# STUDIES IN AUSTRALIAN EMBIOPTERA.

## PART I. SYSTEMATICS.

By Consett Davis, B.Sc.
(*From the Zoology Department, Sydney University.*)

(Forty-three Text-figures.)

[Read 30th September, 1936.]



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### *Introduction.*

The Embioptera represent an order in which some doubt still exists regarding internal anatomy, embryology, and general bionomics; moreover, certain sclerites are of doubtful homology, particularly the cercus-basipodites, and the relation of the genital aperture of the male to the ninth and tenth sternites is obscure.

With regard to internal anatomy, the earlier reports (e.g., Grassi and Sandias, 1896; Melander, 1903) are incomplete and conflicting; and although a report has been published more recently by Mukerji (1927), this description is of a different family from that to which the Australian forms belong. Certain details (e.g., of ovariole structure) have not yet been examined. With regard to embryology, three late stages have been described by Melander (1903), but this is the only work on the subject yet published. The bionomics of several foreign species have been detailed (e.g., Imms, 1913), but the life-cycles, feeding habits, and general ecology of the Australian species are almost completely unknown.

It is evident, therefore, that there is need for a considerable amount of research on all these aspects. Since, however, the two species most abundant near Sydney are undescribed, while previous descriptions of the third common species lack details of the diagnostic characters of greatest importance (the male terminalia), it is necessary to deal with the systematics of the order before proceeding to more general questions.

Except in the remarkable instance recorded by Froggatt (1905) of huge numbers of Embioptera occurring at the refinery of the Colonial Sugar Refining Company at Pyrmont—an occurrence recorded again for 1913 by Friederichs (1923)—this order has never been regarded as common in New South Wales. However, search in the field locally has revealed that three species are both widespread and abundant. The descriptions of species from other States are based on material forwarded by Mr. L. Glauert, of the Western Australian Museum; Mr. A. Tonnoir, of the Division of Economic Entomology, C.S.I.R., Canberra; Mr. J. Clark, of the National Museum, Melbourne; Mr. H. M. Hale, of the South Australian Museum, Adelaide; Dr. R. J. Tillyard; and Mr. F. H. Taylor. Certain species from the East Indies were kindly forwarded by Dr. Lieftinck, of the Zoological Museum, Buitenzorg, for examination. My thanks are due to all of these, and to those who have collected material locally; in the latter case, acknowledgement is made when dealing with the species concerned.

All the Embioptera yet discovered in Australia belong to the family Oligotomidae, in which the venation is more specialized and reduced than in the Embiidae. Some of the Australian forms, more especially some of those here described as new, must be regarded as being amongst the most specialized and advanced in the whole order. The absence of the primitive Embiidae suggests that the order reached Australia late in evolutionary history, probably from the Indo-Malayan region.

As far as practicable, the instructions laid down by Ferris (1928) have been adhered to in specific descriptions. The females are all so similar that, although certain species can be recognized one from another, no exact determination of the species can be made from the female alone. In consequence, the female is described fully only in the first species dealt with, and in subsequent species only points of special importance are mentioned. The females described have been taken in association with males of the species stated, and no records have been admitted where there was any possibility of more than one species living in the situation examined.

I follow Ferris's interpretation in designating an allotype female where the male only was known to the original author, and vice versa. Others of the series from which such an allotype has been selected have been designated paraallotypes.

All measurements were made with a calibrated ocular micrometer; this was also used continually in the preparation of diagrams, to ensure correct proportions and magnifications. The measurements, although made accurately, must not be taken with too much emphasis; they serve as an indication rather than a mathematically certain statement. The averages have been calculated from as large a series as was available, but in a few cases this was strictly limited. With regard to upper and lower limits, in such a variable group one must always be prepared to find an individual lying outside the limits here stated, which are laid down merely on material to hand. Total lengths are especially deceptive, as the reading varies according to whether the abdomen is extended or telescoped, especially with the female before and after oviposition. All measurements of total length, head length, and ratios, are exclusive of wings, cerci, antennae and palps. Ratios have been calculated from averages for the series concerned.

Since the colour varies greatly with the time since the final ecdysis, an attempt has been made to give data of mature and fully darkened specimens in all cases.

## Family Oligotomidae.

With regard to the males, the chief family criterion is the reduced venation, neither $R_{4+5}$ nor M being branched in either wing. When the species is wingless, it must be referred to its family on other characters: the left hemitergite of abdominal segment 10 bears a process, and the left cercus-basipodite is present as a distinct process.

As Friederichs (1914) has already noted, the weakness of certain veins in the wing, although a reliable family character for foreign species, does not hold for all Australian species. This character is discussed below under the consideration of genera within the family.

The females of the family Oligotomidae can be distinguished from those of the family Embiidae by the reduced first abdominal sternite.

It becomes necessary to separate certain Australian species from the genus *Oligotoma*, and therefore a diagnosis of *Oligotoma* sens. str. is appended below. This diagnosis, besides excluding the local species, for which new genera are

erected in this paper, also excludes satisfactorily the species of the North American genus *Anisembia* Krauss.

Genus Oligotoma Westwood, 1836.

*Trans. Linn. Soc. Lond.*, xvii, 1836, 373.—Genotype, *O. saundersi* Wwd., 1836, loc. cit.

To this genus, in the limited sense, are assigned those Oligotomidae in which the right hemitergite of abdominal segment 10 of the male is produced backwards from its outer margin to a long, straight or slightly sinuous process, at least three times as long as broad, and the second segment of the left cercus is subcylindrical, at least three times as long as broad, and distinctly sutured off from the first segment. When wings are present in the male (as is usual), the veins $R_{4+5}$, M, and $Cu_{1a}$ are obscure, being represented by little more than pigment-bands.

Absence of wings is apparently a character of no generic significance, being convergent. Thus, within the genus *Oligotoma* sens. str., there is described below a species with the type form possessing a winged male, and with geographic subspecies in which the male is wingless. The species *Anisembia texana* (Mel.) has winged and wingless males occurring in the same colony, as also has one of the species described below under a new genus. Other forms are also wingless, e.g., the genus *Monotylota*, family Embiidae.

Oligotoma gurneyi gurneyi Frogg., 1904. Figs. 1, 11, 18, 25, 32.

*O. gurneyi* Froggatt, Proc. Linn. Soc. N.S.W., 1904, pp. 672-673.

Concerning this species, Friederichs wrote (1914, p. 243): "Whilst in Sydney I had the opportunity of examining the type (male) of Froggatt's Australian Embiid. . . . It is a dry specimen without an abdomen. The neuration characterises it as an Oligotoma. . . . The (unforked) posterior portion of the radial ramus is only well-developed at its proximal end, the remaining part being only faintly indicated. The same is true of the median and the cubitus. The eye as seen from above is almost circular (as in Enderlein's figure of *O. saundersi*). It is possible that it may be one of the cosmopolitan species (*saundersi* or *latreillei*), but a reliable identification of this specimen is obviously out of the question."

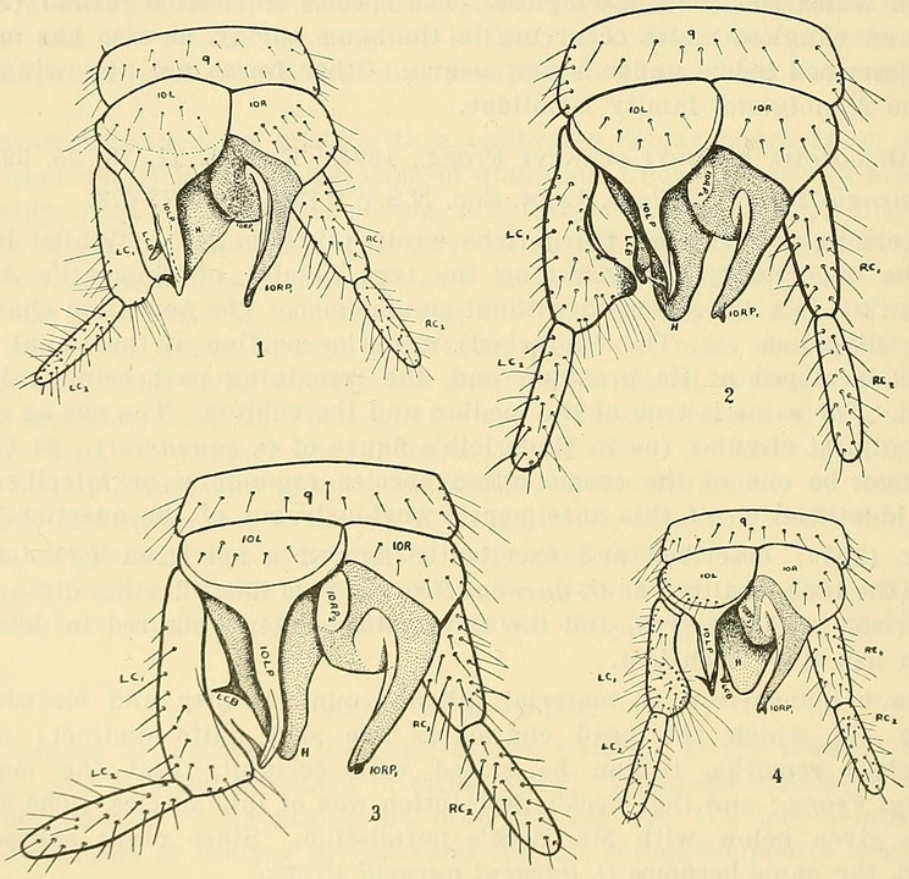
Zeck (1930) described and excellently figured a specimen (♂) taken near Sydney (the type locality) as *O. gurneyi* Frogg. This identification did not rest on a comparison with the type, and the terminalia were not figured in detail. This specimen has since been lost.

From a comparison of material taken around Sydney and elsewhere with the type (in which the head characters are still quite distinct) and with Friederichs's remarks, it can be stated with certainty that the material is *O. gurneyi* Frogg.; and that Zeck's description was of this species. The additional data are given below with Mr. Zeck's permission. Since other subspecies are described, the name becomes *O. gurneyi gurneyi* Frogg.

♂. *Length*, 7·6–11·3 mm., av. 9·2 mm. Head:thorax:abdomen in the ratio 10:22:30 (lengths). *Colour*: Dorsally, the sclerites are rich golden-brown, the mesoscutum and metascutum slightly paler, the head with darker symmetrical tracery, the eyes black. Ventrally, the colour is slightly paler, especially abdominal sternites 1–8. Intersegmental membranes cream. Wings with veins bordered by broad bands of pale brown. *Head* (Fig. 18): Length, 1·23–1·76 mm., av. 1·49 mm. Ratio of length to maximum breadth 10·0:8·2. Broadest at eyes, lateral margins slightly convex and convergent posteriorly, smoothly rounded at posterior limit. Eyes prominent, reniform. *Antennae*: Maximum number of segments observed, 21;

maximum total length, 4·5 mm. Four basal segments with lengths typically in the ratio 3:2:5:3. Distalia subcylindrical with rounded extremities (Figs. 25*a*, *b*).

(*Note.*—It is unusual to find an Embiopteron with the complete number of antennal segments on both sides. This fact has been noted by Friederichs (1906) and Mukerji (1927). The former explains the loss of antennal segments by supposing that a predatory insect or spider occasionally seizes the antenna projecting from the gallery in which the insect lives, whereupon it darts backwards, losing portion of its antenna. Mukerji gives the explanation that the antennae are occasionally nibbled by individuals of the same species, and figures an alimentary canal containing several antennal segments. Whatever the true cause, the descriptions here given include the greatest number of segments observed in the material available; it is impossible to say whether this corresponds in all cases to the complete number, as the last remaining segment rounds itself off at the subsequent ecdysis. In some cases, where specimens have a high and equal number of segments to each antenna, it is probable that this represents the complete number.)



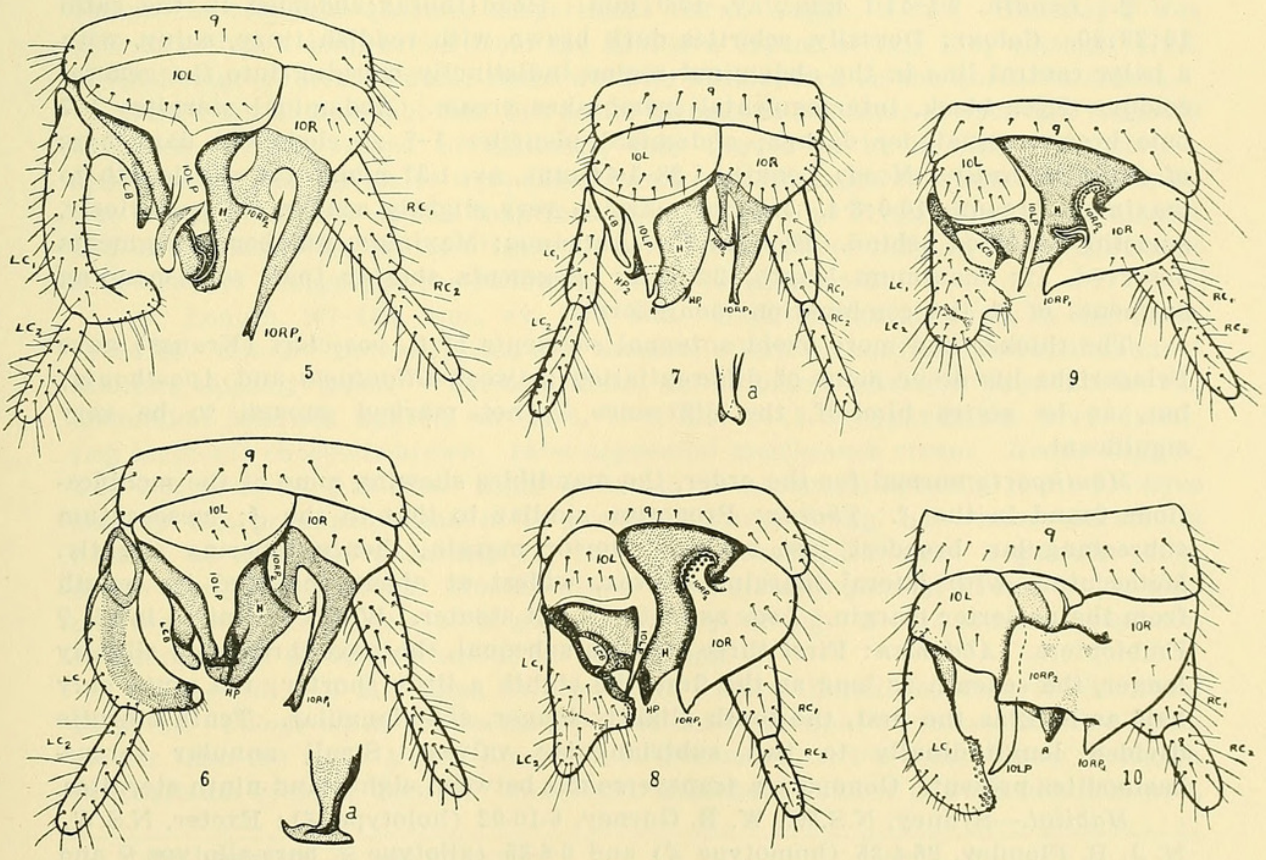

Figs. 1-10.—Terminalia of males of Australian Oligotomidae, viewed dorsally. (× 25.)
1.—*Oligotoma gurneyi gurneyi* Frogg. 2.—*O. gurneyi* Frogg. *centralis*, nov. 3.—*O. gurneyi* Frogg. *spinulosa*, nov. 4.—*O. gurneyi* Frogg. *subclavata*, nov. 5.—*O. tillyardi*, nov. 6.—*O. glauerti* Till. 7.—*O. latreillei* (Ramb.). 8.—*Notoligotoma hardyi* (Fried.). 9.—*N. nitens*, nov. 10.—*Metoligotoma reducta reducta*, nov.

Fig. 6*a*, termination of 10 LP, *O. glauerti* Till. (× 63); fig. 7*a*, termination of 10 $RP_1$, *O. latreillei* (Ramb.) (× 63).

9, ninth tergite; 10 L, 10 R, left and right hemitergites of tenth abdominal segment; 10 LP, process of 10 L; 10 $RP_1$, 10 $RP_2$, outer and inner processes of 10 R; $LC_1$, $LC_2$, first and second segments of left cercus; $RC_1$, $RC_2$, first and second segments of right cercus; LCB, RCB, left and right cercus-basipodites; H, hypandrium or sub-genital plate; HP ($HP_1$, $HP_2$), appendages of H; A, structure probably representing aedeagus.

*Mouthparts*: The mandibles are the only part showing considerable variation throughout the order, and are of some use as systematic criteria. In this species (and all the subspecies within it) the mandibles are very typical (Fig. 32): each with a semicircular concavity about half-way down the inner margin, the left with three, the right with two fairly sharp teeth distally. The genus *Aposthonia* was erected by Krauss (1911) and confirmed by Friederichs (1934), the main generic character being the mandible structure, as described for the above species. The species with which these authors were dealing was *A. vosseleri* Krauss, related to *O. gurneyi* Frogg. on other characters also. However, the male terminalia and other characters for these species are so close to the genotype of *Oligotoma* that it seems incorrect to propose a genus on such small differences. I am therefore demolishing the genus *Aposthonia*; if every species of *Oligotoma*, which differed from the genotype by as little as do *O. vosseleri* (Krauss) and *O. gurneyi* Frogg., were placed in a separate genus, the result would be a number of genera monotypic or nearly so, and the natural relationships of the species at present placed in the genus *Oligotoma* would be masked.

*Thorax*: Prothorax with sides diverging slightly posteriorly, and with a small rectangular area separated off by a slight transverse groove, one-quarter of the length from the anterior margin ("apotom" of Enderlein). Meso- and metathorax with triangular scuta and lateral sclerites. *Legs* normal for the order, the first segment of the fore tarsi dilated, the second legs slender, the hind femora noticeably swollen, the hind tarsi with one bladder ventrally on the first and second segments ("sohlenbläschen" of Verhoeff). *Wings*: Forewing, length 6·7–9·3 mm., av. 7·6 mm.; breadth 1·7–2·3 mm., av. 1·9 mm. Hindwing, length



5·3–7·5 mm., av. 6·1 mm.; breadth 1·6–2·3 mm., av. 1·8 mm. Venation characteristic of the genus. *Abdomen*: First seven segments, viewed dorsally, subequal; eighth slightly shorter, ninth only one-half as long as first and slightly asymmetrical; tenth as long as first.

*Terminalia* (Fig. 1): Tenth tergite divided longitudinally to left and right hemitergites (10 L, 10 R respectively). 10 R produced backwards and inwards from its outer margin to a long, thin, slightly sinuous process (10 $RP_1$), heavily chitinized, tapering distally but ending smoothly. Inner margin of 10 $RP_1$, anteriorly, curving inwards to overlie a second flap-like process, 10 $RP_2$ (median plate of Mukerji, 1935, p. 2, fig. 1e, *mp.*), more heavily chitinized medially. First segment of right cercus ($RC_1$) subcylindrical, arising from a vestigial annular cercus-basipodite (RCB) lateroventrally to 10 R; second segment ($RC_2$) also subcylindrical. Left hemitergite produced distally to a dagger-shaped process (10 LP), curving slightly to the left and bearing distally a small hook directed forwards and downwards. First segment of left cercus ($LC_1$) clavate, produced on the inner side, near its distal end, to a small blunt process; second segment ($LC_2$) subcylindrical. Ventrally (fig. 11) the subgenital plate or hypandrium (H) is produced backwards and slightly to the left to a broad blunt termination, the extremity of which is only weakly chitinized. Right margin of free portion of H slightly sinuous. Left cercus-basipodite (LCB) well developed, fused to the left margin of H for the greater part of its length, but curving outward distally to a smoothly-tapered termination.

The hypandrium undoubtedly includes the ninth sternite, but whether or not it consists of other structures fused thereto (e.g., valves of the tenth sternite) cannot at present be definitely stated.

♀. *Length*, 9·1–11·1 mm., av. 10·0 mm. Head:thorax:abdomen in the ratio 10:23:40. *Colour*: Dorsally, sclerites dark brown with reddish tinge, shiny, with a paler central line in the abdominal region indistinctly merging into the general colour. Eyes black, intersegmental membranes cream. Abdominal sternites 1–7 pale brown, remainder darker; abdominal pleurites 1–7 as elongated dark bars of chitin laterally. *Head*: Length, 1·28–1·44 mm., av. 1·37 mm. Ratio of length to maximum breadth 10·0:8·4. Lateral margins very slightly convergent posteriorly, smoothly rounded behind. Eyes small. *Antennae*: Maximum number of segments observed, 19; maximum length, 2·7 mm. Segments shorter than corresponding segments of ♂, the combination moniliform.

The thicker and more ovoid antennal segments of *O. vosseleri* (Krauss) gave Friederichs his other point of differentiation between *Oligotoma* and *Aposthonia*; but, as he states himself, the difference is not marked enough to be very significant.

*Mouthparts* normal for the order, the mandibles showing none of the modifications found in the ♂. *Thorax*: Pronotum similar to that in the ♂; mesoscutum subrectangular, broadest just behind anterior margin, thence tapering slightly. Metascutum with lateral margins convex, widest at about one-third its length from the posterior margin. *Legs* as in the ♂ but stouter. *Wings* absent as in all ♀ Embioptera. *Abdomen*: First three tergites subequal, the next three each slightly longer, the seventh as long as the first, the eighth a little shorter; the ninth only half as long as the first, the tenth slightly longer, subtriangular. Tenth sternite divided longitudinally to two subtriangular valves. Small annular cercus-basipodites present. Gonopore a transverse slit between eighth and ninth sternites.

*Habitat.*—Sydney, N.S.W., W. B. Gurney, 6-10-02 (holotype ♂); Exeter, N.S.W., N. J. B. Plomley, 26-4-35 (homotype ♂) and 6-6-35 (allotype ♀, para-allotype ♀ and

homotype ♂♂); Eastwood, N.S.W., L. Gallard, 1934 (homotype ♂♂); Callubri, via Nyngan, N.S.W., J. Armstrong, 16-10-34 (homotype ♂♂) and 1-9-35 (homotype ♂ and para-allotype ♀); Tallong, N.S.W., A. Simpson, 26-5-36 (homotype ♂ and para-allotype ♀); Melbourne, Vic., F. A. Singleton, 23-6-26 (homotype ♂); Gippsland, Vic., date and collector unrecorded (National Museum collection) (homotype ♂); Ferntree Gully, Vic., J. Clark, 31-5-36 (homotype ♂); Bulnarring, Vic., A. D. Butcher, 31-5-36 (homotype ♂); Launceston, Tas., V. V. Hickman, 29-6-30.

*Situation.*—Most commonly in galleries in rough bark or old fence-posts; occasionally in dendroid lichens growing on bark. Winged males occasionally taken at light. One specimen has been taken in the nest of the ant *Colobopsis gasseri* Forel, in a log.

*Distribution of Types.*—Homotype ♂ (plesiotype) on slide, homotype ♂ and allotype ♀ in alcohol, Macleay Museum, Sydney University. Homotype males and para-allotype females forwarded to the British Museum; the Australian Museum, Sydney; and the Western Australian Museum, Perth. Homotype males forwarded to the National Museum, Melbourne; the South Australian Museum, Adelaide; the C.S.I.R. collection, Canberra; the Cawthron Institute, Nelson, N.Z.; and the Zoological Museum, Buitenzorg,* Java. The damaged holotype male is in the C.S.I.R. collection, Canberra.

### Oligotoma gurneyi agilis Frogg., 1904.

*Oligotoma agilis* Frogg., Proc. Linn. Soc. N.S.W., 1904, pp. 673-674.

*O. agilis* was described by Froggatt from a female, probably immature. The holotype is a dry, carded specimen in fair condition, but lacks, of course, any good specific characters. This specimen was taken under granite boulders on the hill behind the students' quarters, Experiment Farm, Wagga, N.S.W. Recently I was able to collect a long series from the southern aspect of this hill, amongst dead, fallen foliage under boulders; there were no Embioptera on the northern aspect.

There can be no doubt that this series belongs to the same species as Froggatt's specimen. When reared to maturity, they proved to be a wingless species—approximately thirty males were taken, none with any sign of wings or wing-buds. The colour is slightly darker than in *O. gurneyi gurneyi* Frogg., but the terminalia and other characters are identical. *O. agilis* is therefore reduced to the status of a geographic subspecies, the following being its diagnosis:

♂. *Length*, 9·7–11·2 mm., av. 10·5 mm. Head:thorax:abdomen in the ratio 10:24:35. *Colour*: Dorsally, head and thoracic sclerites chocolate-brown, abdominal sclerites slightly paler. Ventrally, head and thoracic sclerites chocolate-brown, abdominal sclerites lighter, except 6, 7, 8, and 9 (9 = hypandrium, very dark). Leg segments chocolate-brown. Inter-segmental membranes cream. *Head*: Length, 1·41–1·62 mm., av. 1·55 mm. Ratio of length to maximum breadth, 10·0:8·6. Eyes slightly less prominent than in *O. gurneyi gurneyi* Frogg. *Antennae*: Maximum number of segments observed, 15; maximum length, 3·9 mm. Segments as in *O. gurneyi gurneyi* Frogg. *Mouthparts* as in *O. gurneyi gurneyi* Frogg. ♂. *Thorax and legs* as in the female of *O. gurneyi gurneyi* Frogg. *Wings* absent. *Abdomen and terminalia* as in *O. gurneyi gurneyi* Frogg. ♂.

♀. *Length*, 9·5–11·1 mm., av. 10·4 mm. Head:thorax:abdomen in the ratio 10:26:36. *Colour* as in the male, the terminal abdominal sternites likewise being darker than the rest. *Head*: Length, 1·41–1·62 mm., av. 1·48 mm. Ratio of length to maximum breadth, 10·0:9·0. *Antennae*: Maximum number of segments observed,

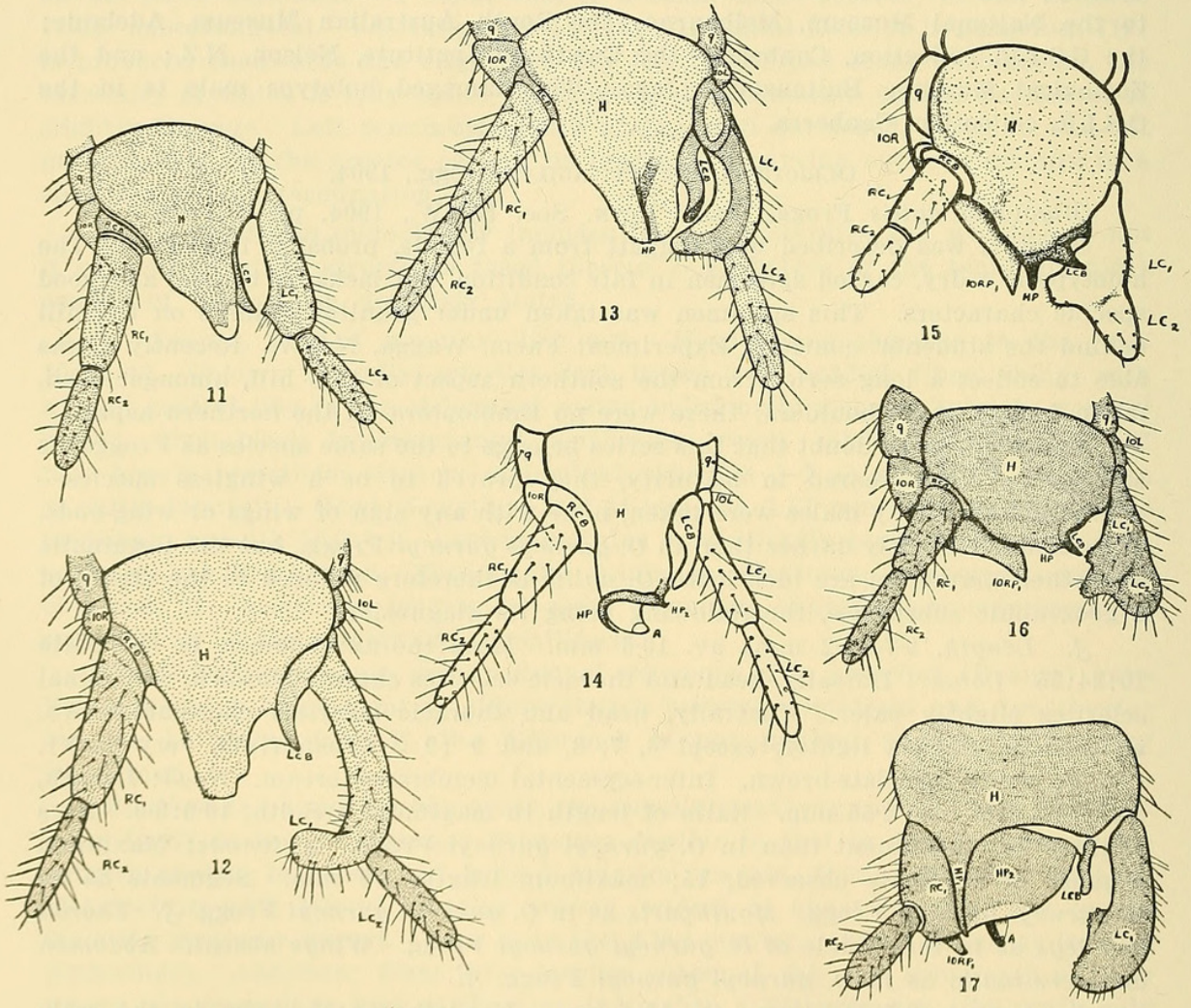
* See postscript at end of paper.

19; maximum length, 3·2 mm. The remaining characters are as in the female of *O. gurneyi gurneyi* Frogg.

*Habitat.*—Granite hill behind students' quarters, Experiment Farm, Wagga, N.S.W., W. W. Froggatt, 1904 (holotype ♀); the author, 12-2-36 (coll.), 20-3-36 et seq. (matured) (allotype ♂, long series of para-allotype ♂ and homotype ♀).

*Situation.*—Froggatt's specimen is recorded as being taken amongst granite boulders. The author's specimens were mostly taken in galleries among dead grass and *Callitris* foliage between granite boulders, while a few were in galleries in the bark of *Callitris* trees, close to the ground.

*Distribution of Types.*—Allotype ♂ on slide, para-allotype ♂ and homotype ♀ in alcohol, Macleay Museum; para-allotype males and homotype females forwarded to the British Museum, the National Museum, the Australian Museum, the Western Australian Museum, and the South Australian Museum; para-allotype males forwarded to the Cawthron Institute and the Zoological Museum, Buitenzorg. Froggatt's holotype female is in the C.S.I.R. collection, Canberra.




Figs. 11-17.—Terminalia of males of Australian Oligotomidae, viewed ventrally, certain dorsal structures omitted. (× 25.)

11.—*Oligotoma gurneyi gurneyi* Frogg. 12.—*O. tillyardi*, nov. 13.—*O. glauerti* Till. 14.—*O. latreillei* (Ramb.). 15.—*Notoligotoma hardyi* (Fried.). 16.—*N. nitens*, nov. 17.—*Metoligotoma reducta reducta*, nov.

Lettering as in Figs. 1-10.

*Note.*—Specimens taken in 1913 at Pyrmont, N.S.W., at the store of the Colonial Sugar Refining Co., were referred by Friederichs (1923) to what was then *O. agilis* Frogg., the reason being that the species appeared to have a wingless ♂ or a wingless form of the ♂, and was different in colour from *O. gurneyi* Frogg., and that only these two species were then known from New South Wales.

Although the form known then as *O. agilis* Frogg. has since been shown to be a wingless subspecies of the other then-known species, I am not inclined to agree with Friederichs, in view of the wide spatial and ecological difference between Pyrmont and Wagga. If Friederichs's assumption, that the Pyrmont specimens included a wingless form of male, be correct, it is more likely that they belonged to one of the wingless species described below from near Sydney.

The point can only be cleared up by collecting mature males from the Pyrmont locality. I recently searched this without success, possibly because of the season. The locality seems very favourable for Embioptera, because (1) there are numerous steam-outlets, so that the general temperature and humidity are high, (2) there are great quantities of raw sugar lying about, accumulated on floors, rafters and posts, and Embioptera have been observed to eat sugar readily in captivity.

OLIGOTOMA GURNEYI Frogg. HILLI, n. subsp.

This subspecies, from near the Cotter Reservoir, F.C.T., is, like the last, wingless; and the male terminalia are identical also. It is differentiated from *O. gurneyi agilis* Frogg. mainly on colour, size and head-length:breadth ratio. The characters of differential importance are given below.

♂. *Length*, 6·4–8·7 mm., av. 7·7 mm. Head:thorax:abdomen in the ratio 10:17:29. *Colour*: Dorsally, sclerites deep, rich brown, head very dark, pronotum darker than rest of body. Paler areas mid-dorsally on meso- and metathorax and abdomen; terminalia darker. Somewhat paler ventrally (except head and subgenital plate). Intersegmental membranes cream. *Head*: Length, 1·17–1·50 mm., av. 1·37 mm. Ratio of length to maximum breadth, 10·0:6·9. *Antennae*: Maximum number of segments observed, 19 (specimens with 18 segments on each side were common); maximum length, 4·6 mm.

♀. *Length*, 7·5–11·7 mm., av. 9·5 mm. Head:thorax:abdomen in the ratio 10:29:43. *Colour* as in the ♂, the eighth sternite dark laterally, and the ninth and tenth sternites dark throughout. *Head*: Length, 1·07–1·27 mm., av. 1·17 mm. Ratio of length to maximum breadth, 10·0:8·2. *Antennae*: Maximum number of segments observed, 19 (specimens with 18 segments on each side were common). Maximum length, 2·8 mm.

Other characters of both sexes as in *O. gurneyi agilis* Frogg.

*Habitat.*—Near Cotter Reservoir, F.C.T., G. F. Hill, 8-8-29 (holotype ♂, paratype ♂♂ and ♀♀); the author, 13-2-36 (immature); R. V. Fyfe and the author, 30-5-36 (allotype ♀, long series of paratype ♂ and ♀).

*Situation.*—In galleries under stones, among the roots of grasses and of the fern *Cheilanthes tenuifolia*, and lichens.

*Distribution of Types.*—Holotype ♂ on slide, allotype ♀, paratype ♂♂ and ♀♀ in alcohol, Macleay Museum. Paratype males and females forwarded to the British Museum, the National Museum, the Australian Museum, the Western Australian Museum, the South Australian Museum, the C.S.I.R. collection, the Cawthron Institute and the Zoological Museum, Buitenzorg.

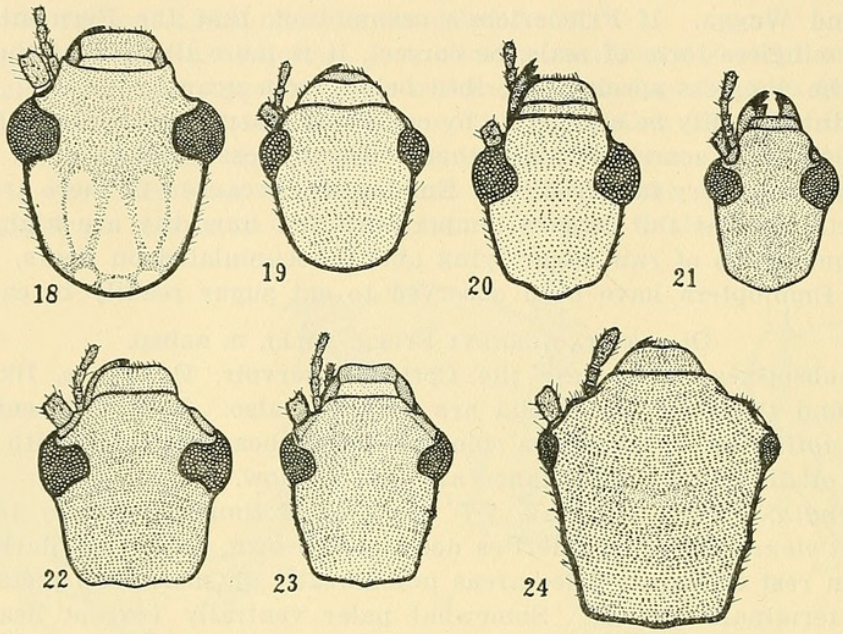
I am naming this subspecies after Mr. G. F. Hill, its discoverer.

OLIGOTOMA GURNEYI Frogg. CENTRALIS, n. subsp. Fig. 2.

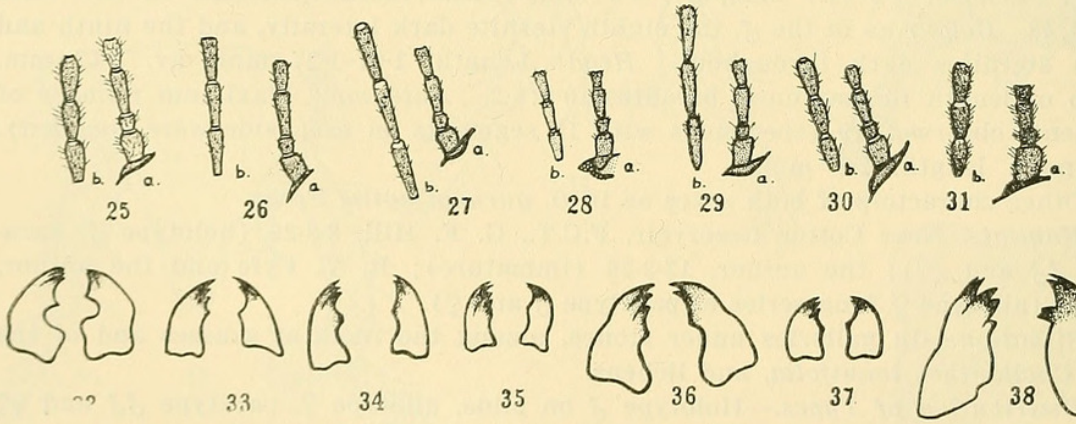
This geographic subspecies is erected for certain specimens (♂) taken in localities in Central Australia. It differs slightly from *O. gurneyi gurneyi* Frogg.

in characters of the terminalia, as well as in colour and generally larger size. The significant characters are given below.

♂. *Length*, 9·5–12·7 mm., av. 11·4 mm. Head:thorax:abdomen in the ratio 10:26:34. *Colour*: General coloration pale golden-brown, eyes black. *Head*: Length, 1·41–1·76 mm., av. 1·62 mm. Ratio of length to maximum breadth, 10·0:8·3. *Antennae*: Maximum number of segments observed, 17; maximum length, 3·2 mm. *Wings*: Forewing, length 7·4–9·9 mm., av. 8·9 mm.; breadth




Figs. 18-24.—Heads of males of Australian Oligotomidae, dorsal view. (× 20.)
18.—*Oligotoma gurneyi gurneyi* Frogg. 19.—*O. tillyardi*, nov. 20.—*O. glauerti* Till. 21.—*O. latreillei* (Ramb.). 22.—*Notoligotoma hardyi* (Fried.). 23.—*N. nitens*, nov. 24.—*Metoligotoma reducta reducta*, nov.







Figs. 25-31.—Antennal segments of males of Australian Oligotomidae. *a*, four basal segments; *b*, typical distalia. (× 20.)
25.—*Oligotoma gurneyi gurneyi* Frogg. 26.—*O. tillyardi*, nov. 27.—*O. glauerti* Till. 28.—*O. latreillei* (Ramb.). 29.—*Notoligotoma hardyi* (Fried.). 30.—*N. nitens*, nov. 31.—*Metoligotoma reducta reducta*, nov.

Figs. 32-38.—Mandibles of males of Australian Oligotomidae, dorsal view. (× 20.)
32.—*Oligotoma gurneyi gurneyi* Frogg. 33.—*O. tillyardi*, nov. 34.—*O. glauerti* Till. 35.—*O. latreillei* (Ramb.). 36.—*Notoligotoma hardyi* (Fried.). 37.—*N. nitens*, nov. 38.—*Metoligotoma reducta reducta*, nov.

1·8–2·5 mm., av. 2·1 mm. Hindwing, length 6·4–8·5 mm., av. 7·6 mm.; breadth 1·8–2·5 mm., av. 2·1 mm. *Terminalia* (fig. 2): The process 10 $RP_1$, instead of being smoothly tapered distally, ends in two closely-approximated points. The left cercus-basipodite is bluntly rounded distally, and the free portion projects upwards. The first segment of the left cercus has the process on the inner side more anteriorly placed than in *O. gurneyi gurneyi* Frogg., so that the segment has an altogether different appearance, with a considerable distance between the process and the junction with the second segment.

All other characters as in *O. gurneyi gurneyi* Frogg. ♂.

♀. Unknown.

*Habitat.*—Macdonnel Downs, Central Australia, 8-30, S. Australian Museum Expedition (holotype ♂ and paratype ♂♂); Alice Springs, Central Australia, Sir Douglas Mawson, 11-27 (paratype ♂).

*Situation.*—Winged males taken at light.

*Distribution of Types.*—Holotype ♂ and paratype ♂♂ (slides), South Australian Museum; paratype males, Macleay Museum, British Museum, and Western Australian Museum.

*Variations.*—Winged males from Lucindale, S.A., F. Secker, 1912, and Adelaide, S.A., A. M. Lea, 28-5-29 (taken at light), agree with the above examples in most points. While the left cercus-basipodite is similar to that of the typical Central Australian forms, the first segment of the left cercus approaches rather more closely to the East Australian *O. gurneyi gurneyi* Frogg., and the termination of the outer process of the right hemitergite of the tenth abdominal segment (10 $RP_1$), which ends smoothly in the East Australian form, and in two approximated points in the Central Australian form, is in these specimens intermediate.

A small series taken at Julia Percy Id., Victoria, by the McCoy Society Expedition, 2-36 (under stones), contained one mature male. This specimen had genitalia similar to the males from Lucindale and Adelaide, but was wingless (like the subspecies *agilis* Frogg. and *hilli*, nov.), and in colour approached more to the subspecies *agilis* Frogg. than to the subspecies *centralis*, nov. The females in association with this male were very similar to those of *O. gurneyi agilis* Frogg.

These specimens are regarded as intermediates between the geographic subspecies *gurneyi* Frogg. and *centralis*, nov., pending the discovery of more material.

### Oligotoma gurneyi Frogg. spinulosa, n. subsp. Fig. 3.

This subspecies, erected for specimens (♂) from Western Australia, is of the same general appearance as the last subspecies described, but is slightly more variable in size, and has small but important differences in the male terminalia distinguishing it from the last subspecies and from *O. gurneyi gurneyi* Frogg. Points of systematic distinction are given below.

♂. Length, 8·7–13·8 mm., av. 11·1 mm. Head:thorax:abdomen in the ratio 10:21:23. *Colour*: Deep golden-brown, eyes black. *Head*: Length, 1·69–2·26 mm., av. 1·91 mm. Ratio of length to maximum breadth, 10·0:8·5. *Antennae*: Maximum number of segments observed, 20; maximum length, 4·2 mm. *Wings*: Forewing, length 8·2–10·0 mm., av. 9·1 mm.; breadth 2·0–2·5 mm., av. 2·3 mm. Hindwing, length 6·7–8·5 mm., av. 7·6 mm.; breadth 2·0–2·5 mm., av. 2·2 mm. *Terminalia* (Fig. 3): The process 10 $RP_1$, as in the last subspecies, ends in two closely-approximated points. The process 10 LP is slightly thinner and more sinuous

than in the previous subspecies, and the small hook at the end of 10 LP is considerably longer, thinner, and more sinuous. The left cercus-basipodite is fused throughout, as far as its posterior limit, to the hypandrium, and near the posterior end gives off at right angles a sharp free spine projecting to the left. The first segment of the left cercus is different from that in *O. gurneyi gurneyi* Frogg. in that it is produced inwards from the junction with the second segment more markedly, the inward process being more distally placed.

All other characters as in *O. gurneyi gurneyi* Frogg. ♂.

♀. Unknown.

*Habitat.*—Morgan's, nr. Mt. Margaret, W.A., per L. Glauert, 10-33 (holotype ♂ and paratype ♂♂); Lake Violet, East Murchison District, per L. Glauert, 10-27 (paratype ♂).

*Situation.*—The specimens from Morgan's were taken swarming after rain, the Lake Violet specimen was taken at light.

*Distribution of Types.*—Holotype ♂ on slide, paratype ♂ in alcohol, Macleay Museum; paratype males forwarded to the British Museum, the Australian Museum, and the Western Australian Museum.

OLIGOTOMA GURNEYI Frogg. SUBCLAVATA, n. subsp. Fig. 4.

This subspecies is erected for some very interesting specimens (♂) taken in North Australia. The smaller size, and noticeable differences in the terminalia, differentiate it clearly from the other subspecies. The diagnostic characters are given below.

♂. *Length*, 6·4–7·5 mm., av. 7·2 mm. Head:thorax:abdomen in the ratio 10:23:31. *Colour*: General coloration yellowish-brown (including the broad bands beside the wing-veins). Eyes black. *Head*: Length, 0·75–1·12 mm., av. 1·02 mm. Ratio of length to maximum breadth, 10·0:7·6. *Antennae*: Maximum number of segments observed, 16; maximum length, 3·2 mm. *Wings*: Forewing, length 5·1–5·5 mm., av. 5·4 mm.; breadth 1·3–1·4 mm., av. 1·4 mm. Hindwing, length 4·3–4·6 mm., av. 4·4 mm.; breadth 1·3–1·4 mm., av. 1·4 mm. *Terminalia* (Fig. 4): The process 10 $RP_1$ ends in two closely-approximated points. The left cercus-basipodite is very similar to that of *O. gurneyi gurneyi* Frogg., but somewhat blunter distally. The process 10 LP is somewhat broader than in *O. gurneyi gurneyi* Frogg., but the hook at the distal end is identical. The greatest difference lies in the first segment of the left cercus; in all the previous subspecies this has some inwardly-directed process, but here the segment is thickened distally, but rounded off.

All other characters as in *O. gurneyi gurneyi* Frogg. ♂.

♀. Unknown.

*Habitat.*—Daly Waters, North Australia, F. H. Taylor, 1-11-34 (holotype ♂ and paratype ♂♂); Anthony's Lagoon, North Australia, F. H. Taylor, 5-11-34 (paratype ♂).

*Situation.*—Winged males taken at light.

*Distribution of Types.*—Holotype ♂ on slide, paratype ♂ in alcohol, Macleay Museum; paratype males forwarded to the British Museum and the Western Australian Museum.

*Note.*—This subspecies is the closest of all the subspecies to the East Indian species *O. vosseleri* (Krauss). The latter is well figured by Silvestri (1912, fig. 6). The differences of importance are (1) *O. vosseleri* (Krauss) lacks the terminal hook at the extremity of the process 10 LP, which is, on the contrary, present

in all subspecies of *O. gurneyi* Frogg.; (2) the left cercus-basipodite in *O. vosseleri* (Krauss) (*c* in Silvestri's figure) is more distinct from the hypandrium, being free practically throughout and curved outwards to a point distally.

It is probable that *O. gurneyi* Frogg. *subclavata*, nov., is the most primitive of the six subspecies, and that the species originated in the North, differentiating as it radiated from that centre.

*Key to the subspecies of* Oligotoma gurneyi *Frogg.* (♂).

1. First segment of left cercus roundly club-shaped ..... *subclavata*, nov.
   First segment of left cercus produced to a process on the inner margin ..... 2
2. Left cercus-basipodite fused along its inner margin to the hypandrium, and at its posterior extremity produced outwards to a sharp spine; hook at end of process of left hemitergite of tenth abdominal segment long and very thin .. *spinulosa*, nov.
   Left cercus-basipodite not as above; hook of process of left hemitergite shorter and thicker ..... 3
3. Outer process of right hemitergite of tenth abdominal segment ending in two closely-approximated points; left cercus-basipodite broadly rounded at posterior end and produced upwards ..... *centralis*, nov.
   Outer process of right hemitergite and left cercus-basipodite both smoothly tapered at posterior extremity ..... 4
4. Winged ..... *gurneyi* Frogg.
   Wingless ..... 5
5. Length of specimens in series examined 6·4-8·7 mm., av. 7·7 mm.; average ratio of head-length to head-breadth 10·0 : 6·9 ..... *hilli*, nov.
   Length of specimens in series examined 9·7-11·2 mm., av. 10·5 mm.; average ratio of head-length to head-breadth 10·0 : 8·6 ..... *agilis* Frogg.

*Note.*—It seems, for the present, wise to consider the six types as geographic subspecies, although some might consider that the last three described deserve specific status. Whether *O. gurneyi agilis* Frogg. and *O. gurneyi* Frogg. *hilli*, nov., are true geographic subspecies, or merely local varieties of *O. gurneyi gurneyi* Frogg., will only be shown by the examination of more material from other localities.

OLIGOTOMA TILLYARDI, n. sp. Figs. 5, 12, 19, 26, 33.

♂. *Length*, 7·4–9·7 mm., av. 8·9 mm. Head:thorax:abdomen in the ratio 10:22:30. *Colour*: Golden-brown, the head slightly darker, eyes black. Wing veins bordered with broad pale-brown bands. *Head* (Fig. 19): Length, 1·31–1·48 mm., av. 1·40 mm. Ratio of length to maximum breadth, 10·0:7·8. Broadest at the eyes, the lateral margins slightly convex and convergent behind. Eyes reniform, prominent. *Antennae*: Maximum number of segments observed, 19; maximum length, 4·6 mm. Basal four segments (Fig. 26*a*) with lengths typically in the ratio 4:2:6:5. Distalia elongate, narrowest at proximal end, sides slightly diverging and relatively straight (Fig. 26*b*). *Mouthparts* normal, mandibles (Fig. 33) somewhat slender; the left with three sharp distal teeth directed slightly inwards, and a blunt tooth on the inner margin behind these; the right with two distal teeth, and basal to these on the inner margin a concavity with a blunt tooth posterior to it. *Thorax*: Structure similar to that of *O. gurneyi gurneyi* Frogg. ♂. *Legs* as in *O. gurneyi gurneyi* Frogg. ♂. *Wings*: Forewing, length 7·5–8·5 mm., av. 7·9 mm.; breadth 1·9–2·0 mm., av. 2·0 mm. Hindwing, length 6·1–7·2 mm., av. 6·7 mm.; breadth 1·9–2·0 mm., av. 1·9 mm. Venation characteristic of the genus. *Abdomen*: Except for the terminalia, as in *O. gurneyi gurneyi* Frogg. ♂.

*Terminalia* (Fig. 5): Tenth tergite divided longitudinally to left and right hemitergites (10 L, 10 R respectively). 10 R produced backwards and inwards

from its outer margin to a long, thin, straight process (10 $RP_1$), heavily chitinized and terminating in two closely-approximated points. Inner process (10 $RP_2$) similar to that in *O. gurneyi gurneyi* Frogg., somewhat blunter. First segment of right cercus ($RC_1$) subcylindrical, arising from a vestigial annular cercus-basipodite (RCB) placed latero-ventrally to 10 R. Second segment ($RC_2$) subcylindrical, thinner than $RC_1$. Left hemitergite produced distally to a process (10 LP) terminating in a forcipate structure, the inner tooth sharply pointed and heavily chitinized, the outer lobe blunt and more membranous, and projecting somewhat dorsally; both lobes curved in towards each other distally. First segment of left cercus ($LC_1$) curved inwards considerably from junction with second segment ($LC_2$), the distal, inner extremity somewhat flattened. $LC_2$ subcylindrical. Ventrally (Fig. 12), the hypandrium (H) projects backwards, with convergent lateral margins, to a blunt termination with two angles. Minute nodules distally and on right-hand margin of H. Left cercus-basipodite (LCB) lying along left-hand margin of H proximally, curving out distally to a free, tapered termination.

♀. Unknown.

*Habitat.*—Morgan's, nr. Mt. Margaret, W.A., per L. Glauert, 10-33 (holotype ♂ and paratype ♂♂).

*Situation.*—Swarming after rain.

*Distribution of Types.*—Holotype ♂ on slide, paratype ♂ in alcohol, Macleay Museum. Paratype males forwarded to the British Museum, the Australian Museum, the Western Australian Museum, the South Australian Museum, the C.S.I.R. collection, the Cawthron Institute and the Zoological Museum, Buitenzorg.

I am naming this species in recognition of the work done by Dr. R. J. Tillyard on the Western Australian Embioptera.

*Note.*—The forcipate termination to the process of the left hemitergite is a character convergent to the Embiid genus *Rhagadochir*. In one specimen of *O. tillyardi*, nov., a small, rounded body was found between the lobes of the forceps; this probably represented a spermatophore.

OLIGOTOMA GLAUERTI Tillyard, 1923. Figs. 6, 13, 20, 27, 34.

*Journ. Proc. Roy. Soc. W. Aust.*, ix, pt. i, 1923.

This species has been well described by Tillyard (l.c.). Whilst transferring the holotype ♂ and a paratype ♂ from deteriorated glycerine jelly mounts to balsam, I was able to examine the terminalia critically in comparison with those of other Australian species. Certain measurements were also made to bring the description into line with those of the other species. The following description is given with Dr. Tillyard's permission.

♂. *Length*, 9·5–10·0 mm. Head:thorax:abdomen in the ratio 10:24:34. *Colour*: Golden-brown, eyes black, wing-veins bordered with pale brown. *Head* (Fig. 20): Length, 1·44–1·49 mm. Ratio of length to maximum breadth, 10·0:7·8. *Antennae*: Maximum number of segments observed, 21; maximum length, 7·5 mm. Four basal segments with lengths typically in the ratio 4:2:5:4 (Fig. 27*a*). Distalia (Fig. 27*b*) longer than those of any other Australian species. *Mouthparts* normal, mandibles (Fig. 34) slender, similar to those of *O. tillyardi*, nov., but with the blunt basal tooth of the left mandible bilobed. *Thorax and legs* as in *O. gurneyi gurneyi* Frogg. ♂. *Wings*: Forewing, average length 8·8 mm., average breadth 2·2 mm.; hindwing, average length 7·5 mm., average breadth 2·2 mm. Venation characteristic of the genus. *Abdomen*: Except for the terminalia, as in *O. gurneyi gurneyi* Frogg. ♂.

*Terminalia* (Fig. 6): Tenth tergite divided longitudinally to left and right hemitergites (10 L, 10 R respectively). 10 R produced backwards and inwards from its outer margin to a long, thin, straight process terminating in two closely-approximated points, the right-hand point placed somewhat dorsally to the left. Inner process (10 $RP_2$) almost identical with that of *O. gurneyi gurneyi* Frogg. First segment of right cercus ($RC_1$) subcylindrical, arising from a vestigial annular cercus-basipodite (RCB) lateroventral to 10 R. Second segment ($RC_2$) subcylindrical, thinner than first. Left hemitergite produced backwards to a narrowing process (10 LP) with sinuous margins, terminating in an anchor-like hook (Fig. 6*a*). First segment of left cercus ($LC_1$) curving inwards strongly from junction with second segment ($LC_2$) and ending in a blunt, round termination. $LC_2$ subcylindrical. Ventrally (Fig. 13), the hypandrium is produced backwards to a rounded termination, with a median longitudinal chitinous structure (HP), probably a spine, posteriorly, but not projecting. To the left of HP there is a trace of a membranous structure, possibly tubular, which may represent the aedeagus. Minute nodules at posterior extremity of right-hand margin of H. Left cercus-basipodite (LCB) fused proximally to anterior part of left margin of H, but distally curving upwards and inwards to a bluntly-rounded termination.

♀. Unknown.

*Habitat.*—Milly Milly Stn., Murchison River, W.A., L. Glauert, 26-5-22 (holotype ♂ and paratype ♂♂).

*Situation.*—Taken at light.

*Location of Types.*—The holotype ♂ is in the Western Australian Museum, and a paratype ♂ in the Macleay Museum.

OLIGOTOMA LATREILLEI (Rambur), 1842. Figs. 7, 14, 21, 28, 35.

*Embia latreillei* Rambur, *Hist. nat. Neur.*, 1842, p. 312.

This tropicopolitan species is recorded from several localities in Queensland. As it is somewhat variable throughout its extensive range, the complete description is appended for the Australian examples.

♂. *Length*, 6·6–8·3 mm., av. 7·5 mm. Head:thorax:abdomen in the ratio 10:20:34. *Colour*: Pale-brown, head a little darker, eyes black. Wing-veins bordered with broad bands of pale-brown. *Head* (Fig. 21): Length, 1·23–1·39 mm., av. 1·30 mm. Ratio of length to maximum breadth, 10·0:7·7. Eyes prominent, sides of head converging slightly posteriorly, rounded off at back. *Antennae*: Maximum number of segments observed, 20; maximum length, 3·5 mm. Four basal segments with lengths typically in the ratio 3:2:4:3 (Figs. 28*a*, *b*). *Mouthparts* normal, mandibles (Fig. 35) slender, the left with two narrow, sharp teeth distally, then two fairly sharp teeth, and behind these a slight bilobed projection, on the inner margin; right mandible with two sharp teeth distally and a slight projection behind these on the inner margin. *Thorax and legs* as in *O. gurneyi gurneyi* Frogg. ♂. *Wings*: Forewing, length 5·1–6·6 mm., av. 5·5 mm.; breadth 1·3–1·6 mm., av. 1·4 mm. Hindwing, length 4·3–5·3 mm., av. 4·6 mm.; breadth 1·3–1·5 mm., av. 1·4 mm. Venation characteristic of the genus. *Abdomen*: Except for the terminalia, as for *O. gurneyi gurneyi* Frogg. ♂.

*Terminalia* (Fig. 7): Tenth tergite divided longitudinally to left and right hemitergites (10 L, 10 R respectively). 10 R produced backwards and inwards from its outer margin to a long, thin, slightly sinuous process (10 $RP_1$) distally curving slightly to the right to a blunt termination, to the left of which is a

small pointed process. It is in this termination of 10 $RP_1$ (Fig. 7*a*) that variations occur in examples from other localities; the present examples resemble specimens examined from New Caledonia and the Dutch East Indies, and are fairly close to the figure given by Enderlein (1912) of an example from Formosa. Inner process of 10 R (10 $RP_2$) very similar to that in *O. gurneyi gurneyi* Frogg. Left hemitergite produced backwards to a dagger-shaped process, lacking any terminal appendage. Right and left cerci each composed of two subequal, subcylindrical segments ($RC_1$, $RC_2$, $LC_1$, $LC_2$); the former arising from a vestigial annular cercus-basipodite (RCB) lateroventral to 10 R, the latter from a free cercus-basipodite (LCB) proximally separating $LC_1$ from the hypandrium, and distally curving round to a blunt termination. Ventrally (Fig. 14) the hypandrium (H) narrows posteriorly and curves to the left; its distal extremity is weakly chitinized, and appears to end in a tubular structure, probably an aedeagus (A). A spiral, heavily chitinized process ($HP_1$) is attached to the left-hand margin of H near its distal extremity, and curves under H, then upwards and round; at the base of $HP_1$ a minute hook ($HP_2$) is given off towards the left.

♀. As yet unrecorded from Australia. Specimens from Noumea, New Caledonia (A. M. Lea, date unrecorded), taken in association with a male referred to this species, are in general colour reddish-brown, and of the following dimensions: Length, 7·7–8·1 mm., av. 7·9 mm. Head:thorax:abdomen in the ratio 10:20:31. Head-length, 1·24–1·30 mm., av. 1·28 mm. Ratio of head-length to maximum breadth, 10·0:8·0. Maximum number of antennal segments observed, 20; maximum length, 1·9 mm.

*Australian localities.*—Brisbane, Q., Dr. R. J. Tillyard, 10-15; Townsville, Q., F. H. Taylor, 1928; Camooweal, Q., F. H. Taylor, 9-11-34 (♂).

*Situation.*—Winged males taken at light, or occasionally swarming in the daytime.

*Distribution of Material.*—Identified males in the Macleay Museum, and forwarded to the National Museum and the Western Australian Museum. In the South Australian Museum are identified specimens (♂, ♀) from Noumea, New Caledonia.

*Key to the Australian species of* Oligotoma (♂).

1. First segment of left cercus subcylindrical; process of left hemitergite of tenth abdominal segment dagger-shaped, and with no hook or other appendage distally ..... *latreillei* (Ramb.)
   First segment of left cercus noticeably clavate; process of left hemitergite with an appendage at the distal extremity ..... 2
2. First segment of left cercus not curved inwards to any great extent from the junction with the second segment; process of left hemitergite terminating in a simple spine produced forwards and downwards ..... *gurneyi* Frogg.
   First segment of left cercus curved, produced inwards a considerable distance from the junction with the second segment; termination of process of left hemitergite not as above ..... 3
3. Process of left hemitergite terminating in a forcipate structure ..... *tillyardi*, nov.
   Process of left hemitergite terminating in a simple anchor-like process .. *glauerti* Till.

## Genus Notoligotoma, n. gen.

Genotype, *Notoligotoma hardyi* (Friederichs) 1914.

*Oligotoma hardyi* Friederichs, *Rec. W.A. Mus. and Art Gall.*, Vol. 1, pt. 3, 1914.

This genus is proposed for the above species and a species, described later, which agrees closely with it. The diagnosis is as follows: Australian Oligotomidae with the second segment of the left cercus greatly reduced, less than twice as long as wide, and not distinctly divided from the first segment, which carries minute

nodules; left cercus-basipodite fused intimately with hypandrium; right hemitergite of tenth abdominal segment massive and subtriangular, lacking any long, thin, backwardly directed process as in *Oligotoma*, but with a dorsal process directed forwards and bearing nodules. Left hemitergite produced backwards from its inner margin to a narrow, dagger-shaped process. Veins $R_{4+5}$, M and $Cu_{1a}$ in the wings (when present) less obscure than in *Oligotoma*.

All the above characters refer to the males only.

Hind tarsi in both sexes with two minute bladders ("sohlenbläschen") on the first segment and one on the second segment.

This genus is convergent to the genus *Anisembia* Krauss (1911) with species from Texas, Mexico and California. It is structurally differentiated by the form of the process of the right hemitergite in the male, and by the number of tarsal bladders.

NOTOLIGOTOMA HARDYI (Fried.), 1914. Figs. 8, 15, 22, 29, 36.

*Oligotoma hardyi* Fried., 1914, l.c.

Friederichs's types (♂) have been lost. The species has been re-described well by Tillyard (1923), and from his description I have been able to identify material from localities in Western Australia, Queensland and New South Wales. In association with the last named was a female which has been designated allotype, and described here.

♂. Length, 8·8–11·0 mm., av. 9·5 mm. Head:thorax:abdomen in the ratio 10:21:24. Colour: Pale golden-brown, eyes black; wing veins bordered by broad pale-brown bands. *Head* (Fig. 22): Length, 1·49–1·76 mm., av. 1·65 mm. Ratio of length to maximum breadth, 10·0:8·4. Sides relatively straight, somewhat convergent, and posteriorly rounded off rather sharply. Eyes reniform, prominent. *Antennae* (Figs. 29*a*, *b*): maximum number of segments observed, 19; maximum length, 4·3 mm. Basal four segments with lengths typically in the ratio 3:2:5:3. *Mouthparts* normal, mandibles (Fig. 36) large, the left terminating distally in three incurved teeth, behind which, on the inner side, is a blunt projection and then a definite concavity; the right similar, but with two instead of three teeth distally. *Thorax*: Structure similar to that in *Oligotoma gurneyi gurneyi* Frogg. ♂. *Legs* normal, but with the hind tarsi possessing two minute bladders ventrally on the first segment and one on the second. In specimens of the genus *Oligotoma* examined there was only one such bladder distally on each of the first two hind tarsal segments. *Wings*: Forewing, length 7·9–10·9 mm., av. 9·8 mm.; breadth 1·9–2·8 mm., av. 2·4 mm. Hindwing, length 6·4–9·6 mm., av. 8·4 mm.; breadth 1·8–2·7 mm., av. 2·3 mm. Disposition of veins typical of the family, but with more cross-veins, and with the veins $R_{4+5}$, M and $Cu_{1a}$ less obscure than in the genus *Oligotoma*. *Abdomen*, except for the terminalia, as in *O. gurneyi gurneyi* Frogg. ♂.

*Terminalia* (Fig. 8): Tenth tergite divided longitudinally to left and right hemitergites (10 L, 10 R respectively). 10 R subtriangular, massive, the distal vertex (10 $RP_1$) projecting backwards and inwards; a hook-like process (10 $RP_2$) arises dorsally about half-way along the inner margin of 10 R, and curves over, upwards and forwards, and bears minute nodules. Right cercus of two subcylindrical segments ($RC_1$, $RC_2$), and arising from a vestigial annular cercus-basipodite (RCB) lateroventrally to 10 R. Left hemitergite subtriangular, and produced backwards from the inner margin to a dagger-shaped process (10 LP). Left cercus very typical, clavate, the first segment ($LC_1$) produced inwards to a blunt process, and bearing minute nodules along the inner margin; second segment ($LC_2$) not sutured off, but represented by a subconical projection on the distal and outer margin of $LC_1$. Ventrally (Fig. 15), the hypandrium (H) is a large

plate, rounded behind, but with a narrow, heavily-chitinized, finger-shaped process (HP) projecting upwards from the centre of the distal margin. Left cercus-basipodite (LCB) intimately fused to H, curving away from it distally to another finger-shaped process, adjacent to HP, pointing outwards, and heavily chitinized.

♀. Length 11·8 mm. Head:thorax:abdomen in the ratio 10:31:45. *Colour*: Head red-brown with darker tracery dorsally; body sclerites red-brown with paler mottling; intersegmental membranes cream. Legs red-brown, antennal segments golden-brown, eyes black. *Head*: Length, 1·37 mm. Ratio of length to maximum breadth, 10·0:8·8. Structure typical of that in female Oligotomidae. *Antennae*: Maximum number of segments observed, 19; maximum length, 2·4 mm. Segments much shorter than in the male. *Mouthparts* normal. *Thorax*: "Apotom" fairly distinctly divided off from rest of pronotum. Mesoscutum and metascutum with sides convex, each widest at a distance from the front equal to about one-third of its length, the metascutum narrowing rather markedly behind its widest point. *Legs* as in the male, somewhat stouter. *Abdomen and terminalia* normal.

*Habitat.*—Perth, W.A., 6-12 (Friederichs's types, ♂); Caversham, W.A., 6-15, C. Kerruish, per L. Glauert (♂); Castle Hill, nr. Townsville, Q., 3-9-22, G. F. Hill (♂ and immature); Callubri, via Nyngan, 21-7-35, J. Armstrong (♂, allotype ♀).

*Situation.*—The Western Australian specimens were taken at light, the Townsville specimens in galleries under stones, and the Nyngan specimens in galleries in rough bark.

*Distribution of Material.*—Identified males in the Macleay Museum and forwarded to the British Museum, the National Museum, the Australian Museum, the Western Australian Museum, the South Australian Museum, the C.S.I.R. collection and the Cawthron Institute. Allotype ♀ in the Macleay Museum.

### Notoligotoma nitens, n. sp. Figs. 9, 16, 23, 30, 37, 39–41.

This species has a dimorphic ♂, winged and wingless forms occurring even in the same colony. Except for the presence or absence of wings and consequent modification of the thoracic sclerites, no significant difference can be observed between these forms in size or any other character.

*Length*, 6·4–10·7 mm., av. 9·1 mm. Head:thorax:abdomen in the ratio 10:22:32. *Colour*: Black, very shiny; wings when present with veins bordered by broad bands of very dark grey. *Head* (Fig. 23): Length, 1·00–1·53 mm., av. 1·38 mm. Ratio of length to maximum breadth, 10·0:6·9. Broadest at the eyes, the lateral margins converging thence posteriorly, slightly sinuous. Eyes comparatively small. *Antennae*: Maximum number of segments observed, 23; maximum length, 5·9 mm. Basal four segments (Fig. 30*a*) with lengths typically in the ratio 3:2:5:3. Distalia (Fig. 30*b*) subcylindrical, smoothly rounded. *Mouthparts* normal, mandibles (Fig. 37) small and stout, the left with three inwardly-directed teeth distally and basad to these a blunt projection; the right similar but with only two distal teeth. *Thorax* (winged ♂): Pronotum with "apotom" fairly distinct, the groove representing the narrowest point, the broadest point at the posterior margin. Mesothorax and metathorax with subtriangular scuta and lateral sclerites. (Wingless ♂): Pronotum similar to winged ♂. Mesoscutum subrectangular, broadest at about one-third of its length from anterior limit, thence tapering slightly posteriorly. Metascutum subrectangular, broadest at one-quarter of its length from the posterior limit. *Legs* as in *N. hardyi* (Fried.), the hind femora more incrassate, the hind tarsal bladders more pronounced (Fig. 39). *Wings* (when present) (Fig. 40): Forewing, length 4·0–7·0 mm., av. 5·9 mm.; breadth 1·0–1·6 mm., av. 1·4 mm. Hindwing, length 3·5–5·7 mm.,

av. 5·0 mm.; breadth 1·0–1·6 mm., av. 1·4 mm. Otherwise as in *N. hardyi* (Fried.). *Abdomen*, except for terminalia, normal.

*Terminalia* (Figs. 9, 16): Similar in general structure to those of *N. hardyi* (Fried.). Just distal to the process 10 $RP_2$ is a small slender spine, placed ventrally on 10 R and projecting inwards. The process HP is not nearly so pronounced or heavily chitinized. The left cercus is very typical, the first segment ($LC_1$) subtriangular, and with minute nodules at the distal apex and on a small tooth on the inner margin just behind the apex. The second segment ($LC_2$) is more or less spherical, arising from the distal part of $LC_1$, and separated therefrom only by a slight narrowing, and not by any suture.

♀. Length, 6·9–12·5 mm., av. 9·7 mm. Head:thorax:abdomen in the ratio 10:27:36. *Colour*: Dorsally, the whole a deep umber-brown, very shiny, especially mesoscutum and metascutum. Antennae, palps, legs and cerci tending to golden-brown. Body sclerites, ventrally, somewhat paler. Intersegmental membranes cream. *Head*: Length, 1·07–1·55 mm., av. 1·33 mm. Ratio of length to maximum breadth, 10·0:8·4. *Antennae*: Maximum number of segments observed, 23; maximum length, 3·7 mm. Segments short and rounded, the combination moniliform. *Mouthparts* normal. *Thorax*: As in *N. hardyi* (Fried.) ♀; the metascutum

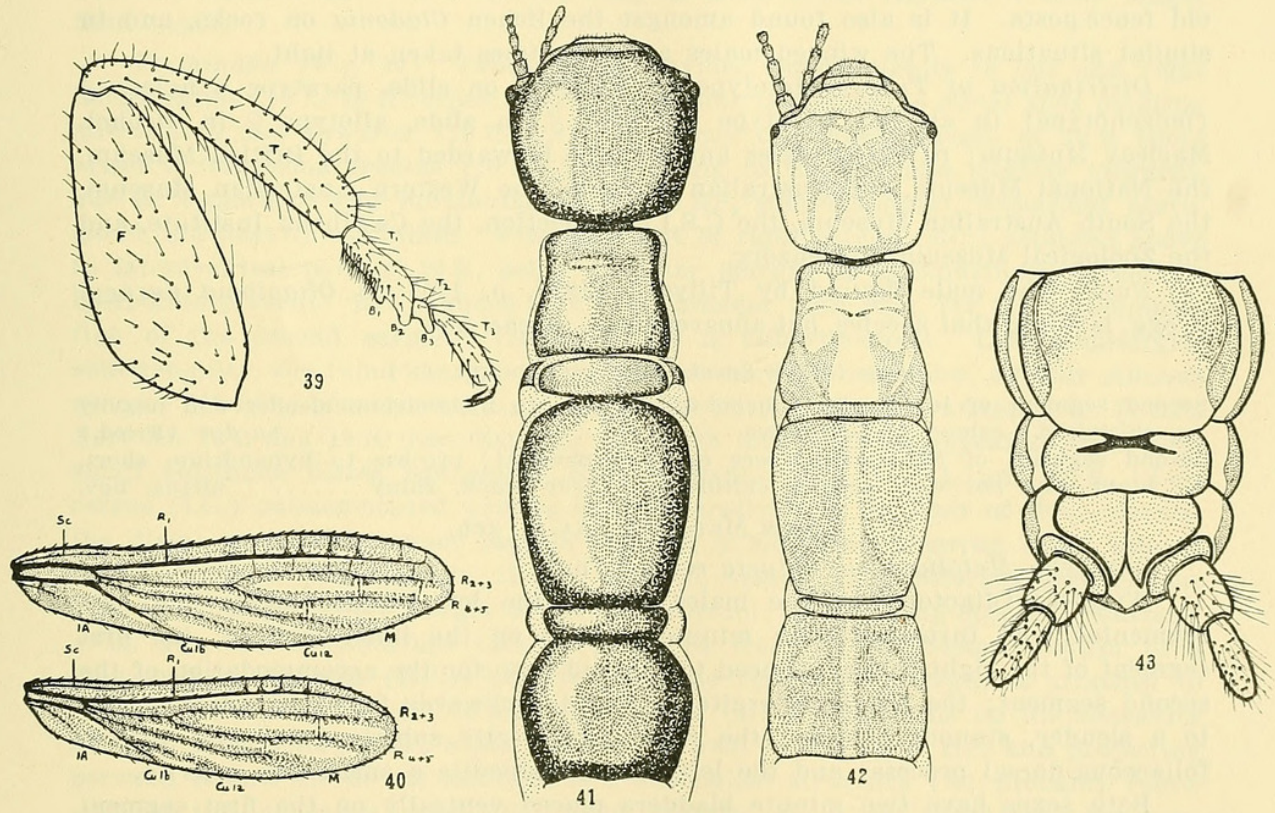



Fig. 39.—Hind leg of *Notoligotoma nitens*, nov. ♂. (× 25.) F, femur; T, tibia; $T_1$, $T_2$, $T_3$, tarsal segments; $B_1$, $B_2$, $B_3$, tarsal bladders (sohlenbläschen).

Fig. 40.—Right fore- and hind-wings of *Notoligotoma nitens*, ♂. (× 6⅝.) Standard lettering for venation.

Fig. 41.—Dorsal view of head and thorax of ♀ *Notoligotoma nitens*, nov. (× 12½). (Note: The head is tilted slightly forwards, exaggerating the ratio of breadth to length.)

Fig. 42.—Dorsal view of head and thorax of ♀ *Metoligotoma reducta reducta* nov. (× 12½.)

Fig. 43.—Ventral view of last three abdominal segments of ♀ *Metoligotoma reducta reducta*. (× 25.)

is widest at about one-third of its length from anterior limit, thence converging noticeably posteriorly (Fig. 41). *Legs* as in the ♂. *Abdomen and terminalia* normal.

*Habitat.*—Sylvania, N.S.W., the author, 29-10-34 (holotype winged ♂) and 11-8-35 (allotype ♀ and paratype ♀♀); Mortlake, N.S.W., Froggatt Collection, 24-10-09 (paratype wingless ♂); Kenthurst, N.S.W., L. Gallard, 15-9-17 (paratype winged ♂); Carlton, N.S.W., E. C. Hall, 18-7-31 (paratype winged ♂); Neutral Bay, Sydney, N.S.W., G. Dun, 5-33 (paratype winged ♂); Dee Why, N.S.W., R. V. Fyfe, 21-10-33 (paratype wingless ♂); Myall Lakes, N.S.W., N. J. B. Plomley, 24-8-34 (paratype winged ♂); Elanora Heights, N.S.W., the author, 7-10-34 (paratype winged and wingless ♂♂); Eastwood, N.S.W., L. Gallard, 1934 (paratype winged and wingless ♂♂); Sherbrooke, N.S.W., Miss G. Rodway, 27-8-35 (paratype winged ♂, and ♀); Wogamia, via Nowra, N.S.W., Miss G. Rodway, 29-8-35 (paratype winged and wingless ♂♂, and ♀); Sublime Point, nr. Austinmer, N.S.W., A. Simpson, 16-4-36 (paratype ♀♀); Austinmer, N.S.W., the author, 9-8-32; Galston, N.S.W., the author, 20-9-34; Killara, N.S.W., M. Day, 7-10-34; Gloucester, N.S.W., H. Davidson, 14-10-34; Bamarang, N.S.W., Miss G. Rodway, 12-2-35.

*Situation.*—This species is found most frequently forming galleries in the rough bark of certain trees (e.g., *Casuarina torulosa*, and various Eucalypts) or in old fence-posts. It is also found amongst the lichen *Cladonia* on rocks, and in similar situations. The winged males are sometimes taken at light.

*Distribution of Types.*—Holotype ♂ (winged) on slide, paratype wingless ♂ (morphotype) in alcohol, paratype wingless ♂ on slide, allotype ♀ in alcohol, Macleay Museum; paratype males and females forwarded to the British Museum, the National Museum, the Australian Museum, the Western Australian Museum, the South Australian Museum, the C.S.I.R. collection, the Cawthron Institute, and the Zoological Museum, Buitenzorg.

*Note.*—The male figured by Tillyard (1926, p. 120) as *Oligotoma gurneyi* Frogg. is not of that species, but apparently *N. nitens*, nov.

*Key to the Species of* Notoligotoma (♂).

Second segment of left cercus subconical; process to hypandrium slender and heavily chitinized; colour golden-brown ..... *hardyi* (Fried.)
Second segment of left cercus more or less spherical; process to hypandrium short, blunt, and not very heavily chitinized; colour black, shiny ..... *nitens*, nov.

Genus Metoligotoma, n. gen.

Genotype, *Metoligotoma reducta reducta*, nov.

Wingless Oligotomidae, the males having the left cercus clavate and one-segmented, and furnished with minute nodules on the inner surface; the first segment of the right cercus reduced to a broad base for the accommodation of the second segment; the left hemitergite produced backwards from its inner margin to a slender, sinuous process; the right hemitergite subtriangular and with a foliaceous dorsal process; and the left cercus-basipodite a small free sclerite.

Both sexes have two minute bladders placed ventrally on the first segment of the hind tarsi, and one bladder on the second segment.

Metoligotoma reducta reducta, n. sp. et subsp. Figs. 10, 17, 24, 31, 38, 42, 43.

♂. *Length* 6·7–10·9 mm., av. 8·4 mm. Head:thorax:abdomen in the ratio 10:14:19. *Colour*: To the naked eye the general colour appears to be dull black. Under the binocular the body sclerites are seen to be very dark brown rather than true black; head black; cerci, intersegmental membranes, and near the joints of antennae and legs cream; antennal and tarsal segments deep golden-brown. *Head* (Fig. 24): Length, 1·81–1·97 mm., av. 1·92 mm. Ratio of length

to maximum breadth, 10·0:8·3. Minutely punctate, broadest at the eyes, lateral margins running back thence, almost straight, to the posterior angles, and converging sharply. Eyes relatively very small. *Antennae*: Maximum number of segments observed, 20; maximum length, 3·7 mm. Basal four segments (Fig. 31*a*) subcylindrical, somewhat variable, but with the lengths typically in the ratio 5:2:4:2. Distalia (Fig. 31*b*) more rounded. *Mouthparts* normal, mandibles (Fig. 38) massive, the left with two sharp points distally, two blunter teeth inside these, and a small blunt tooth immediately posterior to them. Right mandible with two sharp points distally and a bilobed tooth on the inner margin a little behind the apex. *Thorax*: Pronotum with sides almost straight, and broadest at posterior end. "Apotom" not very distinctly divided off. Mesoscutum subrectangular, broadest at about one-third of its length from anterior limit; sides convex. Metascutum also subrectangular, with convex sides, and broadest at about one-quarter of its length from posterior limit, thence converging slightly. None of the thoracic nota as broad as the head. *Legs* normal, the fore femora somewhat incrassate, the hind femora greatly swollen; hind tarsi with two bladders ventrally on the first segment, one on the second. *Wings* absent. *Abdomen*: First seven segments, viewed dorsally, subequal; eighth tergite slightly shorter; ninth tergite only half as long as first; tenth segment a little longer than ninth.

*Terminalia* (Fig. 10): Tenth tergite divided longitudinally to left and right hemitergites (10 L, 10 R respectively). 10 R subtriangular, the distal apex pointing downwards and inwards (10 $RP_1$). From near the inner margin of 10 R there arises a foliaceous process (10 $RP_2$) projecting to the left and slightly upwards, but in a more or less horizontal plane; 10 $RP_2$ subrectangular, somewhat corrugated, not heavily chitinized. First segment of right cercus ($RC_1$) attached above to lateroventral part of 10 R, below to outer margin of hypandrium; no cercus-basipodite present. $RC_1$ reduced to a base, broader than long, for the accommodation of the second segment ($RC_2$), which is subcylindrical. Left hemitergite subtriangular, the inner margin produced backwards to a slender, slightly sinuous process (10 LP), heavily chitinized; proximal part of 10 LP overlapped by 10 $RP_2$. Between 10 L and 10 R, just distal to the ninth tergite, there appear to be several small chitinous plates connecting the proximal parts of 10 L and 10 R. Left cercus ($LC_1$) one-segmented, arising lateroventrally from the body of 10 L; clavate, the distal part of the inner margin forming a blunt face bearing many minute teeth. Left cercus-basipodite (LCB) a small, slender, free sclerite, between the base of $LC_1$ and the left margin of the hypandrium; LCB ending bluntly. Ventrally (Fig. 17), the hypandrium (H) is produced from its right-hand margin to a long, pointed process ($HP_1$), not free, for the right-hand margin is attached to $RC_1$, and the inner margin to another sclerite ($HP_2$) which fills up the concavity between H and $HP_1$. $HP_2$ subtriangular. Dorsal to the plate $HP_2$ and projecting between it and the dorsal sclerites is a subconical structure (A) probably representing the aedeagus; the right-hand margin of A is chitinized, the rest membraneous. *Note*: Both 10 $RP_2$ and LCB are somewhat variable.

♀. Length, 12·0–13·0 mm., av. 12·4 mm. Head:thorax:abdomen in the ratio 10:24:40. *Colour*: Head golden-brown with darker tracery; pronotum deep golden-brown, with paler areas (as in Fig. 42). Mesoscutum and metascutum and abdominal tergites dark brown at lateral borders, ranging through golden-brown to a longitudinal cream central line. Sclerites of leg and antennal segments golden-brown, the former paler near the joints. Intersegmental membranes cream. Ventrally, the body sclerites are pale-brown to cream, the thoracic sclerites,

abdominal pleurites 2–7, and lateral margins of abdominal sternites being darker than the rest. *Head*: Length, 1·60–1·71 mm., av. 1·65 mm.; ratio of length to maximum breadth, 10·0:8·4. Structure normal for the family. *Antennae*: Maximum number of segments observed, 14; maximum length, 2·3 mm. Segments shorter than in the ♂, distalia more or less spherical, the combination moniliform. *Mouthparts* normal. *Thorax and legs* as in the ♂, the widest point of the mesoscutum slightly more anteriorly placed. *Abdomen and terminalia* normal (v. Fig. 43).

*Note.*—Females taken at Austinmer, N.S.W., in association with typical males, were smaller and darker than in the above description. They were mature, and in most cases guarding eggs, so that the bodies were shrunk subsequent to oviposition. The following details of this series are given:

*Colour*: Dorsally, dark brown, no head pattern; trace of pronotal pattern and mid-dorsal longitudinal line. Eyes black. Ventrally, sclerites pale brown with darker areas, especially on eighth sternite. Legs dark brown, paler near joints; membranes cream. Length, 7·7–8·4 mm., av. 7·9 mm. Head:thorax:abdomen in the ratio 10:18:25. Head-length, 1·33–1·60 mm., av. 1·47 mm. Ratio of head-length to maximum breadth, 10·0:8·2. Maximum number of antennal segments observed, 15; maximum antennal length, 2·4 mm.

Members of this series have not been designated paratypes. It is probable, however, that the females of this species are more variable than the first description implies.

*Habitat.*—Elanora Heights, N.S.W., M. Day, and D. Waterhouse, 16-9-34 (holotype ♂ and paratype ♂♂); N. J. B. Plomley, 18-12-34 (paratype ♂) and 27-5-35 (paratype ♂); Jooriland, Burragorang Valley, N.S.W., the author, 1-1-33 (paratype ♂, allotype ♀ and paratype ♀♀); Austinmer, N.S.W., the author, 30-9-34 and 23-8-36 (paratype ♂♂); coll. 1-3-36, matured 1-4-36 et seq. (paratype ♂♂, and ♀♀); Myall Lakes, N.S.W., N. J. B. Plomley 24-8-34 (paratype ♂); Mt. Tambourine, Q., W. H. Davidson, 1-9-24; Tomat Falls, nr. Wollondilly River, N.S.W., the author, 23-8-34; Springwood, N.S.W., and Lawson, N.S.W., D. Waterhouse, 1-10-34; Mittagong, N.S.W., D. Lee, 30-7-35; Lower Burragorang Valley, N.S.W., R. T. Walker, 6-36.

*Situation.*—In the mat formed by *Polypodium serpens*, *P. confluens*, or *Dendrobium linguiforme*, growing on rock faces; also amongst dead leaves, especially in the mat formed by fallen *Casuarina* needles.

*Distribution of Types.*—Holotype ♂ on slide, paratype ♂♂ on slide and in alcohol, allotype ♀ in alcohol, Macleay Museum; paratype males and females forwarded to the British Museum and the Western Australian Museum; paratype males forwarded to the National Museum, the Australian Museum, the South Australian Museum, the C.S.I.R. collection, the Cawthron Institute and the Zoological Museum, Buitenzorg.

### Metoligotoma reducta ingens, n. subsp.

This subspecies is divided off on account of its great size and paler colour. The significant characters are given below; the remaining characters are the same as for the respective sexes of *M. reducta reducta*, nov.

♂. *Length*, 12·0–14·2 mm., av. 12·8 mm. Head:thorax:abdomen in the ratio 10:15:18. Head-length, 2·93–3·41 mm., av. 3·26 mm. Ratio of head-length to maximum breadth 10·0:8·2. Maximum observed number of antennal segments, 13; maximum antennal length, 3·8 mm. *Colour*: Head dark-brown, eyes black; dorsally, body sclerites dull brown, with paler pattern on prothorax and pale mid-

dorsal line on mesoscutum, metascutum and abdominal tergites; ventrally, body brown, abdominal sternites, especially hypandrium, darker than the rest. Legs and antennae golden-brown, intersegmental membranes cream.

♀. *Length*, 14·4–18·7 mm., av. 15·8 mm. Head:thorax:abdomen in the ratio 10:21:31. Head-length, 2·13–2·67 mm., av. 2·41 mm. Ratio of head-length to maximum breadth, 10·0:8·0. Maximum number of antennal segments observed, 18; maximum antennal length, 3·3 mm. *Colour*: Head golden-brown with dark-brown tracery. Remaining parts as in the ♂, the abdominal sternites around the genital aperture dark.

*Habitat.*—Black Mountain, nr. Canberra, F.C.T., R. V. Fyfe, 25-1-35 (holotype ♂, allotype ♀, paratype ♂♂ and ♀♀); the author, coll. 13-2-36, matured 27-3-36 (paratype ♀♀), and coll. 29-5-36 (paratype ♀♀).

*Situation.*—Amongst dead, fallen Eucalypt leaves, forming a moist, decaying mass on the ground.

*Distribution of Types.*—Holotype ♂ on slide, paratype ♂ and allotype ♀ in alcohol, Macleay Museum. Paratype ♂ and ♀ forwarded to the Western Australian Museum, and paratype females forwarded to the British Museum, the National Museum, the Australian Museum, the South Australian Museum, the C.S.I.R. Collection, the Cawthron Institute and the Zoological Museum, Buitenzorg.

*Key to the Subspecies of* Metoligotoma reducta, *nov.* (♂).

Length of specimens in series examined, 6·7-10·9 mm., av. 8·4 mm.; head-lengths of specimens in series examined, 1·81-1·97 mm., av. 1·92 mm.; colour to the naked eye dull-black ..... *reducta*, nov.

Length of specimens in series examined, 12·0-14·2 mm., av. 12·8 mm.; head-lengths of specimens in series examined, 2·93-3·41 mm., av. 3·26 mm.; colour to the naked eye brown ..... *ingens*, nov.

*Key to the Australian Genera of the Family Oligotomidae* (♂).

1. Second segment of left cercus distinctly separated from first by a clear suture, subcylindrical, more than three times as long as thick; right hemitergite of tenth abdominal segment produced backwards from its outer margin to a process, straight or slightly sinuous, at least three times as long as broad (e.g., Fig. 1, 10 $RP_1$). Hind tarsi with less than two bladders on the second segment. Winged or wingless ..... *Oligotoma* Westwood

   Second segment of left cercus reduced or absent; process of right hemitergite not as above. Hind tarsi with two bladders on the second segment ..... 2

2. Second segment of left cercus reduced in length, less than twice as long as thick, and not separated from first segment by a distinct suture; first segment of right cercus subcylindrical, longer than thick. Winged or wingless .. *Notoligotoma*, nov.

   Second segment of left cercus absent; first segment of right cercus reduced, broader than long. Wingless ..... *Metoligotoma*, nov.

## Relationships of Australian Species.

(The following discussion refers to the males.)

Although the members of the genus *Oligotoma* are less specialized in most characters than those of the genera *Notoligotoma* and *Metoligotoma*, the latter two genera could not have been derived directly from *Oligotoma*, since they possess a very different and rather more generalized right hemitergite.

Taking, then, a hypothetical Oligotomid lacking the outer process to the right hemitergite characteristic of the genus *Oligotoma*, we can on the one hand reach, from such an ancestor, the simplest of members of the genus *Oligotoma* (such as *O. latreillei* (Ramb.) ), and, on the other, such genera as *Notoligotoma* and *Metoligotoma*.

From a generalized species of *Oligotoma* the three autochthonous Australian species of this genus are derived chiefly by various modifications of the process of the left hemitergite (terminating in *O. gurneyi gurneyi* Frogg. and subspecies

in a simple hook, an advance on the Sumatran *O. vosseleri* (Krauss), in which it lacks any terminal process; in *O. glauerti* Till. in an anchor-like appendage; and in *O. tillyardi*, nov., in a forcipate structure convergent to that in the Embiid genus *Rhagadochir*). Concomitant with this is the development of the first segment of the left cercus; from the primitive subcylindrical type, the inner process is developed (as in the series *O. gurneyi* Frogg. *subclavata*, nov., *O. gurneyi gurneyi* Frogg., and *O. gurneyi* Frogg. *spinulosa*, nov.), and becomes greatly exaggerated in *O. glauerti* Till. and *O. tillyardi*, nov. Other minor differences, as in the left cercus-basipodite, also supervene.

On the other hand, the development of the genera *Notoligotoma* and *Metoligotoma* is marked chiefly by the reduction or loss of the second segment of the left cercus, present as a small, unsutured protuberance in *Notoligotoma*, but completely lost in *Metoligotoma*. This loss is convergent to that in the genus *Anisembia*, and is a continuation of the process by which the more generalized recent Embioptera with two-segmented cerci on both sides developed from their Permian ancestors with many-segmented cerci on both sides. The reduction or loss of the second segment of the left cercus in *Notoligotoma* or *Metoligotoma* can likewise be traced in ontogeny, when it is gradually resorbed in the last ecdysis, the penultimate instar possessing normal cerci with two subcylindrical segments on both sides. In *Metoligotoma*, the first segment of the right cercus is also reduced.

In both these genera, the hind tarsi develop an extra bladder. *Metoligotoma*, however, is probably not derived directly from *Notoligotoma*, as its right hemitergite has an altogether different form of process, and its left cercus-basipodite is more primitive.

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*Postscript*, added 27th August, 1936.—Since the completion of this paper, information has been received from Dr. Lieftinck that the Embioptera which were forwarded to the Zoological Museum, Buitenzorg, Java, have now been transferred to the Museum of Natural History at Leyden, Holland.