Description of the Male, Pupa and Fourth Instar Larva of *Culiseta (Culiseta) atlantica* (Edwards, 1932) (Diptera: Culicidae), an Endemic Species of the Azores Archipelago

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ABSTRACT. The hitherto unknown male, pupa and fourth instar larva of *Culiseta atlantica* (Edwards, 1932) are described, based on the examination of 25 males, 31 associated pupal exuviae and 77 larvae caught by the writers from rock-pools in the bed of the Ribeira do Salto River, east of the town Ribeira Grande, S. Miguel Island, Azores. Diagnostic characteristics of the adults (external morphology), male terminalia, pupa and fourth instar larva of *Cs. atlantica* and the closely related species *Cs. annulata* (Schrank), *Cs. incidens* (Thomson), *Cs. particeps* (Adams) and *Cs. subochrea* (Edwards) are given and identification keys are provided.

INTRODUCTION

Culiseta atlantica was described in 1932, by F. W. Edwards (as *Theobaldia atlantica*) on the basis of 5 female syntypes caught at the Azores (Pico Island) by J. Balfour-Brown, in July, 1929. The following year (1930), some other female specimens of *Cs. atlantica* were also caught by L. Chopard at Furnas, S. Miguel Island (Azores). Nevertheless, the adult male and the immature stages of the new species remained unknown.

During August, 1977, the present writers were able to collect from rock-pools in the bed of the Ribeira do Salto, east of the town Ribeira Grande, S. Miguel Island (Azores), 77 *Culiseta* larvae and 31 pupae that, on the emergence of the adults (2 females and 25 males) could be identified as *Cs. atlantica*. The notes on the external morphology of the adult female and the descriptions of the adult male, pupa and larva that follow, are based on the examination of this material. The terminology here adopted for larval and pupal setae is that used by Dobrotworsky (1971) when dealing with subgenus *Culiseta*, based on the system developed by Belkin (1962). However, the hyphen is dropped in order to prevent confusion with the minus sign used in certain setal combinations.

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Culiseta (Culiseta) atlantica (Edwards, 1932)

Theobaldia atlantica Edwards, 1932:560 (♀).

Culiseta (?) atlantica, Stone, Knight and Stark (1959:222).

Culiseta (Culiseta) atlantica , Maslov (1964:46); Stone (1967:211); Maslov (1967:136); Knight and Stone (1977:280).

FEMALE. General external morphology as described by Edwards (1932). Differently, however, from what Edwards stated, there is usually a white line on the second abdominal tergite, though it is narrower than in other related species and may even be reduced to a small median white spot in some specimens. Dr. B. White who, at our request, has kindly examined the five females syntypes in the British Museum (Natural History), informed us that "Only one of the syntypes is in a good condition and this has the wings covering tergite II. I have moved the wing enough to see that the median white line is present. Another female shows a few white scales also in this position, but the others are not in good enough condition for the line to be present" (*in litera*). That female in best condition was designated lectotype, being labelled accordingly by Dr. G. B. White, on the 9th March 1979, while the four other females were marked paralectotypes. The labels of all five specimens of the type-series read "Azores:/Ilha do Pico,/Serra Gorda./VII 1929/J. Balfour Brown/B. M. 1932-179."

On the thorax, there are some yellowish-golden mesonotal scales at the anterior border, above the wing roots and prescutelar area. Spiracular bristles numerous. Postspiracular area bare. Anterior pronotum with many long hairs and a few dark scales. Posterior pronotum with numerous hairs and brown narrow scales on the upper part and a few pale, moderately broad scales on the lower part. Numerous dark-brown hairs present at base of subcosta on underside of wing. Cross veins scaled, in line. A few pale scales present at tips of tibiae, specially on the front ones. Tarsal claws as in Fig. 1A.

Abdominal tergum I with many long bristles and a small patch of pale scales at middle.

MALE. General external morphology similar to that of the female.

Head. Maxillary palps dark, paler at joints, slightly longer than proboscis; segments III and IV with long bristles, last segment (V) swollen at the distal half and not turned up. Proboscis mainly dark, including labella with scattered pale scales on the median 1/3, reaching to middle of palpal segment V. Tarsal claws as in Fig. 1B.

Terminalia. Chaetotaxy of the eight tergite (VIII T) (Fig. 1C) somewhat variable, usually with one median isolated spiniform seta near to the hind margin of the segment, but sometimes with two or none. Lobes of the ninth tergite (IX T) (Fig. 1D) separated by a deep sinus, each bearing 11.81 ± 2.07 (range: 7-15; n = 37) well developed setae. Tenth sternite (X S) (Fig. 1E) strongly sclerotized, with 4 or 5 dark teeth at tip. Phallosome (Ph) as in Fig. 1F. Basal lobe of coxite (BL) (Fig. 1G) conical, bearing 4.03 ± 0.48 apical stout pointed spines (range: 3-5; n = 40), two of them always stronger than the others, besides a variable number (usually, about twenty) of less modified spiniform setae with disproportionately large bases. Without apical lobe, but a patch of half a dozen stronger setae present at the corresponding area. Style a little more than half as long as the basistyle, tapered and slightly curved beyond middle, bearing many small papillated setae.

PUPA. Pupal chaetotaxy as illustrated in Fig. 2 A, B and recorded in Table 1.

On the *cephalothorax* (Fig. 2A), setae 1, 2 and 3 CT could be observed only once, all of them bifid. On the abdomen, seta 1 I is dendritic, while seta 0 II and 9 II are always single (n = 34 observations in both cases).

Trumpet index (ratio of maximum length of the respiratory trumpet to its width in middle, see Belkin, 1962) 3.29 ± 0.31 (observed range 2.50 - 3.79; n = 30). "Pinna ratio" (ratio of pinna length to trumpet length) 0.33 ± 0.052 (range 0.27 - 0.54; n = 30). "Meatus ratio" (ratio of meatus length to trumpet length) 0.67 ± 0.067 (range 0.36 - 0.73; n = 30).

Paddles (Fig. 2 B, C) oval, the mibrid reaching to the serrated hind margin. A small, usually single, accessory seta discernible in 31 out of the 48 paddles examined (64.58%), so far as we know, this is a unique feature in the subgenus *Culiseta* (Carpenter & La Casse, 1955; Belkin, 1962; Barr, 1963; Dobrotworsky, 1971).

Paddle index (ratio of length to width, as difined by Belkin, op. cit.) 1.32 ± 0.055, with an observed range 1.19 - 1.43 (n = 34).

LARVA. General morphology and chaetotaxy of the fourth instar larva as depicted in Fig. 3, and recorded in Table 2.

Head (Fig. 3A). Slightly wider than long, cephalic index 0.86 ± 0.05 (observed range 0.74 - 0.98; n = 32). Preclypeals slender, finely drawn out distally, slightly curved inward, distance between their bases to their lengths 1.41 ± 0.16 (range 1.13 - 1.75; n = 31). Modified setae on labrum as illustrated. Antenna small, only 0.33 ± 0.026 the head length (range 0.28 - 0.38; n = 32) darker at base and sparsely and minutely spiculate. Antennal tuft (seta 1A) inserted at or slightly before middle of shaft (0.47 ± 0.04; 0.39 - 0.52; n = 32), with 14.82 ± 3.13 branches (range 11 - 23; n = 22), usually slightly shorter than antennal shaft (0.47 ± 0.05; 0.37 - 0.60; n = 31). Distance between head setae 44' always smaller than distance between setae 55',

ratio $\overline{44}'$ to $\overline{55}'$ 0.78 ± 0.10, ranging from 0.53 to 0.95 (n = 34). Mentum (Fig. 3B) with about 15 teeth each side the median tooth: 15.30 ± 2.12, range 12 - 18 (n = 23).

Thorax and *abdomen* as in Fig. 3C and Table 2.

Comb (Fig. 3D) of segment VIII with 43.21 ± 5.03 scales (CS) (range 32 - 54; n = 33). Siphon index (mounted specimens) small, 2.43 ± 0.17, with range 2.2 - 2.9 (n = 31). Pecten (Fig. 3D) reaching to about 3/4 length of siphon, with 10.94 ± 2.02 (range 6 - 15; n = 32) spines (PT) followed by a row of 17.56 ± 1.90 (range 15 - 22; n = 32) long hairs, 1 - 3 of the most distal ones being usually more widely spaced. Tuft (seta 1S) inserted at base, with 13.00 ± 1.55 plumose branches (range 10 - 17; n = 30), about as long as or slightly longer than siphon breadth at base. Ratio of basal tuft length to siphon width at base 1.13 ± 0.09, ranging from 0.98 to 1.45 (n = 31). Saddle (Fig. 3D) complete, lateral seta (1X) only about half length of saddle: 0.44 ± 0.04 (range 0.33 - 0.53; n = 32). The three branches of the lower caudal seta (3X) have different and somewhat variable lengths, though the median branch is always the longest and strongest.

In 38 larvae examined, the ventral brush consisted of 18.66 ± 0.97 (range 16 - 20) tufts, of which 15.95 ± 0.80 (14 - 17) were inserted in the barred area and 2.70 (range 2 - 3) were precratal, while 2 or 3 of these (mean 2.40) were inserted on saddle. Anal papillae about as long as saddle, dorsal pair slightly longer than ventral pair.

TAXONOMY AND DIAGNOSIS

As was stated by Maslov (1964) on the basis of general morphology and chaetotaxy of the adult female, *Cs. atlantica* belongs to subgenus *Culiseta*. This is now confirmed beyond any doubt, not only by the general morphology and chaetotaxy of the adult male but also by the larval (Dobrotworsky, 1971) and pupal characters (Barr, 1963). An unusual character of the *atlantica* pupa, however, is the presence, in 65 percent of the observations, of the accessory paddle seta characteristic of subgenus *Climacura* Howard, Dyar & Knab (Barr, op. cit.). Within subgenus *Culiseta*, adults of *Cs. atlantica* have unusually dark abdominal tergites with only latero-basal pale patches scarcely visible from above. Besides, imagines of *atlantica* can also be easily separated from those of *Cs. alaskaensis* (Ludlow) and *Cs. inornata* (Williston) by the speckled legs of these two species, from *Cs. bergrothi* (Edwards) and *Cs. glaphyroptera* (Schiner) by the completely dark wings of *atlantica* and from *Cs. impatiens* (Walker) by the entirely black tarsi of the latter (Matheson, 1944; Aitken, 1955; Senevet and Andarelli, 1959). In the identification keys that follow, an attempt is made to separate *Cs. atlantica* and the other four closely related holarctic species of the nominate subgenus: *Cs. annulata* (Schrank), *Cs. incidens* (Thomson), *Cs. particeps* (Adams) and *Cs. subochrea* (Edwards) (see also Ribeiro et al., 1977).

MALES AND FEMALES

1. First segment of hind tarsi with a pale ring at middle 2

- First segment of hind tarsi dark, without a pale ring 3

2. Scales on fifth wing vein all dark; pale scales on abdominal tergites confined to basal bands on segments and to a longitudinal stripe or patch on the second segment. . *annulata*

- Fifth wing vein with some pale scaling; abdominal tergites with a sprinkling of pale scales on the dark areas. . . *subochrea*

3. Wings and legs speckled . . . . . *particeps*

- Wings all dark and legs not speckled 4

4. Wings with scales on cross-veins . . . . . *atlantica*

- Without scales on cross-veins . . . . . *incidens*

MALE TERMINALIA

1. Tenth sternite (paraproct) strongly curved, sickle-shaped. . *annulata*

- Tenth sternite only slightly curved distally 2

2. Lobes of ninth tergite small, separated by a shallow sinus 3

- Lobes of ninth tergite well developed, separated by a deep sinus almost as wide as the lobes 4

3. Eighth tergite bearing a single short, stout spine at the middle of the apical margin . . . . . *particeps*

- Eighth tergite bearing a group of 5 - 8 such spines. . . . . *incidens*

4. Lobes of ninth tergite with about 12 setae . . . . . *atlantica*

- Lobes of ninth tergite with about 20 setae . . . . . *subochrea*

FOURTH INSTAR LARVAE

1. Saddle strongly spiculate dorso-apically 2

- Saddly not obviously spiculate 3

2. The 2 or 3 precratal tufts of the ventral brush on the anal segment arising from the saddle . . . . . *incidens*

- These tufts inserted in a ventral cleft of the saddle . . . *particeps*

3. Distance between head-setae $\overline{44}'$ obviously greater than distance between head-setae $\overline{55}'$ . . . . . *atlantica*

- Distance between head-setae $\overline{44}'$ about the same as distance between head-setae $\overline{55}'$ or less 4

4. Siphon tuft 1S about as long as siphon breadth at base . . . *annulata*

- Siphon tuft 1S obviously shorter than diameter of siphon at base . . . . . *subochrea*

PUPAE

1. Denticles on margin of paddle short and blunt . . . . . *annulata*

- Denticles on paddle margin long and sharp 2

2. Seta 5 much longer and stouter than seta 1 on abdominal segments IV - VI . . . . . *particeps*

- Setae 5 and 1 with about the same length on segments IV - VI 3

3. Seta 7 III with 4 - 8 branches; a small accessory seta on paddle present in about 65 percent of the instances . . *atlantica*

- Seta 7 III with 8 - 11 branches; without accessory seta on paddle 4

4. Seta 9 VIII with 2 or 3 branches . . . . . *incidens*

- Seta 9 VIII with about 9 branches . . . . . *subochrea*

BIOECOLOGY

Our immature specimens of *Cs. atlantica* were all found in shaded rock-pools in the basaltic bed of the Ribeira do Salto River. The breeding water was always dark brown, with decaying leaves of eucalyptus, *Criptomelia japonica*, *Laurus azorica* and *Canna* sp. *Culiseta atlantica* was present in three of the four rock-pools positive for mosquitoes, always associated with larval *Culex pipiens* Linnaeus, and *Culiseta longiareolata* (Macquart).

All the adult specimens were reared in the laboratory from larva or pupa. The writers were never bitten during collecting.

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LEGENDS

Fig. 1. *Culiseta (Culiseta) atlantica*

A. Tarsal claws of adult female

B. Tarsal claws of adult male

C. Male terminalia, tergum VIII

D. Male terminalia, tergum IX

E. Male terminalia, sternum X

F. Aedeagus

G. Basal lobe of coxite

Fig. 2. *Culiseta (Culiseta) atlantica*. Pupa.

A. Cephalothorax

B. Abdomen

C. Paddle fringe

Fig. 3. *Culiseta (Culiseta) atlantica*. Fourth instar larva.

A. Head

B. Mentum plate

C. Thorax and abdomen

D. Abdominal segments VIII, X and siphon

Table 1 - Pupal chaetotaxy of[a] *Culiseta (Culiseta) atlantica*

	Seta nr.	n	Observed range	Mean (X)	95% Confidence Interval	Standard deviation (s)	Mayr's coefficient of variability (CV)
Cephalothorax	4	37	3 - 10	4.05	3.60 - 4.50	1.34	33.09
	8	41	1 - 2	1.90	1.89 - 1.91	0.030	1.58
	9	40	2 - 4	2.58	2.40 - 2.75	0.55	21.36
	10	56	3 - 7	4.75	4.48 - 5.02	1.01	21.26
	11	54	1 - 3	1.39	1.24 - 1.54	0.56	40.29
	12	54	2 - 5	3.83	3.59 - 4.07	0.87	22.72
Abdominal segment I	2	35	1 - 3	1.43	1.24 - 1.62	0.56	39.16
	3	36	8 - 11	9.15	8.85 - 9.45	0.90	9.84
	4	36	1 - 3	2.00	1.86 - 2.14	0.41	20.50
	5	31	2 - 5	3.35	3.04 - 3.66	0.84	25.07
	6	32	2 - 3	2.06	1.97 - 2.15	0.25	12.14
	7	35	1 - 2	1.94	1.86 - 2.02	0.24	12.37
	9	34	1 - 3	1.29	1.09 - 1.49	0.58	44.96
Abdominal segment II	1	30	2 - 8	4.93	4.44 - 5.42	1.31	26.57
	2	34	1 - 2	1.06	0.98 - 1.14	0.24	22.64
	3	33	3 - 6	5.27	4.91 - 5.63	1.01	19.17
	4	33	1 - 4	2.33	2.10 - 2.56	0.65	27.86
	5	34	2 - 4	2.76	2.55 - 2.97	0.61	22.10
	6	32	1 - 3	2.06	1.76 - 2.36	0.84	40.78
	7	32	1 - 5	2.56	2.29 - 2.83	0.76	26.69
Abdominal segment III	1	40	2 - 7	4.68	4.34 - 5.01	1.05	22.46
	3	39	4 - 8	5.92	5.60 - 6.24	1.01	17.06
	4	42	1 - 3	2.12	2.00 - 2.24	0.40	18.63
	5	44	6 - 9	7.32	7.04 - 7.60	0.93	12.70
	6	41	1 - 3	2.00	1.93 - 2.07	0.22	11.00
	7	33	4 - 8	5.61	5.30 - 5.92	0.86	15.33
	10	40	2 - 3	2.18	2.05 - 2.30	0.38	17.47
Abdominal segment IV	1	49	2 - 4	2.49	2.32 - 2.66	0.58	23.29
	5	48	2 - 6	3.92	3.55 - 4.29	1.27	32.40
Abdominal segment V	1	50	2 - 5	2.36	2.18 - 2.54	0.63	26.69
	3	55	5 - 8	6.31	6.09 - 6.53	0.81	12.84
	5	41	2 - 6	2.66	2.33 - 2.99	1.06	39.85
	7	49	5 - 8	5.59	5.36 - 5.82	0.81	14.49
Abdominal segment VI	1	38	2 - 3	2.08	1.99 - 2.17	0.27	13.14
	3	37	1 - 3	2.38	2.18 - 2.58	0.59	24.79
	5	31	2 - 5	2.55	2.20 - 2.90	0.96	37.65
	6	40	1 - 2	1.03	0.97 - 1.08	0.16	15.61
	8	39	2 - 5	3.05	2.82 - 3.28	0.72	23.61
Abdominal segment VII	1	40	2 - 4	2.40	2.23 - 2.58	0.55	22.92
	3	45	1 - 3	2.27	2.10 - 2.44	0.58	25.55
	4	40	1 - 2	1.90	1.80 - 2.00	0.30	15.79
	5	46	2 - 4	2.96	2.72 - 3.20	0.82	27.70
	9	33	3 - 5	3.94	3.72 - 4.16	0.61	15.48
Abdominal segment VIII	4	52	1 - 2	1.98	1.94 - 2.02	0.14	7.07
	9	45	3 - 8	4.64	4.31 - 4.97	1.11	23.92
Paddle	1	48	1 - 4	2.21	2.04 - 2.38	0.58	26.24
	acces-sory	48	0 - 1	0.65	0.51 - 0.79	0.49	74.62

[a] See also text

Table 2 - Chaetotoxy of the fourth instar larva of *Culiseta (Culiseta) atlantica*[a]

		Seta nr.	n	Observed range	Mean ($\bar{x}$)	95% Confidence interval	Standard deviation (s)	Mayr's Coefficient of variability (CV)
Head		4	35	2 - 4	2.71	2.51 - 2.91	0.58	21.40
		5	36	4 - 8	5.72	5.45 - 5.99	0.81	14.16
		6	36	1 - 3	1.33	1.12 - 1.54	0.63	47.36
		7	35	7 - 11	9.17	8.80 - 9.54	1.07	11.66
		8	38	2	2	———	—	—
		9	30	2 - 3	2.17	2.03 - 2.31	0.38	17.51
		10	31	2 - 5	7.00	6.52 - 7.48	1.30	18.57
		11	34	6 - 13	3.03	2.78 - 3.28	0.71	23.43
Thorax	Prothorax	1	34	1 - 2	1.03	0.97 - 1.09	0.17	16.50
		2	33	1	1	———	—	—
		3	32	3 - 5	3.15	3.08 - 3.22	0.20	6.35
		4	38	5 - 10	6.15	5.88 - 6.42	0.83	13.62
		5	38	1 - 2	1.11	0.98 - 1.24	0.39	35.13
		6	41	1	1	———	—	—
		7	41	4 - 5	4.05	3.98 - 4.12	0.22	5.43
		8	41	3 - 5	4.00	3.98 - 4.02	0.07	1.75
		9	39	1	1	———	—	—
		10	39	1	1	———	—	—
		12	35	1 - 2	1.03	0.97 - 1.09	0.17	16.50
	Mesothorax	5	56	1 - 2	1.17	1.07 - 1.27	0.38	32.73
		6	60	1 - 2	1.02	0.99 - 1.05	0.13	12.74
		7	59	1 - 2	1.02	0.99 - 1.05	0.13	12.74
		8	24	7 - 10	8.42	8.12 - 8.72	0.72	8.55
	Metathorax	7	32	9 - 14	11.50	11.00 - 12.00	1.39	12.08
		9	23	8 - 11	8.96	8.63 - 9.29	0.76	8.54
		13	40	4 - 6	4.85	4.65 - 5.05	0.62	12.78
Abdomen	Seg. I	6	36	3 - 4	3.17	2.96 - 3.38	0.61	19.24
	Seg. II	6	34	2 - 5	3.26	2.97 - 3.55	0.83	25.46
	Seg. III	6	30	2	2	———	—	—
	Seg. IV	6	30	2	2	———	—	—
	Seg. VIII	1	34	5 - 10	6.85	6.40 - 7.30	1.28	18.67
		2	31	2 - 3	2.03	1.96 - 2.10	0.18	8.86
		3	40	6 - 15	9.40	8.85 - 9.95	1.72	18.29
		4	35	2	2	———	—	—
		5	37	4 - 6	4.97	4.73 - 5.21	0.72	14.59
	Siphon	1	30	10 - 17	13.00	12.42 - 13.58	1.55	11.92
	Anal seg. (X)	1	37	3 - 8	4.40	4.07 - 4.73	0.98	23.38
		2	32	15 - 19	16.22	15.84 - 16.60	1.04	6.41
		3	41	3 - 4	3.05	2.98 - 3.12	0.22	7.21

[a] See also text

Fig. 1

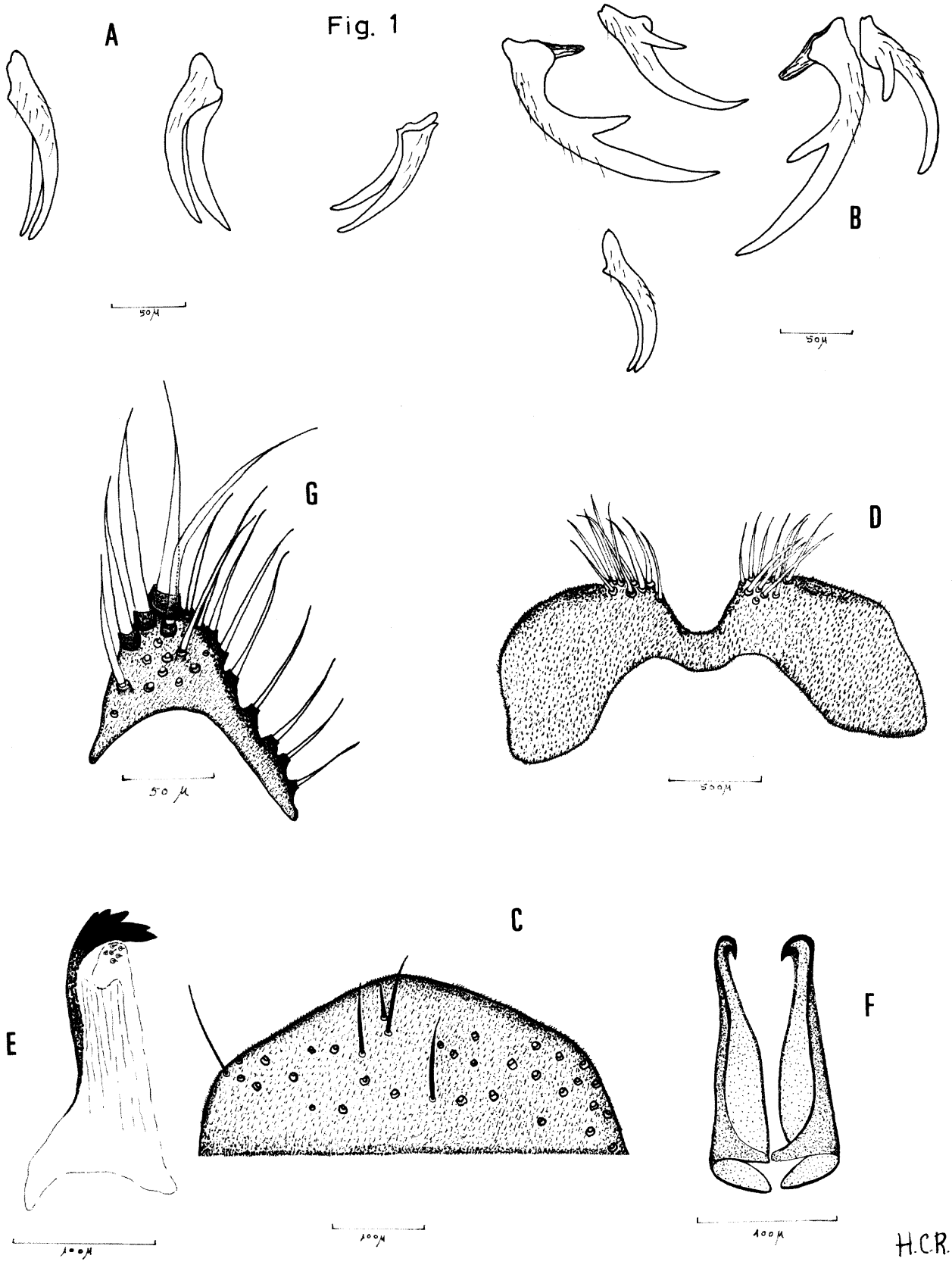

Fig 2

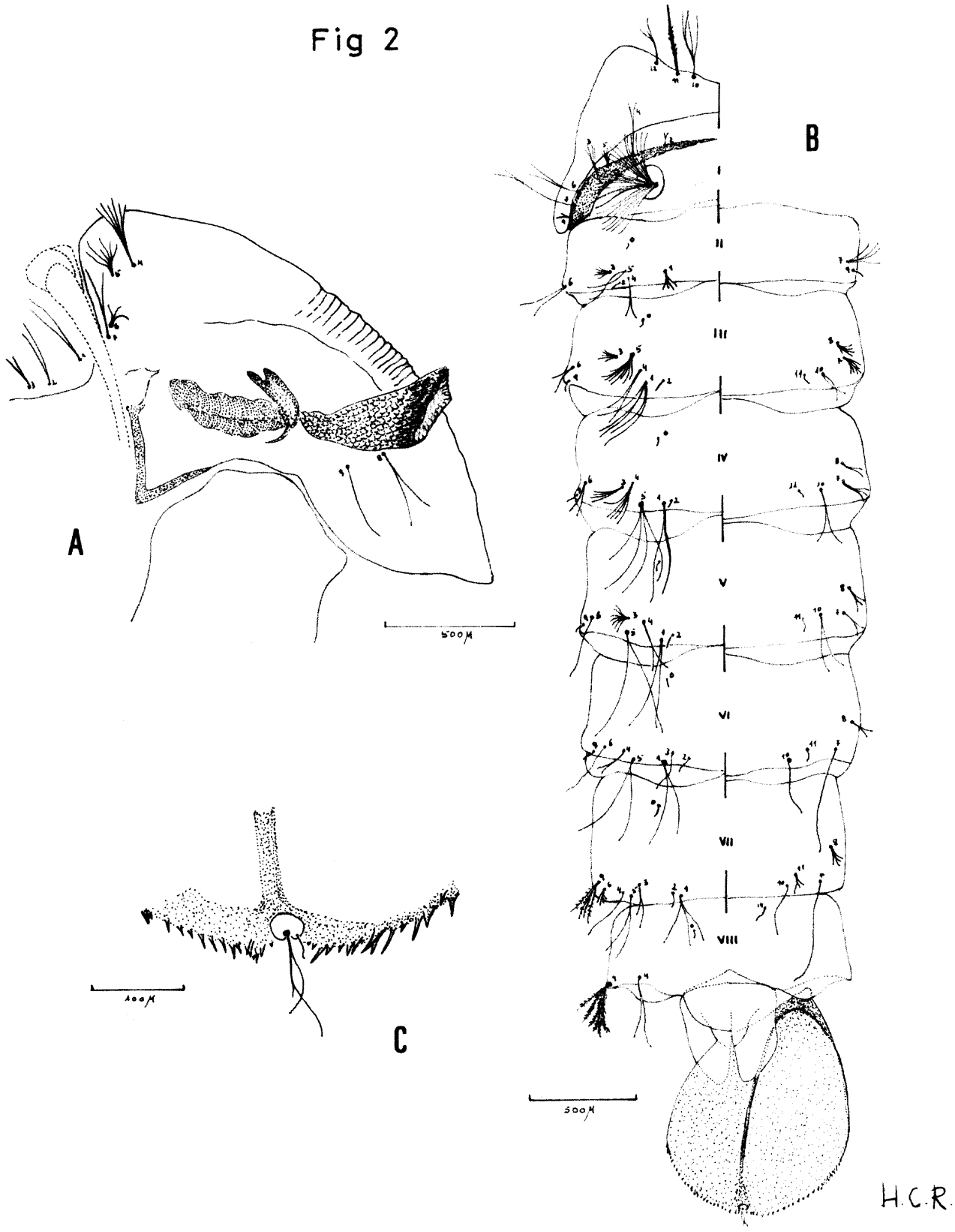

Fig. 3