VOL. 14 PART 2

TRANSACTIONS

OF THE

SOCIETY FOR BRITISH ENTOMOLOGY

World List abbreviation: *Trans. Soc. Brit. Ent.*

Edited by
E. J. POPHAM, D.Sc., Ph.D., A.R.C.S., F.R.E.S.
Department of Zoology, The University, Manchester 13
N. D. RILEY, C.B.E., F.Z.S., F.R.E.S.
7 McKay Road, Wimbledon, London, S.W. 20

Assisted by:
A. E. Gardner, F.R.E.S.; J. W. Heslop Harrison, D.Sc., F.R.S., F.R.S.E.; Francis Hemming, C.M.G., G.B.E., F.R.E.S.; W. D. Hincks, D.Sc., F.R.E.S.; H. E. Hinton, B.Sc., Ph.D., Sc.D., F.R.E.S.; B. M. Hobby, M.A., D.Phil., F.R.E.S.; H. C. Huggins, F.R.E.S.; G. J. Kerrich, M.A., F.L.S., F.R.E.S.; H. B. D. Kettlewell, M.A., M.B., B. Chir., F.R.E.S.; O. W. Richards, M.A., D.Sc., F.R.S., F.R.E.S.

DATE OF PUBLICATION, 27TH MAY 1960

Copies may be purchased from the Publications Secretary,
Department of Entomology, The Museum, Manchester 13

Price 12s. 6d. post free

Published for the Society
by the British Trust for Entomology Ltd.

BRITISH TRUST FOR ENTOMOLOGY LTD.,

41 QUEEN'S GATE, LONDON, S.W.7.

LIST OF PUBLICATIONS FOR SALE (ALL PRICES ARE POST FREE)

TRANSACTIONS OF THE SOCIETY FOR BRITISH ENTOMOLOGY

GENERAL

A New Chapter in Zoological Nomenclature: The Reforms instituted by the Thirteenth International Congress of Zoology, Paris, July. 1948. By F. Hemming, 1950. 8 pp., 1s. 6d.

The Problem of stability in Specific Nomenclature, with special reference to cases where type material is no longer in existence. By F. Hemming, 1951. 16 pp., 2s. 0d.

Some adaptations of insects to environments that are alternately dry and flooded, with some notes on the habits of the Stratiomyidae. By H. E. Hinton, 1953. 20 pp., 3 figs., 5s. 0d.

The terms "Larva" and "Nymph" in Entomology. A summary of the views of W. E. China, H. Henson, B. M. Hobby, H. E. Hinton, T. T. Macan, O. W. Richards, T. Southwood, and V. B. Wigglesworth, followed by a review of The Terminology of Juvenile Phases of Insects by R. G. Davies, 1958. 10s. 0d.

ENTOMOLOGICAL FAUNA OF THE NEW FOREST SERIES

Introduction by J. Cowley, and Part 1, Odonata, by Lt.-Col. F. C. Fraser, 1950. 12 pp., 1s. 6d. Part 2, Neuroptera, by Lt.-Col. F. C. Fraser, 1951. 12 pp., 1s. 6d.

EPHEMEROPTERA

Descriptions of some Nymphs of the British Species of the Genus *Baëtis*. By T. T. Macan, 1950. 24 pp., 6 figs., 2 tables, 3s. 0d.

A Description of the Nymph of *Baëtis buceratus* with notes and a key to other species in the genus. By T. T. Macan, 1957. 8 pp., 3s. 6d.

The Life Histories and Migrations of the Ephemeroptera in a stony stream. By T. T. Macan, 1957. 28 pp., 12s. 6d.

ORTHOPTERA, Etc.

A Summary of the Recorded Distribution of British Orthopteroids. By D. K. McE. Kevan, 1952. 16 pp., 5s. 0d.

HEMIPTERA-HETEROPTERA

Contributions towards an Ecological Survey of the Aquatic and Semi-Aquatic Hemiptera-heteroptera of the British Isles.

Scottish Highlands and East and South England. By E. S. Brown, 1948. 45 pp., 7s. 6d.

The Ribble Valley (Lancashire South and Mid). By E. J. Popham, 1949. 44 pp., 1 map, 8s. 0d.

North-East Wales (Denbighshire and Merionethshire). By E. J. Popham, 1951. 12 pp., 2s. 6d.

The Hemiptera-Heteroptera of Kent. By A. M. Massee, 1954. 36 pp., 7s. 6d.

The Bionomics and Immature Stages of the Thistle Lace Bugs (*Tingis ampliata* H.S. and *T. cardui* L.; Hem., Tingidae). By T. R. E. Southwood and G. G. E. Scudder. 8s. 0d.

COLEOPTERA

The Aquatic Coleoptera of North Wales. By E. S. Brown, 1948. 15 pp., 1 fig., 1s. 0d.

The Aquatic Coleoptera of Wood Walton Fen, with some comparisons with Wicken Fen and some other East Anglian Fens. By F. Balfour-Browne, 1951. 36 pp., 4s. 6d.

TRANSACTIONS OF THE SOCIETY FOR BRITISH ENTOMOLOGY

VOL. 14 MAY 1960 PART II

Studies on the Larvae of the British Chironomidae (Diptera), with Keys to the Chironominae and Tanypodinae

By Derek Bryce
(Dept. of Zoology, The University, Reading)

CONTENTS

(1) Introduction

Very little work has been done on the early stages of the British Chironomidae and little is known concerning the distribution and habitats of the larvae. The main methods of feeding of chironomid larvae appear to correspond each to a different type of head capsule (Bryce, 1958). The different types of head capsules are related to the main classification within the family.

Typically, chironomid larvae have a well developed, non-retractile head capsule with biting mouth parts. There are twelve segments behind the head with a pair of pseudopods on the prothoracic and anal segments. Dorsally the anal segment bears a pair of papillae, each with an apical tuft of setae (fig. 3).

The family may be divided into six subfamilies, viz:— Tanypodinae, Podonominae, Diamesinae, Orthocladiinae, Clunioninae, and Chironominae.

The Tanypodinae, Orthocladiinae and Chironominae contain the bulk of the British chironomid fauna.

The purpose of this paper is to provide an account of the morphology of the subfamilies Tanypodinae, Chironominae and Diamesinae, followed by a systematic account of the Chironominae and Tanypodinae with keys to the species-groups and descriptions of species.

(2) Techniques

The work of this investigation has involved the collection of samples of bottom deposit and vegetation from various aquatic habitats. These samples have been examined in the laboratory and the larval Chironomidae obtained from them have, as far as possible, been sorted into species and each group has been divided in order that some larvae could be preserved and the rest reared to the adult stage. These adults have then been identified by means of the keys of Coe (1953) and Edwards (1929) in order that the preserved larvae may be named. Much of the material was collected from Malham Tarn (Yorks.) and from sand deposits in the River Hodder (Yorks.) and at a nearby Trout Farm (Dunsop Bridge).

Bottom samples of sand or mud were treated in a fine nylon sieve (Jonasson, 1955), half immersed in water, or under running water, in order to remove fine particles. The residual material was then examined in a white enamelled dish containing also a little water. Larvae were removed by pipette and sorted into species under a binocular microscope.

When gravel or peat samples were taken they were examined directly in small quantities as the material was unsuitable for sieving. This also applied to aquatic plant material.

Larvae to be preserved were killed in hot water and then transferred to 70% alcohol.

Larvae required for rearing to the adult stage were placed in small plastic boxes together with water and a little of the pabulum. The latter had either been carefully examined under a binocular microscope to ensure it was free from other larvae, or, if possible, had been treated with boiling water.

In order to study the external morphology of head capsules they were first immersed in hot 10% caustic potash for a few minutes, then stained (1-3 mins.) in glacial acetic acid to which a few drops of acid fuchsin in 20% alcohol had been added. Dehydration for about 30 seconds in glacial acetic acid was followed by clearing in clove oil, after which the heads were mounted in balsam. Before mounting, some of the heads were dissected with fine needles in order to separate the mouth parts.

To study the internal morphology of head capsules, larvae were fixed in hot Carnoy's fluid and then their anterior ends were

brought to 70% alcohol, stained in borax carmine, dehydrated in absolute alcohol, and cleared in xylol. Following this they were embedded in paraffin wax and vertical longitudinal sections, from 8 to 100 mu. thick, were cut as far as the mid-line of the head. This left a sagittal half of the head which was mounted whole. A number of transverse and horizontal sections were also cut.

(3) The Morphology of some Chironomid Larvae, with special reference to their head capsules

The following three larvae have been selected in order to describe the structure in each of three subfamilies. The first and last may be regarded as fairly typical of their respective subfamilies:—

(1) *Chironomus longistylus* Goet. (Chironominae)
(2) *Prodiamesa olivacea* Mg. (Diamesinae)
(3) *Anatopynia nebulosa* Mg. (Tanypodinae)

An account of the internal and external structure of the head of *Chironomus plumosus* (L.) has been given by Goetghebuer (1912). Gouin (1957) describes the structure of the head of this species in some detail. An account of the head of *Prodiamesa olivacea* Mg. and of *Anatopynia* (*Macropelopia*) cf. *nebulosa* Mg. is given by Gouin (1959). The descriptions of Gouin go into considerable detail and are illustrated by drawings of actual sections so that they may be more intelligible to specialist workers in this field than to general zoologists. The following accounts are brief and are intended to provide a general account of structure in relation to modes of life and to serve as an introduction to the terminology used in the systematic part of this paper.

(1) *Chironomus longistylus* Goet.

When full grown, about 12 mm. long, cylindrical and blood-red in colour. Twelve post-cephalic segments, the first with a pair of pseudopods ending in a tuft of serrate setae; the penultimate with two pairs of ventral tubuli; and the anal segment with a pair of dorsal papillae, each with a brush of 6-8 long setae, four anal papillae and, ventrally, a pair of pseudopods, each terminated by an incomplete circle of V-shaped crotchets.

Head capsule almost circular in transverse section. Dorsally consisting of a triangular fronto-clypeus with the base in front and an acute apex pointing backwards, reaching the posterior border of the capsule. On each side of the clypeus a parietal plate curves ventrally to meet its partner at the mid ventral line forming the rest of the capsule.

Anteriorly the fronto-clypeus bears the labrum, and the parietals bear the insertions of the antennae, mandibles and maxillae. Close to the insertion of each antenna each parietal has two eye-spots.

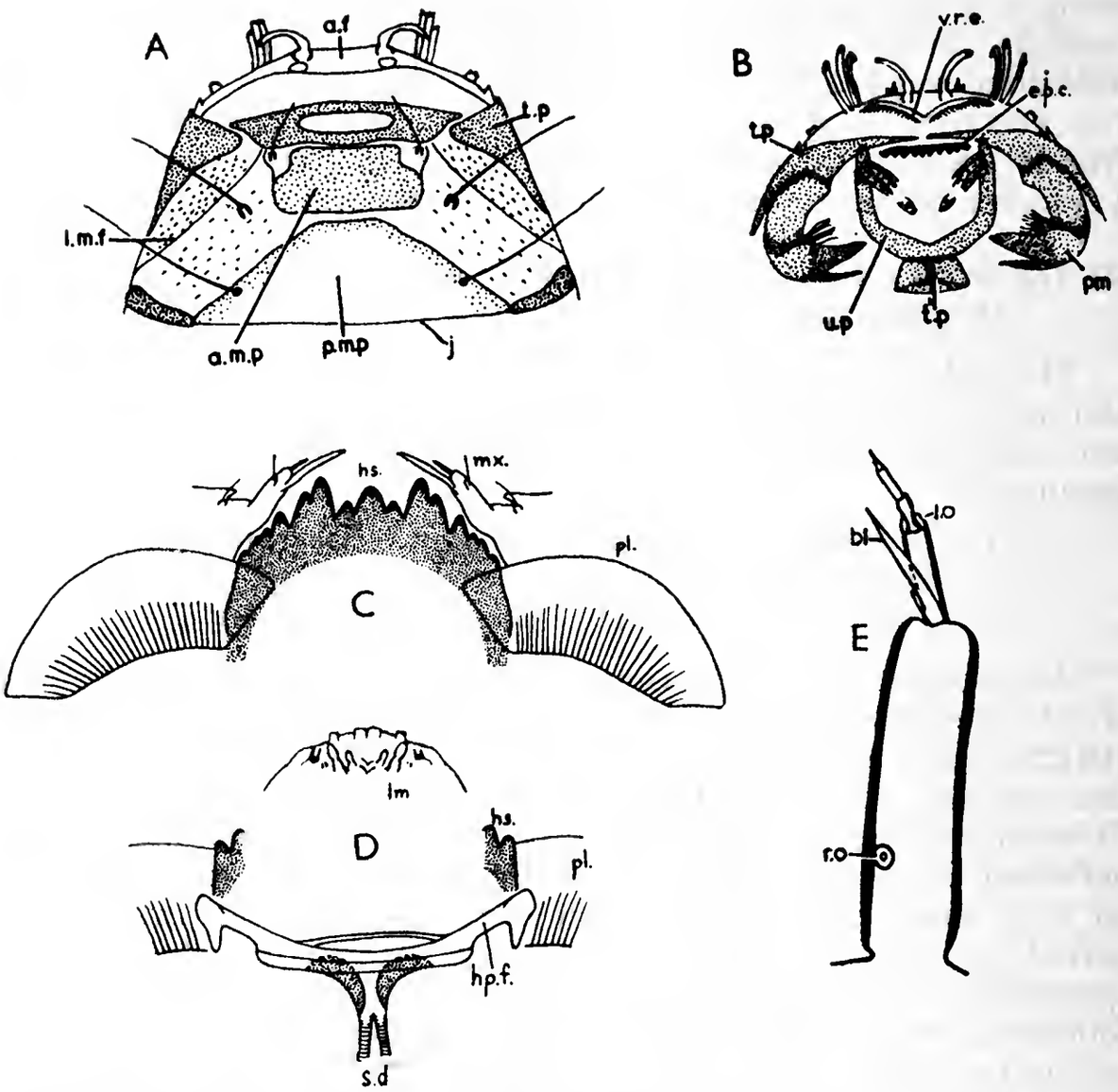

Fig. 1.—*Chironomus longistylus* Goet. A, Labrum, dorsal view. B, Labrumepipharynx, ventral view. C, Hypostomium and "paralabials". D, Anterior-ventral part of labium; hypopharyngeal framework, ventral view. E, Antenna.

Antennae (fig. 1, E) five-segmented, basal segment with a campaniform sensillum ("ring organ", fig. 1, E, r.o.) at its proximal third and with a terminal blade (fig. 1, E, bl.) which has a short lateral peg or "side-blade". Second segment terminally with a pair of small sessile Lauterborn organs (fig. 1, E, l.o.) each consisting of a sensory peg surrounded by a circlet of setae. Ratio of segments from base to apex 45 : 13 : 5 : 5 : 3.

Labrum attached to the anterior edge of the fronto-clypeus by a suture (fig. 1, A, j). Viewed dorsally (fig. 1, A) it appears to consist of several parts (Goetghebuer, 1912): (I) a *posterior median sclerite* (fig. 1, A, p.m.p.) anterior to the fronto-clypeus with a seta at each side; (II) anterior to the latter, a rectangular *anterior median sclerite* (fig. 1, A, a.m.p.) also with a seta at each side; (III) to each side of the latter a *triangular sclerite* (the *torma* of Gouin, 1957) running laterally and then curving under to meet its fellow in the mid ventral line (figs. 1, A; 1, B; t.p.); (IV)

between the triangular and posterior median sclerites a thin-walled area of granular appearance, the *lateral membranous field* (fig. 1, A, l.m.f.), with a single seta; (V) the *anterior field* (fig. 1, A, a.f.) is the thin-walled anterior part of the labrum bearing a number of crotchets and pectinate setae.

The ventral face of the labrum, or *epipharynx* (fig. 1, B), bears posteriorly a median *trapezoidal sclerite* (fig. 1, B, t.p.). Anterior to this there is a horse-shoe-shaped *U-sclerite* (fig. 1, B, u.p.) within the arms of which there are a number of crotchets and anteriorly there is an *epipharyngeal comb* (fig. 1, B, ep.c.) of about ten teeth. Anterior to the latter a pair of pectinate setae appear as a fine comb (fig. 1, B, v.r.e.) situated on what is often termed (e.g. Harnisch, 1923) the "ventral seta-row of the labrum". Gouin (1957) refers to these setae as the "median labral pectinate setae".

Premandibles (fig. 1, B, pm.). Situated to each side of the U-sclerite and articulating with the triangular sclerite. Each distally bifid, spoon-shaped, with a sub-terminal projection and a brush of weak setae originating near its inner distal face.

Mandibles, each terminating in four dark teeth and with a dorsal sub-terminal comb of about twelve setae and a pale accessory tooth proximal to the apical series. Inner basal region with a trifid brush of pale compound setae. Outer convex side with a pair of setae.

Maxillae small and rigid, with a short palp. Inner basal region with a number of blades and setae (fig. 1, C, mx.).

Hypostomial plate or hypochilum (fig. 1, C, hs.) toothed, occupying the mid-ventral region of the head, with a so-called "paralabial" in the form of a striated plate on each side (fig. 1, C, pl.).

Labium-hypopharynx (fig. 1, D), situated dorsal to the hypostomium, consisting of a posterior hypopharyngeal framework or scaffolding (fig. 1, D, hp.f.) associated with the opening of the salivary ducts (fig. 1, D, s.d.). The true labium is a soft lobe situated anterior to the hypopharyngeal framework and ventral to the salivary opening. It bears numerous sensory pegs and papillae (fig. 1, D, lm.). Dorsal to the salivary opening the hypopharynx is weakly developed as a scaly area on the floor of the mouth.

The *internal structure of the head is shown* in figs. 2, A, and 2, B. The musculature of the labrum-epipharynx is interesting and includes: (1) two sets of labro-epipharyngeal muscles, originating from the thickened plates of the labrum, and inserted one on the U-sclerite, the other on the trapezoidal sclerite (fig. 2, B, el.1, el.2); (2) two muscles on each side originating from the posterior dorsal region of the head, which seem to be inserted on the premandibles (fig. 2, A, lm.1, lm.2). A small muscle originating from the mid-dorso-lateral region of the head is inserted at the base of the antenna. The mandibles each have a large flexor muscle (fig. 2, A, md.f.) filling much of the posterior

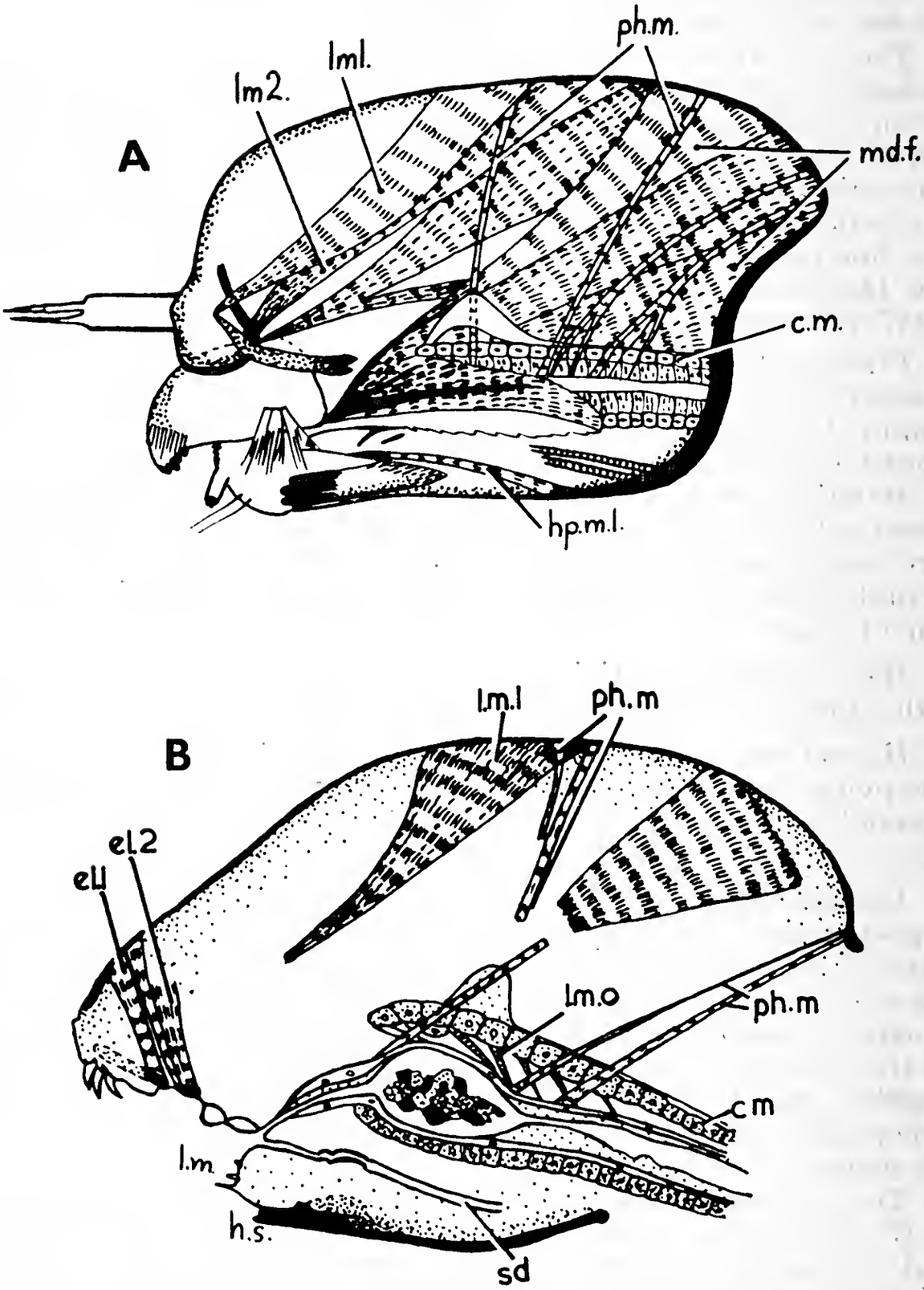

Fig. 2.—*Chironomus longistylus* Goet. A, Sagittal half of head to show muscle arrangement. B, Vertical median section (ca. 100 mu. thick) of head.

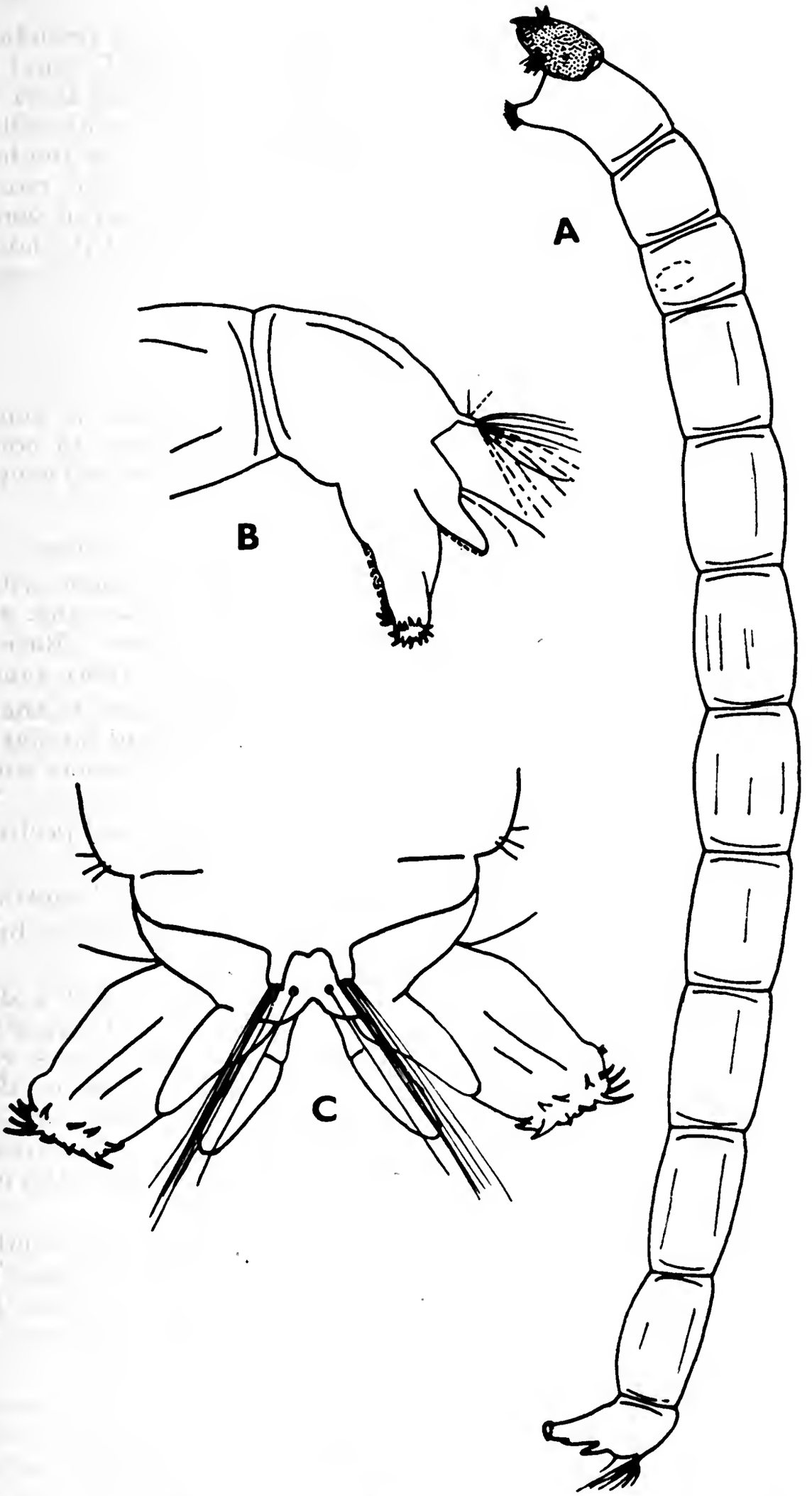

Fig. 3.—*Prodiamesa olivacea* Mg. A, Larva, lateral view. B, Posterior segments, lateral view. C, Posterior segments, dorsal view.

part of the head, and a smaller extensor muscle. The oesophagus has a distinct outer layer of circular muscles (fig. 2, B, c.m.) and finer longitudinal muscles originating from the circular layer and inserted on the intima (fig. 2, B, l.m.o.). A number of fine dilator muscles (fig. 2, B, ph.m.), originating from the walls of the head, are inserted on the intima, by passing between the circular muscles. A pair of muscles originating from the posterior ventral region of the head are inserted on the proximal part of the labium (fig. 2, A, hp.m.l.).

(2) *Prodiamesa olivacea* Mg.

When full grown about 17 mm. long and similar in general appearance to *C. longistylus* except that it is white in colour, without trace of haemoglobin, and there are no appendages on the penultimate segment (fig. 3, A).

Head capsule (fig. 4, A) similar to that of *C. longistylus*.

Antennae (fig. 4, B) four segmented, basal segment with a proximal ring organ (fig. 4, B, r.o.) and a distal blade (fig. 4, B, bl.) which extends beyond the apex of the antenna. Ratio of segments from base to apex 73 : 15 : 5 : 3. No Lauterborn organs.

Labrum-epipharynx with the dorsal surface similar to that of *C. longistylus,* and with the epipharyngeal armament similar except that there is no trapezoidal sclerite and the crotchets within the U-sclerite are radially arranged (figs. 4, D, 4, E). The epipharyngeal comb consists of three scales and a pair of pectinate scales anterior to it each have a comb-like appearance.

Premandibles (fig. 4, E, pm.) similar to those of *C. longistylus*.

Mandibles (fig. 4, C) with a uniramous inner proximal brush composed of non-compound, serrate setae.

Maxillae (fig. 4, E, mx) relatively small and rigid, with a short palp. Postero-lateral to the latter there is a sclerite bearing two contiguous setae. Still more posterior there is another sclerite bearing two setae. This *maxillary plate* (Goetghebuer, 1912) is regarded as a prolongation of the parietal plates for the attachment of the maxilla proper. The posterior inner region bears a sclerite with sensory pegs and spines directed to the mid-ventral line near the hypostomial teeth.

Hypostomial plate (fig. 4, E, hs.) consisting of 18 dark teeth of which the median pair are small and the second laterals large. The "paralabials" are elliptical, non-striate, each with a median row of long, dark setae. According to Gouin (1959) the latter are not homologous with the striated plates of the *Chironominae*.

Labium-hypopharynx with a hypopharyngeal framework similar to that of *C. longistylus* and with a labium bearing various papillae and spines (fig. 4, E, lm.). The hypopharyngeal surface on the floor of the mouth is better developed, consisting of a pad of backwardly directed, pointed scales.

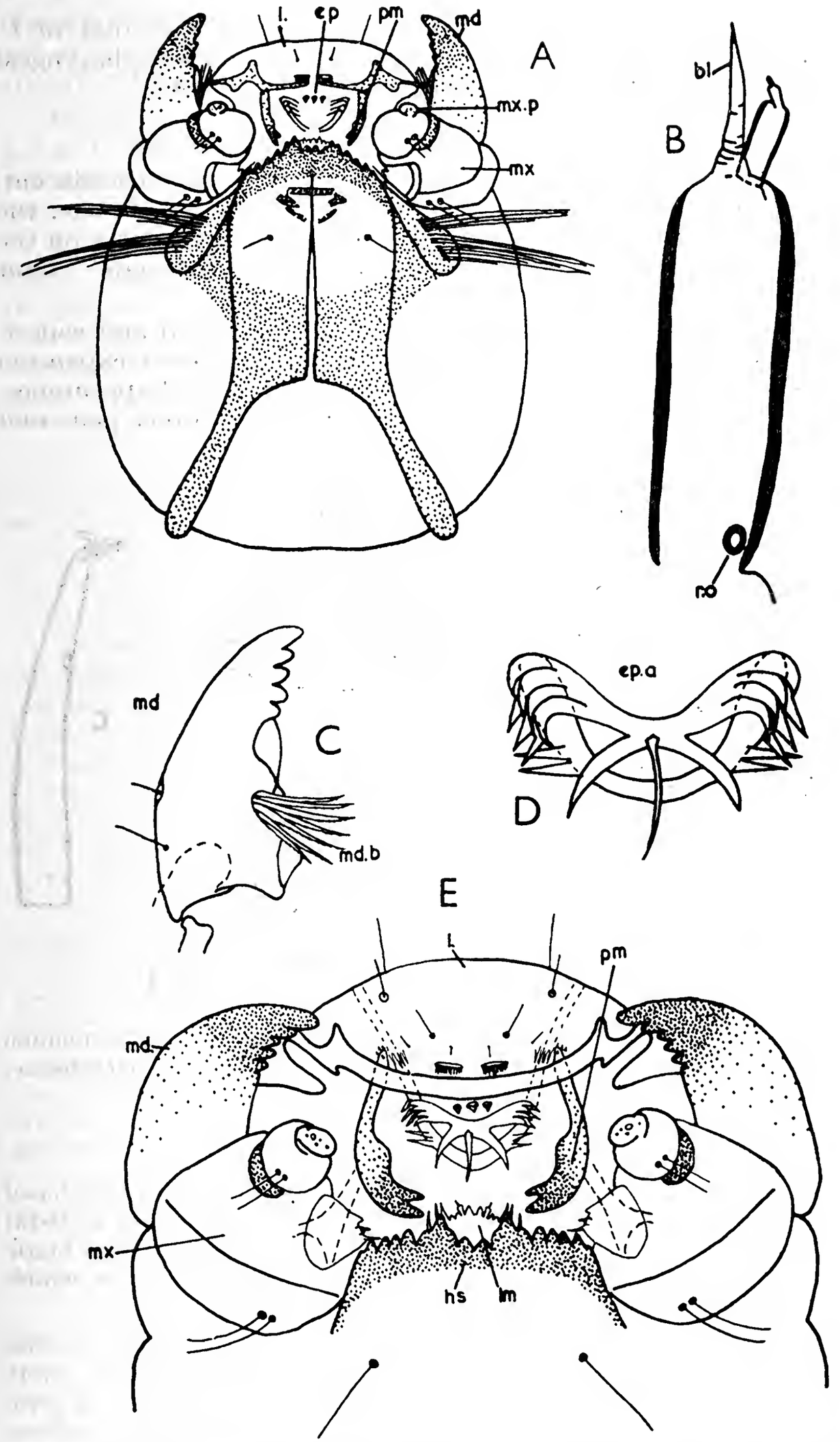

Fig. 4.—*Prodiamesa olivacea* Mg. A, Ventral view of head. B, Antenna. C, Mandible. D, Epipharyngeal armament. E, Ventral view of anterior of head.

The *internal structure* of the head is similar to that of *C. longistylus.* There is but a single set of labro-epipharyngeal muscles due to the absence of the trapezoidal sclerite.

(3) *Anatopynia* (*Macropelopia*) *nebulosa* Mg.

When full grown about 10 mm. long, somewhat translucent, and faintly brown or red in colour. Prolegs long, stilt like, the anterior pair united in the proximal half. No appendages on the penultimate segment. Dorsal preanal papillae elongate. Four pointed anal papillae.

Head capsule somewhat dorso-ventrally flattened and widest, just anterior to its posterior edge, where the posterior expansion of the fronto-clypeus gives this sclerite a pear-shaped appearance. The parietals join the lateral sutures of the fronto-clypeus and make up the rest of the capsule.

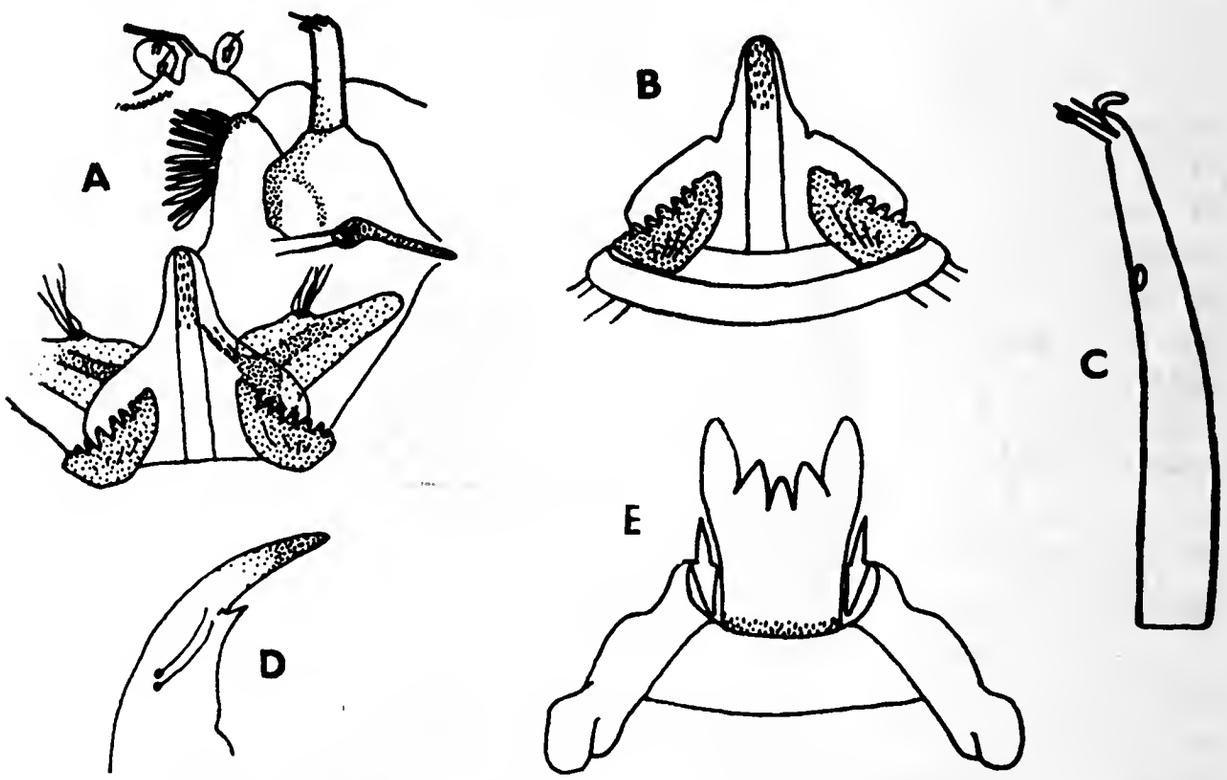

Fig. 5.—*Anatopynia nebulosa* Mg. A, Mouth area. B, Hypostomium and "labial combs". C, Antenna. D, Mandible. E, Glossa, paraglossae, and hypopharyngeal framework.

Antennae (fig. 5, C) retractile in sockets, four-segmented, basal segment long with a ring organ at the distal third and a distal blade with a bulbous base which bears a "side-blade". The blade reaches the apex. Segment two also with a distal blade which almost reaches the apex.

Labrum without the dorsal sclerites characteristic of the chironominae. The anterior edge bears bladders with short papillae, each with a terminal seta (fig. 5, A). There is a two-segmented rod at each anterior lateral angle. Ventral surface without any epipharyngeal armament or premandibles. The

"premandibular Bläschen" of Zavrel and Thienemann (1916) are not homologous with the latter as they have no special muscles (Gouin, 1959).

Mandibles (fig. 5, D) somewhat falciform with a long, dark apical tooth and a smaller trifid tooth at the distal third of the concave face, the middle toothlet largest. The mid region of the convex face bears a pair of setae.

Maxillae (fig. 5, A) larger and less rigid than in the *Chironominae* with a long palp which bears a ring organ similar to that of the antenna. The inner anterior region (lacinial lobe) bears a brush of "club-setae". Basally there is an outer, elongate, sclerite with a pair of setae at its inner expanded end, and a broad inner sclerite with a median tuft of setae and a lancet and seta from its extremity directed towards the mid-ventral region.

Hypostomium (fig. 5, B) soft, triangular, situated in the mid-ventral region of the head, often referred to as the labium. It bears a bright, finger-like band armed with spinules, the "pseudo-radula". The lateral walls of the hypostomium are flexible as shown by folds. At each posterior lateral angle there is a sclerotised "paralabial" or "labial" comb with about seven teeth.

Labium-hypopharynx (figs. 5, E; 7, A; 7, B) strongly developed and compact, situated dorsal to the hypostomium. It consists anteriorly and ventrally of a five-toothed glossa (pre-mental shield, Gouin, 1959) to each side of which there is a smaller, pointed paraglossa. Dorsal to the glossa there are "labial" or "hypopharyngeal" palps and posterior to these there is a double row of backwardly directed hypopharyngeal teeth situated on the floor of the mouth, and supported by part of the hypopharyngeal framework. The latter skeletal structure is strongly developed, uniting the whole complex, and the united salivary ducts pass through its centre.

The *internal structure* of the head is shown in figs. 6 and 7. From these it can be seen that the muscle arrangement differs from that of *C. longistylis* in certain respects.

In the labrum there are dorso-ventral labro-epipharyngeal muscles (fig. 7, el) and on each side a pair of muscles originating from the mid-dorsal region of the head are inserted on the ventral surface (figs. 6 and 7, lm., lm. 1, lm.2).

Each antenna has a retractor muscle (fig. 6, r.a.) taking its origin from the dorso-lateral region of the head.

The flexor and extensor muscles of the mandibles are somewhat ventro-laterally displaced (fig. 6, md.f., md.e.).

A muscle (fig. 6, mx.m.) originating from the posterior ventro-lateral region of the head and inserted on the proximal plates of the maxilla, serves to move the lacinial lobe. A stipitial muscle (fig. 6, st,m.) is inserted on a distal plate of the maxilla, below the base of the palp. Parallel with the latter muscle runs a muscle from the maxillary palp (fig. 6, mx.p.m.).

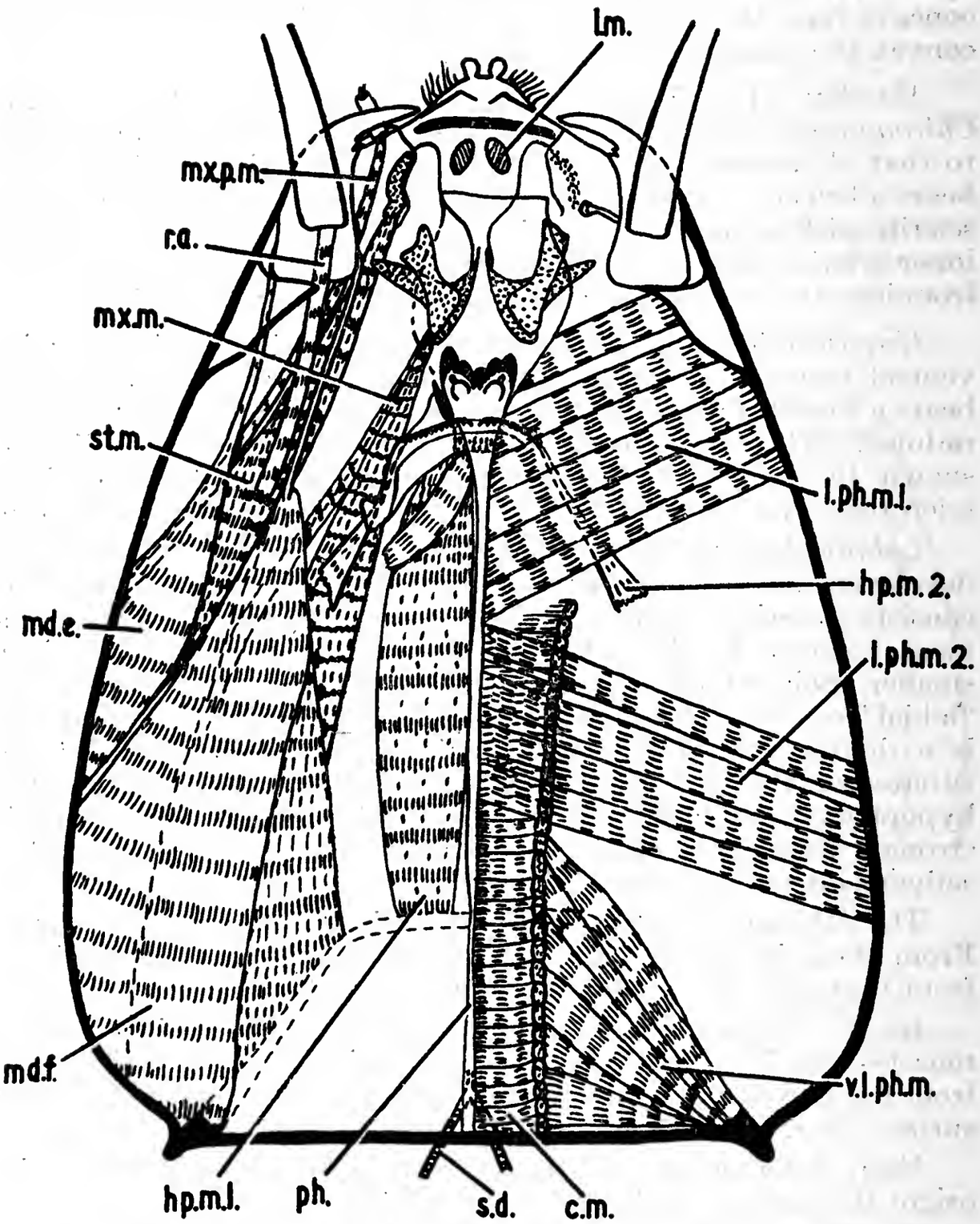

Fig. 6.—*Anatopynia nebulosa* Mg. Dorsal view of head from which the dorsal third has been sliced away.

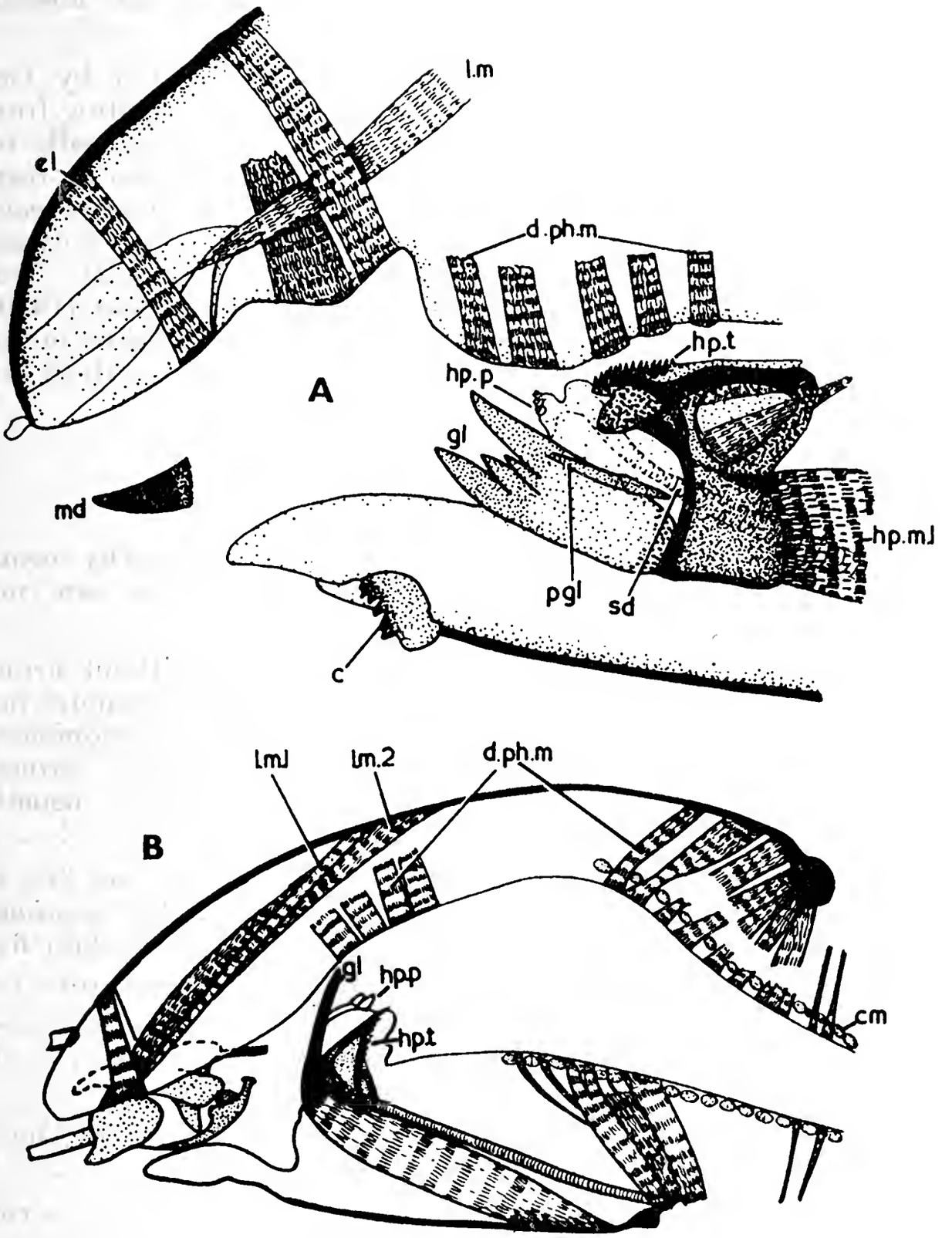

Fig. 7.—*Anatopynia nebulosa* Mg. A, B, Vertical median sections of heads, each about 200 mu. thick.

The gut has the characteristic layer of circular muscles. A difference, however, may be seen in the great development of cibarial and dilator pharyngeal muscles, the latter originating from the walls of the head with insertions on the sides and dorsum of the intima of the pharynx. They are the anterior and posterior lateral dilators (fig. 6, l.ph.m. 1, l.ph.m. 2) and the dorsal dilators (fig. 7, d.ph.m.). In addition, there are ventro-lateral dilators from the posterior of the capsule (fig. 6, vl.ph.m.). Normally dilator

muscles of the pharynx are dorsal. Their separation into laterals may be related to methods of feeding.

The labrum hypopharynx appears to be operated by two muscles on each side:—(I) A large labial muscle originating from the posterior ventral wall of the head is inserted proximally on the glossa (figs. 6 and 7, hp.m. 1); (II) A muscle originating from the dorsal face of the capsule is inserted near the base of each lateral arm of the hypopharyngeal framework and passes between the anterior and posterior lateral dilators (fig. 6, hp.m. 2). This latter muscle is the "retractor angulorum oris" of Gouin (1959). This muscle arrangement results in considerable mobility of the hypopharynx and it can even rotate such that the teeth of the glossa point down the oesophagus (fig. 7, B).

(4) The Taxonomy of British Chironomid Larvae

Chironomid larvae may be separated into subfamilies by means of the following key (N.B., the marine *Clunioninae* are not included):—

1. Antennae retractile into head. Epipharynx without armament. Clypeus expanded posteriorly. Hypostomium not developed as a toothed plate ..... *Tanypodinae* (*Pelopiinae*).
   Antennae non-retractile. Epipharynx usually armed. Clypeus narrowing posteriorly. Hypostomium usually developed as a toothed plate ..... 2.
2. Premandibles (tormae) rudimentary. Anal papillae five to ten times as long as broad (Roback, 1957) ... *Podonominae*.
   Premandibles distinct. Anal papillae usually less than five times as long as broad ..... 3.
3. Paralabial plates present ..... 4.
   Paralabial plates absent ..... 6.
4. Paralabial plates striated. Larvae often red ..... *Chironominae* (*Tendipedinae*).
   Paralabial plates non-striated, sometimes bearded ..... 5.
5. Hypostomium and paralabial plates as in fig. 4, E, with a row of long setae on each paralabial ..... *Diamesinae* (part, viz.: *Prodiamesa*).
   Hypostomium and paralabials not as in fig. 4, E. Paralabials often small**, sometimes with a number of setae ..... *Orthocladiinae* (part).
6. Third antennal segment annulate ..... *Diamesinae* (part).
   Third antennal segment not annulate ..... *Orthocladiinae* (part).

**The apparent "paralabials" of the *Orthocladiinae* are merely wing-like expansions of the hypostomium and are not homologous to the striated plates of the *Chironominae* (Gouin, 1959).

The following account of the systematics of the larvae will only deal with the subfamilies *Chironominae* and *Tanypodinae*.

(1) Chironominae

The larvae may be separated by means of the following key: —

(N.B.—When the hypostomial plate has an odd number of teeth, there is a single median tooth; when it has an even number of teeth, there is a pair of median teeth. Thus the first lateral teeth are those next to the median, or to the median pair of teeth. The terms convex and concave have been used to describe the shape of the toothed edge of the hypostomial plate).

1. Antennae borne on dorsal protuberances of the head, which are always longer than broad (fig. 8, B). Striated plates with the anterior margin only slightly curved, often more than four times as wide as long (fig. 8, D-F) ... *Tanytarsus sens. lat.*
   Antennae sessile, or, if on a protuberance, the latter is never longer than broad. Striated plates with the anterior margin distinctly curved, usually less than four times as wide as long (N.B., *Pseudochironomus,* p. 40) ..... (*Chironomini*) 2.
2. ANTENNAE SIX-SEGMENTED, WITH LARGE LAUTERBORN ORGANS ALTERNATING ON SEGMENTS TWO AND THREE (e.g. fig. 11, J) ..... 3.
   ANTENNAE FIVE-SEGMENTED, WITHOUT LARGE LAUTERBORN ORGANS (N.B., rudimentary ones may be present, e.g., fig. 11, A) ..... 8.
3 ALL HYPOSTOMIAL TEETH UNICOLOROUS ..... 4.
   MEDIAN PART OF HYPOSTOMIUM PALE IN RELATION TO LATERAL PARTS ..... 6.
4. Middle pair of teeth small, 1st laterals large. Median and 1st lateral teeth clearly anterior to the remaining laterals. With 16 hypostomial teeth (fig. 13, C) ..... *Stictochironomus.*
   Middle pair of teeth long, 1st laterals small, 2nd laterals long. Larva in a transportable case ..... 5.
5. Dorsal projection from penultimate abdominal segment directed analwards. Base of hypostomium with a single lateral seta. Case fusiform ..... *Lauterborniella.*
   Dorsal projection from penultimate segment directed oralwards. Base of hypostomium with a lateral tuft of setae. Case spindle-shaped ..... *Zavreliella.*
6. With a single pale broad membranous median tooth and six dark laterals which are progressively smaller ..... *Paralauterborniella.*
   With at least two median teeth pale 7
7. With two pale median teeth, laterals dark. 2nd lateral teeth longest (fig. 13, A). N.B., sometimes there is a minute tooth at the base between the median pair) ..... *Microtendipes.*
   With four pale median teeth, 3rd laterals longest (fig. 13, B) ... *Paratendipes*

8. ALL HYPOSTOMIAL TEETH UNICOLOROUS, USUALLY DARK ..... 11.
MEDIAN AREA OF HYPOSTOMIUM AT LEAST A LITTLE PALER THAN LATERAL AREAS, EITHER MEMBRANOUS OR DEVELOPED AS A SINGLE LARGE PALE TOOTH. Maxillary palp elongate, about three times as long as broad ..... 9.

9. Median area of hypostomium consisting of a single broad pale tooth, lateral teeth dark (fig. 12, F) ... *"defectus"* group (of *Cryptochironomus sens. lat.*).
Median area of hypostomium membranous, indistinctly toothed, lateral teeth not much darker (fig. 12, E) ..... 10.

10. Second antennal segment long, third to fifth small (fig. 11, D). Mandibles with distinct end teeth ..... *"camptolabis"* group. (*Cryptochironomus sens. lat.*).
Second and third antennal segments subequal, fourth and fifth small. End teeth of mandible indistinct, not separated by deep incisions ..... *"fuscimanus"* group. (*Cryptochironomus sens. lat.*).

11. HYPOSTOMIAL PLATE WITH A SINGLE MEDIAN TOOTH ..... 22.
HYPOSTOMIAL PLATE WITH A PAIR OF MEDIAN TEETH ..... 12.

12. Toothed edge of hypostomial plate distinctly concave, with ten more-or-less subequal teeth. Striations hardly distinct on the paralabial plates. (See p. 48) ..... *Stenochironomus.*
Toothed edge of hypostomial plate not concave, often weakly or strongly convex, at least in the middle. Usually with more than ten teeth ..... 13.

13. MEDIAN PAIR OF TEETH LONGER THAN FIRST LATERALS ..... 14.
MEDIAN PAIR OF TEETH SUBEQUAL TO, OR SMALLER THAN, FIRST LATERALS ..... 18.

14. Median pair and first lateral teeth more rounded and less deeply incised than remaining laterals. Toothed edge of hypostomium mainly strongly convex, with the medians anterior and the laterals progressively posterior, except that the extreme lateral teeth are again more anterior than the less extreme laterals (fig. 12, D). (See also couplet 24) ... *"Harnischia"* group. (*Cryptochironomus sens. lat.*).
Toothed edge of hypostomial plate not as above, often more or less convex along whole width ..... 15.

15. Median pair of teeth long and laterals progressively smaller (fig. 13, D) ..... *"laetum"* group. (*Polypedilum*).
First lateral teeth distinctly smaller than second laterals .. 16.

16. Hypostomial teeth acutely pointed, distinctly separate (fig. 13, F) ..... *"Pentapedilum"* (*Polypedilum*).
Hypostomial teeth more rounded (*Polypedilum*) (fig. 13, E) ..... 17.

17. Larvae about 10-13 mm. long. Eye-spots separate. Second antennal segment not or only a little longer than third. Lauterborn organ one third as long as segment three (Lenz, 1941) ..... *"nubeculosum"* group. (*Polypedilum*).
Larvae not more than ca. 7 mm. long. Eye-spots fused. Second antennal segment longer than the last three together. Lauterborn organ as long as third segment (Lenz, 1941) ... *"convictum"* group. (*Polypedilum*).
18. Hypostomial teeth acutely pointed, distinctly separate (fig. 13, G) ..... *Sergentia* (*Phaenopsectra sens. lat.*).
Hypostomial teeth more rounded ..... 19.
19. Second lateral hypostomial teeth only a little smaller than the third laterals (fig. 13, H) ..... *"Lenzia" Phaenopsectra sens. lat.*).
Second lateral teeth small in relation to third laterals ... 20.
20. Median pair of hypostomial teeth separated by a distinct incision. Median teeth always smaller than first laterals. Ring organ at basal third or eighth of basal antennal segment (Lenz, 1955) ..... *"Endotendipes"* (*Endochironomus sens. lat.*).
Median pair of hypostomial teeth more rounded and separated only by a shallow incision. Median pair subequal to, or smaller than, first laterals. Ring organ usually in the basal fifth or fourth of the basal segment (Lenz, 1955) ..... (*Endochironomus*) 21.
21. Middle pair of teeth subequal to first laterals ..... *"nymphoides"* group (*Endochironomus*).
Middle pair of teeth smaller than first laterals (fig. 12, H) ... *"juncicola"* group (*Endochironomus*).
22. Striated plates elongate, more than four times as wide as long, almost touching in the mid-ventral region. With ca, 13 hypostomial teeth of which the median is large. Dorsal preanal papillae elongate ..... *Pseudochironomus.*
Striated plates less than four times as wide as long, clearly separated from each other. Dorsal preanal papillae short .. 23.
23. Hypostomial plate trapezoidal. Median tooth, second, and fourth laterals large, first and third laterals very small. The bases of all these teeth lying in a straight line. Striated plates large, each wider than the hypostomial plate ..... *Xenochironomus.*
Hypostomial plate not consisting of nine alternating large and small teeth ..... 24.
24. Median and first lateral teeth more rounded and less deeply incised than the remaining laterals. Toothed edge of hypostomium mainly strongly convex, with the median tooth anterior and the laterals progressively more posterior, except that the extreme lateral teeth are again more anterior than the less extreme laterals (fig. 12, D). (See couplet 14) ..... *"Harnischia"* group (*Cryptochironomus*) *sens. lat.*
Toothed edge of hypostomial plate not as above, usually more or less convex along whole width ..... 25.

25. With fifteen hypostomial teeth, first laterals large to very small, sometimes present only as distinct lobes at the base of the median tooth ..... 26.
With less than fifteen hypostomial teeth. First laterals seldom much smaller than second laterals ..... 30.

26. First lateral hypostomial teeth subequal in length to second laterals. Striations usually distinct over the whole of the striated plates ..... 27.
First lateral teeth clearly smaller than second laterals. Striations often only distinct on the basal part of the striated plate ..... 28.

27. Median tooth as wide as ca. two lateral teeth together ..... *"varus"* group (*Parachironomus, Cryptochironomus sens. lat.*).
Median tooth as wide as ca. 3-4 laterals together ..... *"pseudotener"* group (*Cryptotendipes, Cryprochironomus sens. lat.*).

28. First lateral teeth minute, but distinctly separate from the median tooth ..... *Kiefferulus* (*Chironomus sens. lat.*).
First lateral teeth present as lobes at the base of the median tooth or else separate and $\frac{1}{3}$ to $\frac{1}{2}$ as long as the median tooth 29

29. With two pairs of ventral tubuli to the penultimate abdominal segment. Hypostomium as in figs. 12, A; 12, B ..... *Chironomus sens. lat.*
Such tubuli absent or reduced in number ..... *"Chironomus-Einfeldia"* group.

30. STRIATED PLATES MORE THAN $2\frac{1}{2}$ TIMES AS WIDE AS LONG ..... 31.
STRIATED PLATES NOT MORE THAN $2\frac{1}{2}$ TIMES AS WIDE AS LONG ..... 32.

31. Striations distinct only on the basal half of the striated plates. Penultimate abdominal segment with a pair of ventral tubuli ..... *"insolita"* group (*Einfeldia*).
Striations distinct over the whole of the striated plates. Penultimate abdominal segment without ventral tubuli. Fourth lateral hypostomial teeth often smaller than third and fifth laterals (fig. 12, G) ..... *Glyptotendipes.*

32. Second lateral hypostomial tooth smaller than, and closely applied to, the first lateral. Striations very distinct over the whole of the striated plate (fig. 12, C). (Often the median tooth appears indistinctly trilobed) ..... *Dicrotendipes.*
Second lateral tooth distinctly separate from the first lateral. Striations distinct over the whole plate ..... 33.

33. Toothed edge of hypostomial plate strongly convex, individual teeth more rounded ..... *"virescens"* group (*Cryptochironomus sens. lat.*) and *"parilis"* group (*Parachironomus, Cryptochironomus sens. lat.*).
Toothed edge of hypostomial plate only weakly convex, individual teeth narrow and pointed ... *"pararostratus"* group (*Cryptochironomus sens. lat.*).

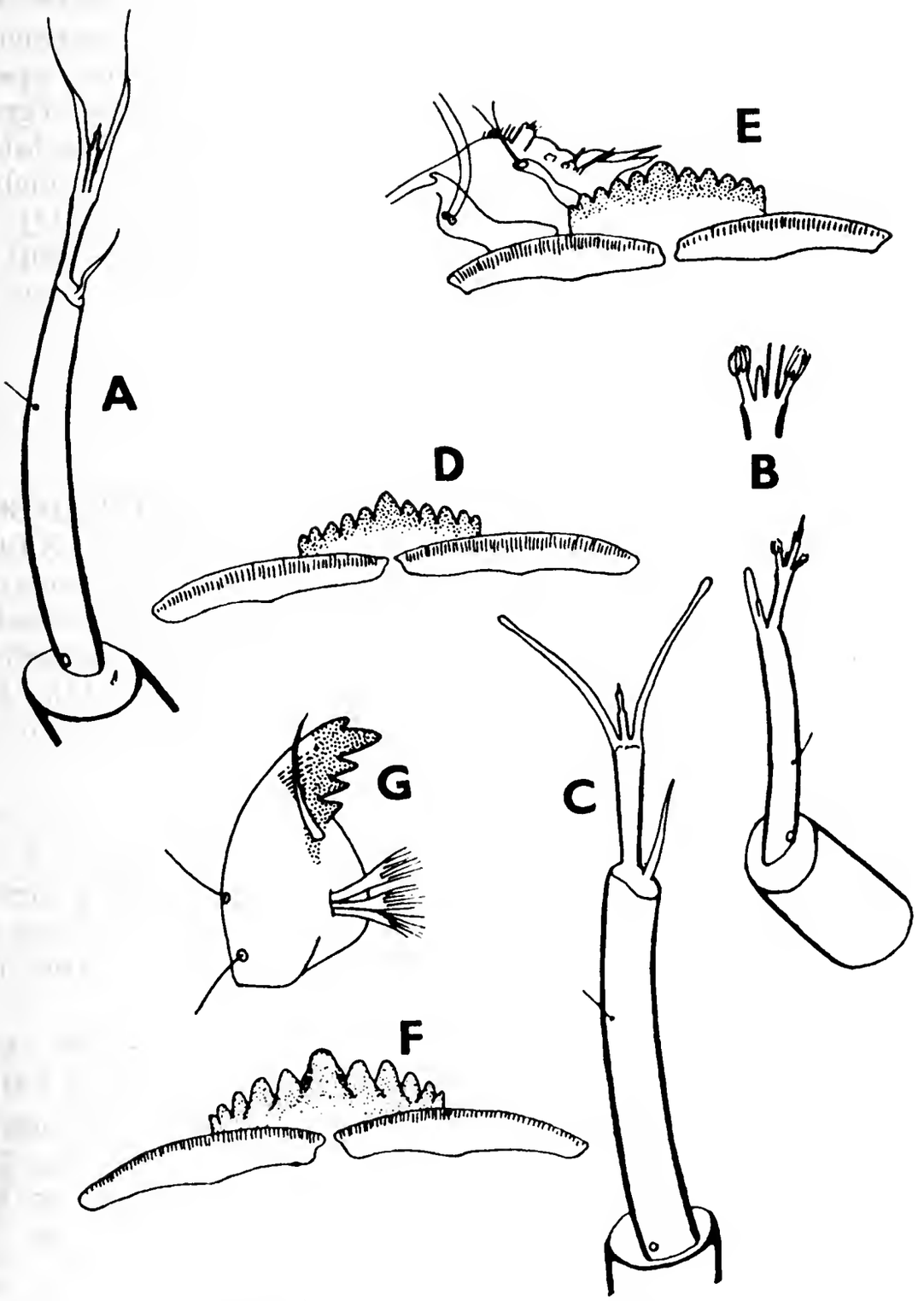

Fig. 8.—*Tanytarsini.* A-C, antennae; D-F, hypostomium and striated plates; G, Mandible. A, D, *Tanytarsus holochlorus* Edw. B, E, *Lundstroemia praecox* Mg. Lauterbonn organs. C, F, G, *Micropsectra fusca* Mg.

DESCRIPTIONS OF SPECIES-GROUPS, ETC., IN THE CHIRONOMINAE

(A) Tanytarsini

Only three species have been examined: *Tanytarsus holochlorus* Edw., *Lundstroemia praecox* Mg., and *Micropsectra fusca* Mg. In each of these three larvae the antennae are five segmented, with a pair of pedunculate Lauterborn organs from the apex of segment two, and a ring organ proximally on the first segment. The hypostomial plate has a large median tooth with five laterals on each side; the striated plates are elongate, almost touching; the mandibles have a long accessory tooth (fig. 8, G); the penultimate abdominal segment shows a slight dorsal hump, and there is a pair of plumose setae on each side of each body segment.

Tanytarsus holochlorus Edw.

Not previously described.

ANTENNAE WITH LONG TAPERING LAUTERBORN ORGANS EACH ABOUT TWO AND A HALF TIMES AS LONG AS SEGMENTS 3-5 INCLUSIVE. Ratio of antennal segments from base to apex 75 : 16 : 9 : 3 : 2. Basal segment with a seta at the distal third (fig. 8, A). Striated plates each about one and one-quarter times as wide as the hypostomial plate (fig. 8 D). Head dark on posterior border. Final instar larva about 7 mm. long and red with a faint greenish tinge.

Lundstroemia pseudopraecox Goet. (= *praecox* Mg.).

Not previously described. Bause (1914) describes a larva as *T. inermipes* Kieff. which Hennig (1950) regards as a synonym of *Micropsectra praecox*. The latter differs from the larva described here.

LAUTERBORN ORGANS RELATIVELY SHORT, PEDUNCULATE, EACH A LITTLE LONGER THAN THE THIRD ANTENNAL SEGMENT (fig. 8, B). Ratio of antennal segments 42 : 11 : 5 : $2\frac{1}{2}$: 2. With a seta at the proximal $\frac{2}{5}$ of the basal segment. Hypostomium (fig. 8, E). Head somewhat truncate and distinctive due to dark dorsal longitudinal striations. Full grown larva about 8 mm. long.

Micropsectra fusca Mg.

Not previously described.

LAUTERBORN ORGANS LONG, TAPERING GRADUALLY, SLIGHTLY EXPANDED DISTALLY (fig. 8, C). Ratio of antennal segments, 59 : 21 : 4 : 3 : 2. Lateral seta at the distal $\frac{2}{5}$ of the basal antennal segment. Full grown larva about 11 mm. long. Posterior segments of abdomen (fig. 9, G). Mandible (fig. 8, G).

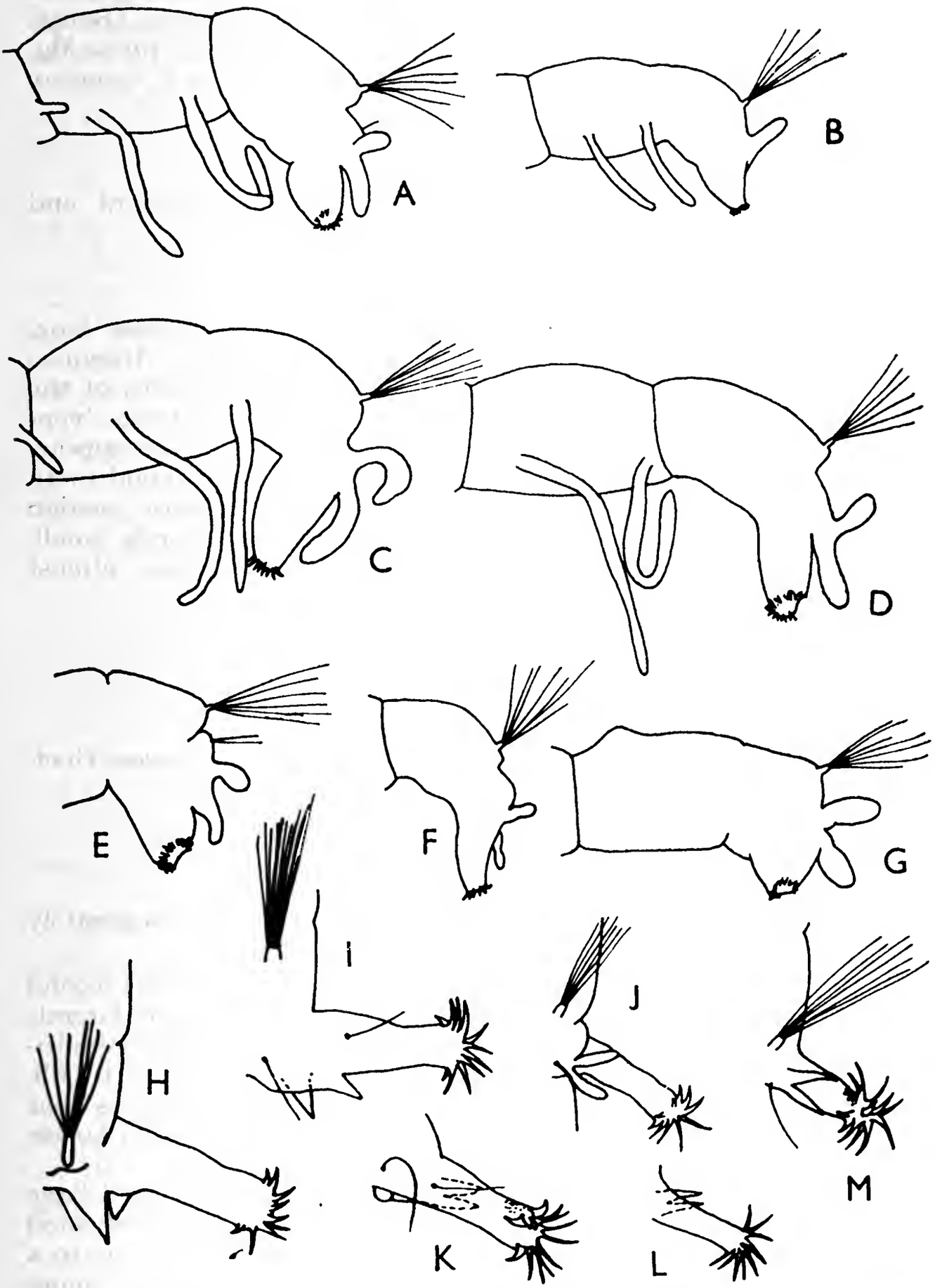

Fig. 9.—Chironomidae, posterior segments. A-G, lateral views; H-M, dorsal halves. A, *Chironomus tentans.* B, *C. lugubris.* C, *C. dorsalis.* D, *C. riparius.* E, *Microtendipes chloris.* F, *Polypedilum laetum.* G, *Micropsectra fusca.* H, *Anatopynia nebulosa.* I, *Procladius choreus.* J, *Pentaneura lentignosa.* K, *P. longimana.* L, *P. nubila.* M, *P. northumbrica.*

It appears that the larvae of the *Tanytarsini* may be separated into groups based mainly on the structure of the antennae (Bause, 1914). It appears that *T. holochlorus* Edw. and *M. fusca* Mg. belong to the "*inermipes*" group of Bause, whereas *L. praecox* Mg. belongs to the "*Lauterborni*" group.

(B) Chironomini

The larvae may be separated into genera, subgenera and species groups as follows: —

Genus Pseudochironomus

Described by Lenz (1941): Dorsal preanal papillae long, directed analwards, each with a tuft of about 8 setae. Antennae five segmented with a ring organ at the proximal fourth of the basal segment. Epipharyngeal comb of three broad teeth, 'ventral row of labrum' (p. 23) with a pair of pectinate setae appearing as a transverse comb. Mandibles with a pale dorsal end tooth and three dark ventral teeth. Hypostomium with a broad median tooth and about six teeth to each side, second laterals small. Striated plates elongate, over four times as wide as long, almost touching.

One British species, viz., *P. prasinatus* (Staeg.).

Genus Graceus

Larva unknown. One British species, viz., *G. ambiguus* Goet.

Genus Chironomus sens lat.

Subgenus Chironomus s.s.

(Including the "Einfeldia" group which is dealt with separately on p. 44).

With fifteen hypostomial teeth of which the median and second laterals are large, the first laterals small, and the third laterals are often closely applied to the larger second laterals. Penultimate abdominal segment usually with a pair of ventral tubuli, but sometimes these are reduced. Branch (1923) observes that in *C. riparius* Mg. the tubuli are absent in newly-hatched larvae and increase in size at each moult.

The larvae in this subgenus are all very much alike and have for some time presented difficulties. Andersen (1949) indicated that more than one morphological type of larva may belong to a species, and that eggs laid by an adult fly may give rise to more than one type of larva. Although it seems likely that the larval form in a species may vary according to the environment, the views of Andersen do not appear to be generally accepted and are not confirmed by the work of Acton (1955) who identified larvae by means of the banding pattern of their salivary chromosomes.

Acton (1956) has indicated that larvae in this subgenus may be separated, at least into species groups, on the pigmentation of the head and the morphology of the posterior body segments. Larvae are said to be of the "*thummi*" type if they have no lateral appendages to the tenth abdominal segment. Where such appendages are present, larvae are said to be of the "*plumosus*" type.

The following key makes use of these characters: —

1. Larvae of the "*plumosus*" type ..... 2.
   Larvae of the "*thummi*" type ..... 4.
2. Head dark only on posterior border ..... *C. dorsalis* Mg.
   Head dark on posterior border and at least also on ventral plates (sometimes pale in *annularius* Deg., Acton, 1956) ... 3.
3. With a dark wedge-shaped mark on dorsum ... *C. tentans* F. and *C. pallidivittatus* Mall.
   Without a dark wedge-shaped mark on dorsum ..... *C. annularius* (Deg.) and *C. anthracinus* Zett.
4. Head dark on posterior border only. Tubuli of penultimate segment about as long as the thickness of the segment ... *C. lugubris* Zett.
   Head dark on posterior border and on ventral plates. Tubuli of penultimate segment longer than the thickness of the segment ..... 5.
5. Ventral plates moderately darkened ..... *C. riparius* Mg. (= *thummi* Kieff.).
   Ventral plates black-pigmented ..... *C. longistylus* Goet.

The above key should be regarded as tentative as the pigmentation characters are not wholly reliable and a number of species are still unknown in the larval state.

The following species have been examined: —

Chironomus tentans F. Described by Malloch (1915, 1917), Goetghebuer (1928) and Johannsen (1937).

Posterior segments, fig. 9, A. Ratio of antennal segments, 43 : 10 : 4 : 4 : 2 (fig. 11, A).

Chironomus anthracinus Zett. Not previously described.

Ratio of antennal segments, 30 : 10 : 4 : 5 : 2. Ring organ at the proximal third of the basal segment. Mandible, fig. 10, A.

Chironomus lugubris Zett. Thienemann (1941) states that the larva of this species (cf. *lugubris* = *spitzbergensis* Kieff.) has relatively short tubuli.

Posterior segments, fig. 9, B. Ratio of antennal segments, 33 : 9 : 3 : 4 : 3 (fig. 11, B). Ring organ between the proximal fourth and third of the basal segment. Accessory mandibular tooth on a short tubercle. Hypostomium, fig. 12, A.

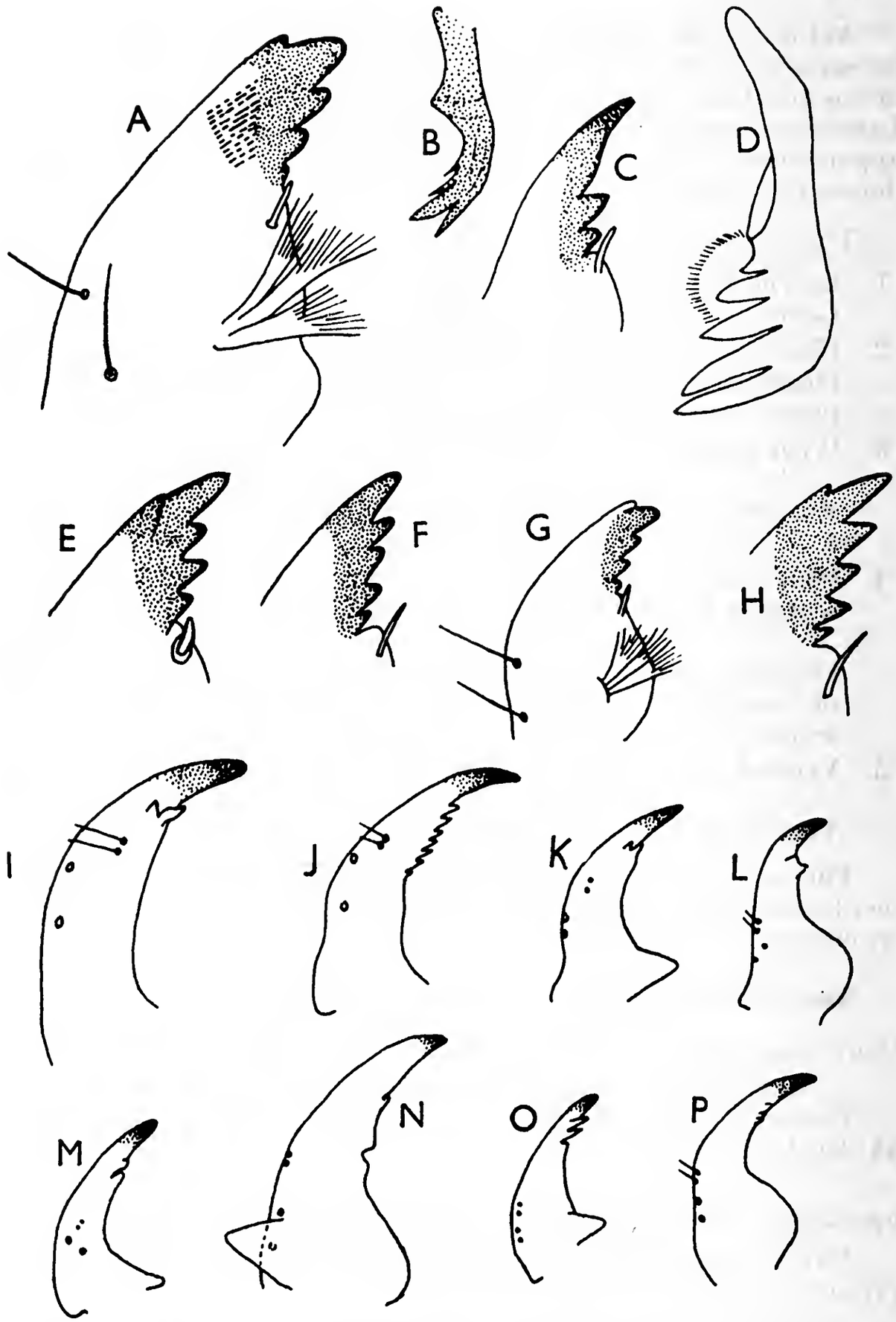

Fig. 10.—Chironomidae. A, C, E-P, mandibles. B, D, premandibles. A, *Chironomus anthracinus* Zett. B, *Cryptochironomus claripennis* Malloch. C, D, *Cryptochironomus "defectus"* gr. E, *Glyptotendipes paripes* Edw. F, *Endochironomus dispar* Mg. G, *Microtendipes diffinis* Edw. H, *Phaenopsectra coracinum* Zett. I, *Anatopynia goetghebueri* (Kieff). J, *A. varia* Fab. K, *Procladius choreus* (Mg.). L, *Pentaneura monilis* (L.). M, *P. lentignosa* (Fries). N, *P. longimana* (Staeg.). O, *P. nubila* (Mg.). P, *P. northumbrica* Edw.

Chironomus longistylus Goet. Not previously described.

For an account of this larva see pages 21-26. It should be noted that this species may be a synonym for *C. cingulatus* Mg. to which Hennig (1950) gives two references, viz., Kraatz (1911) and Goetghebuer (1919).

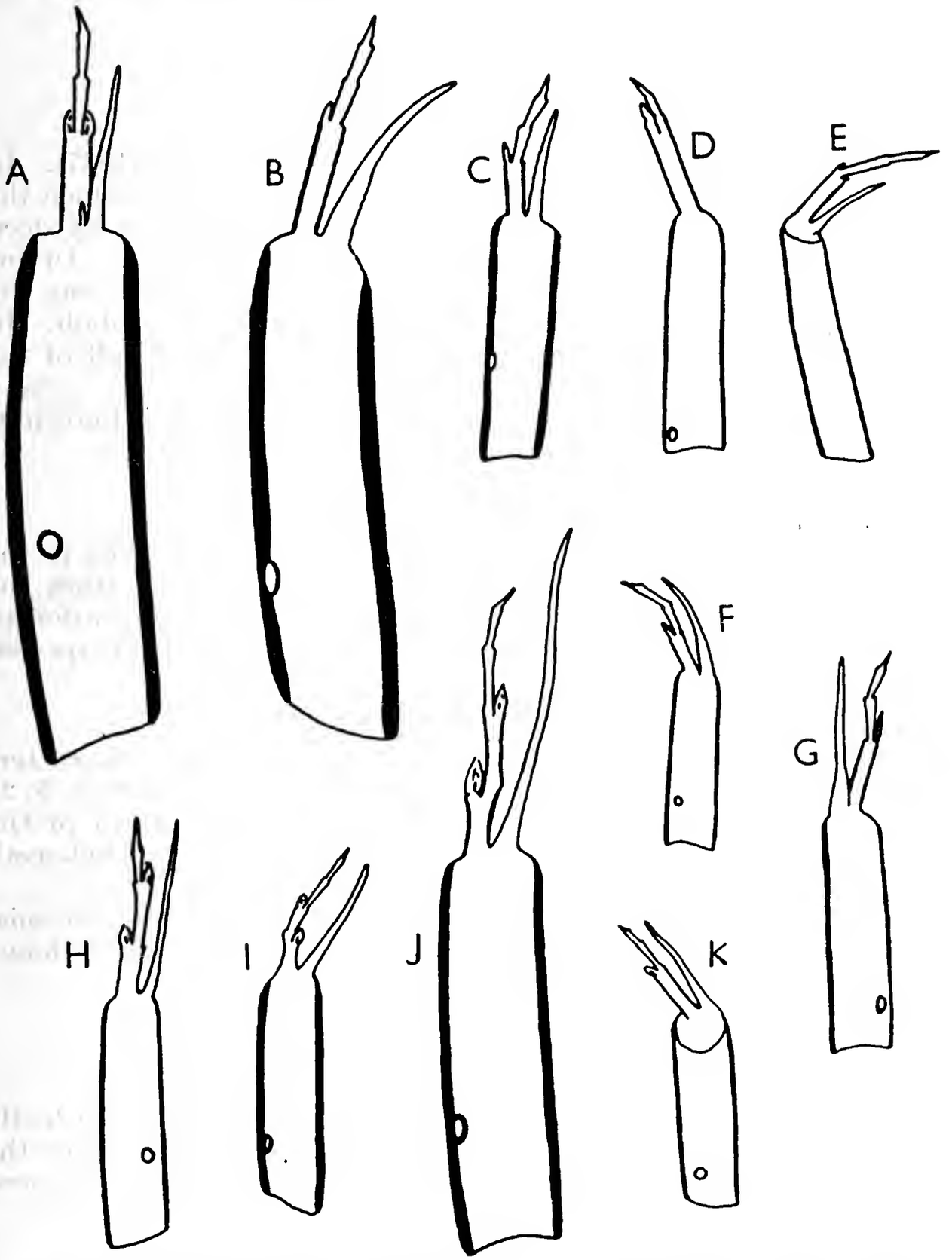

Fig. 11.—Chironominae, antennae. A, *Chironomus tentans* Fab. B, *C. lugubris* Zett. C, *Dicrotendipes pulsus* Walk. D, *Cryptochironomus claripennis* Malloch. E, *Glyptotendipes paripes* Edw. F, *Polypedilum laetum* Mg. G, *Endochironomus dispar* Mg. H, *Paratendipes albimanus* Mg. I, *Stictochironomus pictulus* Mg. J, *Microtendipes chloris* Mg. K, *Phaenopsectra flavipes* Mg.

Chironomus riparius Mg. (=*thummi* Kieff., =*militaris* Joh.). Described many times, Hennig (1950) referring to five accounts.

Posterior segments, fig. 9, D. Ratio of antennal segments, $40:14:3\frac{1}{2}:4\frac{1}{2}:3$.

Chironomus dorsalis Mg. Hypostomium, fig. 12, B.

"Chironomus-Einfeldia" Group

Larvae in this group have been described by Lenz (1937). In his *"pectoralis"* group the hypostomium has 15 teeth of which the 1st laterals and median are rounded and not separated by deep incisions so that the median tooth appears trilobed. In his *"insolita"* group the hypostomium has thirteen teeth and the penultimate abdominal segment has a pair of ventral tubuli. In both groups the striations are distinct over the basal half of the striated plates.

Of the four British species, only *C. dissidens* Walk. is known as a larva; it belongs to the *"insolita"* group (Lenz, 1937).

Subgenus Kiefferulus

Described by Pagast (1936). The characters are given in the key. In addition there is one pair of ventral tubuli from the penultimate segment. One British species, viz., *K. tendipediformis* Goet. It has not been possible to examine material of this species.

Subgenus Xenochironomus

Described by Pagast (1934). In addition to the characters given in the key, the ratio of antennal segments is 21:6:5:5:2; the ring organ is at the proximal one-fifth to one-sixth of the basal segment; the mandibles have three small dark distal teeth and a long accessory tooth.

N.B. Tschernovsky (1949, fig. 29) illustrates the hypostomial plate with a pair of long median teeth, 2nd and 4th laterals long; 1st and 3rd laterals short.

One British species, viz., *X. xenolabis* Kieff.

Subgenus Dicrotendipes (=Limnochironomus)

Antennae five segmented. Hypostomium with thirteen teeth. Striated plates relatively small with distinct striations over the whole surface; anterior margins crenulate. Penultimate segment without tubuli.

Dicrotendipes pulsus Walk. Not previously described.

When full grown about 10 mm. long. Ratio of antennal segments 40:12:7:6:3. Ring organ near the basal third of the first segment (fig. 11, C). Epipharyngeal comb with 5-7 teeth. Accessory mandibular tooth small and peg-like. Hypostomium as in fig. 12, C, with the median tooth indistinctly trilobed.

D. nervosus Staeg. and *D. lobiger* (Kieff.), described by Goetghebuer (1912 and 1928, respectively), appear to be similar to *D. pulsus*.

The British species, *D. notatus* Mg. and *D. tritomus* Kieff., are not known as larvae.

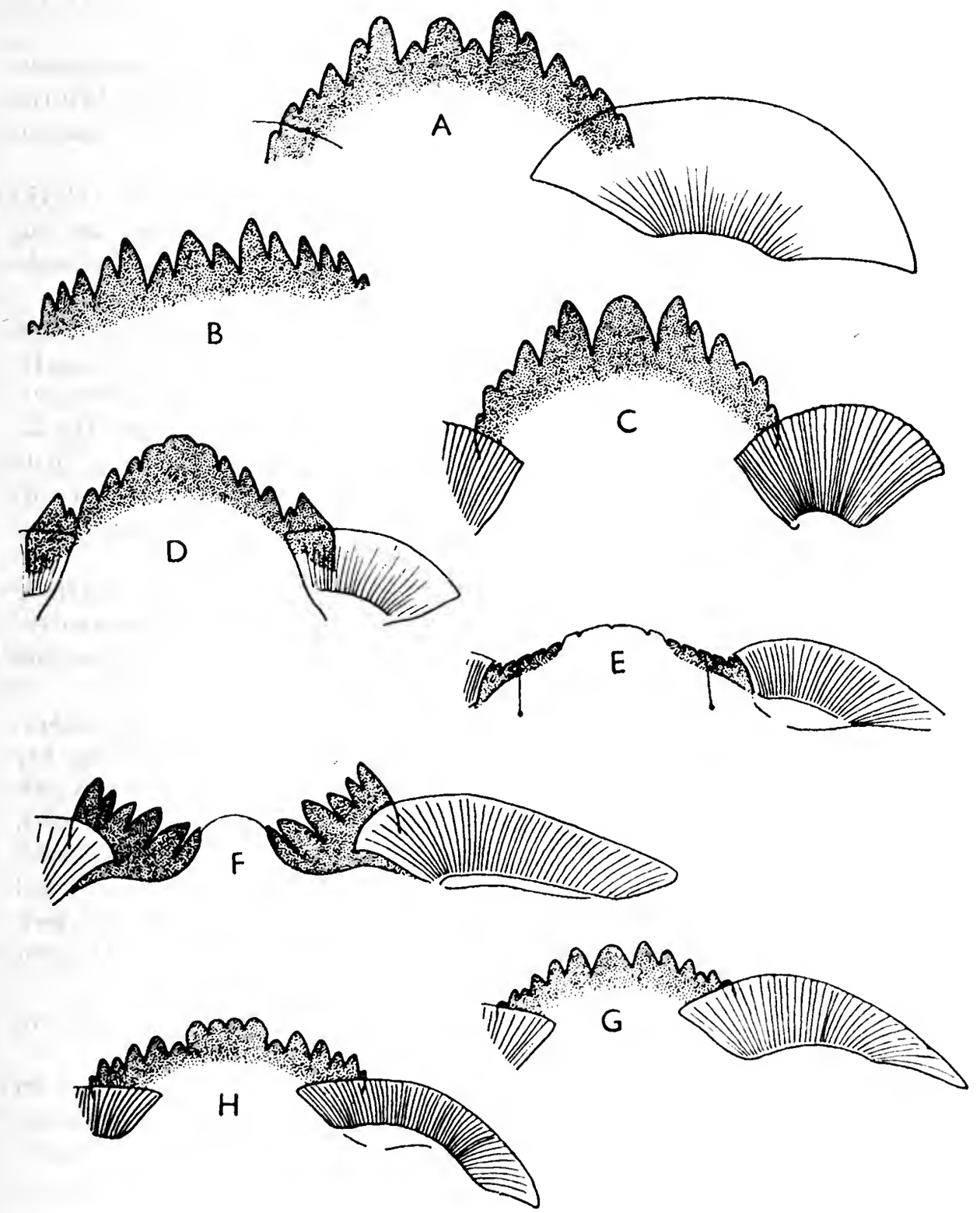

Fig. 12.—Chironominae, hypostomial region. A, *Chironomus lugubris* Zett. B, *C. dorsalis* Mg. C, *Dicrotendipes pulsus* Walk. D, *Harnischia viridulus* (L.). E, *Cryptochironomus claripennis* Malloch. F, *Cr. "defectus"* gr. G, *Glyptotendipes paripes* Edw. H, *Endochironomus dispar* Mg.

Subgenus Cryptochironomus sens lat.

This is a heterogeneous assemblage consisting of several species groups: —

(a) "*Harnischia*" group. Includes all those forms in which the hypostomial plate is of the type shown in fig. 12, D. It is often difficult to decide whether there is a single, or a pair of, median teeth.

Cryptochironomus viridulus (L.) (fig. 12, D). Described by Pagast (1931) as *Microchironomus.*

C. tener Kieff. Described by Pagast (1931) as *Leptochironomus,* and differing from *C. viridulus* in having the 4th lateral hypostomial tooth longer than the 3rd lateral. With a single median tooth.

(b) "*pseudotener*" group (*Cryptotendipes*). Roback (1957) figures the hypostomium of "*Harnischia pseudotenter*" as having a large median tooth, as wide as ca. 3-4 laterals, and seven laterals on each side.

(c) "*Parachironomus*" group. Lenz (1938) describes the British species *varus* Goet. and *monochromus* Wulp. as having 15 hypostomial teeth, the 1st and 2nd laterals subequal. Goetghebuer (1919) describes the British species *parilis* Walk. (as '*mucronatus*', synonym) as having thirteen teeth. Thus *parilis* is very similar to the members of the "*virescens*" group (see below). It may differ from the latter group in having a relatively wider median tooth

(d) "*virescens*" group (Harnisch, 1923). With thirteen strong dark hypostomial teeth, striated plates not extending far laterally. Includes the British species *C. edwardsi* (Krusemann) (=*virescens* synonym).

(e) "*pararostratus*" group (Harnisch, 1923). With thirteen narrow, dark, pointed teeth. Striated plates not extending far laterally. Possibly includes the British species *C. falcatus* Kieff.

(f) "*camptolabis*" group (Harnisch, 1923). Hypostomium with the median area pale, membranous, the lateral areas only slightly darker but with more distinct teeth (fig. 12, E). Second antennal segment long, the last three very small, scarcely divided. Mandibles with three distinct pale end teeth. Includes the British species *camptolabis* Kieff. and *claripennis* Mal.

C. claripennis Malloch: Antennae, fig. 11, D; Hypostomium, fig. 12, E; Premandible, fig. 10, B.

(g) "*fuscimanus*" group (Harnisch, 1923). Hypostomium as in the "camptolabis" group. Second and third antennal segments subequal, the last two very small, scarcely divided. End teeth of mandible indistinct, not separated by clear incisions. Includes the British species *C. pseudosimplex* Goet.

(h) "*defectus*" group (Harnisch, 1923). Hypostomium with a clear pale broad central area and dark, distinct lateral teeth (fig. 12, F). Premandibles with four subequal end teeth (fig. 10, D). Mandibles with three distal teeth of which the apical is long and acute (fig. 10, C). Includes the British species *supplicans* Mg.,

rostratus Kieff., *albofasciatus* Staeg., and *vulneratus* Zett. (Pagast, 1932). The last sp. has 5 lateral teeth whereas the others have 7.

Of the 24 British species of *Cryptochironomus sens. lat.,* 11 are still unknown as larvae.

Genus Glyptotendipes

Hypostomium with thirteen teeth, 4th laterals often small. Striated plates extending laterally. Penultimate segment without ventral tubuli.

Glyptotendipes (*Phytotendipes*) *paripes* Edw. Hypostomium (fig. 12, G). Antenna (fig. 11, E). Mandible (fig. 10, E). Note the broad and relatively short accessory tooth.

Goetghebuer (1919) describes the British species *G. viridis* Macq. In this species the hypostomial plate is much more strongly convex along its toothed edge than in *G. paripes.*

G. gripekoveni Kieff. is described by Gripekoven (1914). In this species the hypostomium is strongly convex and the broad median tooth is only about half as long as the first laterals. Antennae with the ring organ at the proximal third of the basal segment.

Of the eight British species of *Glyptotendipes,* five are unknown as larvae.

Genus Endochironomus

Consisting of at least three species groups: —

(a) *"Endotendipes"* (Lenz, 1955). Recognised by the relatively deep incision between the two median teeth, which are smaller than the 1st laterals. Includes the British species *intextus* Walk. and *lepidus* Mg.

(b) *"nymphoides"* group (Lenz, 1955). In this group the median and first lateral teeth are subequal and not separated by deep incisions. Includes the British species *albipennis* Mg. and *tendens* Fab. (N.B., Goetghebuer, 1928, describes *tendens* as having a single median tooth as in, e.g., *Glyptotendipes*).

(c) *"juncicola"* group (Lenz, 1955). In this group the median teeth are often smaller than the first laterals, and they are not separated by deep incisions. Includes the British species *dispar* Mg. Antennae (fig. 11, G). Mandibles (fig. 10, F). Hypostomium (fig. 12, H).

The British species *E. rufipes* (L.) is not known as a larva. This larva may have a single median tooth as in, e.g. *Glyptotendipes* (i.e., the *"signaticornis"* group, Lenz, 1955).

Genus Phaenopsectra

Consisting of at least two species groups, the characters of which are given in the key. Closely related to *Endochironomus.*

(a) *"Sergentia".* Includes the British species *coracinum* Zett. (Lenz, 1941). Hypostomium (fig. 13, G). Mandible (fig. 10, H).

(b) *"Lenzia".* Includes the British species *punctipes* Wiedmann and *flavipes* Mg. (Lenz, 1941).

Phaenopsectra flavipes Mg. Not previously described.

When full grown about 12 mm. long. Ratio of antennal segments, 40 : 12 : 6 : 5 : 4. Ring organ at proximal eighth of basal segment. Antenna (fig. 11, K). Accessory mandibular tooth curved. Inner lobe of maxilla with a series of four blades which decrease in size posteriorly. Hypostomium (fig. 13, H).

Genus Stenochironomus

As well as the characters mentioned in the key, the following may be added from Kalugina (1958):—Abdominal segments not clearly separate, second thoracic segment longer and wider than either the first or third; anal papillae long and narrow, slightly constricted for the basal third; ring organ near basal third of first antennal segment, blade not much longer than second segment.

Two British species: *S. gibbus* (Fab.) described by Kalugina (1958), and *S. fascipennis* Zett. described by Zablotskii (1939).

The accounts given by Zablotskii and Kalugina are in agreement.

However, Roback (1957) gives a different account of larvae in this subgenus: Antennae six segmented; all teeth dark; median teeth longer than first laterals; medians and first laterals may either project beyond the long second laterals, or be recessed between the long second laterals.

It has not been possible to examine any larvae of *Stenochironomus.*

Genus Paratendipes

Antennae six segmented. With sixteen hypostomial teeth, of which the median and first laterals are pale and in a straight line. The remaining laterals are dark and the third lateral teeth are the longest.

Paratendipes albimanus Kieff. Previously described by Bause (1914), Johannsen (1937) and Zavrel (1943).

When full grown about 7-8 mm. long. Ring organ distal to the proximal third of the basal antennal segment. Proximal Lauterborn organ small, distal one larger and extending three quarters of the length of the fourth segment (fig. 11, H). Hypostomial plate (fig. 13, B).

Two British species. *P. nudisquama* Edw. is not known as a larva.

Subgenus Nilothauma

Described by Roback (1957): Antennae 5-segmented. Hypostomium with the median pair of teeth very small, set between the tips of the 1st laterals; 2nd laterals longer than outer laterals. Mandible with a long apical and four short lateral teeth. The laterals set in a straight line. One British species, viz., *N. brayi* Goet. Previously placed in *kribioxenus.*

Genus Microtendipes

Antennae six segmented. Eye spots black and contiguous. Median pair of hypostomial teeth pale, laterals dark, 1st laterals small, 2nd laterals long. In some larvae a minute median tooth is present at the base of the incision between the median pair of teeth. It is possible that in some species the median pair of teeth may be more or less darkened.

Microtendipes diffinis Edw. Not described previously.

When full grown about 12 mm. long. Ratio of antennal segments, 37 : 6 : 7 : 6 : 5 : 3. Ring organ at proximal fourth of basal

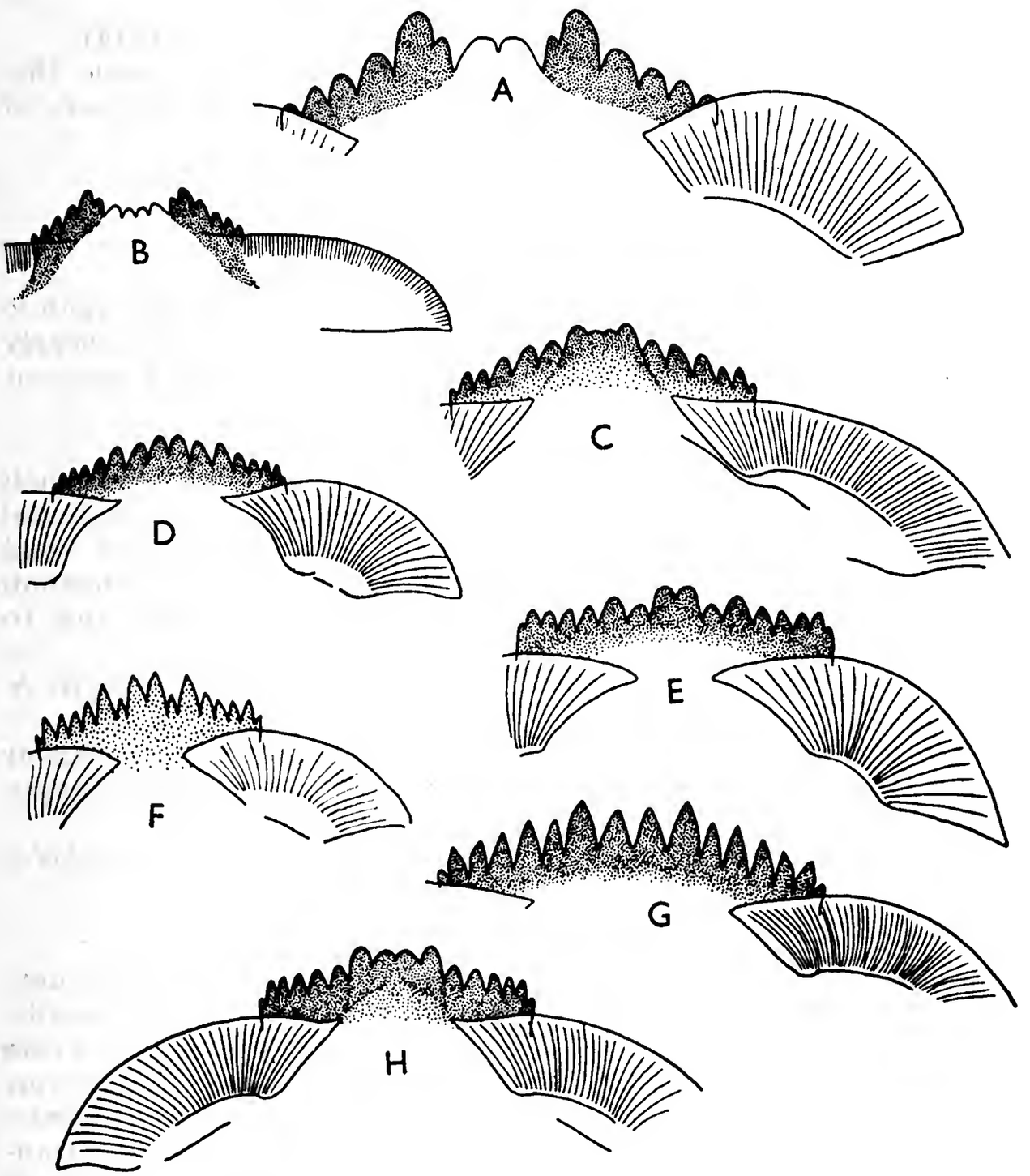

Fig. 13.—Chironominae, hypostomial region. A, *Microtendipes diffinis* Edw. B, *Paratendipes albimanus* Mg. C, *Stictochironomus pictulus* Mg. D, *Polypedilum laetum* Mg. E, *P. "nubeculosum"* gr. F, *P. tritum* (Walk.). G, *Phaenopsectra coracinum* (Zett.). H, *Phaenopsectra flavipes* Mg.

segment. Epipharyngeal comb of three to five scales and, anterior to this, in the 'ventral row of the labrum', a pair of scales recurve into a total of ca. 16 teeth giving the appearance of a comb. Dorsal apical mandibular tooth pale (fig. 10, G). Maxillary palp almost twice as long as broad. Hypostomial plate with fourteen teeth (fig. 13, A).

Microtendipes pedellus Deg. Previously described by Gouin (1936).

The larva of this species and that of *M. diffinis* appear to be identical. Gouin states that the comb in the 'ventral row of the labrum' consists of 20 teeth.

Microtendipes chloris Mg. Partly described by Bause (1914).

Similar to *M. diffinis.* Lauterborn organs almost sessile (fig. 11, J). The comb in the ventral row of the labrum consists of 22-28 fine teeth. Posterior segments, fig. 9, E.

Of ten British species, only three are known as larvae.

Genus Stictochironomus

Antennae six segmented. Sixteen hypostomial teeth, middle pair small, first laterals long. Median and first lateral teeth clearly anterior to remaining laterals. Penultimate abdominal segment without tubuli.

Stictochironomus pictulus Mg. Not previously described.

When full grown about 12 mm. long. Head strikingly small when compared with the first thoracic segment. Ratio of antennal segments, 40 : 6 : 6 : 6 : 5 : 4. Ring organ at proximal third of basal segment (fig. 11, I). Hypostomium, fig. 13, C (N.B., the median and first lateral teeth often appear as a single structure due to wear).

S. histrio (Fab.). Described by Lenz, 1941. Similar to *S. pictulus.*

S. maculipennis Mg. Described by Goetghebuer, 1928. Similar to *S. pictulus,* but may differ in having the second lateral hypostomial teeth relatively shorter.

The only British species not known as a larva is *S. rosenscholdi* Zett.

Genus Polypedilum

The characters of the four species groups are given in the key. Note also that the anal papillae are often constricted in the middle.

(a) *"laetum"* group. Includes the British species *P. laetum* Mg. When full grown, about 10-12 mm. long. Posterior abdominal segments, fig. 9, F. Ratio of antennal segments, 20 : 7 : 5 : 6 : 2. Second antennal segment with a peg-like rudimentary lauterborn organ (fig. 11, F). Epipharyngeal comb with nine teeth. Hypostomium with 14 dark teeth, medians long, laterals progressively smaller (fig. 13, D).

(b) *"nubeculosum"* group (Lenz, 1941). Hypostomium, fig. 13, E. Includes the British species *leucopum* Mg., *nubeculosum* Mg., and *prolixitarsis* Lundstr.

(c) "*convictum*" group (Lenz, 1941). Includes the British species *acutum* (Kieff.), *convictum* Walk., and *scaelinum* (Schrank.).

N.B. There are two types of *scaelinum* larvae: one with normal antennae; the other with apparently 4-segmented antennae, 3rd segment very small, 2nd and 4th long, subequal (Roback, 1957).

(d) "*Pentapedilum s. str.*" Previously placed with *Phaenopsectra* and *Kiefferulus* but now regarded as a sub-genus of *Polypedilum*. Hypostomium, fig. 13, F. Includes the British species *tritum* Walk and *uncinatum* Goet.

Polypedilum rydalensis Edw. *P. flavonervosus* Staeg., *P. nubens* Edw. and *P. sordens* Wulp. are not known as larvae.

Genus Lauterborniella sens. lat.

Consisting of three groups which have been given generic status (Lenz, 1941):—

(a) *Zavreliella.* Larvae living in a spindle-shaped case. Prepenultimate abdominal segment with a pair of long ventral tubuli; penultimate segment with an oralwards directed dorsal projection. Hypostomium with the median pair and second lateral teeth long, the first laterals small; the base with a lateral tuft of setae.

Includes the British species *Z. marmoratus* Wulp.

(b) *Lauterborniella s. s.* Larvae living in a fusiform case. Prepenultimate abdominal segment with a pair of short lateral processes; penultimate segment with an analwards directed projection. Hypostomium as in *Zavreliella* but with only a single lateral seta at the base. Antennae with large Lauterborn organs.

Includes the British species *L. agrayloides* (Kieff.).

(c) *Paralauterborniella.* Antennae six segmented and hypostomium with a broad pale median membranous tooth and six dark laterals on each side.

Includes the British species *P. brachylabis* Edw.

The only British *Lauterborniella sens. lat.* unknown as a larva is *L. orophilus* Edw.

(2) Tanypodinae (Pelopiinae)

The larvae of the *Tanypodinae* do not construct tubes and are usually predaceous, often on other chironomid larvae. They have retractile antennae and a single pair of eye-spots. The labium-hypopharynx has a well developed supporting framework.

The genera of the *Tanypodinae* may be separated by the following key (partly after Lenz,* 1936):—

1. Narrow. Head index (100 × breadth: length) 45-66. Labrum with numerous clear "club-setae" at the front edge (fig. 14, L-O). No "paralabial combs" but hypostomium with "labial bladders" (fig. 15, L-O). Body without swim-setae. Both pairs of anal papillae situated near to the anal orifice (fig. 9, J-M) ..... (*Pentaneurini*) *Pentaneura.*
   With broad segments. Head index 66-100. Labrum with

*In Hennig (1950).

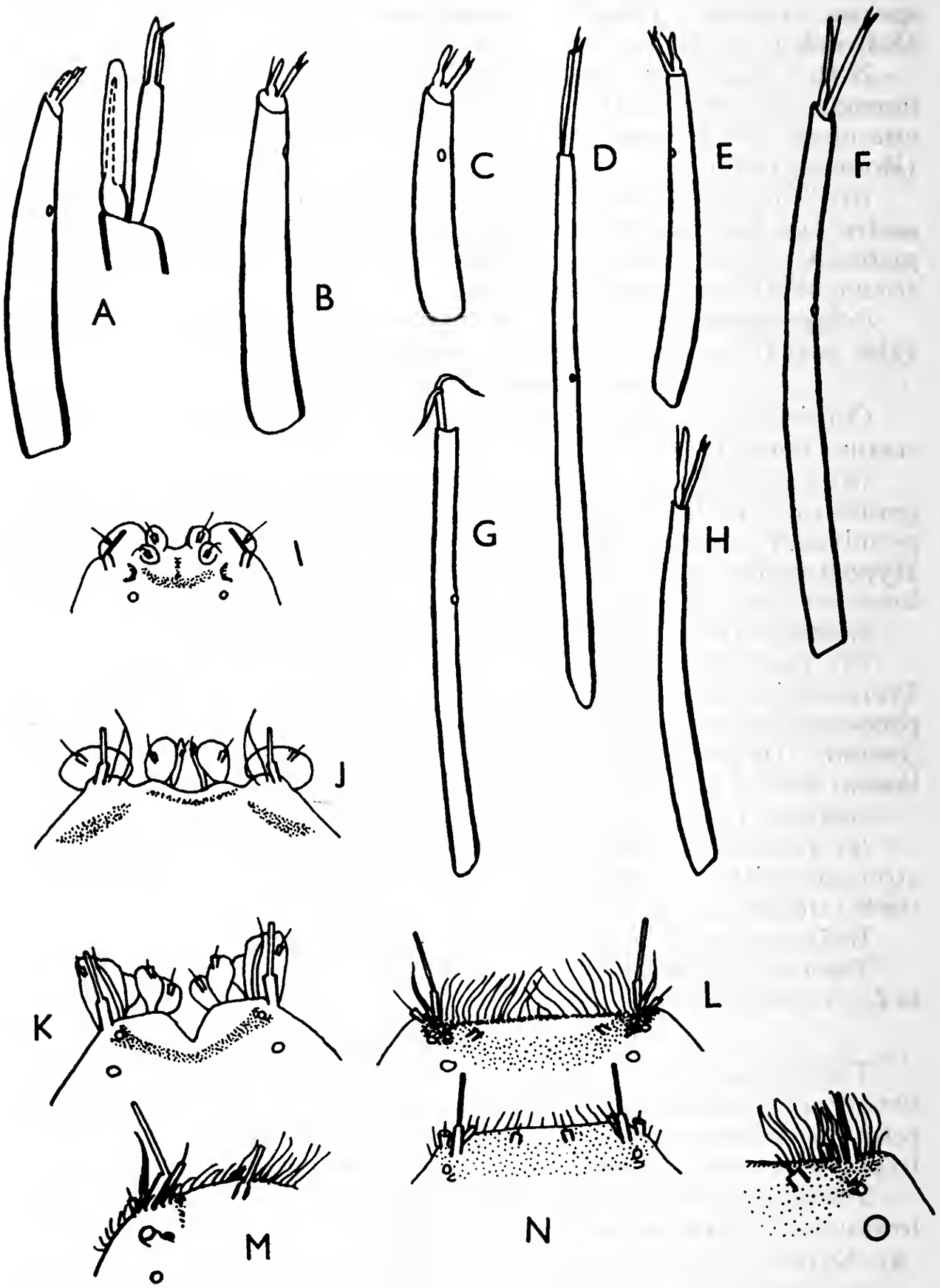

Fig. 14.—Tanypodinae. A-H, Antennae. I-O, Dorsal views of labrum. A, I, *Anatopynia goetghebueri*. B, J, *A. varia*. C, K, *Procladius choreus*. D, *Pentaneura monilis*. E, L, *Pentaneura lentignosa*. F, M, *P. longimana*. G, N, *P. nubila*. H, O, *P. northumbrica*.

six sense bladders in front (figs. 14, I-K). Hypostomium with "paralabial combs" (fig. 15, I-K), *or,* with separate sclerotised points (see p. 53). Body with swim-setae. Anal papillae relatively short, the ventral pair (or, when three pairs are present, the second pair) situated on the base of the pseudopods (fig. 9, H-I) ..... *Tanypodinae,* 2.

2. No "paralabial combs", instead separate sclerotised points (see p. 53). Antennae three quarters as long as head ..... *Clinotanypus.*

"Paralabial combs" present. Antenna $\frac{1}{4}$-$\frac{1}{3}$ as long as head .. 3.

3. Six anal papillae. Glossa with five equal yellow teeth ... *Tanypus.*

Four anal papillae ..... 4.

4. Paraglossae scale-like with a toothed edge (fig. 15, C) and glossa five-toothed (*Procladius* and *Psilotanypus*) ..... 5.

Either paraglossae with a toothed edge and glossa with four yellow teeth (fig. 15, B), *or,* paraglossae bifid (N.B., one point may be reduced to a spur) and glossa five-toothed (fig. 15, A) ..... *Anatopynia sens. lat.,* 6.

5. "The free margin of maxillary lobe with only thick clavate blunt setae" (Koreneva, 1957). Posterior border of head darkened at most only on the ventral side ... *Psilotanypus.*

"The free margin of maxillary lobe with both thick and slender bifurcated setae" (Koreneva, 1957). Posterior border of head dark all over ..... *Procladius.*

6. Glossa four toothed (fig. 15, B) ... *Anatopynia* (*Psectrotanypus*) *varia* F.

Glossa five toothed (fig. 15, A) ..... 7.

7. Paraglossae small, the two end teeth of equal length. Mandibles hook-like with distinct small lateral and "side-teeth" (Lenz,* 1936). Probably no British representatives) ... *Anatopynia s.s.*

Paraglossae stylet-like, the two end teeth of unequal length. Mandibles and labrum with tufts of setae ("bristle-brushes") ..... 8.

8. Head dark brown. Maxillary palp twice as long as broad at the base. "Paralabial comb" with five teeth. Body dark brown with yellow marmorations ..... *Anatopynia* (*Psectrotanypus*) *trifascipennis* Zett.

Head reddish yellow. Maxillary palp more than twice as long as broad at the base. "Paralabial comb" with seven teeth. Body usually blood red ..... *Anatopynia,* s.g. *Macropelopia.*

Genus Clinotanypus

The main diagnostic feature is the presence of a row of minute spines parallel to each free edge of the sub-triangular hypostomium. These spines may easily be overlooked as they are not visible under a low magnification. It has not been possible to examine material of the one British species, *C. nervosus* (Mg.).

*In Hennig (1950).

Genus Psilotanypus

P. rufovittatus is described by Koreneva (1957). This author states (unpublished) that it is not yet known whether the form of the maxillary setae will hold good as a means of separating all species of *Psilotanypus* from *Procladius*.

The British species *lugens* Kieff. and *flavifrons* Edw. are not known as larvae.

Genus Procladius

The diagnostic features are given in the key. The larvae are brown with white or yellow marmorations.

Procladius choreus Mg. Described many times previously, a good account being that of Malloch (1917).

When full grown about 9 mm. long. Dorsal preanal papillae each with a tuft of about 16 long setae. Anal papillae short, pointed (fig. 9, I). Ratio of antennal segments, $50:6:2\frac{1}{2}:1\frac{1}{2}$ (fig. 14, C). Labrum (fig. 14, K) with the usual sensory bladders, etc. Mandibles (fig. 10, K) with a long dark apical tooth and a smaller tooth at the distal fourth of the concave face with a "side-tooth" lateral to it.. Glossa (fig. 15, C) with five dark teeth, the median smallest, the outermost largest. Paraglossae with their outer edges serrated. "Paralabial" combs each with ca. 8 teeth and hypostomium almost trifoliate (fig. 15, K).

P. crassinervis Zett. and *P. sagittalis* Kieff. Adults referable to these two species have been reared from larvae morphologically indistinguishable from larvae of *P. choreus* Mg.

The British species *P. simplicistilus* Freeman is not known as a larva.

Genus Tanypus

The larvae in this genus are easily recognised by the presence of six anal papillae instead of the usual four.

It has not been possible to examine any larvae of the British species *T. punctipennis* Mg. and *T. vilipennis* (Kieff.).

Genus Anatopynia sens. lat.

Four anal papillae. "Paralabial combs" present. Either glossa five toothed and paraglossae bifid, or, glossa four toothed and paraglossae pectinate.

Anatopynia (*Macropelopia*) *nebulosa* Mg. Already described (pp. 28-32).

Anatopynia (*Macropelopia*) *goetghebueri* Kieff. Little has been published concerning this larva. Zavrel and Thienemann (1921) merely state that this larva (as *M. adaucta* synonym) differs little from that of *M. bimaculata* (= *A. notata* Mg.). Morgan (1949) briefly refers to the larva.

The larva is similar to *A. nebulosa* Mg. and when full grown is about 10 mm. long and brownish red in colour. Ratio of antennal segments, 60:5:2:1 (fig. 14, A). Mandibles as in fig. 10, I). Hypostomium (fig. 15, I) with the free edges showing less indication of folding or indentation than in *A. nebulosa* Mg.

Anatopynia (*Psectrotanypus*) *trifascipennis* (Zett.). Similar to *A. nebulosa* Mg. but easily recognised, even when alive, by the dark reddish-brown colour of the head capsule (yellowish-red, paler, in the other species of this genus). This larva differs from *A. varia* F. in the form of the glossa and paraglossae.

Anatopynia (*Psectrotanypus*) *varia* F. Described several times previously, a good account being that of Zavrel and Thienemann (1921).

Similar to *A. nebulosa* Mg. but differing as follows:—Ring organ near distal fourth of basal antennal segment (fig. 14, B). Mandibles (fig. 10, J) with a row of small teeth along the concave margin. Posterior maxillary sclerite (subcardo) with a single seta from its median projection (cf. a tuft of setae in *A. nebulosa* Mg.). Hypostomium with two indentations near the middle of each free edge, with a small, bladder-like outpushing between them (fig. 15, J). Glossa, fig. 15, B.

It has not been possible to examine larvae of *A. notata* (Mg.), *A. punctata* (Fab.), or *A. nugax* (Walk.).

Genus Pentaneura

Head clearly long and narrow. No "paralabial" combs. Antennae about half as long as head and about three times as long as mandibles.

This is a large genus, many of whose members are not known as larvae.

Pentaneura (*Isoplastus*) *monilis* L. Described many times previously (Hennig, 1950).

When full grown 6-7 mm. long and yellowish-brown in colour. Antennae (fig. 14, D) with the ratio basal segment: end segments about 6:1. Mandibles (fig. 10, L) slender, with two acute "side-teeth" on the concave side. Maxillary palp long, segmented; lacinial lobe of maxilla with long "club-setae". Hypostomium (fig. 15, L) triangular with a "labial bladder" on each side. Glossa (fig. 15, D) with five dark teeth of which the median is slightly shorter than the laterals. Each paraglossa with a long outer and a short inner prong.

Pentaneura lentignosa Fries. Not previously described.

When full grown about 10 mm. long and amber in colour. Each dorsal preanal papilla with an apical brush of 6-8 long setae. Anal papillae each almost four times as long as broad, bluntly acute at the tip and slightly constricted at the base (fig. 9, J). Ring organ at distal fourth of basal antennal segment (fig. 14, E). Anterior edge of labrum pale, with a number of weak blades and setae (fig. 14, L). Mandibles (fig. 10, M) elongate, curved, with an acute black apical tooth and a pair of small teeth on the concave side. Maxillary palp almost four times as long as wide with a "ring organ" at the distal fourth. Glossa (fig. 15, E) with a waist-like constriction and ending in five dark teeth of which the median is short, the outermost long. The outer fork of each paraglossa a little longer than the inner one. Hypostomium (fig. 15, M) sub-triangular with large "labial bladders".

Pentaneura longimana Staeg. Not previously described.

When full grown about 9 mm. long and pale brown in colour. Anal papillae (fig. 9, K) each tapering to an acute apex. The anal pseudopods each end in two different types of crotchets. Ring organ distal to middle of basal antennal segment (fig. 14, F). Ratio of antennal joints ca. 180 : 30 : 4 : 2. Anterior edge of labrum as in fig. 14, M. Mandibles (fig. 10, N) curved; apical tooth dark, bluntly acute; "side-teeth" of concave region greatly reduced. Maxillary palp about five times as long as wide; lacinial lobe of maxilla with a fringe of long narrow "club-setae". Hypostomium (fig. 15, N) subtriangular, anterior angle blunt. Glossa (fig. 15, F) slightly constricted, with the median and first lateral teeth of equal length, the outer pair (i.e., 2nd laterals) longer. The inner prong of each paraglossa is reduced to a spur.

Pentaneura nubila Kieff. Not previously described.

When full grown about 9 mm. long and pale brown in colour. Anal papillae (fig. 9, L) acute. Crotchets of anal pseudopods elongate and all of one kind. Ring organ distal to middle of basal antennal segment (fig. 14, G). Ratio antennal segments one: two is 12 : 1. Segment two with two apical flagella. Anterior edge of labrum (fig. 14, N) fringed by weak setae. Mandible (fig. 10, O) with a pair of distinct elongate teeth on the concave face. Maxillary palp about three and a half times as long as broad with a median "ring organ". Hypostomium (fig. 15, O) triangular. Glossa (fig. 15, G) with a proximal constriction and distally five equal dark teeth. Outer fork of each paraglossa a little longer than the inner one.

Pentaneura northumbrica Edw. Not previously described.

When full grown 8-9 mm. long and yellowish-white in colour. Anal papillae (fig. 9, M) acute. Crotchets of anal pseudopods of two kinds; one long, narrow, and slightly curved; the other short, broad, and curved. Ring organ before distal fourth of curved basal antennal segment (fig. 14, H). Ratio of segments 80 : 12 : 3 : 1. Mandibles (fig. 10, P) curved, wide proximally, narrow distally, with a pair of "side-teeth" on the distal concave region. Maxillary palp with a "ring organ" at the distal fourth. Glossa (fig. 15, H) with a waist-like constriction and five apical teeth of which the median is short and the outer pair are long. The outer edge of each first lateral tooth is clearly concave (convex in most spp.). Paraglossae with the outer fork longest.

(5) Discussion

(A) Morphology

The structures of the head capsules of the three species described (pp. 21-32) may be better understood when examined in relation to their modes of feeding:

Chironomus and *Prodiamesa*

Chironomus larvae usually feed on detritus from the ends of their tubes and they are also capable of filter feeding. *Prodiamesa* larvae are free living in sand where they ingest fine particles

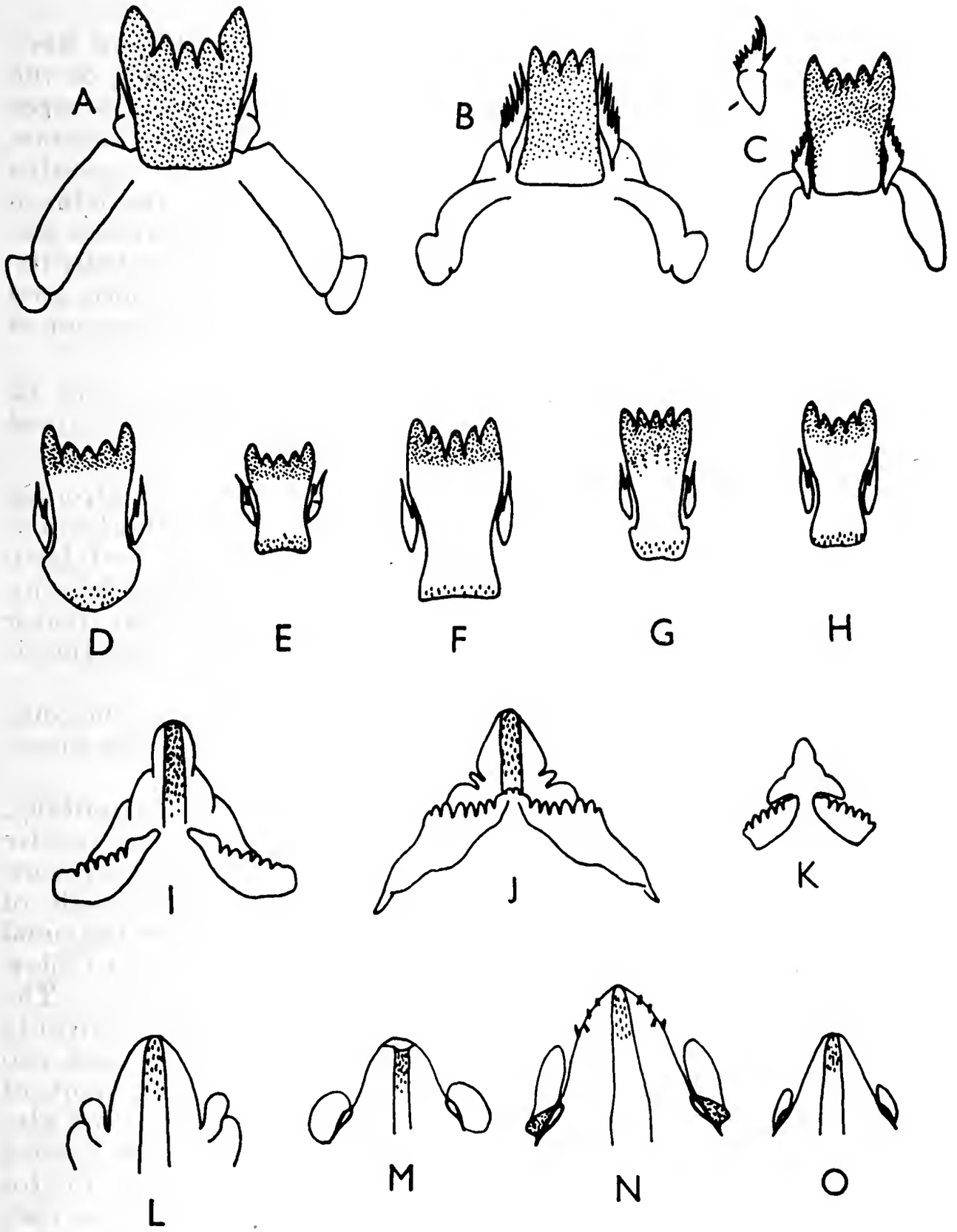

Fig. 15.—Tanypodinae. A-H, Glossae and paraglossae. I-K, Hypostomium and "labial combs". L-O, Hypostomium and labial bladders. A, I, *Anatopynia goetghebueri*. B, J, *A. varia*. C, K, *Procladius choreus* (inset a paraglossa). D, L, *Pentaneura monilis*. E, M, *P. lentignosa*. F, N, *P. longimana*. G, O, *P. nubila*. H, *P. northumbrica*.

almost in earthworm fashion. As these methods of feeding do not greatly differ, the head capsule morphology is similar in both genera.

In both *Chironomus* and *Prodiamesa* the mandibles are stout and move in an oblique plane, biting against the teeth of the hypostomial plate. The latter plate also functions as a scraper for feeding from surfaces. The combination of armed labrum, mandibles and hypostomial plate forms an efficient apparatus for the above types of feeding. The musculature of the labrum is such that the epipharyngeal crotchets and premandibles can be moved downwards and backwards, thus interlocking with the setae of the dorsal mandibular comb and helping to push food into the mouth. This act is also facilitated by the movement of the inner proximal mandibular brush.

Goetghebuer (1912) notes that the premandibles cannot be regarded as homologous with the epipharyngeal crotchets as these have no special muscles.

In *Chironomus* the hypopharyngeal surface is not strongly developed. This surface is better developed in *Prodiamesa* and its backwardly-directed spinules presumably push food down the oesophagus by the action of the ventral muscles of the labium-hypopharynx. In both genera the cibarial muscles and dilator pharyngeal muscles are slender and few in number and this is consistent with feeding on small particles.

Anatopynia larvae are free living and actively predaceous. Therefore the head capsule differs from the type seen in the above two genera.

In *Anatopynia* the mandibles are falciform, move horizontally, and bite against each other. They function as pincers to seize the prey and pass it to the mouth, as these animals do not chew the food, but swallow it whole. Associated with this mode of feeding there is no epipharyngeal armament, no inner proximal mandibular brush, and the hypostomium is membranous to allow for expansion instead of being a rigid toothed structure. The form and musculature of the labium-hypopharynx have already been described (pp. 29 and 32). The fact that the glossa can rotate so that its teeth point down the oesophagus is important for pushing the prey into the gut. The hypopharyngeal teeth also function for this purpose. Now in order to facilitate swallowing the prey whole there has been a great development of dilator pharyngeal muscles and cibarial muscles. These dilators may partly account for the posterior expansion of the clypeus. The retractile nature of antennae and maxillary palps and the general body form are also associated with the mode of life of this larva.

Thus the main morphological differences between the tanypodine and non-tanypodine larvae appear to be related to their modes of feeding. Certain other differences between groups of chironomid larvae (e.g., presence or absence of haemoglobin) appear to be related to the conditions of the habitats in which they live.

(B) Systematics

"In winged insects adult and larva have evolved along quite different lines and, therefore, neither adult nor larval characters have over-riding importance for taxonomy" (Van Emden, 1955). Furthermore, the characters used in the foregoing account for separation of chironomid larvae (mouth parts, etc.) are highly adaptive, so that it is not surprising that the larval groups do not entirely correspond to the adult classification.

For the sake of simplicity in use, the keys to the *Chironominae* have been constructed, using mainly features of the antennae and hypostomial plate. As more material becomes available it may be possible to issue detailed accounts of the larvae within each clearly definable group using all available characters.

Although the larvae of the *Tanypodinae* may be easily separated into genera, there is still much scope for further work, particularly on the difficult genus *Pentaneura*.

In a number of cases the evidence from the larvae casts doubt on the validity of some species. This seems to be the case with *Microtendipes diffinis* Edw. and with some species of *Procladius*. However, in some groups, morphologically identical larvae may belong to more than one species, differences being then of a purely physiological nature. In all such cases, work on salivary chromosomes may provide more conclusive results.

This paper shows, if nothing else, that there is still much scope for further work on the systematics of chironomid larvae. It is hoped that it will provide a basis for further work and also be of some immediate use to persons interested in fresh water biology.

(6) Acknowledgments

I wish to thank Professor L. E. S. Eastham for supervision and facilities at the Department of Zoology, Sheffield University; Mr. J. Hancock for photographic assistance; Dr. W. D. Hincks for suggesting the work; Mr. A. Brindle for assistance in collecting material; Dr. P. Freeman for checking the identifications; Professor F. Lenz, Dr. Fittkau and Dr. Koreneva for supplying material; Mr. P. Holmes for permitting collecting at Malham Tarn; the Manager of the Trout Farm, Dunsop Bridge, and the gamekeepers at Malham and Whitewell.

Part of the work was carried out during the tenure of a Nature Conservancy Research Studentship at Sheffield.

(7) References

Acton, A. B. 1955. Larval groups in the sub-genus *Chironomus* Mg. *Arch. Hydrobiol.* **50**: 64-75.

Acton, A. B. 1956. The identification and distribution of the larvae of some species of *Chironomus* (Dipt.). *Proc. R. Ent. Soc. Lond.* (A) **31**: 161-164.

Andersen, F. S. 1949. On the subgenus *Chironomus*, III. *Vidensk. Medd. Fra. Dansk. Naturh. Foren.* Bd. **111**.

Bause, E. 1914. Die Metamorphose Der Gattung *Tanytarsus*. *Arch. Hydrobiol. Suppl.*, **II**: 1-128.

Branch, H. E. 1923. The life history of *Chironomus cristatus* Fab. with descriptions of the species. *Journ. N. Y. Ent. Soc.*, **31**: 15-30.

Bryce, D. 1958. The postembryonic stages of the Chironomidae. Ph.D. thesis, University of Sheffield.

Coe, R. L. 1953. Handbooks for the identification of British Insects, **IX**, 2, *Diptera, Nematocera*: 121-206. London.

Edwards, F. W. 1929. British Non-Biting Midges (Diptera, Chironomidae). *Trans. Ent. Soc. Lond.*, **77**: 279-430.

Goetghebuer, M. 1912. Etudes sur les Chironomides de Belgique. *Mém. Acad. Roy. Belg.* (Cl. des Sciences), **3**: 1-26.

Goetghebuer, M. 1914. Recherches sur les larves et les nymphes des Chironomides de Belgique. *Mém. Acad. Roy. Belg.* (Cl. des Sciences), **3**: 1-48.

Goetghebuer, M. 1919. Observations sur les larves et les nymphes de quelques Chironomides de Belgique. *Ann. Biol. Lac.*, **9**: 51-78.

Goetghebuer, M. 1928. *Faune de France, 18*, Chironomidae **III**: 1-174. Paris.

Gouin, F. 1936. Métamorphoses de quelques Chironomides d'Alsace et Lorraine. *Rev. Franc. Ent.*, **3**: 151-173.

Gouin, F. 1957. Etudes sur l'anatomie de la tête larvaire de quelques Chironomidae (Dipt. Nematoc.) I—Les structures Chironomines. *Ann. Soc. Ent. Franc.*, **126**: 107-138.

Gouin, F. 1959. Morphology of the larval head of some *Chironomidae* (Diptera, Nematocera). *Smithsonian Misc. Collections*, **137**: 175-201.

Gripekoven, H. 1914. Minierende Tendipediden. *Arch. Hydrobiol. Suppl.*, **2**: 129-230.

Harnisch, O. 1923. Metamorphose und System der Gattung *Cryptochironomus* K., *sens. lat. Zool. Jahreb., Syst.*, **47**: 271-308.

Hennig, W. 1950. *Die Larvenformen Der Diptern, II* Teil: 277-324. Berlin.

Johannsen, O. A. 1937. Aquatic Diptera, **III**: 3-80; **IV**: 3-57. *Mem. Cornell Univ. Agric. Expt. Sta.*, **205**.

Jonasson, P. M. 1955. The efficiency of sieving techniques for sampling fresh water botton fauna. *Oikos*, vol. **6**, fasc. *2*: 183-207.

Kalugina, H. C. 1958. *Stenochironomus gibbus* Fab. "Scientific Reports of Universities," Moscow, No. **I**: 21-26.

Kraatz, W. 1911. Chironomiden Metamorphosen. *Jahresber. Westfal. Pros. Ver. Wissensch. Kunst. Zool. Sekt.*, **39**: 71-114.

Koreneva, T. A. Muragina. 1957. The Ecology and Systematic of the Pelopiinae (Diptera, Tendipedidae) of the Utsha Reservoir, Vicinitu of Moscow. *Revue d'Entomologie de l'URSS, XXXVI*, **2**: 436-450.

Lenz, F. 1921. Chironomiden Puppen und Larven. *Deutche. Ent. Zeit.*: 148-162.

Lenz, F. 1927. Chironomiden aus Norwegischen Hochebirgesseen. *Nyt. Magasin. Fur Naturvid.*, **66**: 111-192.

LENZ, F. 1937. Die *Einfeldia*—Gruppe der Chironomariae. Morphologie und Ökologie der Larven und Puppen. *Festschrift STRAND*, **2**: 289-301.

LENZ, F. 1938. Die Gattung *Parachironomus*. Beschreibung der Larve und Puppe von *P. varus* Goet. nebst einer Übersicht über die Gattung. *Arch. Hydrobiol*, **32**: 700-714.

LENZ, F. 1941. Die Jungenstadien der Sectio Chironomariae (Tendipedini) connectentes (subf. Chironominae = Tendipedinae). *Arch. Hydrobiol.*, **38**: 1-69.

LENZ, F. 1955. Revision der Gattung *Endochironomus* Kieff. (Diptera, Tendipedidae). *Zeitschrift fur Angewandte Zoologie.*, Part **I**: 109-121.

LENZ, F., and GOETGHEBUER, M. 1936. *Tendipedinae-Pelopiinae* in Linder, *Die Fliegan der Paläarktischen Region*, 13b, Stuttgart.

MALLOCH, J. R. 1915. Chironomidae, or Midges of Illinois. *Illinois State Lab. Nat. Hist. Bull.*, **10**: 275-543.

MALLOCH, J. R. 1917. A Preliminary Classification of Diptera, *Ibid.*, **12**: 161-410.

MORGAN, M. J. 1949. Notes on the Morphology of Some Species of Tanypodinae (Diptera: Chironomidae). *Proc. Roy. Ent. Soc. Lond.*, **24**: 39-45.

PAGAST, F. 1931. Chironomiden aus der Bodenfauna des Usma-Sees in Kurland. *Folia Zool. Hydrobiol.*, **3**: 199-248.

PAGAST, F. 1932. Über die Metamorphosestadien von *Chironomus vulneratus* Zett. (Gruppe *Cryptochironomus* s. str.). *Konowia*, **11**: 155-162.

PAGAST, F. 1934. Über die Metamorphose von *Chironomus xenolabis* Kieff., eines Schwammparasiten. *Zool. Anz.*, **105**: 155-158.

PAGAST, F. 1936. Chironomidenstudien II. *Stett. Ent. Zeit.*, **97**: 270-278.

ROBACK, SELWYN S. 1957. The Immature Tendipedids of the Philadelphia area. *Acad. Nat. Sci. Philadelphia.* Monograph No. **9**.

THIENEMANN, A. 1941. Lapplandische Chironomiden. *Arch. Hydrobiol. Suppl.*, **17**: 1-253.

TSCHERNOVSKY (or CHERNOVSKY). 1949. List of the Culicine Family Tendipedenae. Tabl. *Anal. Faune. U.R.S.S.*

VAN EMDEN, F. I. 1955. In GORDON, I. Importance of Larval Characters in Classification. *Nature*, **176**: 911-912.

ZABLOTSKII, A. A. 1939. Larvae and Nymphes of *Stenochironomus fascipennis* Zett. *Trav. Inst. Biol. Peterhof, Leningrad*, **17**: 143-148.

ZAVREL, J., and THIENEMANN, A. 1916 and 1921. Die Metamorphose der Tanypinen, I and II. *Arch. Hydrobiol. Suppl.*, **2**: 566-654 and 655-784.

ZAVREL, J. 1943. Holenbewohnende Chironomiden Larven. *Arch. Hydrobiol*, **40**: 250-264.

(8) Key to Lettering of Figures

a. Antenna.
a.f. Anterior field.

a.m.p.	Anterior median sclerite.
r.a.	Muscle from antenna.
bl.	Blade from first antennal segment.
c.	"Paralabial comb".
c.m.	Circular muscles.
d.ph.m.	Dorsal dilator pharyngeal muscles.
el, el. 1, 2.	Labro-epipharyngeal muscles.
ep.	Epipharynx.
ep.a.	Epipharyngeal armament.
ep.c.	Epipharyngeal crotchets.
gl.	Glossa.
hp.	Hypopharynx.
h.p.f.	Hypopharyngeal framework.
hp.m. 1, 2.	Hypopharyngeal muscles.
hp.p.	"Hypopharyngeal palps".
hp.t.	Hypopharyngeal teeth.
h.s.	Hypostomium.
j.	Suture between labrum and fronto-clypeus.
l.	Labrum.
lm.	Labium.
l.m. 1, 2.	Motor muscles of labrum.
l.m.f.	Lateral membranous field.
l.m.o.	Longitudinal muscles.
l.o.	Lauterborn organ.
l.ph.m. 1, 2.	Lateral dilator pharyngeal muscles.
md.	Mandible.
md.b.	Mandibular brush.
md.f.	Flexor muscle of mandible.
md.e.	Extensor muscle of mandible.
mx.	Maxilla.
mx.m.	Muscle from basal plates of maxilla.
mx.p.	Maxillary palp.
mx.p.m.	Muscle from maxillary palp.
pgl.	Paraglossa.
ph.	Pharynx.
ph.m.	Dilator pharyngeal muscle.
pl.	"Paralabial" plate.
pm.	Premandible.
p.m.p.	Posterior median sclerite.
r.o.	Ring organ.
s.d.	Salivary duct.
st.m.	Stipitial muscle.
t.p.	Triangular sclerite.
t'.p.	Trapezoidal sclerite.
u.p.	U-shaped sclerite.
v.l.ph.m.	Ventro-lateral pharyngeal muscles.
v.r.e.	"Ventral seta row of labrum".

LEPIDOPTERA

List of the Lepidoptera of Dorset. Part 2. By W. Parkinson Curtis, 1947. 138 pp., 4 pls., 11s. 0d.

Postural Habits and Colour-Pattern Evolution in Lepidoptera. By M. W. R. de V. Graham, 1950. 16 pp., 4 pls., 4 figs., 4s. 0d.

The Life History and Behaviour of *Coleophora alticolella* Zell. By A. M. Jordan, 1958. 16 pp., 10s. 0d.

HYMENOPTERA

The Hymenoptera Aculeata of Bedfordshire. By V. H. Chambers, 1949. 56 pp., 3 maps, 10s. 0d.

An Introduction to the Natural History of British Sawflies. By R. B. Benson, 1950. 98 pp., 9 pls., 10s. 0d.

Notes on Some British Myrmaridae. By W. D. Hincks, 1950. 42 pp., 5 figs., 1 pl., 5s. 0d.

The British Species of the Genus *Ooctonus* Haliday, with a Note on some Recent Work on the Fairy Flies (Hym., Myrmaridae). By W. D. Hincks, 1952. 12 pp., 8 figs., 4s. 0d.

The Natural History of some *Pamphilius* Species (Hym., Pamphiliidae). By V. H. Chambers, 1952. 16 pp., 4 pls., 5s. 0d.

A Study of some British Species of *Synergus*. By J. Ross, 1951. 16 pp., 4s. 0d.

A Revision of Section I (Mayr, 1872) of the Genus *Synergus* (Hym., Cynipidae) in Britain, with a Species New to Science. By R. D. Eady, 1952. 12 pp., 4 pls., 4s. 0d.

The British Ants Allied to *Formica fusca* L. (Hym., Formicidae). By I. H. H. Yarrow, 1954. 16 pp., 8 figs., 3 maps, 5s. 0d.

The British Ants Allied to *Formica rufa* L. (Hym., Formicidae). By I. H. H. Yarrow, 1955. 48 pp., 58 figs., 1 map, 10s. 6d.

Keys to the British Genera and Species of Elachertinae, Eulophinae, Entedontinae and Euderinae (Chalcoidea). By M. W. R. de V. Graham, 1959. 36 pp., 12s. 6d.

A Contribution to the Biology and Taxonomy of the British Species of the Genus *Eudecatoma* Ashmead (Eurytomidae). By M. F. Claridge, 1959. 20 pp., 7s. 0d.

The British Species of the Genus *Alaptus* Haliday in Walker (Chalcidoidea Mymaridae). By W. D. Hincks, 1959. 12 pp., 7s. 6d.

Notes on Pteromalidae (Chalcidoidea) with descriptions of New Genera and Species. By M. W. R. de V. Graham, 1959. 16 pp., 7s. 6d.

A Key to the Species of Ants (Formicidae). By C. A. Collingwood, 1958. 28 pp., 10s. 6d.

Systematic Notes on British and Swedish Cleonymidae, with Description of a New Genus (Chalcidoidea). By G. J. Kerrich and M. W. R. de V. Graham, 1957. 48 pp., 15s. 0d.

DIPTERA

An Outline of a Revised Classification of the Syrphidae (Diptera) on Phylogenetic Lines. By E. R. Goffe, 1952. 28 pp., 3 figs., 6s. 0d.

A Revision of the British (and notes on other) Species of Lonchaeidae (Diptera). By J. E. Collin, 1953. 28 pp., 3 pls., 3 figs., 6s. 0d.

The Distribution and Habits of the British Conopidae (Dipt.). By Kenneth G. V. Smith, 1959. 20 pp., 10s. 6d.

Notes on the Identification of *Limnophila* Larvae (Tipulidae). By Allan Brindle, 1958. 12 pp., 5s. 0d.

A Short Synopsis of the British Scatophagidae. By J. E. Collin, 1958. 20 pp., 7s. 6d.

A Review of the British Subfamilies and Genera of the Family Muscidae. By E. C. M. D'A. Fonseca, 1956. 16 pp., 6s. 0d.

ORDERS, accompanied by the appropriate remittance, should be addressed to Dr. W. D. HINCKS, Manchester Museum, Manchester 13.

CONTENTS.

T. BUNCLE AND CO. LTD., ARBROATH.