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**Description and biology of a new genus of flies related to Anthoclusia and representing a new family (Diptera, Schizophora, Neurochaetidae)**

by

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SYNOPSIS

The new family Neurochaetidae is established in the superfamily Asteroidea to include the genera *Anthoclusia* Henning (Oligocene) and *Neurochaeta* (Recent), the latter here described as new. The following new species are described: *Neurochaeta priola* (Rhodesia); *N. sinckelbergi* (Malagasy); *N. inersa* (Australia). The larva and puparium of *N. inersa* are described and an account given of its biology, including its association with the plant *Miconia mucronatiflora* (family: Araceae), and the extraordinary adult behaviour.

INTRODUCTION

My interest in the Australian species, round which the present study has grown, commenced 20 years ago when material was received from the South Australian Museum and the University of Queensland. In 1961, when we observed the curious habits of the adult fly for the first time, the insect became known as the 'upside-down fly'. No satisfactory clue to its relationships was available till after publication of Henning's description of *Anthoclusia gephyreya*, a Baltic amber fossil, in 1965. Henning (1969) described a second fossil species, *A. remotioris*, and in 1971 removed the genus *Anthoclusia* from the Anthomyzidae, in which it was originally placed, as it was not considered referable to any recent family. Henning's writings and a brief mention of recent forms by Colless & McAlpine (1974: 96) comprise all that has been previously published on flies referable to the new family Neurochaetidae.

SUPERFAMILY ASTEROIDEA

This superfamily name has been previously used by Colless & McAlpine (1970) in the sense in which I now employ it. Henning (1971; 1973) used the name Anthomyzoida in a similar but wider sense. The family-group name 'Asteroidea' was used by Loew as early as 1861 (and earlier in a different form—C. W. Sabrosky *in litt.*), whereas the name Anthomyzidae was apparently first used by Czerny (1903). In accordance with articles 35 and 36 of the International Code of Zoological Nomenclature, Asteroidea should be used as having priority over Anthomyzoidae. Opmomyzidae, a family included in this group by Henning (1971), but not by Colless & McAlpine (1970), is of much earlier date, having been used in the form Opmomyzides by Fallen (1820). In view of the current disagreement as to the inclusion of the Opmomyzidae, it is considered that greater stability will be achieved by uniform use of the name Asteroidea. Colless & McAlpine (1970; 1974) use the name Opmomyzoidae for a superfamily of different scope, admitting doubts as to its limits. A more satisfactory but

still tentative arrangement of the families (slightly modified from Colless & McAlpin 1974) is proposed as follows:

Superfamily Opomyzoidea: Neottiophilidae, Piophilidae (Thyreophoridae, Opomyzidae, Clusiidae, (?) Acartophthalminidae.  
 Superfamily Agromyzoidea: Odiniidae, Agromyzidae, Fergusoninidae, Carnidae  
 Superfamily Asteroidea: Neurochaetidae, Periscolidae, Teratomyzidae, Aulaci-  
 gasiridae, Asteidae, (?) Anthomyzidae.

The genera *Cyanops* Melander and *Stenomiera* Coquillett I refer provisionally to the Periscolidae (following Brues, Melander & Carpenter 1954; *Stenomiera* therein mentioned under its synonym *Podocera* Czerny). Hennig (1971) refers these to Aulaciagastriidae, but the antennal structure is very different (see below). I omit the genera *Protantagaster* and *Protanthomyza* Hennig (1965) from consideration as their superfamily position is doubtful.

Of the other families which have been included under these superfamily headings the Chyromyidae should probably be referred to the Helcomyzoidea, and just possibly the Anthomyzidae belong here also. The Pallopteridae and Lonchaeidae appear to be related to Tephritioidea. The closely related genera *Gajomyia* Malloch and *Schizomyia* Malloch, though referred to Anthomyzoidea without family assignment by Hennig (1971), seem in better agreement with Sciomyzoidea (as defined by Colless & McAlpine 1970).

I do not attempt to place the insects here treated according to the highly innovative system of Griffiths (1972) which is based largely on characters of the male post-abdomen. These characters are highly unstable above the species level, very often showing much greater differences between related species than any other morphological characters. Hence for higher levels of classification they must be regarded as among the least reliable of characters, though there appear to be occasional areas of relative stability.

In the present sense the superfamily Asteroidea includes flies with the following characters:

Size small to minute; habitus usually slender; face more or less sclerotised (weakly so in some small forms but in these the differentiated mesofacial not narrowed by a broadening of the parafacial as in Piophilidae and Opomyzidae) with lower, epistomal margin separating it from peribuccal region well defined; lower part of face inflexed to a variable degree so as to be visible in ventral aspect; vibrissa present (reduced in some Periscolidae); legs not greatly lengthened; tibiae without preapical dorsal bristles; costa without break in position just beyond humeral crossvein (except in some Teratomyzidae); subcosta variably weakened distally; anal cell, when distinct, not of the drosophiloid kind (see McAlpine 1976); distal section of vein 6 short (except in Teratomyzidae); cerci of female separate.

#### Family Neurochaetidae fam. n.

Small flies of medium to slender habitus. Head with sloping postfronts, in profile not prominent near insertions of antennae; eyes broadly to quite narrowly oval, oblique, almost smooth; face almost flat or variably convex below, its epistomal margin slightly to very strongly reflexed; parafacials narrow below, following contour

of eye-margin; prelabrum narrowly horseshoe-shaped; outer vertical bristles inserted level with or slightly in advance of inner vertical bristles; postvertical bristles, when present, rather small, posteriorly directed, subparallel or with apices slightly curved outwards; ocellar bristles distinct; fronto-orbitals 3 or 4, the most anterior one or two sloping or curving inwards, the others entirely or predominantly reclinate; vibrissae distinct, not situated on parafacials, each succeeded by a series of peristomal or cheek bristles, alternating somewhat irregularly with shorter setulae. Antenna with segment 2 hood-like, notched or slit dorsally, without lobes other than those demarcated by slit, with some strong bristles on inner side distally; segment 3 short, more or less ovate, deflexed, with basal dorsal process fitting into cavity of segment 2; arista more or less long-plumose (bipectinate), three-segmented, with second segment short so far as known. Palpus short, cylindrical or variably spatulate; proboscis short, with short, broad, rounded labella.

Thorax at most moderately slender, often depressed; the following bristles normally present: humeral, 1 + 1 notopleurals, one or two dorsocentrals, supra-alar (sometimes present), postalar (on postalar callus), and one or two sternopleurals; presutural (usually), posterior supra-alar (second postalar of some authors), and mesopleural absent; mesoscutum with numerous hairs on much of surface, which are non-seriate or in part very irregularly seriate, never with a distinguishable median series; scutellum without discal hairs; prosternum narrow, without precoxal bridges. Legs more robust than in Anthomyzidae and Asteidae, especially the femora: hind femur longer than other femora and longer than hind tibia; hind basitarsus at least as long as mid basitarsus; fore femur with a series of well-developed posteroventral bristles, but without the single spinescent bristle of many anthomyzids; tibiae without preapical bristles; mid tibia with one long apical spur. Wing of moderate width or rather narrow; costa broken only at end of Sc, the break distinctly incised, not (as in *Cyanops*, *Stenomiera*) consisting of a mere narrowing of the vein; subcosta weak distally, where it is little pigmented or unpigmented and sometimes reduced to a mere crease of the membrane, always separate from vein 1; anterior and discal crossveins moderately to very widely separated (always more distant than in Teratomyzidae); vein 6, when visible beyond anal cell, rather short; anal crossvein, when distinctly developed, recurved; alula distinct but sometimes narrowed. Haltere with large inflated capitulum, which is sharply marked off from pedicel.

Abdomen more or less ovate, with very broad preabdominal sternites, sometimes almost as broad as tergites; preabdomen of male consisting of five segments, with spiracles in pleural membrane, so far as known; male postabdomen so far as known with two dorsal sclerites between segment 5 and genital segment; surstylus distinct.

The new genus *Neurochaeta* is chosen as type of the family in preference to the previously described *Anthochaeta*, as the type species of the former is much better known than the fossil forms.

#### RELATIONSHIPS OF NEUROCHAETIDAE

Hennig (1971) placed *Anthochaeta* among the families of the division Periscolidae of the superfamily Anthomyzoidea. This idea of its affinities remains valid in erecting a new family to include *Anthochaeta*, but further consideration of relationships among some of the significant taxonomic characters is necessary.

Hennig (1971) divided the superfamily 'Anthomyzoidae' into two divisions: the Periscelididae (families Periscelidae, Aulacigastridae, Asteiidae, and Teratomyzidae), and the Anthomyzidae (families Acartophthalmidae, Clusiidae, Anthomyzidae, Opomyzidae, and Chyromyidae). The whole of the Periscelididae, with the possible addition of the Anthomyzidae from the Anthomyzidae constitute my concept of the superfamily Asteioidae.

The most constant morphological distinction between Periscelididae and Anthomyzidae given by Hennig (1971) is the uniformly sclerotised face of the former and the centrally membranous (desclerotised) face of the latter. My work shows the facial structure not to be uniform in either division and to be particularly diverse in the families referred to Anthomyzidae. In some (e.g. the Chyromyidae and some anthomyzids) the desclerotisation of the face seems to be part of a general lessening of the sclerotization of the head capsule associated with a decrease in overall size. The Anthomyzidae (unlike the Clusiidae) generally retain a distinguishable (but not prominent) lower (epistomal) margin to the face, separating it from the peribuccal cavity. In some anthomyzids (e.g. *Mimeropsia*) the face is not markedly desclerotised and in *Apterosepsis basilewskyi* Richards (1962), which I regard as a true anthomyzid, it is quite strongly sclerotised. The Anthomyzidae are the only family of Hennig's Anthomyzidae with a facial structure approaching that of families here included in Asteioidae. In the material of Aulacigastridae and Asteiidae available to me the lateral borders of the peribuccal cavity are formed by broad ventrolateral extensions of the mesofacial, which are distinct from the genal-parafacial areas. In the Anthomyzidae these extensions form a narrower raised ridge of similar extent. In the Periscelididae and Neurochaetidae there are no such extensions of the mesofacial, and the genal-parafacial areas border directly on the peribuccal cavity. In the Teratomyzidae the parafacial suture is lost and there is thus no distinction between parafacial and mesofacial.

Hennig (1971: 37) gives the absence of the posterior postalar bristle as an apomorphic character of the ground-plan of the Periscelididae. The bristle referred to is not situated on the postalar callus, and appears better considered as a posterior member of the intra-alar series. A posterior member of this series is present in examples of Aulacigastridae and of two asteid genera at present available to me, though this bristle is situated a little further forward than the true postalar. Other asteid flies I have examined have only the usual postalar bristle.

A typical presutural bristle is present in the Anthomyzidae and Teratomyzidae, and in several of the Aulacigastridae and Asteiidae there is apparently a reduced presutural. I doubt if a true presutural bristle can be identified in the remaining families of Asteioidae. In some species of *Stenomera* there is an apparent presutural bristle but this bristle is probably a secondary development not present in the ground-plan of the genus. In many species of the genus, including an exceptionally plesiomorphic one from Malaysia, there is only a longitudinal series of two or three hairs in this position, and, in those species in which the apparent presutural bristle is strongly developed, it seems to be derived from an enlarged member of this series. Similarly the occurrence of an apparent presutural bristle in a single known species of Neurochaetidae probably indicates a late secondary development of the bristle.

The absence of a costal break near the end of the subcosta may not always be

primary as there could well be secondary loss of the break in small forms with tendency to reduction in venation. In the Asteioidae forms with least development of the break (Periscelididae and Asteiidae) have relatively great reduction of the subcosta, a condition suggesting that this part of the wing is highly apomorphic. The presence of a distinct break in Neurochaetidae does not necessarily indicate synonymy with other asteid groups (Anthomyzidae, Teratomyzidae, Aulacigastridae) having such a break.

The families of Asteioidae may be divided quite sharply into groups from antennal structure. The Neurochaetidae and Periscelididae have segment 3 rather narrowly oval, sharply deflexed, with dorsal sub-basal tubercle fitting into a cavity of segment 2 which is cap-like with a dorsal slit. The remaining families of Asteioidae have segment 3 rounded to rather broadly oval and porrect to somewhat drooping, but without the concealed sub-basal tubercle, and segment 2 is not cap-like, its distal articular surface facing anteriorly, with dorsal margin not slit but at most broadly sinuate.

The periscelidid-neurochaetid type of structure is so distinctive that its possessors seem to require some sort of separate status from the remainder of the asteid families, and the placement of *Cyanops* and *Stenomera* in the Aulacigastridae seems untenable. *Stenomera* and *Aulacigastris* have both lost or almost lost the basal segmentation of the arista but this similarity is apparently due to convergence, each of these genera being less closely related to the other than to a form with segmented arista.

Outside the Asteioidae the periscelidid type of antenna occurs with slight variation in a number of groups of Schizophora (e.g. in many of the Muscoidea (ceky praes); Tephritidae, and Drosophilidae), and in the families Nothyidae and Psilidae). It is possible that this set of antennal characters is in the ground plan of a large section of the Schizophora, though this section may prove difficult to define in view of the probability that the characters have become modified in some lineages.

In the Asteioidae the forms with the periscelidid type of antennal structure also share the following characters: (1) loss of the presutural bristle; (2) loss of the intra-alar bristle (shared with Anthomyzidae and Teratomyzidae); and (3) the long-bipinnate arista (shared with some representatives of Anthomyzidae, Aulacigastridae, and Asteiidae). Though these characters cannot be considered to provide proof of the monophyletic origin of Neurochaetidae plus Periscelididae, they do indicate a degree of uniformity in the families possibly indicative of close relationship.

I conclude that the balance of evidence at present indicates a relationship of the Neurochaetidae to the Periscelididae but that the resemblance is not so close as to suggest that they be included in one family.

The Neurochaetidae differ from the Periscelididae in not having the vibrissae displaced high above the epistomal margin, in having the lateral arm of the palpal suture separate from the parafacial suture and following the contour of ventral margin of eye, and in having a greater number of fronto-orbital bristles (three or more). The Neurochaetidae further differ from the *Cyanops-Stenomera* complex in the extensive, uniform, not very distinctly serrate hairing of the mesoscutum and in the presence of ocellar bristles. They differ from the remaining periscelid genera (Periscelididae s. str.) in the presence of a costal break.

From the Anthomyzidae, with which Hennig (1971) initially associated them, the

Neurochaetidae differ (in addition to the antennal characters already noted) in having one or more pairs of long incurved lower fronto-orbital bristles, in having the post-vertical bristles, when present, not convergent (the single exception in Anthomyzidae noted by Hennig (1971) does not seem phylogenetically significant), in having the lateral arms of the ptilinal suture extended below lower margin of eye, in lacking the ventrolateral extensions of the mesofacial round the peribuccal cavity, in the more posteriorly situated sternopleural bristles, in the narrow prosternum, and in the very broad abdominal sternites. The condition of the ptilinal suture and prosternum is still unrecorded for the fossil neurochaetids.

The comparative morphology of acalyptrate larvae is generally too little known to provide evidence of phylogenetic relationships. This is particularly true within the Asteroidea, but the known larva of *Neurochaeta* exhibits striking differences from other known asteroideid larvae, even though existing descriptions sometimes give little detail. *N. inversa* is the only known asteroideid larva with a pair of elongate anal processes. In the Anthomyzidae s. str. (Czerny 1928; Séguy 1934; de Meijere 1944) the larva further differs from that of *Neurochaeta* in the short last segment not drawn out into a postanal spiracle-bearing process, and in the presence of a dentate sclerite below the mouth-hook. In the Perisselididae (Duda 1934; Teskey 1976) the known larvae are much less elongate than in *Neurochaeta* with numerous soft cuticular processes and a dense covering of fine hairs; each of the pair of posterior spiracles is at the tip of a separate elongate process arising from the short, broad terminal segment. The larva of *Stenomiera* (Williams 1939) differs from that of *Neurochaeta* in having short lateral bristles or hairs and in having the posterior spiracles at the tips of separate appendages. The larva of *Atalagaster* (Malloch & McAtee 1924; Teskey 1976) is distinctive in having a much longer posterior respiratory siphon, as well as extremely long, retractile anterior respiratory appendages, and a complete covering of minute cuticular spicules. I have seen no description of an asteroideid or teratomyzid larva.

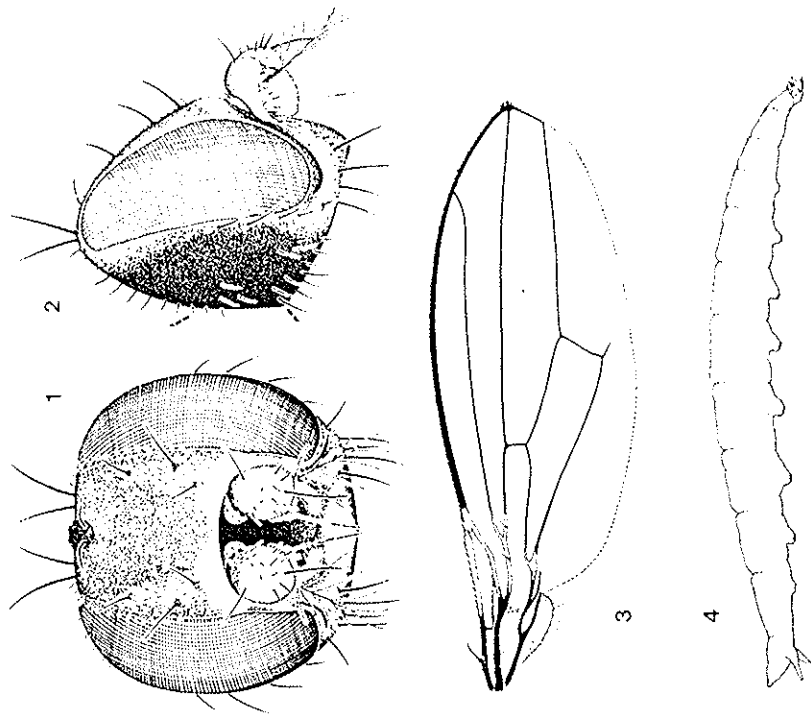
#### Key to genera of Neurochaetidae

1. Fronto-orbital bristles all aligned; cheek region with only the peribuccal series of bristles; scutellum not abbreviated; Oligocene . . . . . **Anthochusia**
- One anterior fronto-orbital inserted mesad from the rest of the series; cheek region with one or more strong postgenal bristles near postero-ventral margin of eye, in addition to peribuccal series; scutellum not more than half as long as wide; Recent . . . . . **Neurochaeta**

#### Genus *Neurochaeta* gen. n.

Type species: *N. inversa* sp. n.

Small to minute flies, distinguished from other living acalyptrates by the simultaneous possession of the following characters (using the key to families of Schizophora in Colless & McAlpine (1970) as a basis for comparison): free-living, fully winged insects with general characters of the acalyptrate families; subcosta distally becoming indistinctly sclerotised and unpigmented, distinct from but not widely separated from vein 1, not abruptly bent forward near distal end; hind basitarsus not notably shorter than mid basitarsus; foremost of the 3 or 4 fronto-orbital bristles



Figs 1-4. *Neurochaeta inversa*. 1-2, head of holotype. 3, wing of holotype. 4, last instar larva.

incurved; anal cell (CuP) not angularly produced, sometimes much reduced; arista (so far as known) long-plumose (bipectinate). Some other notable characters are as follows: face uniformly sclerotised; ocellar bristles strong; postvertical bristles, when present, more or less parallel; inner vertical bristles making a more acute angle with the horizontal than do the outer ones; antenna (unknown in *N. privata*) with segment 2 very large and hood-like and segment 3 vertically deflexed; palpus distinct, not more than half as long as labellum; thorax very depressed; abdomen depressed; female postabdomen without specially modified segments, with separate tergite 7 and sternite 7, and separate cerci.

In the key to families of Diptera given by Hennig (1973), *Neurochaeta* runs most readily to the Muscidae at couplet 82, a calyptrate family with which it obviously has

no true affinity. If, however, at couplet 78 it is taken on to couplet 84 on the grounds of having the slit (*Längspalt*) in antennal segment 2 not as deep as in many muscids (though still present), the insect cannot be taken to any family because of decided disagreement with any of the alternatives after couplet 132.

The characters given in the key to genera herein are the only ones which can at present be asserted absolutely to differentiate *Neurochaeta* from *Amblochaeta*, the only previously described genus of Neurochaetidae. However, there is also some less clear evidence of morphological divergence between the genera in some other characters. It appears that the thorax of *Amblochaeta* is much less flattened than in *Neurochaeta*. In *Neurochaeta* vein 3 always ends in the wing apex with vein 4 ending distinctly behind apex. This is not the case in *A. gephyra* but in *A. renthieris* the difference from *Neurochaeta* is slight. There may be a considerable difference in antenna segment 2 (very large and cucullate in *Neurochaeta*, apparently shorter than segment 3 in *Amblochaeta*), but in the most plesiomorphic species of *Neurochaeta* (*N. prisca*) the antenna is unknown. The possession of spaced anterior to anteroventral series of spinose bristles on the costa may well be a character of the groundplan of *Neurochaeta* which is absent in *Amblochaeta*. But *N. inversa* has the bristles reduced to slightly differentiated setulae, and the costal armature of the fossils needs closer study. The presence of macrotrichia on the radial sector (vein 3 and stem of veins 2 and 3) could be a further character of the groundplan of *Neurochaeta* not present in *Amblochaeta*, but, if so, they must have been secondarily lost in *N. stuckenbergi*, and should be searched for carefully in *A. gephyra* to ascertain if they are really absent.

Wherever it seems possible to decide the direction of evolution of a distinguishing character, *Amblochaeta* has a more primitive condition than *Neurochaeta*. It is therefore possible that *Amblochaeta* lies near the ancestry of *Neurochaeta* and that *Neurochaeta* is a monophyletic unit, its species being united by synapomorphic characters. On account of the large number of contrasting characters among the three species of *Neurochaeta*, these characters are set out in Table I instead of in a key. *N. prisca* has the greatest number of apomorphic characters, while *N. inversa* has the greatest number of apomorphic characters. On the other hand the distinguishing characters of *N. prisca* are not entirely plesiomorphic, e.g. the number of scutellar bristles is reduced. *N. stuckenbergi* has a presutural bristle, the possession of which might be interpreted as plesiomorphic. However, as this is the only known occurrence of such a bristle in the family, it may be that the bristle has developed secondarily in this species. *N. stuckenbergi* and *N. inversa* share certain apomorphic characters which indicate that they are probably sister-species. By comparison with *N. prisca* these species have the costal incision at end of subcosta deeper, vein 2 shorter and curved forward distally, anal cell reduced in size, apparent apical scutellar bristle displaced laterally, postscutellum very convex and prominent.

Despite the evidence for synapomorphy between *N. stuckenbergi* and *N. inversa* the amount of phenetic difference between them is too great to warrant any taxonomic segregation of this pair from *N. prisca*. Of the characters listed in Table I, *N. inversa* and *N. stuckenbergi* resemble each other and differ from *N. prisca* in only three while *N. stuckenbergi* and *N. prisca* resemble each other and differ from *N. inversa* in six. *N. stuckenbergi* shows an intermediate condition between the other two species in two characters. The differences between the three species might be considered a

TABLE I

Specific characters in *Neurochaeta*

	<i>inversa</i>	<i>stuckenbergi</i>	<i>prisca</i>
fronto-orbital bristles	3	4	4
incurred fronto-orbital	inserted before fore-most reclinate bristle	inserted level with fore-most reclinate bristle	inserted behind fore-most reclinate bristle
postvertical bristle	absent	present	present
postgenal bristles	several	1	1
presutural bristle	indistinguishable	distinct	indistinguishable
dorsocentral bristles	1	2	1
supra-alar bristle	absent	present	present
scutellar bristles	apical pair displaced laterally, 2 or 3 secondary distal pairs present, lateral pair present	apical pair widely separated, secondary bristles absent, lateral pair present	apical pair approximately medial, secondary bristles absent, lateral pair replaced by several fine setulae
postscutellum	very convex and prominent	very convex and prominent	not prominent
spaced costal bristles	weak, poorly differentiated	strong, inserted anteroventrally	strong, inserted anteriorly
costal break	rather deeply incised, producing a very short lobe	very deeply incised, producing a long, finger-like lobe	simple, not strongly incised
distal termination of costa	at vein 4	just beyond vein 3	at vein 4
macrotrichia on base of radial sector, dorsally	3 long erect bristles	absent	few small hairs
second basal cell	confluent with first basal cell	confluent with distal cell	complete
anal cell	much reduced	much reduced	well formed
coxus of ♀	broad, plate-like, with fringe of hairs	narrow, subyindrical, with hairs and 2 short terminal spines	narrow, subyindrical, with hairs and one long terminal bristle

least equivalent to those separating genera in some acalyptrine families, but I am convinced that the establishment of three monotypic genera is not the best course at present. Such an arrangement would fail to indicate anything significant about the inter-relationships of the species, and to show that they apparently form a monophyletic unit independent of the fossil forms of the family, whereas in any classification the generic name fulfils its original function (often forgotten by splitters) of immediately indicating the relationship of the species. If in a later date numerous additional species of the alliance are found, which can be segregated into groups by significant character combinations, then one might consider whether additional genera or subgenera should be used.

*Neurochaeta prisca* sp. n. (Figs 9-11, 21)

*Male and Female:* agreeing essentially with description of *N. inversa* except as indicated below.

*Coloration:* head pale buff with bristles brown to yellowish; occipital region suffused with greyish brown; mouthparts yellowish buff. Thorax pale fulvous, shading to pale brown dorsally, with extensive greyish white pruinescence, the visible extent of which changes with angle of view, but which appears thickest in vicinity of dorso-central lines; bristles brown to almost black. Legs pale fulvous with faint brownish suffusions on femora. Wing hyaline, without markings; veins brownish fulvous. Haltere pale buff, becoming fulvous basally. Abdomen fulvous with yellowish-brown to blackish hairs and bristles.

General form more depressed than in other species.

Head depressed; face shorter than in *N. inversa*, nearly vertical and nearly flat except for the broad shallow antennal foveae, its ventral limit apparently represented by a transverse line close in front of prelabrum, the face thus rather broadly visible from ventral aspect; cheek about one-quarter the height of eye; fronto-orbital plate with very fine pale hairs; fronto-orbital bristles 4, the foremost broken off in both specimens but presumably reclinate from similarity of the series to that of *N. stuckenbergi*; second (incurved) fronto-orbital situated between and mesad of first and third bristles; postvertical bristles short, subparallel but very slightly convergent, directed posteriorly from just behind vertex; a series of about five peristomial bristles, of which only the anterior two are as large as vibrissae, and alternating shorter setulae present; some irregularly placed bristles and setulae behind these, but the outwardly directed bristle of *N. inversa* not represented; a single strong postgenal bristle near lower margin of eye.

Thorax: postscutellum transversely narrowed, not at all prominent or gibbous; presutural bristle absent; supra-alar bristle present; a pair of long approximated apical bristles and no others on scutellum, the lateral bristles replaced by several fine marginal setulae; two upper posterior sternopleural bristles present. Mid femur with several non-seriate short bristles or thickened setulae near middle of anteroventral surface; hind femur with several dorsal bristles and one anterior bristle; hind tibia with two anterodorsal bristles near middle in male only. Costa distinctly broken at end of subcosta but wing margin not conspicuously incised at this point, the section of costa proximal to break terminating in a pair of somewhat enlarged bristles; section of costa beyond break with anterior series of short, strong, black spaced bristles which are discontinued before end of vein 2; costal index about 4.4; subcosta only becoming indistinct near distal extremity; stem of veins 2 and 3 with three or four fine hairs on basal part only; second basal and anal cells complete; distal section of vein 6 strongly developed, but discontinued well short of wing margin; alula relatively broad.

Abdomen broadly oblong, depressed; tergites 2-5 with three or four bristles at each lateral margin; sternites 2-5 even broader than in *N. inversa*, sternites 3-5 as broad as tergites of their respective segments; preabdominal spiracles in pleural membrane. Male postabdomen very asymmetrical; tergite 6 well developed, transversely oblong, slightly asymmetrical; sternite 6 transversely oblong, much displaced

towards left, side but extending to right of median ventral line; sternite 7 smaller, situated on left side and rather narrowly continuous with sternites 6 and 8 at left lateral extremity; sternite 8 rather large, dorsal spiracles of segment 6 situated in pleural membrane, those of segment 7 not definitely located, possibly absent; epandrium large, with short lateroventral lobe on each side; surstylus broadened proximally, slightly clavate distally, basally articulated with epandrium but only weakly united to it; hypandrium with pair of large external plates, each bearing two minute setulae near inner margin and a knob-like setulose gonite at each posterolateral angle; aedeagus moderately elongate, complex, with several darkly pigmented longitudinal strips; cerci small, rounded, haired, well separated. Female postabdomen: cercus narrow with numerous hairs and a rather long terminal bristle.

*Dimensions:* total length, ♂ 4.2 mm, ♀ 3.9 mm; length of thorax, ♂ 1.7 mm, ♀ 1.6 mm; length of wing, ♂ 3.6 mm, ♀ 3.5 mm.

*Distribution:* eastern RHODESIA (Zimbabwe).

*Holotype* ♀; Meisetter, X.1950 (H. K. Munro), Natal Museum (2188). *Paratype* ♂; same data.

*Neurochaeta stuckenbergi* sp. n. (Figs 5-8, 12)

*Female:* agreeing essentially with description of *N. inversa* except as indicated below. *Male:* unknown.

*Coloration:* head predominantly fulvous; occipital region dark brown; antenna, including arista, entirely yellowish; palpus pale yellowish; cephalic bristles and hairs yellowish. Thorax fulvous; mesoscutum (except for a large median postsutural whitish-pruinescent area), humeral callus, scutellum, and upper part of mesopleuron tawny-brown; postscutellum with thick pubescence, which appears brilliant silvery white or dull yellowish, depending on angle of view. Legs pale fulvous; distal third of hind femur dark brown. Wing fulvous-hyaline with slightly paler area on subcostal cell and region immediately behind it. Haltere fulvous.

Head somewhat compressed anteroposteriorly; face about as long as postfrons; lower part of face strongly convex, with margin rather strongly inflexed and broadly visible from ventral aspect; cheek about one-sixth height of eye; fronto-orbital bristles 4, the incurved one inserted mesad of foremost reclinate one and almost level with it; postvertical bristles present, parallel; a series of 4 peristomial bristles present in addition to some more posterior bristles, but the outwardly directed bristle of *N. inversa* not represented; setulae in peristomial region minute; one strong postgenal bristle as in *N. prisca*.

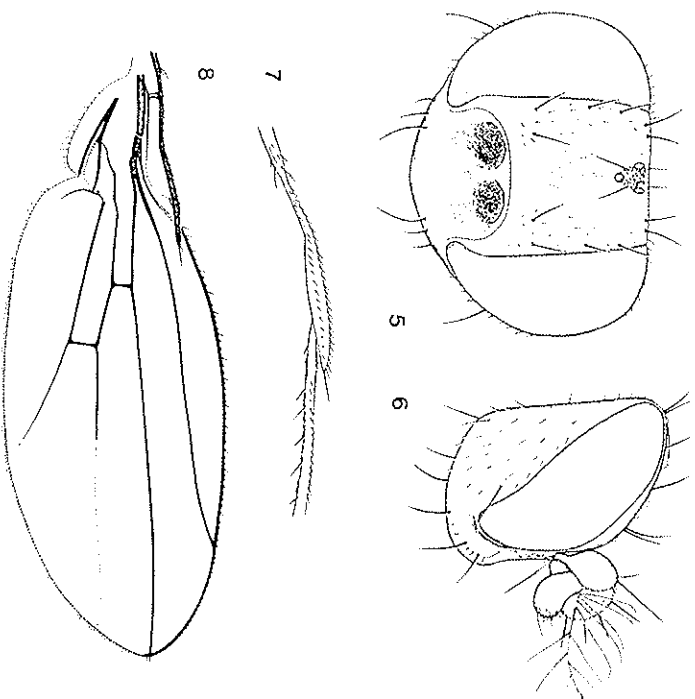
Thorax somewhat broader and less depressed than in *N. inversa*; hairs on mesoscutum fairly regularly seriate, forming eight rows between anterior dorsocentrals; supra-alar bristle rather strong; presutural bristle a little weaker, situated rather close to notopleurals and possibly not homologous with the presutural bristle of Anthomyzidae; two dorsocentral bristles present, the anterior one shorter; scutellum with two pairs of marginal bristles, those of apical pair widely separated; additional setulae absent; one posterior and no anterior sternopleural bristles present, also a setula in front of former. Fore legs about as slender as mid legs and slightly shorter; hind legs longer and stouter than others; dorsal bristles on fore femur little developed except

for one near base and one near apex; mid femur with three unequal anteroventral bristles; hind femur with four short ventral bristles near base in addition to bristle corresponding to those in *N. inversa*. Costa terminating just beyond vein 3, very deeply incised at end of subcosta so as to form a long, finger-like lobe, between basal and apex with series of short, spaced, brown anteroventral bristles only in addition to the more numerous hairs and anterodorsal spinules; costal index about 2.6; macrotrichia on vein 3 and stem of veins 2 and 3 absent; distal section of vein 4 very weakly developed; second basal cell confluent with discal cell, separated from first basal cell anal cell reduced in size and distally narrowed, the veins enclosing it weakly developed distal section of vein 6 distinct, short, curved.

Abdomen broadly ovate; tergites 3 to 7 each with several lateral bristles; cercus relatively small and narrow, with short hairs and two short terminal spines.

*Dimensions*: total length 1.9 mm; length of thorax 0.7 mm; length of wing 1.5 mm  
*Distribution*: eastern MALAGASY (Madagascar).

*Holotype* ♂ (unique): lagoon shore, Fénérive, XII.1955 (B. R. Stuckenberg), Natural History Museum, Paris.

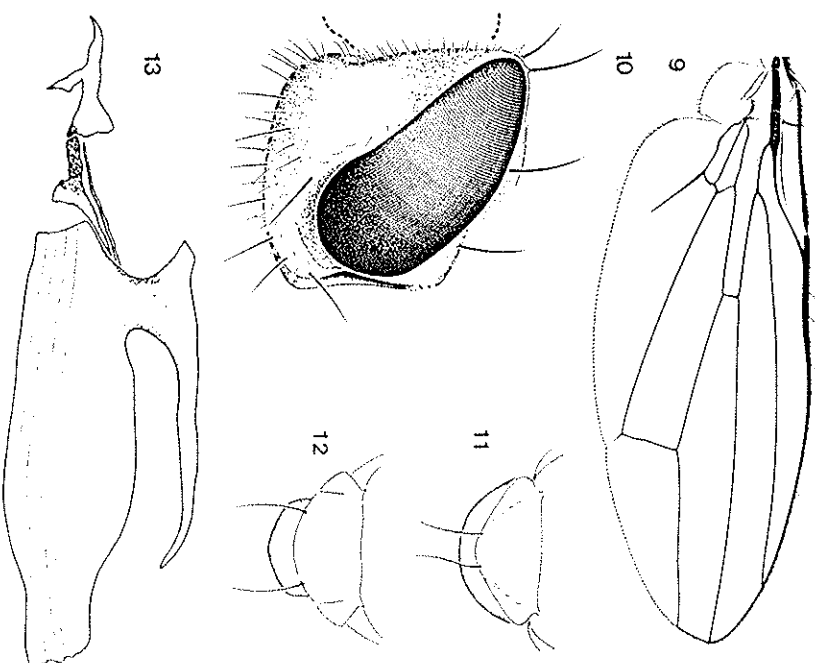


Figs 5-8. *Neurochaeta stuckenbergi*, holotype. 5-6, head. 7, part of costa of left wing, anterior aspect. 8, right wing.

### *Neurochaeta inversa* sp. n. (Figs 1-4, 13-20, 22-25)

#### *Male and Female*

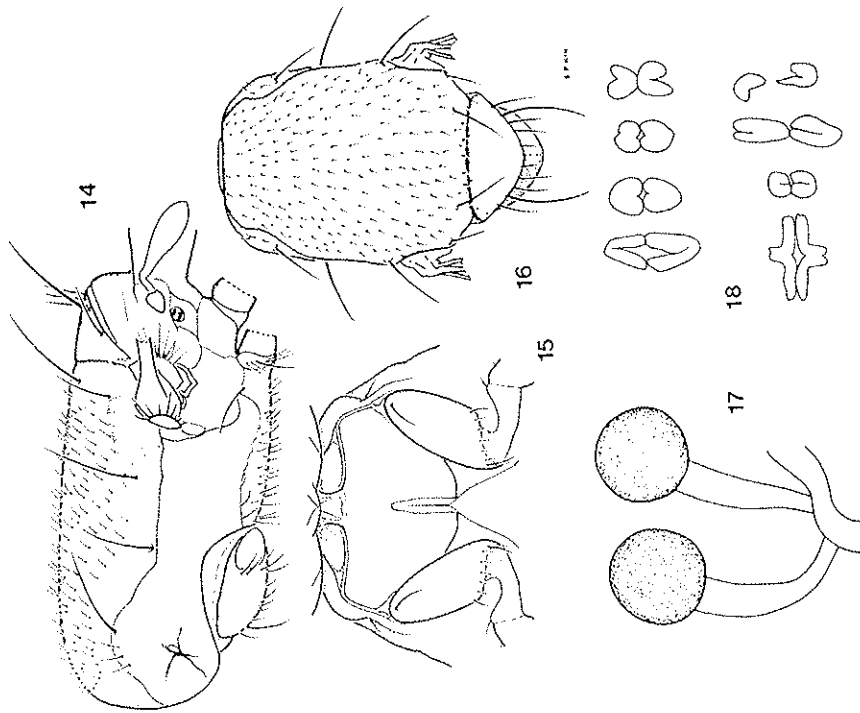
*Coloration*: head brown-black; face and anterior parts of frons and cheeks dull yellowish; antenna pale yellowish, with segment 3 often brownish near base; arista brown; palpus brown; cephalic bristles black (as are most thoracic bristles). Thorax dark brown with grey pruinescence; postscutellum appearing silvery from some angles. Coxae brownish yellow; femora deep brown, the middle and hind ones pale yellowish at bases; fore tibia brownish yellow, paler at base; middle and hind tibiae brown-black with pale yellowish bases; fore and hind tarsi yellowish with brown apical segment; middle tarsus brown with basal and apical segments usually darkest. Wing



Figs 9-13. 9, *Neurochaeta inversa*, wing of holotype. 10, head of same (damaged). 11, scutellum of same. 12, *N. stuckenbergi*, scutellum. 13, *N. inversa*, cephalopharyngeal skeleton of first instar larva.

pale brown with a milky hyaline patch just beyond base. Haltere pale yellowish with brown pedicel. Abdomen deep brown; segment 1 and the reduced terminal segments pale yellowish.

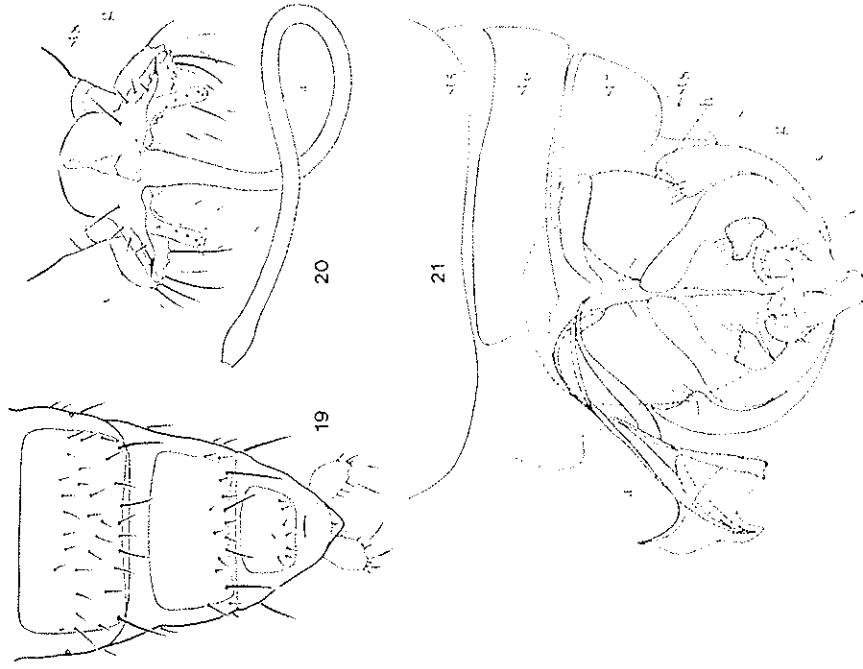
Head not depressed; lower part of face only faintly convex and lower margin only slightly inflexed, face thus only narrowly visible from ventral aspect; cheek at narrowest part about one-tenth the height of eye; fronto-orbital bristles 3, the incurved one inserted in front of level of foremost reclinate one; postvertical bristle absent; a series of three strong peristomial bristles behind vibrissa directed forwards and downwards and an outwardly directed bristle near the most posterior of these; several fine setulae



Figs 14-18. *Neurochaeta inversa*. 14, thorax lateral aspect. 15, prosternal region of thorax. 16, dorsal aspect of thorax. 17, spermathecae. 18, chromosomes of two cells at late metaphase I of spermatogenesis.

situated between peristomial bristles; some longer setulae on postgenal region and a row of postgenal bristles along lower posterior margin of eye.

Thorax depressed; postscutellum very gibbous and prominent; the numerous hairs of mesoscutum only very irregularly seriate; humeral callus with long setulae; sternopleuron with numerous fine setulae; one dorsocentral bristle present; presutural and supra-alar bristles absent; scutellum with the following pairs of marginal bristles: the longest one sublateral (from comparison with those of *N. stuckenbergi* probably homologous with the original apical), two or three shorter distal marginals, one lateral, these bristles usually more or less erect; one long upper posterior sternopleural bristle;



Figs 19-21. 19, *Neurochaeta inversa*, female postabdomen from segment 6, ventral aspect. 20, *N. inversa*, male postabdomen, ventral aspect. 21, *N. privala*, the same, a = aedeagus, c = cercus, e = epandrium, g = gonites, h = hypandrial plate, s = surstylus, st = sternite.



and two or three shorter upper anterior ones present. Mid leg more slender than others; fore leg of similar length with femur much swollen; hind leg much longer, the femur about as stout as that of fore leg; fore femur with a row of well-developed posteroventral bristles not extending to base and a row of shorter dorsal bristles; mid femur with a short anteroventral bristle near middle; hind femur with a long dorsal bristle and two anterior bristles beyond middle; hind tibia without strong bristles. Costa extending to vein 4, deeply incised at end of subcosta, thus produced into a very short subareolar lobe with one terminal bristle on proximal side of break, between break and apex with a yellowish antero-dorsal series and black anteroventral series of small spaced setulae in addition to the numerous smaller costal hairs; costal index about 3.3; subcosta distally desclerotised from commencement of forward curvature and distinguishable only by a crease of the membrane, rather close to but not merging with vein 1; vein 3 and stem of veins 2 and 3 dorsally with three erect bristles each longer than width of adjacent part of first basal cell, one of these situated distal to this point; distal section of vein 4 well developed; second basal cell confluent with first basal cell; anal cell reduced, very narrow, not closed apically; vein 6 absent; alula distinct but narrow.

Abdomen rather narrowly ovate; preabdominal tergites with short scattered setulae, those behind tergite 1 with a bristle near each posterolateral angle; preabdominal sternites much broader than long, but sternites 2-5 not as wide as tergites of their respective segments; preabdominal spiracles situated in pleural membrane. Male postabdomen approximately symmetrical; tergite 6 large, well sclerotised with setulae much as on tergite 5; sternites 6 and 7 absent; only one distinct dorsal sclerite behind tergite 6, which from its lateral connections to anterior extremity of hypandrium and remonens from surstylus, may be the inverted sternite 8 rather than the epandrium, this sclerite rather narrowly transverse, bearing a pair of submedian bristles and no other macrotrichia; epandrium, on this interpretation, apparently absent; what remains of the reduced genital segment not distinctly delimited; surstylus with broad anteriorly and posteriorly extended basal part and obtuse, straight, finger-like distal part, not attached to any major external sclerite; hypandrium with two basally connected processes (gonites) on each side, which bear few relatively large setulae; aedeagus long, coiled in repose below segment 6, forming a simple tube with only very indistinct longitudinal skeletal strip; cerci quite separate, very broad, plate-like. Female postabdomen with spiracle 6 in pleural membrane, spiracle 7 apparently absent; cercus remarkably similar to that of male. Spermathecae two, spherical, black, 0.09 mm in diameter, on short, separate, almost unimpinged ducts from the median oviduct.

*Dimensions:* total length, ♂ 2.2-3.3 mm, ♀ 2.2-3.1 mm; length of thorax, ♂ 0.9-1.4 mm, ♀ 1.0-1.4 mm; length of wings, ♂ 1.9-2.7 mm, ♀ 2.0-2.7 mm.

*Karyotype:*  $n = 4$  (from testes); three or possibly all chromosomes acrocentric.

*Last instar larva* (Figs 4, 13, 22-24) colourless, elongate, subcylindrical, tapered at each end; cuticle for the most part smooth, segmentation normal, there being almost no secondary annulation. Each anterior spiracle on a short, slender, clavate horn, with three openings, each at the summit of a short urn-shaped process; several rake-

like transverse ridges bearing hooked processes situated in front of and on each side of atrial opening; three or four rounded papillae situated close in front of atrial opening; each segment ventrally with several rows of denticles, on each of abdominal segments 2-7 (apparent segments 5-10) forming two main rows of hooked spines which are situated on a raised pad; these pads most prominent laterally and thus perhaps to be designated as pairs of pseudopodia; terminal segment (abdominal segment 8) slender somewhat constricted near middle and divided into three processes posteriorly—a pair of ventral processes, one each side of anus, and a much stouter subconical median process, which bears the spiracles on a pair of short terminal tubercles; each posterior spiracle with three simple openings and four short, branched, almost stellate hydrophobe hairs; cephalopharyngeal skeleton for the most part very lightly pigmented; mouth hook pale yellowish, yellowish brown anteriorly, dark brown on lower posterior angle, with an elongate ventral apophysis; hypostomal sclerite elongate, dark brown in front of the almost unimpinged bridge, pale yellow posteriorly; parastomal bar long and slender, faintly pigmented; pharyngeal sclerite almost unimpinged except for the dark brown margin of anterior sinus and more diffuse yellowish coloration on posterior sinus; dorsal cornu remarkably slender; floor of pharynx with several longitudinal folds. Length about 4 mm.

*Puparium* (Fig. 25) curved, fusiform (i.e. almost banana-shaped), much depressed anteriorly, almost smooth and somewhat shining, pale yellowish, transparent so that pupa or pharate adult is readily visible, on most segments with 3 narrow annular thickenings forming internal ridges. Spiracles of pupa not on visible processes. Length of puparium about 3.4 mm.

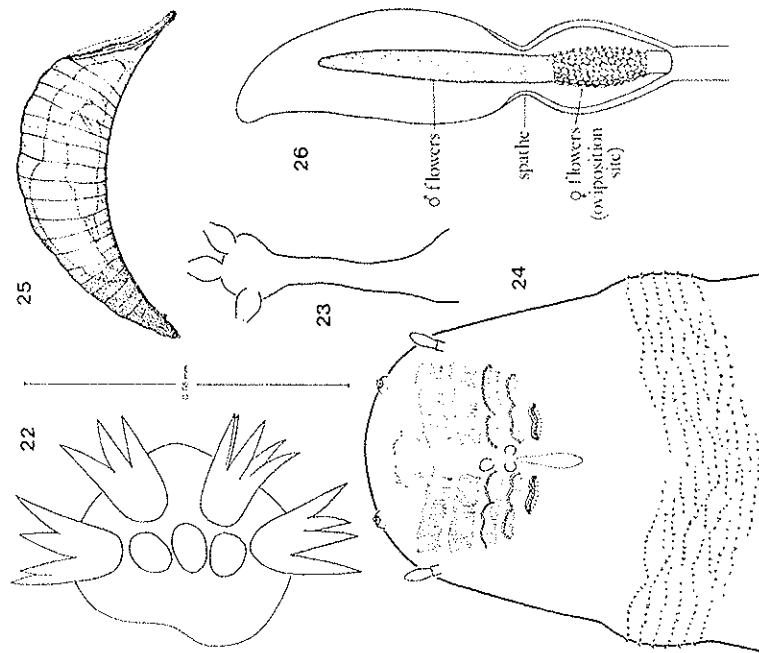
*Distribution:* coastal eastern AUSTRALIA from northern side of Hunter River basin (New South Wales) to Miriam Vale district (Queensland), also on Atherton Tableland. I have failed to find examples of the species in apparently suitable habitat in the Eungella (Daintree Heights) district west of Mackay, Queensland, though the search was not exhaustive. There remains a gap of about 1 000 km in the known distribution of the species.

*Holotype* ♂: The Island Reserve, Bellinger, New South Wales, 2.IV.1961 (H. G. Cogger & D. K. McAlpine) Australian Museum.

*Paratypes* (all from New South Wales collected D. K. McAlpine except as indicated): Whian Whian State Forest, near Lismore, II.1965, 15 ♂, 16 ♀; Dorrigo National Park, near Dorrigo, XI.1966, 1 ♂, 1 ♀; The Island Reserve, Bellinger, II.VI.1961-1971, 208 ♂, 281 ♀ (some coll. H. G. Cogger); Brimleyville, near Bellinger, IV.1977, 57 ♂, 59 ♀ (coll. H. G. Cogger & L. Cameron); Wilson River Reserve, near Bellinger, XI.1966, 7 ♂, 10 ♀; Upper Allyn, near Eccleston, III.XI.1958-1969, 41 ♂, 83 ♀ (some coll. E. F. Rick); in the following collections: Australian Museum, Sydney; Australian National Insect Collection, Canberra; National Museum of Victoria, Melbourne; Queensland Museum, Brisbane; South Australian Museum, Adelaide; University of Queensland Entomology Collection, Brisbane; British Museum (Natural History), London; Hungarian National Museum, Budapest; National Museum of Natural History, Paris; U.S.S.R. Academy of Science, Leningrad; Zoological Museum, Helsinki; Zoological Museum of Humboldt University, East Berlin; Natal Museum (2189), Pietermaritzburg; Biosystematics Research Institute, Ottawa; B.P. Bishop

Museum, Honolulu; United States National Museum, Washington; Department of Scientific and Industrial Research, Auckland.

*Other material seen from the following localities (all in Queensland):* Lake Eacham, near Atherton (Australian Museum); The Crater, near Herberton (Australian Museum, Queensland Museum); Austral Forest, near Bulburin, Miriam Vale district (Australian Museum, Queensland Museum); Melony, Nambour district (Queensland Museum); Mount Glorious, Brisbane district (University of Queensland); Mount Tennyson-Woods, near Mount Glorious (Australian Museum, University of Queensland); Tamborine Mountain (Australian Museum, South Australian Museum).



Figs 22-26. 22. *Neurochaeta inversa*, posterior spiracle of last instar larva. 23. anterior spiracle of same. 24. oral region of same, ventral aspect. 25. *N. inversa*, puparium. 26. *Alocasia macrorrhizos*, inflorescence at anthesis, diagrammatic, spathe partly cut away. Note constriction of spathe, at level of which the lower chamber becomes sealed.

#### BIOLOGY OF *NEUROCHAETA INVERSA*

##### *The host plant*

Populations of *N. inversa* have always been found in association with the araceous plant *Alocasia macrorrhizos* (Linné) G. Don (known as conjevoi or spoon lily), growing in its original habitat. The flies have not yet been found on cultivated examples, which are common in Sydney gardens. So far they have not been found on any other plant, even as a casual visitor, despite much sweeping of vegetation for insects near the *Alocasia*. The life cycle is so intimately connected with this plant that some consideration of the plant is necessary.

*A. macrorrhizos* is common in or at the edge of rain forests of Queensland and New South Wales as far south as the Hunter River district. It may persist in moist places after the rain forest is removed. Outside Australia the species extends to South-east Asia and some of the Pacific islands. The appearance of the plant is typical of the family Araceae to which it belongs. The lower part of the stem forms a horizontal rhizome while the younger parts are erect and bear large, hastate, somewhat shining, bright green leaves often as much as 60 cm long. The plants frequently reach a height of 150 cm under favourable conditions. The bases of the petioles are stem-clasping and often trap rain-water in their axils. The inflorescence (Fig. 26) is a compact spike or spadix on a relatively long peduncle and is partly enclosed in a bract or spathe. Male flowers are borne on the upper part of the spadix, female flowers on the lower part. The spathe is loosely constricted round the spadix between the male and female flowers to form an incompletely enclosed cavity round the latter at anthesis (i.e. generally November to April in New South Wales). After pollination the spathe further constricts round the spadix so that the female flowers are completely sealed in before the fruit develop. The parts of the spathe and spadix above the constriction wither at this time. The ripe fruits are later exposed when the rest of the spathe withers. They are red ovoid berries 4-8 mm long.

The entire plant is reported to be highly poisonous, but the rhizome may be eaten by man when suitably cooked. I have observed birds of the honey-eater family (Meliphagidae) eating ripe fruit.

Flies of many families rest on the leaves of *Alocasia*, and, as they are readily seen on the broad expanse of leaf, the plants are a useful source of dipterous study material. The following flies have been regularly found on *Alocasia* leaves in suitable habitats in eastern Australia: *Lasioviria* sp. (Platystomatidae); *Strongylophthalmyia* spp. (Tanypetidae); *Cyanops* spp., *Stenomera* spp. (Petriselidae); spp. of an undescribed genus (Aulacigastridae); *Chloropella bipartita* Malloch (Chloropidae). Many other flies are less frequent visitors.

##### *Life cycle*

Although oviposition has not been observed it is apparent that eggs are laid on the female part of the inflorescence, in New South Wales probably during late November and December, and, presumably by a later generation, in February. Ruptured chorions, presumably of *Neurochaeta*, have been found with larvae at a later stage. Ovipositing female flies may well be pollinators of *Alocasia*, but as many insects come to the flowers they are probably not the sole pollinating agents.

The larvae live between the developing fruitlets. They are often in contact with a watery liquid found within the spathe, which forms a sealed chamber during the whole of the larval development. Examination of large numbers of infested inflorescences shows that larvae do not eat into or otherwise damage the fruitlets. Therefore the most probable larval food is micro-organisms in the liquid. Other kinds of larvae have not been found in the same microhabitat as *Neurochaeta*, but larvae of *Cadonia* sp. (Chloropidae) have been found in the moist, decaying upper part of the spathe. Pupation takes place and often emergence of numbers of adults while the fruitlets are still unripe and the spathe sealed. These adults cannot escape until the spathe splits when the fruitlets are ripe. Sometimes dead adults are found inside the closed spathe. It is of course possible that these belong to the earlier parental generation and were trapped as adults when the spathe closed. It seems from field studies and laboratory examination of freshly collected material that by late March copulation and oviposition have ceased and, though spermatogenesis takes place within the first few days after eclosion of males, the sperm is stored in the testes. Ovaries at this period are undeveloped. Even during the second half of February at Upper Allyn relatively few well-developed ova were found in females and it appears that development of ova is being deferred in some individuals. These individuals are presumably those which overwinter, deferring reproductive activity till flowering of *Alexandria* recommences in November. However, some larvae and pupae are still to be found in early May. Overwintering adults have been observed in May (at Upper Allyn), July and August (at Bellingham), and copulating pairs of adults which had presumably overwintered were found in the earliest *Alexandria* inflorescences of the season on 29.XI.1966 at Wilson River Reserve.

The rate of development of *N. inversa* has not been measured experimentally but it seems probable that the period from oviposition to eclosion of adult is in the order of five to six weeks. This would enable two or three generations to be passed during the summer flowering-fruitlet period of the host. The fact that some adults can be found at almost any time in this period indicates that the broods are not sharply defined.

No doubt the development of the immature stages in a sealed cavity confers a degree of protection from natural enemies, and no parasitoid Hymenoptera have yet been reared from the larvae or pupae of *N. inversa*. Parasitic nematodes have been found in the abdominal cavity of numerous adult females collected at Upper Allyn in February. In all such females the ovaries were at a very rudimentary stage of development. Nematode stages included inactive females containing numerous eggs and often newly hatched young which appeared to be breaking through the body wall of the parent.

#### *Behaviour of adults*

Adult flies live on the leaf surface (upper or lower), on the outer surface of the petiole, within the hollow petiole base, or in the spathe of the inflorescence at anthesis. When in the open they move about for much of the time, and their orientation while walking (usually so rapidly as to be termed running) is an outstanding feature of the insect. Whenever the fly is on a vertical or sloping surface the head is directed downwards so far as this is possible while retaining the long axis of the body parallel with

the substrate. In all the thousands of individuals I have seen in the field I have not seen an exception to this rule of orientation except in the case of injured individuals. When numbers of flies are placed in a collecting jar those on the vertical glass surface are oriented vertically with the head downwards. If the jar is then inverted, every fly immediately turns so as to restore the original orientation. Compensating for the strict limit on body orientation is the ability of the fly to run in any direction. Direction of movement, however, has for much of the time a strong forward (downward) or backward (upward) component so that the path of movement of an active fly describes a largely zigzag course, the more acute angles of which point upwards and downwards and indicate points where the direction of movement is abruptly reversed. As can be seen from Fig. 27 this manner of movement enables the fly to cover a



Figs 27-28. Approximate paths covered by two flies on *Alexandria* leaves, each for about 30 seconds before coming to rest (0.5 × actual size). Arrows indicate starting points. 27. *Neurochaeta inversa*. 28. *Stenomacrus* sp.

large area of substrate surface in a short time. The only flies known to me with comparable manner of movement are members of the genus *Stenomiera* (numerous species observed in various species-groups in Australia, New Guinea, and Malaysia). These species, however, maintain a constant orientation with the head upwards, although they move apparently with equal facility in all directions, they do so much more slowly than *Neurochaeta* (see Fig. 28). Other asteroiid flies I have seen in the field (of the genera *Anthomyza*, *Amygdalops*, *Cyanops*, *Asteta*, and an undescribed aulacigastrid genus) walk normally forwards and maintain no constant orientation of the body in relation to gravity. Though *Stenomiera* is one of the genera that may be related to Neurochaetidae, it is probably much more closely related to *Cyanops*. I view also of the fact that *Neurochaeta* maintains an inverted position in relation to *Stenomiera* it seems that the similarities between these two genera in movement may be due to convergence in a similar environment rather than to synapomorphy.

Adults of *N. inversa* often congregate in the hollow petiole bases of the host especially, it appears, when weather conditions are unfavourable outside. On two occasions in winter at Bellingen (July and August), after a search had failed to locate any specimens on numerous *Alocasia* plants, a large aggregation of the flies were eventually found in a single petiole. In early May at Upper Allyn many of the flies were sheltering in petiole bases. After a cool morning with heavy dew several flies were observed on *Alocasia* leaves moving actively in full sunlight, the leaves then being dry (about 10 a.m.). None had been observed on the leaf blades a short time earlier when they had a heavy deposit of dew. Three of the flies were seen to congregate for a time, decreasing the amplitude of their movements, and the two others inclining their long axes so as to increase the frequency of contact between them. Thus it seems that decrease of activity when in contact with other individuals of the species is a factor in producing the large aggregations often found in petiole bases. These aggregations disperse when disturbed, the flies running out into the open and often taking flight.

Possibly the manner of movement of *N. inversa* has special adaptive value enabling recently eclosed adults to search out minute apertures for escape from sealed unripe fruiting inflorescences. It may also aid the searching out of other individuals under conditions which induce aggregation, the finding of source of substances (such as sweet secretions of homopterous insects) on leaves, and evasion of such predators as dolichopodid flies which abound on *Alocasia* leaves. If, as is probable, the three large bristles on the dorsal surface of each wing are tactile organs then they presumably are important when the fly is moving in a very narrow space such as occurs within a spathe or petiole base. The dorsoventrally compressed body is probably a further adaptation to moving through narrow spaces.

#### ACKNOWLEDGEMENTS

I am indebted to Mr S. P. Kim and Miss M. A. Schneider for preparing most of the illustrations, and to Dr H. G. Cogger, Messrs G. A. Holloway, A. Hughes, and

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Date received: 28 June 1977