processes 1, 2 and 4 styliform, covered basally with short spinules; process 2 very short. Lateral processes of abdominal segments I to V small, boot-shaped, ending apically in a stout seta; mediodorsal processes lacking, setae short, simple. Rudimentary respiratory areas on dorsum of abdominal segments I to VII. Respiratory horn broad, slightly boot-shaped, bearing about ten spiracular papillae over top (Fig. 2, G).

Female.— Length about 1.5 mm. T.R. 3.00–3.06; A.R. 2.19–2.29. Wing 1.1 x 0.4 mm. Face, proboscis pale; eyes black, pubescent above and below; antennae dusky. Thorax dark brown with light brown scutellum. Halteres cream-colored. Abdomen brown above, pale beneath. Scutellum with four long marginal bristles and four much shorter ones (Fig. 2, K). One spermatheca, globular, tapering gradually to neck (Fig. 2, J). Third palpal segment scarcely swollen, bearing a sunken, cylindrical sensory pit (Fig. 2, L). Wings with macrotrichia present distally in cells R_4 , M_1 , M_4 , Cu and A, and along veins r_4 , r_5 , m_1 , m_{3+4} , cu_1 , cu_2 and a; microtrichia fine; first radial cell narrow, about a third as long as the second (Fig. 1, G).

Male.— Length about 1.8 mm. Wing 1.2 x 0.5 mm.; macrotrichia absent. Color similar to that of female. Genitalia: ninth sternite with deep excavation in middle of posterior margin, bearing four long setae; ninth tergite rounded, slightly exceeding basistyles; basistyles and dististyles slender, dististyles tapered with apices pointed and incurved; aedeagus with basal arms slender, basal arch low and broad, posterior arch broadly rounded, caudolateral shoulders broad; basistylar apodemes crescent-shaped (Fig. 2, M).

Material examined: six ♀♀, 18 ♂♂, many larvae and associated pupal exuviae, Saskatoon, Canada, September 9, 1955, reared from larvae extracted from algae covering moist soil by Berlese funnel. Material to be deposited in National Collection, Ottawa, and United States National Museum, Washington.

This species is one of those in which the larvae have median unpaired respiratory areas on the dorsal side of the mesothorax and abdominal segments I to VII. Other significant features are the stub-like head seta 10, the dorsoanal process on the prothorax only and the long body setae. The pupa is distinguished by the mesothoracic processes and the arrangement of the spiracular papillae of the respiratory horn. The hairiness of the wing and scutellum are the best characters in the female. In the male genitalia the

Figure 2. Atrichopogon sp. A. A, entire larva; B, first and second larval abdominal segments, dorsal view; C, same, lateral view; D, ventral view of last larval segment; E, larval head; F, prothoracic pseudopod of larva, ventral view; G, pupal respiratory horn; H, pupa; I, female antenna; J, spermatheca; K, female scutellum, dorsal view; L, female palp; M, male genitalia.

very deep excavation of the ninth sternite and the shape of the aedeagus are distinctive.

Atrichopogon species B, n. sp.

Larva.— Length about 2.9 mm. Body color yellow-brown, head middle brown. Head: eye large, raised above surface, set high; all setae developed as simple bristles; antennal socle moderately long (Fig. 3, B). Body segments: (Fig. 3, A and C) seta A present on prothorax to eighth abdominal, borne on a short mediodorsal process; setae B and D present on prothorax to eighth abdominal; seta C present on mesothorax to seventh abdominal; setae E and F apparently present on prothorax only; laterodorsal process well developed on prothorax to eighth abdominal; dorsoanal process present on prothorax and metathorax to eighth abdominal, well developed and covered with stout spinules; paired dark-colored sclerites present on laterodorsal surfaces of prothorax and eighth abdominal; similar sclerite on dorsum of ninth abdominal, unpaired; respiratory areas present as in sp. A; anterior abdominal segments about four times as broad as long. Prothoracic pseudopod barely cleft medially, each lobe with a posterior row of eight hooklets and an anterior row of two (Fig. 3, D); anal pseudopod as in sp. A.

Pupa.— (Fig. 3, E) Length about 2.1 mm. Frontal and epicranial processes short, setae short, spur-like. Mesothoracic process 3 entirely lacking; process 4 forward bent with small spines on its posterior surface; process 5 styliform, with small spines along the distal half; process 2 very short. Lateral processes of abdominal segments I to IV large and many-branched, lacking on segment V; mediodorsal processes lacking; mediodorsal and lateral setae short and simple, present on segments I to IV only. Rudimentary respiratory areas on dorsum of abdominal segments I to VII. Respiratory horn narrow with angular base, bearing about 12 spiracular papillae over top (Fig. 3, F).

Female.— Length about 1.8 mm. T.R. 2.82; A.R. 1.68-1.72. Wing 1.4 x 0.4 mm. Face, proboscis pale; eyes black, pubescent above and below; antennae ochreous. Thorax dark brown with light brown scutellum. Halteres creamy-white. Scutellum with four long marginal bristles and 14 much shorter ones (Fig. 3, K). One spermatheca, globular, tapering abruptly to neck (Fig. 3, G). Third palpal segment slightly swollen below, bearing a sunken, cylindrical sensory pit (Fig. 3, J). Wings with a few macrotrichia present distally in cells R_5 and M_1 , and along veins r_5 , m_1 , m_{3+4} , cu_1 and cu_2 ; microtrichia fine; first radial cell broad, about a third as long as the second (Fig. 3, I).

Male.— Length about 2.0 mm. Wing 1.4 x 0.4 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with deep excavation in middle of posterior margin, bearing five long setae; ninth tergite rounded, shorter than basistyles; basistyles and dististyles slender, dististyles tapering to sharp point; aedeagus with basal arms slender, arch low and broad, posterior arch broadly rounded, caudolateral shoulders moderate; basistylar apodemes crescent-shaped (Fig. 3, L).

Material examined: three ♀♀, five ♂♂, 16 larvae, Nanaimo, Canada, July 22, 1926, reared from larvae on stones in stream, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The most distinctive feature of the larva is the very broad body segments, hence the name. Other significant features are the dorsoanal processes, the large lateral processes and the respiratory areas. The pupa is distinguished by the processes of the mesothorax and abdomen. The female is difficult to separate from other species; the reduction of the macrotrichia of the wings, hairiness of scutellum and globular spermatheca are the best characters. The deep excavation of the ninth sternite bearing five setae and the crescent-shaped basistylar apodemes are distinctive in the male

Figure 3. Atrichopogon sp. B. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, prothoracic pseudopod of larva, ventral view; E, pupa; F, pupal respiratory horn; G, spermatheca; H, female antenna; I, female wing; J, female palp; K, female scutellum, dorsal view; L, male genitalia. dop, dorsoanal process; ldp, laterodorsal process.

genitalia.

Atrichopogon species C. n. sp.

Larva. - Length about 2.4 mm. Color (preserved) light orange-brown; head dark brown. Head: eye large, set high; all setae developed as simple bristles, seta 7 long, seta 4 setaceous; antennal socle long (Fig. 4, B). Body segments: (Fig. 4, A and C) seta A present on prothorax to eighth abdominal, borne on a short mediodorsal process; setae B and D present on prothorax to eighth abdominal, seta B long and setaceous; seta C present on mesothorax to seventh abdominal, well developed on mesothorax; setae E and F present on prothorax and abdominal I to VII, seta E well developed on prothorax and borne at the posterior tip of the laterodorsal process, lacking on eighth abdominal, seta F lacking on meso- and metathorax; laterodorsal process present on prothorax to eighth abdominal, well developed; dorsoanal process present on prothorax and metathorax to eighth abdominal, well developed and covered with stout spinules; sclerites and respiratory areas present as in sp. B. Prothoracic pseudopod deeply cleft medially, hooklets as in sp. A (Fig. 4, D); anal pseudopod as in sp. A.

Pupa. - (Fig. 4, E) Length about 1.7 mm. Exuviae pale yellowish. Processes on frons and epicranium well developed, covered with branched spines, setae spur-like. Mesothoracic processes styliiform, covered with branched spines. Lateral processes of abdominal segments I to V well developed, covered on the anterior and posterior sides with many branched spines, setae spur-like; mediodorsal setae placed on small processes. Rudimentary respiratory areas on dorsum of abdominal segments I to VII. Respiratory horn slightly boot-shaped, bearing about 12 spiracular papillae over top (Fig. 4, F).

Female. - Length about 1.2 mm. T.R. 3.13-3.57; A.R. 2.04-2.13. Wing 0.9 x 0.4 mm. Face, proboscis medium brown; eyes black, pubescent above and below; antennae medium brown. Thorax dark brown above, pale beneath,

with light brown scutellum. Halteres white. Abdomen light brown. Scutellum with four long marginal bristles and eight much shorter ones (Fig. 4, H). One spermatheca, subspherical, with short neck (Fig. 4, J). Third palpal segment scarcely swollen, bearing a sunken, oval sensory pit (Fig. 4, G). Wings with macrotrichia confined to apices of cells R_4 and M_1 , and along veins r_4 , r_5 , m_1 , m_{3+4} and cu_1 ; microtrichia coarse; first radial cell about a third as long as the second (Fig. 4, K).

Male.— Length about 1.3 mm. Wing 0.9 x 0.4 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with shallow posterior excavation bearing four long setae; ninth tergite rounded, attaining apices of basistyles; basistyles and dististyles slender, dististyles gradually tapering to pointed, slightly incurved apices; aedeagus with basal arms slender, basal arch shallow, caudolateral shoulders moderate, mesal lobe with cap-like apex; basistylar apodemes hook-like, short (Fig. 4, L).

Material examined: two ♀♀, three larvae, five pupal exuviae, Tobago, B.W.I., May 31, 1953, reared from larvae on wood in stream, coll. L.G. Saunders; three ♀♀, two ♂♂, three larvae, four pupal exuviae, Georgetown, British Guiana, May 20, 1953, reared from larvae in water-filled palm sheath, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The long antennal socle, simple head setae, respiratory areas and dorsoanal processes are the most characteristic features of the larva. The pupa is distinguished by the development of the branched processes on the mesothorax and abdomen and the arrangement of the spiracular papillae of the respiratory horn. In the female the coarse microtrichia and the reduction of the macrotrichia of the wings are good characters, as also is the hairiness of the scutellum. In the male genitalia the shallow excavation of the ninth sternite with the four long setae and the shape of the basistylar apodemes are the best characters; the aedeagus, basistyles and dististyles are close to those of sp. B.

Figure 4. *Atrichopogon* sp. C. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, larval prothoracic pseudopod, ventral view; E, pupa; F, pupal respiratory horn; G, female palp; H, female scutellum, dorsal view; I, female antenna; J, spermatheca; K, female wing; L, male genitalia.

Atrichopogon species D, n. sp.

Larva.— Length about 2.3 mm. Color (preserved) dull brown; head medium brown. Head: eye set high, large; seta 10 developed as a short stub, other setae developed as simple bristles, seta 7 very long, setae 3 and 4 setaceous; antennal socle long (Fig. 5, B). Body segments: (Fig. 5, A and C) body setae developed as in sp. C; laterodorsal process present on prothorax to eighth abdominal, well developed; dorsoanal process present on prothorax to eighth abdominal, well developed and covered with stout spinules; paired dark-colored sclerites present on laterodorsal surfaces of prothorax; similar unpaired sclerite on dorsum of ninth abdominal; respiratory areas present as in sp. A. Prothoracic pseudopod with shallow cleft medially, hooklets as in sp. A (Fig. 5, D); anal pseudopod as in sp. A.

Pupa.— (Fig. 5, E) Length about 2.0 mm. Color (exuviae) pale brown. Processes on frons and epicranium well developed, covered with branched spines, setae spur-like. Mesothoracic process 3 reduced to an inconspicuous node, others styliform, covered on the anterior and posterior sides with many branched spines. Lateral processes developed as in sp. C; mediodorsal seta of abdominal segments I to V placed on a small, unbranched process. Rudimentary respiratory areas present on dorsum of abdominal segments I to VII. Respiratory horn cylindrical, bearing about 12 spiracular papillae in a semicircle around the extremity (Fig. 5, F).

Female.— Length about 1.4 mm. T.R. 2.75-2.88; A.R. 1.74-1.81. Wing 0.9 x 0.4 mm. Face, proboscis ochreous; eyes black, pubescent above and below; antennae yellowish-brown. Thorax dark brown above, pale brown beneath, with light brown scutellum. Halteres white. Abdomen grey-brown. Scutellum with four long marginal bristles and six much shorter ones (Fig. 5, G). One spermatheca, subglobular, with a short tapered neck (Fig. 5, J). Third palpal segment stout, with a sunken, oval sensory pit (Fig. 5, K).

Figure 5. Atrichopogon sp. D. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, larval prothoracic pseudopod, ventral view; E, pupa; F, pupal respiratory horn; G, female scutellum, dorsal view; H, female wing; I, female antenna; J, spermatheca; K, female palp.

Wings with macrotrichia confined to apices of cells R_4 and M_1 , and along veins r_4 , r_5 , m_1 , m_{3+4} and cu_1 ; microtrichia fine; first radial cell broad, about a third as long as the second (Fig. 5, H).

Material examined: three ♀♀, three larvae, one pupal exuviae, Mayaguez, Puerto Rico, February 25, 1953, reared from larvae on rotten leaves bordering stream, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

This species is distinguished from the others in which the larvae have the respiratory areas by the presence of well developed dorsoanal processes on the prothorax to the eighth abdominal segment. The very long antennal socle and head seta 7, setaceous head setae 3 and 4, stub-like head seta 10 and the absence of the dark-colored sclerites on the eighth abdominal segment are other good characters. The pupa is distinguished from that of sp. C by the reduced mesothoracic process 3 and the arrangement of the spiracular papillae of the respiratory horn. The reduction of the macrotrichia and the fine microtrichia of the wings, the hairiness of the scutellum and the shape of the third palpal segment are the most distinctive characters in the female.

Atrichopogon fuscus (Meigen)

The larva and pupa of this species were originally described by Goetghebuer in 1923. With regard to the genus of this species, Goetghebuer retains the name Kempia, claiming that it belongs to a distinct group with pubescent eyes in the adult. However, Edwards (1926) and Wirth (1952) have found intermediate forms between Kempia and Atrichopogon and have sunk the former under the latter. Study of the larvae and pupae shows many points in common between the two, but no striking differences.

For specimens of this species I am indebted to Dr. M. Goetghebuer who

gave them to Dr. L.G. Saunders. The species is redescribed here and made uniform with others of this paper.

Larva.- Length about 4.6 mm. Color (preserved) middle brown; head dark brown. Head: eye large, scarcely raised above surface; all setae developed as simple bristles, seta 7 long; antennal socle very low (Fig. 6, B). Body segments: (Fig. 6, A, C and D) seta A present on prothorax to eighth abdominal, borne on a long, tapering mediodorsal process; setae B and D present on prothorax to eighth abdominal; seta C present on mesothorax to seventh abdominal, well developed on mesothorax; setae E and F present on prothorax and abdominal I to VII, seta E lacking on eighth abdominal, seta F lacking on meso- and metathorax; laterodorsal process present on prothorax to eighth abdominal, protruding into a big, distally tapering tracheal gill; dorsoanal process present on prothorax and metathorax to eighth abdominal; unpaired, dark-colored sclerite present on dorsum of ninth abdominal; respiratory areas lacking. Prothoracic pseudopod barely cleft medially, each lobe with a posterior row of ten hooklets and an anterior row of three (Fig. 6, E); anal pseudopod with a ventral row of five pairs of hooklets and a dorsal row of five pairs (Fig. 6, C).

Pupa.- (Fig. 6, F) Length about 3.7 mm. Abdomen light brown, thorax and head middle brown. Frontal and epicranial processes small, setae short, spur-like. Mesothoracic process 3 reduced to an inconspicuous node, process 6 entirely lacking; process 4 forward bent, covered on the posterior side with small spines. Lateral processes of abdominal segments I to IV large and many-branched, simple on segment V; mediodorsal processes of abdominal segments I to V small, setae short, spur-like. Characteristic "pigment spots" present on dorsum of abdominal segments I to VII, placed as in Fig. 6, F. Respiratory horn flattened, triangular, with the apex rounded, bearing about 34 spiracular papillae along the margin of the distal portion (Fig. 6, G).

Female.-- Length about 2.0 mm. T.R. 3.14-3.23; A.R. 2.31. Wing 1.7 x 0.5 mm. Face, proboscis and antennae middle brown; eyes black, pubescent above and below. Thorax dark brown with light brown scutellum and white halteres. Abdomen grey-brown. Scutellum with four long marginal bristles and 20 much shorter ones (Fig. 6, K). One spermatheca, elliptical, tapering to unsclerotized duct (Fig. 6, I). Third palpal segment cylindrical, bearing a sunken, cylindrical sensory pit (Fig. 6, H). Wings with macrotrichia present distally in cells R_4 , M_1 , M_4 , Cu and A, and along veins r_4 , r_5 , m_1 , m_{3+4} , cu_1 and cu_2 ; microtrichia fine; first radial cell narrow, half as long as the second (Fig. 6, L).

Male.-- Length about 2.2 mm. Wing 1.7 x 0.5 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite about three times as broad as long, with a deep excavation in the posterior margin, bearing about 12 long setae; ninth tergite rounded, attaining apices of basistyles; basistyles and dististyles broad, dististyles tapering gradually to rounded apices; aedeagus with basal arms slender, basal arch low and broad, caudolateral shoulders broad, mesal lobe with cap-like apex; basistylar apodemes crescent-shaped (Fig. 6, M).

Goetghebuer (1923) says that the larvae are truly aquatic, living in algae on the surface of ponds. The habitats are well described in the paper referred to.

Material examined: one ♀, four ♂♂, one larva, five pupal exuviae, coll. M. Goetghebuer. Material to be deposited in National Collection, Ottawa.

The larva is distinctive in having all the body processes and setae well developed and in having the laterodorsal process developed as a tracheal gill. These processes are very thin-walled and richly tracheated; thus there "cannot be much doubt-- that we have to do with respiratory organs" (Nielsen, 1951). The low antennal socle is also a good character. The pupa is distinguished by the development of the mesothoracic and abdominal processes, the abdominal "pigment spots" and the shape of the respiratory horn. The females are not

Figure 6. Atrichopogon fuscus. A, entire larva; B, larval head; C, last three larval segments, ventral view; D, first and second larval abdominal segments, dorsal view; E, larval prothoracic pseudopod, ventral view; F, pupa; G, pupal respiratory horn; H, female palp; I, spermatheca; J, female antenna; K, female scutellum, dorsal view; L, female wing; M, male genitalia.

easy to distinguish; the hairiness of the wings and scutellum and the high tarsal ratio are the best characters. The deeply excavated, wide ninth sternite, the shape of the aedeagus and dististyles are distinctive in the male genitalia.

Atrichopogon polydactylus Nielsen

The specimens at hand fit the description of Nielsen (1951) very well. The species is described and figured again to conform with others in the present paper.

Larva.— Length about 4.9 mm. Color orange-brown, head dark. Head: eye set high, raised above surface; all setae developed as simple bristles, seta 7 short; seta 10 represented by two very close-set and slender bristles; antennal socle moderate (Fig. 7, B). Body segments: (Fig. 7, A and C) seta A present on prothorax to eighth abdominal, borne on a long mediodorsal process; setae B and D present on prothorax to eighth abdominal; seta C present on mesothorax to seventh abdominal; setae E and F present as in fuscus; laterodorsal process lacking on prothorax, present on remaining segments as a long, tapering tracheal gill; dorsoanal process lacking; paired dark-colored sclerites present on laterodorsal surfaces of prothorax; similar unpaired sclerite on dorsum of ninth abdominal; respiratory areas lacking. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of ten hooklets and an anterior row of four (Fig. 7, D); anal pseudopod as in fuscus (Fig. 7, E).

Pupa.— (Fig. 7, F) Length about 3.4 mm. Exuviae pale yellowish. Frontal and epicranial processes and setae short; anal process of frons lacking. Mesothoracic process 3 reduced to an inconspicuous node, others styliform, covered with small spinules. Lateral processes of abdominal segments I to V slender, unbranched and covered distally with small spinules; mediodorsal processes short; mediodorsal and lateral setae developed as

short, slender bristles. On the lateral surfaces, abdominal segments II to VIII have a thin-walled, finger-like process, which probably has a respiratory function. Respiratory horn cylindrical with a U-shaped row of spiracular papillae, the oral part of which eventually bends across the dorsal side of the tube to continue proximally on the posterior side (Fig. 7, H).

Female.— Length about 2.2 mm. T.R. 2.52; A.R. 2.51-2.56. Wing 1.7 x 0.6 mm. Face, proboscis and antennae yellow-brown; eyes black, bare. Thorax middle brown, shining, with yellow-brown scutellum. Halteres white. Abdomen pale with dark markings on the dorsum. Scutellum with four long marginal bristles and 18 much shorter ones (Fig. 7, I). Two spermathecae, elliptical, tapering to narrow neck (Fig. 7, J). Third palpal segment swollen distally, bearing a sunken, cylindrical sensory pit (Fig. 7, M). Wings with second radial cell about 3.5 times as long as the first; macrotrichia in apices of cells R_4 , M_1 , Cu and A, and along veins r_5 , m_1 , m_{3+4} , sv, cu_1 and cu_2 ; microtrichia fine (Fig. 7, K).

Male.— Length about 2.7 mm. Wing 2.0 x 0.7 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with deep excavation in posterior margin, bearing about 22 long setae; ninth tergite coming to broad point, exceeding basistyles by half their length; basistyles broad, dististyles slender, tapering gradually to apices and slightly incurved; aedeagus with basal arms slender, basal arch shallow, caudolateral shoulders rounded, mesal point well developed; basistylar apodemes short, hook-like (Fig. 7, N).

Material examined: one ♀, two ♂♂, two pupal exuviae, 12 larvae, Saskatoon (Pike Lake), Canada, September 2, 9 and 25, 1956, reared from larvae extracted from moss along the edge of a slough by Berlese funnel. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The larva resembles that of fuscus in having the laterodorsal process expanded as a tracheal gill, but differs in details of chaetotaxy. The species is at present unique in having finger-like gills on the pupal abdomen; the respiratory horn is very distinctive, but not unique. The long second radial cell, two spermathecae and hairiness of scutellum are the best features

Figure 7. Atrichopogon polydactylus. A, entire larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, prothoracic pseudopod of larva, ventral view; E, last larval segment, ventral view; F, pupa; G, mesothoracic process 1 of pupa; H, pupal respiratory horn; I, female scutellum, dorsal view; J, spermathecae; K, female wing; L, female antenna; M, female palp; N, male genitalia.

in the female. The male is distinguished by the long, pointed ninth tergite.

Atrichopogon species E, n. sp.

Larva. - Length about 2.9 mm. Color (preserved) reddish-brown, head dark brown. Head: eye large, scarcely raised above the surface; all setae developed as simple bristles, seta 7 lacking, seta 10 very long; antennal socle very low (Fig. 8, B). Body segments: (Fig. 8, A and C) seta A present on prothorax to eighth abdominal, very long, borne on short mediodorsal process; setae B and D present on prothorax to eighth abdominal, seta B long, seta D long on prothorax, short on remaining segments; seta C present on mesothorax to seventh abdominal, longer on mesothorax; setae E and F present on prothorax and abdominal I to VII, seta E lacking on eighth abdominal, seta F lacking on meso- and metathorax; laterodorsal process present on prothorax to eighth abdominal; dorsoanal process lacking; unpaired, dark-colored sclerite present on dorsum of ninth abdominal. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of three hooklets and an anterior row of two (Fig. 8, E); anal pseudopod with a ventral row of five pairs of hooklets and a dorsal row of four pairs (Fig. 8, D).

Pupa. - (Fig. 8, F) Length about 2.2 mm. Exuviae yellow-brown. Frontal and epicranial processes short, setae stout, spur-like. Mesothoracic processes well developed, styliform. Lateral and mediodorsal processes of abdominal segments I to V long and tapered, each bearing a spur-like seta apically. Respiratory horn cylindrical with a bend at the base, bearing about 12 spiracular papillae along the posterior side and over the top (Fig. 8, G).

Female. - Length about 1.8 mm. T.R. 2.43; A.R. 1.50-1.64. Wing 1.2 x 0.5 mm. Face, proboscis and antennae middle brown; eyes black, pubescent above and below. Thorax dark brown, subshining, with a light brown scutellum. Halteres white. Abdomen pale with dark markings on the dorsal surface. Scutellum with four long marginal bristles and 12 much shorter ones (Fig. 8, K).

Figure 8. *Atrichopogon* sp. E. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, last larval segment, ventral view; E, prothoracic pseudopod of larva, ventral view; F, pupa; G, pupal respiratory horn; H, female palp; I, female antenna; J, spermatheca; K, female scutellum, dorsal view; L, female wing; M, male genitalia. a-f, setae of larval body segments.

One spermatheca, globular, tapering gradually to long neck (Fig. 8, J). Third palpal segment slightly swollen, bearing a sunken, oval sensory pit (Fig. 8, H). Wings with second radial cell about three times as long as the first; macrotrichia confined to apices of cells R_4 , M_1 , M_4 and Cu, and along veins r_4 , r_5 , m_1 , m_{3+4} , sv, cu_1 and cu_2 ; microtrichia fine (Fig. 8, I).

Male.— Length about 1.7 mm. Wing 1.2 x 0.4 mm.; macrotrichia absent.

Color as in female. Genitalia: ninth sternite with posterior margin transverse, with an irregular row of about 12 long setae; ninth tergite rounded, attaining apices of basistyles; basistyles broad, dististyles slender, nearly straight, with tip slightly bent inward; aedeagus with basal arms slender, basal arch to about halfway, posterior margin with rounded, expanded shoulders, mesal point with cap-like apex; basistylar apodemes crescent-shaped (Fig. 8, M).

Material examined: two ♀♀, two ♂♂, two larvae, three pupal exuviae, Nanaimo, Canada, July 22, 1926, reared from larvae on rotting wood in water, coll. L.G. Saunders; two ♀♀, one larva, on wood, Antelope Lake, Saskatchewan, August 1, 1938, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The larva is unique in having head seta 7 lacking, although this may be an aberrant feature in the small number of specimens examined. The very long body and head setae distinguish the larva from all others yet known. The pupa is simple and very Forcipomyia-like. The female shows no unusual features, the hairiness of the scutellum and the shape of the spermatheca being the best characters. The shape of the aedeagus and the transverse posterior margin of the ninth sternite are the only distinguishing features of the male genitalia.

Atrichopogon minutus (Meigen)

The specimens at hand fit the descriptions of Kieffer (1925), Edwards

(1926) and Wirth (1952) very well. The immature stages are described here for the first time.

Larva. - Length about 2.5 mm. Color (preserved) middle brown, head dark brown. Head: eye large, raised above surface; seta 10 developed as a stub, other setae developed as simple bristles, seta 7 short; antennal socle moderately long (Fig. 9, B). Body segments: (Fig. 9, A and C) seta A developed as a short stub, present on prothorax to eighth abdominal, borne on a short mediodorsal process; setae B and D present on prothorax to eighth abdominal, seta B setaceous; seta C present mesothorax to seventh abdominal, borne dorsally on anterior tip of laterodorsal process, well developed on mesothorax; seta E present on prothorax to eighth abdominal, well developed on prothorax and borne on posterior tip of laterodorsal process; seta F apparently lacking on all segments; laterodorsal process well developed on prothorax to eighth abdominal; dorsoanal process well developed on prothorax to eighth abdominal; paired dark-colored sclerites present on shoulders of prothorax and eighth abdominal; similar unpaired sclerite on dorsum of ninth abdominal; respiratory areas lacking. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of five hooklets and an anterior row of two (Fig. 9, D); anal pseudopod with a ventral row of five pairs of hooklets and a dorsal row of four pairs.

Pupa. - (Fig. 9, E) Length about 1.8 mm. Exuviae pale yellowish. Frontal and epicranial processes short, setae developed as stout spurs. Mesothoracic processes all well developed, styliform. Lateral and mediodorsal processes present on first five abdominal segments, well developed, ending apically with a stub-like seta. Respiratory horn broad, distinctly boot-shaped, with a curving row of about ten spiracular papillae up back and over top (Fig. 9, F).

Female. - Length about 1.6 mm. T.R. 2.30-2.45; A.R. 2.00-2.11. Wing 1.1 x 0.4 mm. Face, proboscis and antennae pale brown; eyes black, bare. Thorax dark black-brown, shining, with a dark brown scutellum. Halteres white.

Figure 9. *Atrichopogon minutus*. A, anterior region of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, prothoracic pseudopod of larva, ventral view; E, pupa; F, pupal respiratory horn; G, female scutellum, dorsal view; H, female antenna; I, spermatheca; J, female palp; K, female wing; L, male genitalia.

Abdomen pale with dark markings on the dorsal surface. Scutellum with two long marginal bristles and six much shorter ones (Fig. 9, G). One spermatheca, subglobular, tapering to neck (Fig. 9, I). Third palpal segment distinctly swollen, bearing a sunken, cylindrical sensory pit (Fig. 9, J). Wings with macrotrichia sparse, confined to apex of cell R_4 and along vein m_1 ; microtrichia fine; first radial cell broad, about a third as long as the second (Fig. 9, K).

Male.— Length about 1.4 mm. Wing 1.1 x 0.4 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with shallow excavation in the posterior margin, bearing about 11 long setae; ninth tergite rounded, longer than basistyles; basistyles and dististyles slender, dististyles tapering to pointed, incurved apices; aedeagus with basal arch shallow, arms short, caudolateral shoulders moderate, mesal lobe with cap-like apex; basistylar apodemes hook-like, short (Fig. 9, L).

Material examined: 16 ♀♀, 22 larvae, 4 pupal exuviae, Lit. Abington, Cambs., England, August 27, 1924, reared from larvae found under wood in swamp, coll. L.G. Saunders; three ♀♀, three ♂♂, 17 larvae, 11 pupal exuviae, Victoria, Canada, August 26, 1947, on wood, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The prominent boot-shaped laterodorsal processes of the larva constitute the outstanding feature of this species. The dorsoanal processes and the absence of seta F on the body segments are also good characters. The shape of the respiratory horn and the arrangement of the spiracular papillae are the best characters in the pupa. The wings and scutellum offer the best features in the female, and the long ninth tergite is distinctive in the male genitalia.

Atrichopogon species F, n. sp.

Larva.— Length about 1.8 mm. Color middle brown, head dark brown. Head: eye large, raised above surface; head seta 10 developed as a stub,

others developed as simple bristles, seta 4 setaceous; antennal socle moderately long (Fig. 10, B). Body segments: (Fig. 10, A and C) seta A present on prothorax to eighth abdominal, developed as a short stub, borne on a short mediodorsal process; setae B and D present on prothorax to eighth abdominal, seta B with short spinules at distal end; seta C absent; seta E present on prothorax to seventh abdominal, well developed on prothorax and borne on posterior tip of laterodorsal process, very small on remaining segments; seta F absent; laterodorsal process present on prothorax to eighth abdominal, well developed on prothorax; dorsoanal process present on prothorax to eighth abdominal, small; paired dark-colored sclerites present on shoulders of prothorax and eighth abdominal; similar unpaired sclerite present on dorsum of ninth abdominal; respiratory areas lacking. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of five hooklets and an anterior row of three (Fig. 10, D); anal pseudopod as in minutus (Fig. 10, E).

Pupa.- (Fig. 10, F) Length about 1.7 mm. Exuviae pale yellowish. Frontal and epicranial processes longer than in minutus, setae spur-like. Mesothoracic processes all well developed, styliiform, process 2 very long. Lateral and mediodorsal processes of abdominal segments I to V well developed, ending apically with a stub-like seta. Respiratory horn broad, distinctly boot-shaped, bearing a U-shaped row of ten spiracular papillae at the distal end (Fig. 10, G).

Female.- Length about 1.3 mm. T.R. 2.75-3.00; A.R. 1.86. Wing 0.9 x 0.6 mm. Face, proboscis and antennae middle brown; eyes black, pubescent above, bare below. Thorax dark brown, shining, with a middle brown scutellum. Halteres cream-colored. Abdomen pale with dark markings on dorsal surface. Scutellum with two long marginal bristles and four much shorter ones (Fig. 10, L). One spermatheca, globular, tapering to neck (Fig. 10, I). Third palpal segment slightly swollen, bearing a sunken, cylindrical sensory pit (Fig. 10, H). Wings with macrotrichia, sparse, confined to apex of cell

Figure 10. Atrichopogon sp. F. A, entire larva; B, larval head; C, first and second larval abdominal segments, dorsolateral view; D, larval prothoracic pseudopod, ventral view; E, last larval segment, ventral view; F, pupa; G, pupal respiratory horn; H, female palp; I, spermatheca; J, female wing; K, female antenna; L, dorsal aspect of female scutellum; M, male genitalia.

R_4 and along vein m_1 ; microtrichia fine; first radial cell broad, about a third as long as the second (Fig. 10, J).

Male.- Length about 1.7 mm. Wing 1.1 x 0.5 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with shallow excavation in the posterior margin, bearing about 12 long setae; ninth tergite rounded, longer than basistyles; basistyles and dististyles slender, dististyles tapering to pointed incurved apices; aedeagus with basal arch low and broad, basal arms slender, caudolateral shoulders moderate, mesal point with cap-like apex; basistylar apodemes hook-like (Fig. 10, M).

Material examined: six ♀♀, three ♂♂, nine larvae, 12 pupal exuviae, Saskatoon, Canada, September 17-24, 1955, reared from larvae extracted from algae covering moist soil by Berlese funnel. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The most distinctive feature of the larva is the absence of setae C, E and F of the body segments. The stub-like head seta 10, setaceous head seta 4 and seta B of body segments, and the dorsoanal processes are other good characters. The respiratory horn distinguishes the pupa from minutus and its small size separates it readily from other species. The bristles of the scutellum and the shape of the palpus distinguish the female from minutus, as does also the shape of the aedeagus and basistylar apodemes of the male genitalia.

Atrichopogon (Melochelea) meloesugans Kieffer

In 1956 Wirth erected the subgenus Melochelea to include those species in which the females attack meloid beetles. The females of the species are characterized by an unusually upcurved proboscis, a character which Wirth presumes to be adaptive to the feeding habit and possessed by no other species

of the genus. The immature stages are described here for the first time.

Larva.— Length about 3.2 mm. Color (preserved) dark reddish-brown, head dark brown. Head: eye large and slightly raised; all setae developed as simple bristles, seta 7 short; antennal socle long (Fig. 11, C). Body segments: (Fig. 11, A and B) seta A present on prothorax to eighth abdominal, borne on a well developed mediodorsal process; setae B and D present on prothorax to eighth abdominal; seta C lacking; seta E present on prothorax to eighth abdominal, borne on posterior tip of laterodorsal process on pro- and mesothorax, seta F apparently lacking; laterodorsal process well developed and covered with short spinules, on prothorax to eighth abdominal; dorso-anal process present on prothorax and mesothorax to eighth abdominal, short, covered with spinules; paired dark-colored sclerites present on shoulders of prothorax and seventh abdominal; similar unpaired sclerite on dorsum of ninth abdominal. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of four hooklets and an anterior row of two (Fig. 11, D); anal pseudopod with a ventral row of five pairs of hooklets and a dorsal row of four pairs (Fig. 11, E).

Pupa.— (Fig. 11, F) Length about 2.1 mm. Exuviae yellowish-brown. Processes on frons and epicranium well developed, unbranched, covered with small spinules, setae spur-like. Mesothoracic processes styliiform, with small spinules at the apex. Lateral and mediodorsal processes of abdominal segments I to IV long and tapered, setae developed as long, stout spurs; processes and setae lacking on segment V. Prothoracic respiratory horn cylindrical with a bend at the base, bearing eight spiracular papillae along the posterior side to the top (Fig. 11, G).

Female.— Length about 1.7 mm. T.R. 2.14-2.45; A.R. 2.45. Wing 1.5 x 0.5 mm. Face, proboscis pale brown, antennae dusky; eyes black, bare. Thorax dark orange-brown, subshining, with light brown scutellum. Halteres white. Abdomen light brown. Proboscis long and distinctly upcurved. Scutellum with four long marginal bristles and eight much shorter ones (Fig. 11, K).

Figure 11. Atrichopogon (Melochelea) meloesugans. A, anterior and posterior regions of larva; B, first and second abdominal segments of larva, lateral view; C, larval head; D, prothoracic pseudopod of larva, ventral view; E, last larval segment, ventral view; F, pupa; G, pupal respiratory horn; H, third and fourth abdominal segments of pupa, lateral view; I, female palp; J, female antenna; K, dorsal aspect of female scutellum; L, spermathecae; M, female wing; N, male genitalia.

Two spermathecae, elliptical, tapering gradually to long neck (Fig. 11, L). Third palpal segment slightly swollen, bearing a sunken, oval sensory pit (Fig. 11, I). Wing hairy with macrotrichia almost to base; microtrichia fine; first radial cell long and narrow, about half as long as the second (Fig. 11, M).

Male.— Length about 1.9 mm. Wing 1.3 x 0.4 mm.; small number of macrotrichia confined to apex of cell R_4 . Color as in female. Proboscis upcurved as in female. Genitalia: ninth sternite with deep excavation in the posterior margin, bearing about 16 long setae; ninth tergite rounded, shorter than basistyles; basistyles slender, dististyles broad at base, tapering to slightly incurved apices; aedeagus with basal arms slender, basal arch shallow and broad, caudolateral shoulders rounded but not prominent, apex broadly conical with broad flattened cap; basistylar apodemes short, hook-like (Fig. 11, N).

Material examined: four ♀♀, one ♂, 11 larvae, 12 pupal exuviae, Strelley, Notts, England, November 3, 1922, reared from larvae on under side of rotting logs, coll. L.G. Saunders. Adults identified by W.W. Wirth. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The upcurved proboscis, hairy wing and two spermathecae are good characters in the female, as is also the palpus. The shape of the dististyles and the irregular row of setae across the ninth sternite are fair characters, but the whole male genitalia is practically identical with that of minutus. The larva of this species shows affinities with that of minutus; it has the same short head seta 7 and same expanded laterodorsal processes, but differs in the size of the mediodorsal processes and other details of chaetotaxy. The pupa is the most characteristic stage, having processes on the first four abdominal segments only.

Atrichopogon species G, n. sp.

One larva and one pupal exuviae were collected by Dr. L.G. Saunders from under rotting wood, Rio de Janeiro, Brazil, July 26, 1923.

Larva.— Length about 2.5 mm. Color (preserved) middle brown, head dark

Figure 12. Atrichopogon sp. G. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, larval prothoracic pseudopod, ventral view; E, pupa; F, pupal respiratory horn.

brown. Head: eye large, slightly raised above surface; seta 10 developed as a stub, others developed as simple bristles, seta 7 short; antennal socle short (Fig. 12, B). Body segments: (Fig. 12, A and C) seta A present on prothorax to eighth abdominal, borne on a short mediodorsal process located just inside the base of the laterodorsal process; setae B and D present on prothorax to eighth abdominal; seta C lacking; setae E and F present on prothorax and abdominal I to VII, seta E lacking on eighth abdominal, seta F lacking on meso- and metathorax; laterodorsal process present on prothorax to eighth abdominal, well developed, covered with short spinules; dorsoanal process present on prothorax only; unpaired, dark-colored sclerite present on dorsum of ninth abdominal. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of five hooklets and an anterior row of three (Fig. 12, D); anal pseudopod with a ventral row of five pairs of hooklets and a dorsal row of four pairs.

Pupa.- (Fig. 12, E) Length about 1.8 mm. Exuviae pale yellowish. Frontal and epicranial processes long, setae long, spur-like. Mesothoracic process 6 reduced to inconspicuous node, others well developed, long. Mediodorsal and lateral processes present on first five abdominal segments, well developed, bearing a long bristle apically. Respiratory horn narrow, slightly boot-shaped, with a curving row of about ten spiracular papillae up back and over top (Fig. 12, F).

The larva resembles those of minutus, meloesusugans and sp. F in having the "two-pronged" laterodorsal process of the prothorax, but differs considerably in other details of chaetotaxy. The reduction of mesothoracic process 6 distinguishes the pupa from those of the above mentioned species.

Atrichopogon species H, n. sp.

Larva.- Length about 6.3 mm. Color dark reddish-brown, head dark brown. Head: eye small, slightly raised above surface; all setae developed as simple bristles, seta 7 short, seta 10 represented by two close-set,

slender bristles of equal length; antennal socle low (Fig. 13, B). Body segments: (Fig. 13, A and C) seta A present on prothorax to eighth abdominal, stub-like, borne on a low mediodorsal process; setae B and D present on prothorax to eighth abdominal, seta D borne dorsally and subapically on lateral process; seta C present on mesothorax to seventh abdominal; setae E and F present on prothorax and abdominal I to VII, seta E lacking on eighth abdominal, seta F lacking on meso- and metathorax; laterodorsal process small; lateral process present on mesothorax to eighth abdominal, "fringed" with long, slender spinules; dorsoanal process lacking; paired dark-colored sclerites present on shoulders of prothorax and eighth abdominal; similar unpaired sclerite present on dorsum of ninth abdominal. Prothoracic pseudopod deeply cleft medially, each lobe with a posterior row of ten hooklets and an anterior row of three (Fig. 13, D); anal pseudopod with a ventral row of about 25 pairs of hooklets and a dorsal row of about 22 pairs.

Pupa.- (Fig. 13, E) Length about 3.4 mm. Exuviae reddish-brown. Frontal and epicranial processes short, setae spur-like. Mesothoracic and abdominal processes well developed, abdominal processes each with a short, spur-like seta. Respiratory horn stout-stemmed with only a slightly swollen knob, bearing about 26 spiracular papillae curving up back and over top (Fig. 13, F).

Female.- Length about 3.0 mm. T.R. 2.73-2.90; A.R. 1.93-2.00. Wing 2.0 x 0.6 mm. Face, proboscis light brown, antennae dusky; eyes black, bare. Thorax middle brown above, light brown below, with a light brown scutellum. Halteres white. Abdomen light brown. Scutellum with four long marginal bristles and 20 much shorter ones (Fig. 13, J). One spermatheca, elliptical, tapering gradually to neck (Fig. 13, I). Third palpal segment distinctly swollen, bearing a sunken, oval sensory pit (Fig. 13, H). Wings with first radial cell broad, about a third as long as the second; macrotrichia present distally in all cells and along veins m_1 , m_2 , m_{3+4} ,

Figure 13. Atrichopogon sp. H. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, prothoracic pseudopod of larva, ventral view; E, pupa; F, pupal respiratory horn; G, female antenna; H, female palp; I, spermatheca; J, dorsal aspect of female scutellum; K, female wing; L, male genitalia.

sv, cu₁, cu₂ and a; microtrichia coarse (Fig. 13, K).

Male.- Length about 2.9 mm. Wing 1.9 x 0.5 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with very shallow excavation in the posterior margin, bearing about 24 long setae; ninth tergite rounded, shorter than basistyles; basistyles and dististyles slender, dististyles tapering gradually to pointed, incurved apices; aedeagus with basal arms slender, basal arch low and broad, caudolateral shoulders rounded, mesal point with cap-like apex; basistylar apodemes inverted "T"-shaped (Fig. 13, L).

Material examined: six ♀♀, five ♂♂, many larvae and pupae, Petropolis, Brazil, July 27, 1923, reared from larvae on sticks above stream, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The large, fringed lateral processes of the larvae are the most distinctive feature; the "twinning" head seta 10, low antennal socle and subapical seta D are also good characters. The pupa is simple and hard to distinguish from other species; the arrangement of the spiracular papillae of the respiratory horn is a fair character, as is also the size of the pupa. The broad first radial cell of the wing, the third palpal segment and the hairiness of the scutellum are distinctive in the female. The shape of the aedeagus and basistylar apodemes are good characters in the male genitalia.

Atrichopogon species I, n. sp.

Larva.- Length about 4.2 mm. Color grey-brown, head dark brown. Head: eye small, slightly raised above surface; all setae developed as simple bristles, seta 7 short, seta 10 represented by two close-set, slender bristles, posterior one shorter; antennal socle low (Fig. 14, B). Body segments: (Fig. 14, A and C) setae represented as in sp. H; mediodorsal

and laterodorsal processes small; lateral process well developed on first to eighth abdominal, small on meso- and metathorax, not fringed; dorsoanal process lacking; paired dark-colored sclerites present on shoulders of prothorax and eighth abdominal; similar unpaired sclerite on dorsum of ninth abdominal. Prothoracic pseudopod as in sp. H (Fig. 14, E); anal pseudopod with a ventral row of nine pairs of hooklets and a dorsal row of eight pairs (Fig. 14, D). Three small pigment spots present on dorsum of abdominal segments I to VII, one placed lateral to and one between the mediodorsal processes.

Pupa.- (Fig. 14, F) Length about 3.1 mm. Frontal and epicranial processes small, setae developed as simple bristles. Mesothoracic and abdominal processes well developed, covered with small spinules, abdominal processes bearing a stout, spur-like seta apically. Pigment spots present on dorsum of abdominal segments I to VII; one placed lateral to each mediodorsal process on the first segment, one lateral to and one between the mediodorsal processes on segments II to V, one median dorsal spot on segments VI and VII. Respiratory horn cylindrical, with about 34 spiracular papillae arranged in a broad S-shaped figure, as in polydactylus (Fig. 14, G).

Female.- Length about 2.2 mm. T.R. 2.51; A.R. 1.99-2.00. Wing 1.7 x 0.7 mm. Face, proboscis and antennae middle brown; eyes black, bare. Thorax black-brown above, shining, middle brown below, with a cream-colored scutellum. Halteres white. Abdomen pale with dark markings on the dorsal surface. Scutellum with four long marginal bristles and 16 much shorter ones (Fig. 14, H). One spermatheca, globular, tapering gradually to neck (Fig. 14, J). Third palpal segment swollen, bearing a sunken, spherical sensory pit (Fig. 14, I). Wings with first radial cell broad, about a third as long as the second; macrotrichia present distally in all cells and along veins as in sp. H; microtrichia fine (Fig. 14, L).

Male.- Length about 2.5 mm. Wing 1.8 x 0.7 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with a very shallow excavation

Figure 14. Atrichopogon sp. I. A, entire larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, last larval segment, ventral view; E, larval prothoracic pseudopod, ventral view; F, pupa; G, pupal respiratory horn; H, female scutellum, dorsal view; I, female palp; J, spermatheca; K, female antenna; L, female wing; M, male genitalia.

in the posterior margin, bearing about 24 long setae; ninth tergite rounded, shorter than basistyles; basistyles and dististyles slender, dististyles almost as long, tapering to rounded apices; aedeagus with basal arms slender, basal arch shallow, caudolateral shoulders narrow, mesal point with broad, cap-like apex; basistylar apodemes crescent-shaped (Fig. 14, M).

Material examined: six ♀♀, two ♂♂, many larvae and pupae, Saskatoon, (Beaver Creek), Canada, August 25, 28, 1955, reared from larvae above water line on partly submerged wood. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The larva of this species has many features in common with the larva of sp. H; the pigment spots, lateral processes and anal pseudopod show distinctive characteristics. The spiny processes of the pupa and the arrangement of the spiracular papillae of the respiratory horn are good characters. Color, hairiness of scutellum and shape of spermatheca are the most distinctive features in the female. The shape of the basistylar apodemes and the low basal arch of the aedeagus are good characters in the male genitalia.

Atrichopogon species J, n. sp.

Larva.— Length about 4.7 mm. Color (preserved) light grey, head dark brown. Head: eye small, slightly raised above surface; all setae developed as simple bristles, setae 4 and 7 short, seta 10 represented by two close-set slender bristles, posterior one shorter; antennal socle low (Fig. 15, B). Body segments: (Fig. 15, A and C) setae represented as in sp. H; mediodorsal and laterodorsal processes small; lateral process well developed on mesothorax to eighth abdominal, not fringed; dorsoanal process lacking; paired dark-colored sclerites present on shoulders of prothorax and eighth

abdominal; similar unpaired sclerite present on dorsum of ninth abdominal. Prothoracic and anal pseudopods as in sp. I (Fig. 15, D).

Pupa.- (Fig. 15, E) Length about 3.0 mm. Exuviae middle brown. Frontal and epicranial processes small, setae developed as simple bristles. Mesothoracic process 5 reduced to inconspicuous node, others well developed. Mediodorsal processes of abdominal segments I to V short, setae spur-like; lateral processes present on segments II to V only, lateral setae present on segments I to V, spur-like. Pigment spots present on shoulders of first six abdominal segments. Respiratory horn cylindrical, bearing about 45 spiracular papillae arranged in a broad S-shaped figure as in polydactylus (Fig. 15, F).

Female.- Length about 2.3 mm. T.R. 2.55-2.65; A.R. 1.62-1.80. Wing 1.5 x 0.6 mm. Face, proboscis medium brown, antennae pale brown; eyes black, bare. Thorax dark brown, shining, with light brown scutellum. Halteres cream-colored. Abdomen pale with dark markings on the dorsal surface. Scutellum with four long marginal bristles and eight much shorter ones (Fig. 15, H). One spermatheca, elliptical, tapering gradually to neck (Fig. 15, G). Third palpal segment distinctly swollen, bearing a sunken, oval sensory pit (Fig. 15, I). Wings with first radial cell narrow, about a fourth as long as the second; macrotrichia arranged as in sp. H; microtrichia fine (Fig. 15, K).

Male.- Length about 2.3 mm. Wing 1.6 x 0.6 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with transverse margin, bearing about 19 long setae; ninth tergite rounded, shorter than basistyles; basistyles and dististyles slender, dististyles tapering abruptly to pointed, incurved apices; aedeagus with basal arms slender, basal arch low and broad, posterior arch broadly rounded, caudolateral shoulders broad, mesal point with cap-like apex; basistylar apodemes L-shaped (Fig. 15, L).

Material examined: three ♀♀, three ♂♂, two larvae, five pupal exuviae, Mayaguez, Puerto Rico, March 27, 1953, reared from larvae on wood in stream,

Figure 15. *Atrichopogon* sp. J. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, larval prothoracic pseudopod, ventral view; E, pupa; F, pupal respiratory horn; G, spermatheca; H, dorsal aspect of female scutellum; I, female palp; J, female antenna; K, female wing; L, male genitalia.

coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The larva differs from sp. I in not having the pigment spots of that species. The short head seta 10 and well developed lateral processes are good characters. The pupa is the most distinctive stage, with mesothoracic process 5 reduced and lateral processes present on abdominal segments II to V only. The number and arrangement of the spiracular papillae of the respiratory horn and the pigment spots on the dorsum of the abdominal segments are also good characters in the pupa. The third palpal segment is distinctive in the female, as is also the scutellum. The straight margin of the ninth sternite, the very low basal arch and the shape of the basistylar apodemes are all good characters in the male genitalia.

Atrichopogon species K, n. sp.

Larva.- Length about 4.5 mm. Color (preserved) golden-brown, head dark brown. Head: eye small, slightly raised above surface; all setae developed as simple bristles, seta 7 short, seta 10 represented by two close-set bristles, posterior one shorter; antennal socle low (Fig. 16, B). Body segments: (Fig. 16, A and C) seta A present on prothorax to eighth abdominal, borne on a short mediodorsal process; setae B and D present on prothorax to eighth abdominal; seta C present on mesothorax to seventh abdominal, well developed on mesothorax; setae E and F present on prothorax and abdominal I to VII, seta E lacking on eighth abdominal, seta F lacking on meso- and metathorax; laterodorsal processes small; lateral processes not fringed; dorsoanal process lacking; paired dark-colored sclerites present on shoulders of prothorax and eighth abdominal; similar unpaired sclerite on dorsum of ninth abdominal. Prothoracic pseudopod barely cleft medially, each lobe with a posterior row of ten hooklets and an anterior row of

three (Fig. 16, D); anal pseudopod with a ventral row of 11 pairs of hooklets and a dorsal row of four pairs.

Pupa.- (Fig. 16, E) Length about 3.2 mm. Exuviae light brown. Frontal and epicranial processes small, setae developed as simple bristles. Mesothoracic and abdominal processes well developed, abdominal setae developed as stout spurs. Faint pigment spots present on shoulders of abdominal segments I to V. Respiratory horn stout, slightly boot-shaped, with a curving row of about 25 spiracular papillae up back and over top (Fig. 16, F).

Female.- Length about 2.4 mm. T.R. 2.22-2.59; A.R. 1.63. Wing 1.5 x 0.7 mm. Face, proboscis and antennae middle brown; eyes black, bare. Thorax dark brown, shining, with creamy scutellum. Halteres white. Abdomen middle brown with dark markings on the dorsal surface. Scutellum with four long marginal bristles and about 26 much shorter ones (Fig. 16, H). One spermatheca, globular, tapering gradually to neck (Fig. 16, J). Third palpal segment swollen, bearing a sunken, cylindrical sensory pit (Fig. 16, I). Wings with macrotrichia present apically in all cells and along veins r_4 , r_5 , m_1 , m_2 , m_{3+4} , sv , cu_1 , cu_2 and a ; microtrichia coarse; first radial cell broad, about a third as long as the second (Fig. 16, K).

Male.- Length about 2.5 mm. Wing 1.6 x 0.7 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with transverse posterior margin, bearing about 24 long setae; ninth tergite rounded, faintly bilobed, shorter than basistyles; basistyles and dististyles slender, dististyles tapering gradually to pointed, incurved apices; aedeagus about as broad as long, basal arms long and slender, basal arch low and broad, caudolateral shoulders broad, mesal point with cap-like apex; basistylar apodemes L-shaped, long (Fig. 16, L).

Material examined: two ♀♀, one ♂, four larvae, five pupal exuviae, Fiburgo, Brazil, July 31, 1923, reared from larvae above water on partially

Figure 16. Atrichopogon sp. K. A, anterior and posterior regions of larva; B, larval head; C, first and second abdominal segments of larva, lateral view; D, larval prothoracic pseudopod, ventral view; E, pupa; F, pupal respiratory horn; G, female antenna; H, dorsal aspect of female scutellum; I, female palp; J, spermatheca; K, female wing; L, male genitalia.

submerged bamboo, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa.

Seta D borne apically on the lateral process distinguishes the larva of this species from those of sp. I and sp. J. It is further distinguished from sp. J by the long head seta 4 and from sp. I by the absence of the pigment spots on the dorsum of the abdomen. The spiracular papillae of the respiratory horn distinguishes the pupa from sp. I and sp. J, but the pupa is almost identical with sp. H. The third palpal segment, scutellar spines and color are fair characters in the female. The "bilobed" ninth tergite is the best character in the male genitalia; the shape of the basistylar apodemes and the transverse posterior margin of the ninth sternite are also useful.

Atrichopogon species L, n. sp.

A fairly large species with a distinctive golden-yellow colored larva.

Larva.— Length about 3.4 mm. Color golden-yellow, head dark brown.

Head: eye large, raised above surface; seta 10 short, stub-like, other setae developed as simple bristles, seta 7 long; antennal socle moderate (Fig. 17, B). Body segments: (Fig. 17, A) seta A present on prothorax to eighth abdominal, stub-like, borne on a short mediodorsal process located just inside the base of the large laterodorsal process; seta B small, stub-like, borne at tip of laterodorsal process, present on prothorax to eighth abdominal; seta C absent; seta D present on prothorax to eighth abdominal; setae E and F present on prothorax and abdominal I to VII, seta E lacking on eighth abdominal, seta F lacking on meso- and metathorax; laterodorsal process well developed on prothorax to eighth abdominal, very long and covered with small spinules on the anterior surface; dorsoanal process well developed on prothorax to eighth abdominal, covered with stout,

branched spinules; unpaired dark-colored sclerite present on dorsum of ninth abdominal. Prothoracic pseudopod barely cleft medially, each lobe with a posterior row of three hooklets and an anterior row of one (Fig. 17, D); anal pseudopod with a ventral row of four pairs of hooklets and a dorsal row of one median pair (Fig. 17, C).

Pupa.- (Fig. 17, E) Length about 1.7 mm. Exuviae middle brown. Frontal processes long, setae spur-like; epicranial setae developed as simple bristles, processes lacking. Mesothoracic processes 3 and 6 entirely lacking, others well developed, long, tapering. Mediodorsal process present on first abdominal segment only, small; mediodorsal seta entirely lacking. Lateral process and seta present on first three abdominal segments only. Terminal processes of ninth abdominal segment covered with short spinules distally. Respiratory horn broad, slightly boot-shaped, with a U-shaped row of 16 spiracular papillae at the tip (Fig. 17, F).

Female.- Length about 1.7 mm. T.R. 2.53-2.56; A.R. 1.16-1.21. Wing 1.0 x 0.4 mm. Face, proboscis light brown, antennae middle brown; eyes black, pubescent above and below. Thorax dark brown, shining, with dark brown scutellum. Halteres white. Abdomen pale with dark markings on dorsal surface. Scutellum with two long marginal bristles and four much shorter ones (Fig. 17, H). One spermatheca, globular, tapering gradually to neck (Fig. 17, J). Third palpal segment swollen, bearing a sunken, elongate sensory pit (Fig. 17, G). Wings with first radial cell broad, about two-fifths as long as the second; macrotrichia confined to extreme apex of cell R_4 ; microtrichia fine (Fig. 17, K).

Male.- Length about 2.0 mm. Wing 1.2 x 0.4 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite almost transverse, bearing an irregular row of 12 long setae; ninth tergite coming to a broad point, shorter than basistyles; basistyles and dististyles long and slender, dististyles tapering to pointed and incurved apices; aedeagus highly modified,

Figure 17. Atrichopogon flavus. A, entire larva; B, larval head; C, last larval segment, ventral view; D, larval prothoracic pseudopod, ventral view; E, pupa; F, pupal respiratory horn; G, female palp; H, female scutellum, dorsal view; I, female antenna; J, spermatheca; K, female wing; L, male genitalia. par, pa here

basal arms long and incurved, arch low with a forward-turned ventral lobe, caudolateral shoulders narrow, mesal point trilobed; basistylar apodemes short, hook-like, apparently expanding into broad, plate-like parameres (Fig. 17, L).

Material examined: three ♀♀, one ♂, six larvae, one pupal exuviae, Saskatoon (Beaver Creek), Canada, October 8, 1955, reared from larvae extracted from moss by Berlese funnel; one ♂, two larvae, one pupal exuviae ex moss, Saskatoon (Sutherland Beach), Canada, June 6, 1956. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

The long laterodorsal processes, dorsoanal processes, stub-like head seta 10 and long head seta 7, prothoracic and anal pseudopods all offer good distinguishing characters in the larva. The pupae are easily distinguished by the reduction in number of the mesothoracic and abdominal processes. The reduction of the macrotrichia of the wings, the hairiness of the scutellum, and the third palpal segment are good characters in the female. The very modified aedeagus of the male genitalia is unique in many respects.

Atrichopogon species M, n. sp.

Larva.— Length about 1.9 mm. Color (preserved) pale brown, head dark brown. Head: eye large, raised above surface; seta 10 short, stub-like, seta 6 represented by two close-set bristles, one long, one very short; other setae developed as simple bristles, seta 7 long; antennal socle long (Fig. 18, B). Body segments: (Fig. 18, A) seta A and mediodorsal process apparently lacking; seta B borne apically on a long laterodorsal process, stub-like, present on prothorax to eighth abdominal; seta C present on mesothorax to seventh abdominal, stub-like, borne on the basal part of the laterodorsal process; seta D present on prothorax to eighth abdominal;

setae E and F present on mesothorax to seventh abdominal, seta E lacking on eighth abdominal, seta F lacking on prothorax; laterodorsal process well developed on prothorax to eighth abdominal, covered with small nodules; dorsoanal process present on prothorax to eighth abdominal, small, unbranched; unpaired dark-colored sclerite present on dorsum of ninth abdominal. Prothoracic pseudopod barely cleft medially, each lobe with a posterior row of three hooklets and an anterior row of two (Fig. 18, D); anal pseudopod with a ventral row of six pairs of hooklets and a dorsal row of three pairs (Fig. 18, C).

Pupa.- (Fig. 18, E) Length about 1.2 mm. Color (exuviae) dark brown. Frontal processes moderately long, setae spur-like; epicranial processes and setae apparently lacking. Mesothoracic processes 3 and 6 entirely lacking, others well developed, tapering. Abdominal segments lacking processes and setae. Respiratory horn cylindrical, with a curving row of about nine spiracular papillae up back and over top (Fig. 18, F).

Female.- Length about 0.9 mm. T.R. 2.41-2.78; A.R. 1.73-1.95. Wing 0.6 x 0.3 mm. Face, proboscis pale brown, antennae middle brown; eyes black, pubescent above and below. Thorax light yellowish-brown, subshining, with a white scutellum. Halteres white. Abdomen pale brown. Scutellum with four long marginal bristles and two shorter ones (Fig. 18, K). One spermatheca, subglobular, tapering gradually to neck (Fig. 18, I). Third palpal segment swollen, bearing a sunken hourglass-shaped sensory pit (Fig. 18, H); fourth and fifth palpal segments fused. Wings with first radial cell narrow, about a third as long as the second; macrotrichia confined to extreme apex of cell R_4 ; microtrichia fine (Fig. 18, J).

Male.- Length about 1.0 mm. Wing 0.7 x 0.3 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with moderate excavation in the posterior margin, bearing seven long setae; ninth tergite coming to a broad point, shorter than basistyles; basistyles and dististyles long and slender, dististyles tapering to pointed and incurved apices; aedeagus

Figure 18. Atrichopogon sp. M. A, anterior region of larva; B, larval head; C, last larval segment, ventral view; D, larval prothoracic pseudopod, ventral view; E, pupa; F, pupal respiratory horn; G, female antenna; H, female palp; I, spermatheca; J, female wing; K, dorsal aspect of female scutellum; L, male genitalia; M, aberrant pupal respiratory horn.

highly modified, as in Fig. 18, L; basistylar apodemes lacking, no parameres.

Material examined: four ♀♀, two ♂♂, four larvae, five pupal exuviae, Siquirres, Costa Rica, June 6, 9, 1956, reared from larvae in moss extracted by Berlese funnel, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa, and U.S.N.M.

A larva with the long laterodorsal processes like sp. L but differing in details of chaetotaxy. The complete absence of the processes and setae from the abdomen in the pupa is so far unique. The very small size of the female and the fusion of the fourth and fifth segments of the palpus are good characters. The male genitalia are highly modified and offer many distinctive characters; the absence of the basistylar apodemes is so far unique.

Two pupal exuviae with a very modified respiratory horn were also seen (Fig. 18, M).

Atrichopogon species N, n. sp.

Larva.— Length about 2.5 mm. Color (preserved) grey-brown, head black. Head: eye large, raised above surface; setae 7 and 10 stub-like, other setae developed as simple bristles; antennal socle very long (Fig. 19, B). Body segments: (Fig. 19, A and C) seta A present on mesothorax to eighth abdominal, borne on a short mediodorsal process located just inside the base of the large laterodorsal process; seta B present on prothorax to eighth abdominal, borne at apex of laterodorsal process; seta C lacking; setae D, E and F present on prothorax to seventh abdominal, seta E or F lacking on eighth abdominal; laterodorsal process present on prothorax to eighth abdominal, long, covered with spinules on the anterior and posterior surfaces basally; laterodorsal process on prothorax with an extra stub-like seta on the anterior surface, corresponding, perhaps, to seta A of this segment; dorsoanal process well developed, covered with spinules, present on prothorax

to eighth abdominal; unpaired dark-colored sclerite present on dorsum of ninth abdominal. Prothoracic pseudopod barely cleft medially, each lobe with a posterior row of three hooklets and an anterior row of two (Fig. 19, E); anal pseudopod with a ventral row of six pairs of hooklets and a dorsal row of two pairs (Fig. 19, D).

Female.— Length about 1.3 mm. T.R. 2.67-2.86; A.R. 1.82-1.86. Wing 0.9 x 0.4 mm. Face, proboscis and antennae middle brown; eyes black, pubescent above and below. Thorax black, shining, with dark brown scutellum. Halteres light brown. Abdomen middle brown. Scutellum with four long marginal bristles and two much shorter ones (Fig. 19, G). One spermatheca, elliptical, tapering gradually to neck (Fig. 19, H). Third palpal segment swollen, bearing a sunken, oval sensory pit (Fig. 19, I). Wings with first radial cell broad, about two-fifths as long as the second; macrotrichia confined to apex of cell M_1 ; microtrichia fine (Fig. 19, J).

Male.— Length about 1.6 mm. Wing 0.9 x 0.4 mm.; macrotrichia absent. Color as in female. Genitalia: ninth sternite with an almost transverse margin, bearing about 12 long setae; ninth tergite coming to a broad point, shorter than basistyles; basistyles and dististyles long and slender, dististyles tapering to pointed and incurved apices; aedeagus highly modified, basal arms short and stout, arch low and broad with a forward turned ventral lobe, caudolateral shoulders broad, posterior arch rounded ending in a U-shaped mesal point; basistylar apodemes short and stout (Fig. 19, K).

Material examined: two ♀♀, two ♂♂, two larvae, Siquirres, Costa Rica, June 18, 1956, reared from larvae on rotting log, coll. L.G. Saunders. Material to be deposited in National Collection, Ottawa.

The larva of this species has the long laterodorsal processes of sp. L and sp. M, but can readily be distinguished by the chaetotaxy. The antennal socle is the longest yet seen in proportion to the size of

Figure 19. Atrichopogon sp. N. A, anterior region of larva; B, larval head; C, dorsal aspect of first and second larval abdominal segments; D, last larval segment, ventral view; E, prothoracic pseudopod of larva, ventral view; F, female antenna; G, female scutellum, dorsal view; H, spermatheca; I, female palp; J, female wing; K, male genitalia.

the head. The almost complete absence of macrotrichia of the wing and the hairiness of the scutellum are good characters in the female. As in sp. L and sp. M, the male genitalia are highly modified and show many good characters.

DISCUSSION AND CONCLUSIONS

The present investigation seems to throw some light upon the question of the reliability of those imaginal characters which are employed in distinguishing Atrichopogon species. It will be seen from Table 1, that although there appears to be a statistical difference between species in size and antennal and tarsal ratios, there is also a great deal of overlapping of these characters. This overlapping between species, along with the great individual variation and, in many cases, a variation between the two sides of the same individual (Table 1, minutus, sp. I, sp. M, sp. N), renders these characters of little use. Turning to the wings and scutellum it can be seen that in these organs there is very little difference between many species. The shapes of the palpi and spermathecae offer more promise but necessitate special mounts and are not mentioned in most existing descriptions.

In Connecticut, Lewis (1956) reported that three Atrichopogon species, which he does not name, could easily be separated by use of the tibial comb. He further reported that the comb is identical in pattern on both male and female tibiae. My investigation of, presumably, other species shows that this is not the case; not only is there a variation in the number of spines on the comb between the sexes (Table 1, polydactylus, sp. E, minutus, sp. F, sp. J, sp. K, sp. L), but many individuals show a variation in number between the right and left sides of the body (Table 1, sp. A, sp. C, polydactylus, sp. F, sp. H, sp. I, sp. N).

It is surprising that, except for Wirth (1952), authors have given such little attention to the male genitalia. Although here, too, there seems to be a certain degree of overlapping of characters between species, variation in

the shape of the aedeagus, basistylar apodemes, ninth tergite, basistyles and dististyles, and the degree of excavation of the posterior margin of the ninth sternite and the number of setae it bears, could possibly be used with a greater degree of certainty than the imaginal characters so far considered.

It will appear that by means of the imaginal characters it is very difficult to distinguish between species which, on the basis of the larvae, can be shown to be specifically different. On the other hand (as Nielsen says), if enough attention is not paid to individual variation, it could lead to the establishment of too many species. In a recent paper on the subgenus Chironomus, Sjøgaard Andersen (1949) has shown that the same (current) species can be reared from two or three larval types and that more than one species can be reared from the same larval type. Nielsen gives as one possible explanation that those characters which are employed to separate the Chironomus species actually are not specific, but characters which vary in the same way within the various species of the subgenus. The same appears to be the case in the genus Atrichopogon. I must agree with Nielsen that although the imaginal characters seem to differ statistically, it is better to define species on the basis of the larvae and/or the pupae until qualitative, distinctive characters can be found between imagines reared from different larval types. In the present state of our knowledge it would require a statistical study of a long series to characterize each species as adults. Most species which can now easily be recognized in the immature stages can scarcely be differentiated, if at all, as adults. Work should be directed towards rearing larvae and finding qualitative, distinctive characters between their imagines.

Although the immature stages of Atrichopogon offer an infinite variety in the nature and arrangement of setae and cuticular processes, I can give no distinctive character applicable to all known species that would separate the immature stages of this genus from those of Forcipomyia. I must agree

with Saunders (1956) that the only dependable way to separate these genera is on the basis of imaginal characters (see p. 5).

Based on larval morphology I distinguish four broad groupings among the species discussed in this paper. Where present, characters that appear in common in the other stages are also given. These groups are not intended as subgenera, but are given with the hope of providing a groundwork for the establishment of subgenera in the future, when more material is available. The inadequacies of most existing larval descriptions prevent the inclusion of other known species into these groupings, except for Nielsen's speculiger, dubius and cornutus.

Group A.- The most outstanding feature of this group, which includes the species A, B, C and D, is the presence of the respiratory areas on the dorsum of the larvae. The long head seta 7, moderately long antennal socle, very short mediodorsal process and presence of seta C are other characters which, taken in combination, are peculiar to the larvae of this group.

The pupae are difficult to characterize. They all have rudimentary respiratory areas on the dorsum of the first seven abdominal segments, but this character is often difficult to see. The branched spines on the lateral abdominal processes are common to sp. B, sp. C and sp. D, but are not present in sp. A. The pupa of fuscus, a species which obviously does not belong to this group, also has these digitate lateral abdominal processes. In regard to this species, however, Nielsen supposes that Goetghebuer (1923) has made an error in collection and that the larva he describes does not really belong to the species fuscus at all.

The male genitalia of sp. A, sp. B and sp. C have one good character in common which separates them from other species discussed here, namely the deeply excavated ninth sternite with a row of a small number (either four or five) of long setae. The females have a number of features in common but even taken in combination these are not peculiar to the group.

Nielsen's speculiger, dubius and cornutus are other species which fit into this group. Unfortunately, Nielsen does not include descriptions or figures of the male genitalia in his publication.

Group B.- The larvae of minutus, sp. F and sp. G have a number of characters in common which, taken in combination, separate them from the other species discussed in this paper. These characters are the well developed laterodorsal processes which are "two-pronged" on the pro- and mesothorax, the very short mediodorsal processes, the short head seta 7 and stub-like head seta 10, and the deeply cleft prothoracic pseudopod.

The pupae are difficult to distinguish from those of Group C. The shape of the respiratory horn and the arrangement of the spiracular papillae are only fair characters. The long ninth tergite of the male genitalia is peculiar to the group, but the aedeagus is much like that in other species. The combination of almost bare wings, single spermatheca and only two long marginal bristles on the scutellum separates the females from all but those of Group D.

Group C.- The well developed lateral processes, the complete absence of the dorsoanal processes, the short mediodorsal processes, the large number of hooklets in the anal pseudopod and the "twinned" head seta 10, when taken in combination, easily separate the larvae of sp. H, sp. I, sp. J and sp. K from those of other species treated here.

The pupae of this group are not so easily distinguished. The mesothoracic and abdominal processes are all well developed in sp. H, sp. I and sp. K, but mesothoracic process 5 and the lateral processes of the first abdominal segment are lacking in sp. J. The respiratory horns of sp. J and sp. I have the S-shaped row of spiracular papillae, but the horns of sp. H and sp. K are not so distinctive and are difficult to distinguish from those of other species.

The almost straight posterior margin of the ninth sternite bearing an

irregular row of a large number of long setae and the simple, broad aedeagus are distinctive in the male genitalia, but not peculiar to the group.

Group D.- Larvae of sp. L, sp. M and sp. N have the following characters in common: very long laterodorsal processes which end apically in a stub-like seta; well developed dorsoanal processes present on the prothorax to the eighth abdominal segment; prothoracic pseudopod barely cleft medially; long antennal socle and stub-like head seta 10. The very long laterodorsal processes and their stub-like setae are the only characters peculiar to the larvae of this group, but it is only among these three species that the other characters mentioned occur in this combination.

Pupae of sp. L and sp. M are peculiar in that most of the abdominal processes and setae are lacking. Unfortunately, I do not have pupae of sp. N. The male genitalia of all three species have a very modified aedeagus.

Subgenus Melochelea.- In 1956 Wirth erected the subgenus Melochelea to include those species in which the females attack meloid beetles and have an unusually upcurved proboscis. The immature stages of only one species, meloesugans, are known. The larva of meloesugans shows affinities with those of Group B but the well developed mediodorsal process of this species may still keep it distinct. This is fortunate, for the characteristic upcurved proboscis in the female of meloesugans is not found in minutus or sp. F.

The remaining species discussed in this paper do not fit into these groupings. Larvae of polydactylus have the long laterodorsal processes like those of Group D, but differ in many other respects. The larva of fuscus seems to have a great similarity to that of polydactylus, except for the antennal socle and head seta 10, but the pupae of these two species are very different. As regards fuscus, however, see p. 71. In many respects the larva of sp. E is very distinctive. The extremely long body and head setae are the most obvious characters but the absence of head seta 7 is so far unique. In this regard, however, see p. 37.

SUMMARY

1. The metamorphosis of 18 Atrichopogon species, 14 of which are described as new, is treated from a morphological point of view. The bulk of the material was collected by Dr. L.G. Saunders in many countries over many years. Five species were taken in localities around Saskatoon, Canada.
2. Table 1 lists, for the species treated in the present work, the most important imaginal characters that have been used in the classification of the genus. The reliability of these characters is discussed.
3. The taxonomy of the genus is a very difficult matter. Most of the characters that are employed in distinguishing adults of the species are of a quantitative nature and subject to great individual variation. Andersen (1949) has shown that several species of Chironomus can be reared from the same larval type, and that the same species can be reared from more than one larval type. The same may be the case in the genus Atrichopogon. Work should be directed towards rearing larvae and finding qualitative, distinctive characters between their imagines. If these characters cannot be found, and my investigation seems to point in this direction, we are perhaps in the peculiar situation of being forced to base the taxonomy to a great extent upon the immature stages, and yet at present the genus can be clearly separated from Forcipomyia only on the basis of adult characters.
4. Four broad groupings are distinguished on the basis of larval morphology. These groupings are given with the hope of providing a groundwork for the establishment of subgenera in the future, when more material is available.

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