

A REVIEW OF THE MESOCHRYSSINAE AND NOTHOCHRYSSINAE (NEUROPTERA: CHRYSOPIDAE)

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ABSTRACT

In this preliminary subfamilial classification of the Chrysopidae, Mesochrysopidae is reduced to subfamilial rank. Keys to subfamilies and to genera of Nothochryssinae are presented. The Nothochryssinae, as newly constituted, is characterized by retention of jugum and frenulum, lack of alar tympanal organ, archaic pseudomedia (except in *Nothochrysa* and *Dyspetochrysa*) and little sclerotized prosternum. It includes *Paleochrysa*, *Archaeochrysa*, *Dyspetochrysa*, *Tribochrysa*, *Dictyochrysa*, *Triplochrysa*, *Hypochrysa*, *Kimochrysa*, *Pamochrysa*, *Pimachrysa*, and *Nothochrysa*. The living species of Nothochryssinae are cataloged, and the North American species described and illustrated.

New fossil taxa are: *Archaeochrysa*, new genus for *Paleochrysa creedi* Carpenter, *fracta* (Cockerell) and *paranervis* n. sp. (Florissant, Colo.); *Dyspetochrysa*, n. gen. for *Tribochrysa vetuscula* Scudder. New Recent species are: *Pimachrysa albicostales*, Baja Calif., and Arizona; *fusca*, *intermedia* and *nigra*, southern Calif.

INTRODUCTION

This study comprises the first section of a taxonomic revision of the North American Chrysopidae. The concept of the subfamily Nothochryssinae as herein employed is en-

tirely new, necessitating a preliminary reclassification of the family.²

There appears no justification for retaining in a separate family the Mesozoic forms, which are placed in the family Mesochrysopidae. These already have achieved the alignment of the inner gradate veins which precedes the pseudomedia of the later forms. In addition, they show the fundamental chrysopid characteristics: many straight, unforked branches of Rs, which diverge from R at a wide angle; two regular gradate series; MP1 and MP2 few-branched, intersecting the wing margin near the base, so that most of the discal area is occupied by the R-Rs-MA system. These basic features of proportion, while difficult to define, readily separate the Chrysopidae from all other families.

The Apochryssinae, a distinctive and homogeneous group, has recently been revised by Kimmins (1952b). The Chrysopinae constitutes a receptacle for the remaining vast and various assemblage of forms, doubtless requiring subdivision when better understood.

All described genera of Mesochryssinae and Nothochryssinae are included in the keys, and all species have been cataloged. Descriptions and illustrations have been included for all living North American

² Although this paper was submitted for publication prior to the appearance of Tjeder's paper, 1966, it has been possible to include his new taxa. He delimits the Nothochryssinae (=Dictyochryssinae) similarly.

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species, and for such fossil or Old World species as are of particular interest. I have not examined material of *Dictyochrysa* or *Triplochrysa*, which were reviewed by Kimmins (1952a).

It is interesting that the southwestern United States should have such a rich representation (two genera, six species) of this archaic group, which has changed but little since the Miocene (Adams, 1957). This concentration of these relics is rivaled by South Africa, with two genera and four species, and Australia and Tasmania, also with two genera and four species. Such a distribution contributes to the mounting evidence that the southwestern United States has served as an evolutionary refugium for the Neuroptera.

ACKNOWLEDGMENTS

Grateful acknowledgment is made of the help and encouragement of F. M. Carpenter and P. J. Darlington, Jr., of the Museum of Comparative Zoology (MCZ), Harvard. Ellis MacLeod, of the Biological Laboratories, Harvard, has made many valuable criticisms, and has given generously of his time during the preparation of the manuscript. D. E. Kimmins has kindly examined type material and has made useful suggestions. Material has also been made available through the courtesy of C. D. MacNeil, California Academy of Sciences (CAS), J. D. Powell, University of California, Berkeley, California Insect Survey (CIS), J. N. Belkin, University of California, Los Angeles (UCLA), P. R. Timberlake, University of California, Riverside (UCR), L. Stange, University of California, Davis (UCD), J. Lattin, Oregon State College (OSC), E. I. Sleeper, Long Beach State College, J. E. H. Martin, Entomology Research Branch, Canada Department of Agriculture, Ottawa (CNC), Hugo Rodeck, University of Colorado Museum, and Floyd Werner, University of Arizona.

Financial assistance has been provided through grants-in-aid from Sigma Xi-RESA, the American Academy of Arts and Sci-

ences, and the University of California, Santa Barbara.

DISCUSSION OF CHARACTERS

The wing-coupling apparatus consists of a large jugal lobe on the fore wing, and a frenulum, bearing several long setae, on the hind wing; this is essentially the same apparatus as in Hemerobiidae, etc. The Chrysopinae may have a weak frenulum, but the jugal vein is thin, and there is no jugal lobe. Loss of the wing-coupling apparatus appears associated with narrowing and strengthening of the wing base, and is probably of great adaptive significance. A similar modification has occurred in the evolution of the Myrmeleontidae and Ascalaphidae from an osmyloid ancestor (Adams, 1958), and in the Mantispidae.

In the Nothochrysiniae, there is no obvious tympanal organ (Friedrich, 1953; Erhardt, 1916) in the base of R in the fore wing, and the stem of M is easily visible extending in a straight line adjacent to R. In the Chrysopinae, the tympanal organ forms a conspicuous bulge in R, at the point where Cu diverges; the base of M usually is coalesced with R, but if visible, makes a detour posteriorly around the tympanal organ. Probably this is an auditory organ (Adams, 1962).

In *Nobilinus* (Apochrysiniae), the tympanal organ involves a large area between R and M, but is longer and does not form a bulge on the underside of R, as in Chrysopinae.

Another character, probably of great adaptive significance, is the pseudomedia, which differs fundamentally in the more primitive chrysopids, and in the Chrysopinae—Apochrysiniae. In *Pimachrysa* (Figs. 1, 2), *Hypochrysa* (Fig. 5), and in most of the fossil genera, Psm is composed of crossveins alternating with the branches of Rs + MA, and is merely a basad extension of the inner gradate series. The course of the longitudinal veins and composition of the primitive pseudomedia is particularly clear in *Hypochrysa*. In the Chrysopinae

(Fig. 45), and Apochrysinæ (Fig. 44), and in *Nothochrysa* (Fig. 3), Psm, at least basally, is composed of overlapping zig-zagged branches of Rs and M, with no crossveins between them. (Some specimens of *N. fulviceps* show no overlap.) In a few genera of Chrysopinæ, such as *Yumachrysa* and *Chrysopiella*, there is a transition from the primitive arrangement apically, with no overlap, to the more advanced arrangement basally, with overlapping veins.

Primitively, the longitudinal veins forked at the posterior wing margin, except for the anals in both wings, and CuP in the hind wing. This condition may be seen in the hind wing of *Archaeochrysa* (Figs. 40, 41). There is a tendency for the point of furcation to move proximally until it reaches the outer gradate crossveins; when this occurs, the pseudomedial cells appear each to give rise to two marginal veinlets. This process begins at the wing base, and proceeds apically; the sequence is best seen in the fore wing of *Archaeochrysa paranervis* (Fig. 40). Frequently the longitudinal veins fail to fork at all.

The pseudocubitus has evolved like the pseudomedia, by alignment of longitudinal veins and gradate crossveins. In the Nothochrysinæ it usually is more strongly developed than Psm, especially in the fore wing. In the Chrysopinæ, where the longitudinal veins may overlap at Psc, it is impossible to determine, in most cases, which marginal veinlets have arisen from which longitudinal veins. For this reason the overlap at Psc shown in Figures 44 and 45 is conjectural, although consistent with the tracheation of Psc in *Chrysopa signata* Walker, as demonstrated by Tillyard (1916).

Evolution of the basal Banksian cell of the hind wing has been described by Carpenter (1935). The archaic condition is exemplified by *Archaeochrysa*, where MPI is connected to Rs + MA by the sectorial crossvein, which intersects MPI in a Y-formation. More advanced genera exhibit slight basad migration of MF, and fusion

of MPI with Rs + MA. This evolutionary sequence can be seen by comparing Figures 41, 5, 4, and 2.

In Chrysopinæ and Apochrysinæ, the wing flexes along a line immediately anterior to Psm (dotted line, Figs. 44, 45). To facilitate this flexion in the fore wing, the first sectorial crossvein (first crossvein distal to the base of Rs + MA) and the branches of Rs + MA are interrupted or articulated at the point of intersection with the pseudomedia. In the Nothochrysinæ, the sectorial crossvein is always interrupted, but the branches of Rs + MA never are so (except in *Nothochrysa*). Flexion along the pseudomedia is accomplished, in *Hypochrysa*, by folds traversing the crossveins of Psm (Fig. 5). In *Pimachrysa*, there appears to be no distinct line of flexion, except perhaps in *P. nigra* (Fig. 4). In this species the veins show no obvious weakening or articulation, but most specimens have a slight wrinkle in the membrane parallel and anterior to Psm. A similar line of flexion occurs between MA and MP in most other families of Neuroptera. In Chrysopidae, this line has been lost early in evolution; the pseudomedial fold is its functional, but not morphological, equivalent. As an interesting example of parallel evolution, the shape of the wing, and course of the pseudomedial fold in Chrysopinæ is strikingly like that of the smaller Nymphidae (e.g. *Osmylops*, *Nesydrion*). In the *Nodita-Leucochrysa* complex (Chrysopinæ), Psm curves up to join the outer gradate series; this evolutionary line has culminated in the Apochrysinæ, of which the nymphid, *Myiodactylus*, is a counterpart.

Another striking feature of the Nothochrysinæ is the near uniformity in thickness of most of the veins at the wing base. In Chrysopinæ and Apochrysinæ, R is expanded basally, and Cu is always inflated near the intersection with the first medial crossvein.

The Apochrysinæ appear to be specialized derivatives of the *Nodita-Leucochrysa* complex (Chrysopinæ). The closest resem-

blance is to forms such as *Gonzaga*, from which the less specialized Apochrysinæ, such as *Synthochrysa* (Fig. 44), differ only in the loss of the basal subcostal crossvein, less distance between Psm and Psc, condition of MP2, and slight changes in the proportions of the wing.

In *Gonzaga* (Fig. 45), MP2 bends close to CuA, then up toward MP, thence down to CuA again, which it joins to form part of Psc. If MP2 were to shift posteriorly so that it joined CuA directly, eliminating the zig-zag, a configuration like that in the Apochrysinæ would result. It may be noted that the second apparent medial crossvein of the Apochrysinæ (Fig. 44) lies in exactly the same relationship to the first sectorial (sxv) and cubital crossveins as does the medial fork in *Gonzaga*. This is significant, since, if MP2 had instead moved anteriorly to coalesce with MP1, the apparent second medial crossvein would be expected to intersect CuA at the middle of the second cubital cell.

The degree of overlap of the branches of Rs + MA in Apochrysinæ is the same as in Chrysopinae, and may be verified by matching branches of Rs + MA with the veinlets between Psm and Psc, working basally from the distal end of Psm. Such a count would not, of course, bear on the question of whether MP2 had disappeared by moving forward and coalescing with MP1, or whether it may have moved posteriorly and fused with CuA. But it precludes the possibility that the first median crossvein is MP2, as suggested by Kimmins (1952b), since in that case one would have to account for an extra crossvein between MP and CuA.

Investigation of male genitalic structures in a wide variety of neuropterous types has led me to believe that in the Planipennia, the ninth gonocoxites primitively articulate on the arms of the gonarcus. In the Chrysopidae, the "parameres" of most authors appear to be the gonocoxites and are referred to as such below.

Key to the Subfamilies of Chrysopidae

1. Media posterior 1 runs in an even curve to margin, not angulate at intersections with basal inner and outer gradate crossveins. These crossveins intersect MP at nearly a right angle, so that MP does not appear interrupted by either Psm or Psc (Mesozoic) Mesochrysoptinae.
- Media posterior 1 usually definitely angulate at intersections with basal outer and inner gradates, so that it appears interrupted by a definite pseudocubitus, and (usually) a pseudomedia 2.
2. Jugal lobe of fore wing large; frenulum present on hind wing; tympanal organ of fore wing absent Nothochrysoptinae.
- Jugal lobe of fore wing and frenulum of hind wing reduced or absent; tympanal organ of fore wing present (reduced in Apochrysinæ) 3.
3. In fore wing, basal subcostal crossvein and intramedian cell present; space between Psm and Psc relatively wide (Fig. 45) Chrysopinae.
- In fore wing, basal subcostal crossvein and intramedian cell absent; space between Psm and Psc relatively narrow (Fig. 44) Apochrysinæ.

Subfamily MESOCHRYSOPTINAE Handlirsch

Mesochrysoptidae Handlirsch, 1908, *Die fossilen Insekten*: 612, pl. 48, fig. 14. Type: *Mesochrysoptia* Handlirsch 1908.

Genus MESOCHRYSOPTA Handlirsch

Mesochrysoptia Handlirsch, 1908, *Die fossilen Insekten*: 612. Type (by monotypy): *Hageniotes zitteli* Meunier, 1898.

***Mesochrysoptia zitteli* Meunier**

Hageniotes zitteli Meunier, 1898, *Arch. Mus. Teyl.* (2) 6: 34, pl. 2, fig. 2 (reference from Handlirsch).

Mesochrysoptia zitteli: Handlirsch, 1908, *loc. cit.* Tillyard, 1916, *Proc. Linn. Soc. N.S. Wales* 41: 245-248, text-fig. 8. Martynova, 1949, *Trudy Paleontol. Inst., Akad. Nauk SSSR* 20: 169. Adams, 1957, *Psyche* 63: 72.

Discussion. From the Jurassic limestone of Bavaria. A myrmeleontid appearance derives from the long slender wings, with Sc and R apparently fused apically, and with many branches of Rs. But the absence of pectinate branching of MP and CuA precludes relationship with the osmyloid-

myrmeleontoid families. Although the inner and outer gradate series are somewhat irregular, the basal inner gradates are strongly inclined, forming a well-defined pseudomedia, which does not include MP. The multiplication and irregularity of veins is likely a function of the insect's large size (fore wing 36 mm long); the arrangement is essentially like that of the following genus.

Genus *MESYPOCHRYSA* Martynov

Mesypochrysa Martynov, 1927, *Izvestia Akad. Nauk SSSR* 21: 764. Type species (by monotypy): *Mesypochrysa latipennis* Martynov, 1949, *Trudy Paleontol. Inst. Akad. Nauk SSSR* 20: 169.

Mesypochrysa latipennis Martynov

Mesypochrysa latipennis Martynov, 1927, *Izvestia Akad. Nauk SSSR* 21: 765, figs. 10–12 (hind wing and body structure). Martynov, 1949, *Trudy Paleontol. Inst. Akad. Nauk SSSR* 20: 169. Type from the Jurassic of Kara-tau (Turkistan), *Paleontol. Inst. Acad. Sci. USSR*, not examined.

Discussion. Martynov's figure (redrawn as Fig. 37) shows the body and hind wing in some detail. The course of MP is probably drawn too straight; one would expect slight zig-zagging at the intersection of the basal gradate crosswing. Probably two crossveins were present between the branches of MP, as in nearly all chrysopids.

This fossil is of particular interest in that the hind wing is exactly what one would postulate in the ancestor of *Archaeochrysa*. The basal Banksian cell is similar, but the inner crossvein is longer and more strongly inclined in *Mesypochrysa*. The basal branches of Rs + MA are only slightly zig-zagged, not strongly bent as in *Archaeochrysa*. It differs from more advanced chrysopids in the short, transverse pronotum.

Subfamily NOTHOCHRYSINAE Navás

Nothochrysinos Navás, 1910, *Broteria* 9: 38–59. Type: *Nothochrysa* McLachlan.

Nothochrysinini Navás, 1913, *Ann. Soc. Sci. Bruxelles* 37: 303. Type: *Nothochrysa* McLachlan.

Dietyochrysinae Esben-Petersen, 1918, *Ark. Zool.* 11 (26): 26. Tjeder, 1966, p. 246. Type: *Dietyochrysa* Esben-Petersen. NEW SYNONYMY (subjective).

Description. Wing veins of nearly uniform diameter near base, tapering evenly apically; MP extends adjacent to R, but is not fused with it; no tympanal organ apparent on ventral side of R in fore wing; jugal lobe of fore wing conspicuously produced; Psm (except in *Nothochrysa* and *Dyspetochrysa*) composed of branches of Rs alternating with crossveins. Prosternal area largely membranous. Color rarely green.

Discussion. Navás (1910) based his tribal division of the Chrysopidae on relatively trivial venational characters. His tribe Nothochrysinos included all the forms which had the intramedian cell (the cell immediately distal to the fork of MP) either quadrangular, or absent. This resulted in the inclusion of *Nothochrysa* (most species of which belong in *Italochrysa*), *Leucochrysa*, and *Nesochrysa*. With the exception of three species of *Nothochrysa*, all of these are members of the Chrysopinae. *Hypochrysa* was placed in the "Chrysopinos."

There is some question as to the validity of Navás' 1910 names. The taxa were clearly designated as tribes and names properly constructed but for the colloquial plural endings. These names bore correct terminations in the 1913 paper, and have priority from that date at latest. While Navás' usage of the name makes it nomenclatorially available, the concept of the subfamily here proposed is entirely new.

The Tertiary genera differ from living forms in position of the basal subcostal crossvein only. Furthermore, *Kimochrysa africana* (Recent) has the crossvein as in the fossils. Two Tertiary chrysopids appear to have been described from Eurasia, both belonging to Recent genera (*Nothochrysa*, *Chrysopa*). Martynov (1949) reports having collected a series of wing imprints from the Miocene of Stavropol (North Caucasus), but these have not been described.

Nothochrysa is included here because of its many archaic features, not found in any member of the Chrysopinae. However, the development of the pseudomedia is more advanced than in any other nothochrysin (except *Dyspetochrysa*), and does not differ from that of the Chrysopinae. Sclerotization of the prosternum is intermediate between that of *Pimachrysa* and *Hypochrysa*, and Chrysopinae. These are both important evolutionary advances over the rest of the Nothochrysinae, and tribal separation might be advisable, but for the small number of genera involved.

Biology. Biological information on this subfamily is meagre. *Nothochrysa* (Killington, 1937; Toschi, 1966) and *Hypochrysa* (Principi, 1958) lay stalked eggs. The larvae of *Hypochrysa* (Brauer, 1867) and *Nothochrysa* (Killington, 1937; Toschi, 1966) have been described. Both *N. capitata* and *N. fulviceps* may occasionally carry trash, but have exceptionally small thoracic tubercles. There is some indication of preference by adults for ancient host-plants: *Nothochrysa fulviceps* associates with oak, and *N. capitata* with pine (Killington), *N. californica* with both conifers (W. Wade, pers. comm.) and oak. *Pimachrysa intermedia* feeds on willow pollen; other species of *Pimachrysa* have been taken in bait traps (*fusca*, *albicostales*) or on flowers (*nigra*, on *Ceanothus*) and may be pollen or nectar feeders.

In *Nothochrysa* and *Hypochrysa nobilis*, a pale mass of material is deposited on the dorsal surface of the female abdomen. This has been erroneously interpreted as a spermatophore (Killington, Principi). However, Toschi, 1966, has observed that in female specimens of *N. californica* bearing such a dorsal mass, the spermatophore is to be found internally in the bursa. In *Pimachrysa fusca*, and presumably the other species, a sac-like spermatophore (Fig. 21, sp) may often be found protruding from the gonocoxites ("gonapophyses laterales") which marginally bear hooked hairs, probably for its retention (Fig. 20).

Key to the Genera of Nothochrysinae

1. Basal subcostal crossvein of fore wing arises distally to origin of Rs + MA, approximately opposite the medial fork (MF, Fig. 42); mostly fossil genera 2.
- Basal subcostal crossvein of fore wing arises basally to origin of Rs + Ma, or subcostal crossveins numerous; living genera 6.
2. Innermost branch of Rs + MA coalesced with MP 1 + 2 *Dyspetochrysa* gen. n.
- Innermost branch of Rs + MA connected to MP 1 + 2 by a crossvein 3.
3. In fore wing Rs + MA arises basally, nearer the first medial crossvein than to MF; in hind wing MP and Rs joined by a crossvein *Archaeochrysa* gen. n.
- In fore wing, Rs + MA arises more apically, nearer MF than to first medial crossvein; in hind wing MP coalesces with Rs for a short distance 4.
4. Inner gradate series forms a smooth curve continuous with Psm 5.
- Apical inner gradate series closer to Rs + MA than is Psm, thus forming a broken curve, with basalmost inner gradate of apical series arising proximally to most distal inner gradate of basal series *Tribochrysa*.
5. Subcosta and costa fused apically; living species 11.
- Subcosta and costa not coalesced; fossil species *Paleochrysa*.
6. More than two series of gradates in both wings 7.
- Only two series of gradates in both wings 8.
7. Three regular series of gradates *Triplochrysa*.
- Six or seven irregular series of gradates; discal area divided into a meshwork of polygonal cells *Dictyochrysa*.
8. Proximal branch of Rs + MA usually coalesced for a short distance with MP 1; in living species, pseudomedial fold follows entire length of Psm in both wings *Nothochrysa*.
- Proximal branch of Rs + MA never coalesced with MP 1, so that Psm consists of alternating longitudinal veins and crossveins; pseudomedial fold intersects first sectorial crossvein above intramedial cell, and may cross some basal gradates of the Psm, but never extends the full length of Psm 9.
9. Hooked hairs on ninth gonocoxites ("gonapophyses laterales") of female; basal crossveins of Psm not interrupted by pseudomedial fold *Pimachrysa*.

- No hooked hairs on ninth gonocoxite of female; basal crossveins of Psm interrupted by pseudomedial fold 10.
- 10. In fore wing, 2A and 3A fused apically; male epiproct fused with ninth tergite, with ventral processes *Hypochrysa*.
- In fore wing, 2A and 3A connected by a crossvein; male ectoproct demarked from ninth tergite, with no ventral processes 11.
- 11. Intramedian cell rhomboid, almost as high as long; fore pterostigma shorter than half wing width *Pamochrysa*.
- Intramedian cell about twice as long as high; fore pterostigma as long as two-thirds wing width *Kimochrysa*.

Genus *DICTYOCHRYSA* Esben-Petersen

Dictyochrysa Esben-Petersen, 1917, Proc. Linn. Soc. New South Wales 42: 214-215 (type, by original designation, *D. fulva* Esben-Petersen); 1918, Arkiv for Zool. 11(26): 1-37. Kimmins, 1952, Ann. Mag. Nat. Hist. (12)5: 70-72 (key to species).

Dictyochrysa fulva Esben-Petersen

D. fulva Esben-Petersen, 1917, Proc. Linn. Soc. N.S. Wales 42: 214-215, pl. 13, fig. 10. Holotype, from Queensland, Australia, Froggatt Collection, CSIRO, Canberra (not seen). Kimmins, 1952, Ann. Mag. Nat. Hist. (12)5: 71-72.

Dictyochrysa petersenii Kimmins

D. petersenii Kimmins, 1952, Ann. Mag. Nat. Hist. (12)5: 70-71, fig. 2 (wings, head, pronotum). Holotype, from Mt. Kosciuszko, New South Wales, 6000 ft., 12 December 1931, R. J. Tillyard, coll. In Brit. Mus. (Nat. Hist.), not seen.

Additional distribution. Mt. Maria, Tasmania?

Dictyochrysa latifasciata Kimmins

D. latifasciata Kimmins, 1952, Ann. Mag. Nat. Hist. (12)5: 71-72, fig. 3 (male genitalia). Holotype male, from Mt. Wellington, S. Tasmania, 1300-2300 ft., 12-21 March 1913. Abdomen in balsam. Brit. Mus. (Nat. Hist.), not seen.

Genus *TRIPLOCHRYSA* Kimmins

Triplochrysa Kimmins, 1952, Ann. Mag. Nat. Hist. (12)5: 69-70 (type, by original designation, *T. pallida* Kimmins).

Triplochrysa pallida Kimmins

T. pallida Kimmins, 1952, loc. cit., fig. 1 (wings). Holotype female, from Bunya Mt., Queensland, Australia, 27 January 1951, in Brit. Mus. (Nat. Hist.), not seen.

Genus *HYPOCHRYSA* Hagen

Hypochrysa Hagen, 1866, Stettiner Entomol. Zeit. 27: 377. Type species (by monotypy): *Chrysopa nobilis* Schneider.

Hypochrysa nobilis (Schneider)

Figures 5, 32, 33

Chrysopa elegans Burmeister, 1839, Handb. d. Entomol.: 981. Type locality "Harze," Saxe-sen collector, probably in the Zoological Museum, Univ. of Halle (not seen). This name has priority, but is a *nomen oblitum* under Rule 23b. Not to be confused with *Hemerobius elegans* Guerin 1838, which was transferred to *Chrysopa* by Schneider in 1851, and probably is a *Gonzaga*; this name is pre-occupied by *Hemerobius elegans* Stephens 1836.

Chrysopa nobilis Schneider, 1851, Symb. ad Monogr. Gen. Chrysopae: 142-144, pl. 51. (Name replaces *elegans* Burmeister.)

Hypochrysa nobilis: Hagen, 1866, Stettiner Entomol. Zeit. 27: 377. Brauer, 1867, Verh. Zool.-Bot. Ges. Wien 17: 27-29, pl. 9, fig. 1 (larva). Navás, 1913, Insecta 28: 129-130, fig. 1; 1915, Arx. Inst. Cien., Barcelona 3(2): 88. Principi, 1956, Atti Acad. Sci. Inst. Bologna, Rend. (XI)3: 1-3, pl. 1 (Ethology, photographs of adult, egg, habitat); 1961, Mem. Mus. Civ. Stor. Nat. Verona 9: 109.

Description. Male ninth tergite fused with ectoprocts, not articulated with ninth sternite. Eighth and ninth sternites not fused, but moveable. Ectoprocts (Fig. 32, ect.) each posteroventrally bearing heavily sclerotized toothed process. Gonarcus flattened, heavily sclerotized, black; mediuncus bilobed; gonocoxites ("parameres") weakly sclerotized, dorsolateral to mediuncus lobes.

Distribution. Widespread in southern Europe.

Remark. *Hypochrysa argentina* Navás, 1911, is a *Chrysopa* (Tjeder, 1966).

Genus *KIMOCHRYSA* Tjeder

Kimochrysa Tjeder, 1966, S. African Anim. Life 12: 254. Type species (by original designation): *Kimochrysa impar* Tjeder.

***Kimochrysa impar* Tjeder**

Kimochrysa impar Tjeder, *ibid.*: 256–259, figs. 820–834. Holotype male, Kleimmond, Cape Province, S. Africa, in the South African Museum, Cape Town (not seen).

Discussion. This is the only species of the *Nothochrysinæ* with numerous subcostal veinlets in the fore wing. In the male, the ninth abdominal tergite is not hinged to the eighth and ninth sternites, and these sternites are completely fused.

***Kimochrysa africana* (Kimmins)**

Hypochrysa africana Kimmins, 1937, *Ann. Mag. Nat. Hist.* (10) 19: 307–308, fig. Holotype female, from Worcester, Cape Province, S. Africa, in *Brit. Mus.* (Nat. Hist.) (not seen).

Kimochrysa africana: Tjeder, 1966, *S. African Anim. Life* 12: 259–261, figs. 835–838.

***Kimochrysa raphidioides* Tjeder**

Figures 10, 29–31

Kimochrysa raphidioides Tjeder, 1966, *ibid.*: 261–262, figs. 839–844. Holotype female, from “Cap Drege” (abbreviation for “Cape of Good Hope, Drege, collector”), in the MCZ (examined).

Description. Head marked with dark as in Figure 10. Pronotum transverse, a thin transverse black line at outer edge of furrow, a short longitudinal line at posterior corner. Subcostal crossvein distal to origin of $R_s + MA$. Male ninth tergite hinged to ninth sternite (Fig. 31); fusion of eighth and ninth sternites demarked by internal sclerotized ridge. Gonocoxites (Figs. 29, 30, *gex*) paddle-shaped.

Discussion. In addition to the type, a male with no data is also in the MCZ. This species is doubtfully distinct from *africana*, from which it differs only by the position of the subcostal crossvein (proximal to the origin of $R_s + MA$ in *africana*), and by greater sclerotization of the spermatheca (which may be due to different degrees of maturity in the specimens). Tjeder differentiates these two species principally on the position of the second medial crossvein. But in *africana*, it varies in position from distal to proximal to the fork (Kimmins,

pers. comm.). In the male of *raphidioides*, the crossvein intersects MP at the fork. In the specimen of *K. impar* figured by Tjeder, the second medial crossvein is proximal to the fork on one wing, and distal on the other.

The coloration of the two species is similar, although the frontal markings below the antennae are absent on the type of *africana*, and faint on the second specimen; the interantennal marks are faint on both specimens of *africana* (Kimmins, pers. comm.).

Genus PAMOCHRYSA Tjeder

Pamochrysa Tjeder, 1966, *S. African Anim. Life* 12: 248. Type species (by original designation): *Pamochrysa stellata* Tjeder.

***Pamochrysa stellata* Tjeder**

Pamochrysa stellata Tjeder, *ibid.*: 250–253, figs. 797–815. Holotype male, from Cathedral Peak, Forestry Reserve, Indumeni River, Drakensberg, Natal, S. Africa, March 1959, in the Natal Museum, Pietermaritzburg, not seen.

Genus NOTHOCHRYSA McLachlan

Nothochrysa McLachlan, 1868, *Monograph of the British Neuroptera-Planipennia*. *Trans. Entomol. Soc. London* (1868): 195. Type species, *Chrysopa fulviceps* Stephens, designated by Banks, 1903, *Trans. Amer. Entomol. Soc.* 29: 142. Tjeder, 1941, *Entomol. Tidskrift* (1941): 30–31. Principi, 1946, *Bol. Inst. Entomol. Univ. Bologna* 15: 86.

Nathanica Navás, 1913, *Trans. 2nd Intern. Congr. Entomol., Oxford, 1912*, 2: 181 (type [by subsequent designation of Tjeder, 1941, *ibid.*): *Hemerobius capitatus* Fabricius).

As McLachlan failed to designate a type for this genus, Banks' listing of *N. fulviceps* as type constitutes a valid type designation. Principi (1946) restricted *Nothochrysa* to include *fulviceps* and *capitata* only, erecting a new genus, *Italochrysa*, for *N. italica* Rossi. It appears that the great majority of Old World species formerly included in *Nothochrysa* belong instead to *Italochrysa*.

Description. Head wide, vertex low, eyes small, labrum emarginate. Antennae

about as long as fore wing; scape about as long as wide, flagellar segments longer than wide. Prosternum small (Fig. 35). Tarsal claw either with basal enlargement (*fulviceps*) or simple (*capitata* and *californica*). Fore wing (Figs. 3, 43): basal subcostal crossvein opposite midpoint between first medial crossvein and medial fork. Rs originates basad of medial fork; two rows of gradates. Psm formed by overlapping longitudinal veins, may extend beyond basal inner gradates; pseudomedial fold present; MP2 parallels MP1, connected by a crossvein; second medial crossvein intersects MP2 midway between Mp and CuA. Psc parallels Psm; runs into outer gradate series. 1A forked apically; 2A and 3A simple. Jugal lobe prominent. Hind wing: frenulum well developed, MP coalescent with Rs for a moderate distance; two rows of gradates. Psm well developed, but longitudinal veins do not overlap (except basally in *fulviceps*); instead each intersects the next where it bends sharply apicad, so that the veins between Psm and Psc are exactly opposite the basal branches of Rs (a very conspicuous and characteristic feature). Pseudomedial fold present. Psc runs into outer gradate series.

Male: (Fig. 17) ninth abdominal tergite heavily sclerotized anteroventrally, with irregular margin; fused with ectoproct. Eighth sternite distinct or only weakly fused with ninth sternite. Cuticular gland openings present. Gonarcus (Figs. 18, 19) bears wide triangular mediuncus; gonocoxites small. Female: No hooked hairs on ninth gonocoxites; eighth sternum bilobed, lobes fitting into cuplike ninth valvulae ("diverticulos linguiformes" of Principi) so as to close the genital cavity anteriorly, as in *Chrysopinae*.

Key to the Recent Species of NOTHOCHRYSA

1. Pronotum membranous medially; Psm in fore wing extends beyond inner gradate series; head orange and black; North American *californica*.
- Pronotum sclerotized medially; Psm in fore wing runs into inner gradate series;

- head concolorous, orange or orange-brown; European 2.
2. Thorax with median pale band, tarsal claws with basal expansion; several marginal veinlets from Psc forked; large species (expanse 37-48 mm) *fulviceps*.
 - Thorax orange-brown, no median band; tarsal claws simple; marginal veinlets from Psc rarely forked; smaller (expanse 27-36 mm) *capitata*.

Nothochrysa fulviceps (Stephens)

Chrysopa fulviceps Stephens, 1836, Illustr. Brit. Entomol. Mand., 6: 101. Types: 4 syntypes in the Brit. Mus. (Nat. Hist.), not seen.

Nothochrysa fulviceps: McLachlan, 1868, Trans. Entomol. Soc. London (1868): 207.

Nathanica fulviceps: Navás, 1913, Trans. 2nd Intern. Congr. Entomol., Oxford, 1912, 2: 181. Killington, 1937, Monogr. Brit. Neuropt. 2: 236-242, fig. 114 (male genit.), fig. 115 (female genit.), pl. 27, fig. 2 (wing), pl. 30, fig. 3 (larva).

Nathanica fulviceps var. *flavida* Navás, 1919, Bol. Soc. Entomol. España 2: 55.

Nothochrysa fulviceps: Tjeder, 1941, Entomol. Tidskrift (1941): 30-31.

Distribution. Europe.

Nothochrysa capitata (Fabricius)

Hemerobius capitatus Fabricius, 1793, Entomol. Syst. 2: 82. Type locality "Germania. Dom. de Paykull." Zool. Mus., Univ. of Kiel, not seen.

Chrysopa capitata: Curtis, 1834, Brit. Entomol. pl. 520.

Nothochrysa capitata: McLachlan, 1868, Trans. Entomol. Soc. London (1868): 207.

Nathanica capitata: Navás, 1913, Trans. 2nd Intern. Congr. Entomol., Oxford, 1912, 2: 181. Killington, 1937, Monogr. Brit. Neuropt. 2: 242-246, fig. 115c (female genit.), pl. 27, fig. 3 (wings), pl. 30, fig. 4 (larva).

Nothochrysa capitata: Tjeder, 1941, Entomol. Tidskrift (1941): 30.

Distribution. Europe.

Nothochrysa californica Banks

Figures 3, 8, 17, 18, 19, 22, 35

Nothochrysa californica Banks, 1892, Trans. Amer. Entomol. Soc. 19: 373. Male holotype from Los Angeles, Calif., MCZ No. 11406, examined. 1903, Trans. Amer. Entomol. Soc. 29: 142, pl. 2, fig. 3 (wing base); 1904, Cat. Neuropt. In-

sects U.S., Philadelphia: 26. MacGillivray, 1894, *Canad. Entomol.* (1894): 171. Smith, 1932, *Ann. Entomol. Soc. Amer.* 35: 582, pl. 1, fig. 5 (body and wings, color). Bickley and MacLeod, 1956, *Proc. Entomol. Soc. Washington* 58: 182-183.

Description. Head (Fig. 8): antennal sockets large, margins black. A black line extending down suture from antennal socket to anterior tentorial pit; black line connecting pits bent posteriorly in middle; dark mark on clypeus connected to this line laterally; black genal spot, near mandibular articulation. Vertex elevation slight; median and lateral stripes connected to circumantennal marks. Antennae black; scape wider than long. Palpi dark, pale at joints.

Pronotum divided by median longitudinal pale membranous area; lateral sclerites dark umbraceous, lateral margins pale. Alinotum dark, mesoprescutum with posterior pale band interrupted by black median longitudinal suture; mesoscutum pale anteriorly. Propleuron and sternum dark. Meso- and metapleura dark, pale posteriorly. Coxae dark, trochanters dark basally; femora with dorsal and ventral longitudinal dark stripes, confluent on hind femur. Tibiae pale with dark basal and apical marks; tarsi fuscous, dark apically. Claws lack basal tooth.

Fore wing (Fig. 3): veins black, except C, R, 3A and posterior marginal vein pale basally; sensory area posterior to apex of 3A and posterior marginal vein pale basally; sensory area posterior to apex of 3A, and jugal lobe, fuscous; stigma fuscous, spaces between apical subcostal crossveins ivory. MPI desclerotized at intersection with basal sectorial crossvein; Psm continues beyond basal inner gradates. Hind wing: venation dark, R white to stigma; Rs and MPI white basally; CuP white; stigma as in fore wing.

Abdomen: tergites black, narrowly pale apically; sternites may be pale both basally and apically. Female ninth tergite with pale spot posterolaterally; tenth tergite pale, callus cerci and posterior margin black. Eighth sternum (Fig. 22) bilobed. Dorsal postcopulatory mass white or creamy yellow.

Male ninth sternum pale ventrally. Callus cerci fused to ninth tergum; ninth sternum partially coalescent with eighth (Fig. 17). Cuticular gland openings lacking on heavily sclerotized anteroventral area of ninth tergum, and tenth tergum. Mediuncus (Figs. 18, 19) broad, hoodlike; gonocoxites small, platelike.

Measurements (mm): Fore wing length 12.5-15. (13.5); width 4.5-5.5 (5.1); antenna 10-12 (11.2).

Distribution: CALIFORNIA: Alameda Co.: E. C. Van Dyke (USNM); Berkeley, 28-IV-12, ♀, J. C. Bridewell (USNM); Oakland, 17-IV-15, E. P. Van Duzee (MCZ); Hills back of Oakland, 30-IV-1911, ♂, 9-V-09, ♂, E. C. Van Dyke (CAS). Contra Costa Co.: Near Orinda, 21-IV-50, W. Wade (CNHM). Marin Co.: Mill Valley, 28-II-26, ♀, 6,7-III-26, 2 ♀, E. P. Van Duzee (CAS), 25-III-52, 2 ♂, 1 ♀, H. B. Leach (CAS), 8-V-56, E. S. Ross (CAS); Muir Woods, 23-IV-1911, ♀, E. C. Van Dyke (CAS); San Geronimo, 20-IV, O. Sacken (MCZ). Mendocino Co.: Caspar Lumber Camp, 12 mi. E. Fort Bragg, 20-VI-38, ♀, Van Dyke (CAS); Van Damme State Park, 18-V-47, ♂, H. Welsh (CAS); Yorkville, 1-V-24, ♀, E. P. Van Duzee (CAS). Santa Clara Co.: Stevens Cr. 16-III-41, ♀, E. S. Ross (CAS); Palo Alto, 27-V-92 (MCZ); Hills back of Palo Alto, 29-IV-1928, ♀, (CAS); Stanford Univ. 5-IV-04, ♀, (MCZ). San Mateo Co.: King's Mt., 5-VII-46, ♂, E. S. Ross (CAS).

OREGON: Benton Co.: Corvallis, 19-V-45, ♀, Marge Johnson (OSC); McDonald For., 5 mi. N. Corvallis, 26-V-56, ♀, J. R. Mori (OSC); Sulfur Spgs., 6 mi. N. Corvallis, 11-V-56, ♀, J. F. O'Brien (OSC); Rock Cr., 12 mi. W. Corvallis, 4-V-56, ♀, N. E. Johnson (OSC); 1 mi. N. Dawson, 2-V-62, 4 ♀, 1 ♂, W. Barnett, (OSC); 2 mi. S.E. Summit, 12-IV-57, ♂, J. Lattin (OSC).

WASHINGTON: Kittitas Co.: Easton, A. Koebele (USNM).

BRITISH COLUMBIA: Bowser, 5-IV-55, 20-VI-55, 1 ♂, 1 ♀, J. W. Brown (CNC); So. Pender Is., 30-V-50, on Douglas Fir,

1 ♀, (CNC); Vancouver, 31-V-31, on snow, 4700 ft., Seymour Mt., H. B. Lceeh (MCZ); Victoria, 4-V-18, W. B. Anderson (Smith, 1932).

Diagnosis. This species differs markedly from *N. fulviceps* and *capitata* in head coloration, in Psm extending beyond the basal inner gradates, and in the peculiar separation of the lateral pronotal sclerites by a median membranous area. It is retained in *Nothochrysa* because it shares with the other species the well developed Psm and Psc.

Discussion. The paucity of material from Oregon, Washington, and western Canada probably indicates less collecting activity, rather than scarcity. In the San Francisco Bay area it sometimes is locally fairly numerous. W. Wade (pers. comm.) collected eggs on conifers in the Orinda, California, area. D. Breedlove (pers. comm.) has noted adults abundantly on oak near Oakland, California. Throughout its range, it appears to be restricted to moist forest areas, not far from the coast. The type is probably mislabelled; in spite of intensive collecting around Los Angeles since 1892, no additional specimens have been taken.

Nothochrysa praeclara Statz

Figure 43

Nothochrysa praeclara Statz, 1936, Bechiana 93: 215–216, fig. 3 (photograph of fore wing), fig. 4 (drawing of fore wing). Holotype, from Rott am Siebengebirge, West Germany, mid-Tertiary, in the Los Angeles County Museum (examined).

This species, known from a single fore wing, differs from *capitata* only in having fewer overlapping veins in Psm. In all the specimens of *capitata* examined, at least four branches of Rs + MA coalesce with the next proximal vein at the Psm, whereas only one basal branch is so coalesced in *praeclara*. This may not be significant; in *fulviceps* the venation is very irregular, and some specimens show no overlap at all. *Praeclara* differs from *fulviceps* in smaller size (fore wing length 16.33 mm, 16 branches of Rs + MA).

Genus *PIMACHRYSA* Adams

Pimachrysa Adams, 1957, Psyche 63: 67–70. Type (by original designation): *P. grata* Adams.

Description. Vertex moderately elevated; anterior tentorial pits large; labrum barely emarginate. Antennal length variable; scape short, little swollen; apical flagellar segments more than twice as long as wide. Tarsal claws simple, without basal enlargement. Prosternum unsclerotized anteriorly to sternal pits (Fig. 34). Male with ninth tergite clearly separated from ectoproct; ninth sternite clearly demarked from eighth, posterior margin acute (Figs. 11, 14). Mediuncus slender, apex angulate (Figs. 12, 13, 15, 16). Cuticular gland openings present. Female with enlarged ninth gonocoxites bearing marginally a band of spoon-shaped setae (Figs. 20, 21). Eighth sternite (subgenital plate) and ninth valvulae lie on membrane of genital opening, so that it is permanently closed anteriorly. Spermatophore ovoid, protruding from gonocoxites.

Fore wing: costal area narrow; basal subcostal crossvein slightly basal to origin of Rs; Rs arising basally to cubital fork. MP2 not fusing with MPI, but turning to wing margin at apex of intramedian cell. Second mediocubital crossvein near MF, usually distal to it. Two gradate series, extending smoothly into Psm and Psc (except in *P. nigra*); no overlap of adjacent longitudinal veins on Psm or Psc. Pseudomedial fold undeveloped except for weak spot at intersection of first sectorial crossvein and MPI. Anals neither branched nor anastomosed. Jugal lobe prominent, with jugal vein.

Hind wing: frenulum present. Costal area narrow. Rs and MP merely touching, or fused for a short distance; basal Banksian cell large. Psm and Psc similar to those of fore wing. Anals neither forked nor anastomosed.

Discussion. This genus is most similar to *Hypochrysa*, but differs in having enlarged ninth gonocoxites, bearing modified hairs, probably serving to hold the spermatophore in place. In *Hypochrysa*, a

postcopulatory mass is placed on the dorsal surface of the female abdomen, the second mediocubital crossvein is more basal and some anal veins are anastomosed; the eyes are smaller in relation to the remainder of the head, than in *Pimachrysa*.

Key to the Species of PIMACHRYSA

1. A slight break between inner gradates and Psm; only 1 or 2 branches of Rs forked marginally; color yellow-orange and black *P. nigra* sp. n.
- Inner gradates merge smoothly with Psm; nearly all branches of Rs forked marginally 2.
2. Head unmarked except for interantennal mark; body mostly pale yellow; stigma white *P. grata* Adams
- Head with dark marks on face and vertex; subcostal veinlets of stigma conspicuously dark-bordered; body gray-pruinose 3.
3. Discal veins of hind wing mostly black *P. intermedia* sp. n.
- Veins of hind wing (except Sc) all pale 4.
4. Costal veinlets of fore wing pale; in hind wing MPI touches Rs + MA at one point only *P. albicostales* sp. n.
- Costal veinlets of fore wing black; in hind wing MPI coalesced with Rs + MA as far as length of first radial crossvein *P. fusca* sp. n.

Pimachrysa grata Adams

Figures 9, 23

Pimachrysa grata Adams, 1957, *Psyche* 63: 67-70 (1956), figs. 1-5 (head and pronotum, genitalia, wings). Holotype female, from Madera Canyon, Santa Rita Mts., Arizona, 26 August 1949, at light. P. Adams, col. MCZ No. 29624, examined.

Description. Head (Fig. 9): straw yellow, marked with black; flagellum black. Pronotum ivory, with three fuscous stripes. Meso- and metanota yellow, scuta infusate posterolaterally. Meso- and metapleurae bright yellow, with fuscous marks. Legs ivory, femora with wide apical fuscous band.

Wings (Adams, 1957, Fig. 1) more acute than in *fusca*; inner gradate series sinuous, so that in middle of series, the distance between inner and outer gradates equals half or less the distance from inner gradates to

Rs. Second medial crossvein of fore wing basal to MF. Most marginal veinlets forked.

Fore wing: costa, subcosta and R white, stigma white; other veins fuscous except at wing base.

Abdomen (♀) short, slender, terminal segments greatly enlarged. Gonocoxites larger than in other species, with more hooked setae. Subgenital plate (Fig. 23) ligulate, with transverse ridge on ventral (anterior) surface. (The illustration, from Adams, 1957, shows a ventral view, with the distal margin uppermost. In the other species a posterior view is shown, with the distal margin below.)

Measurements (mm): Antennae 16; fore wing length 14.

Diagnosis. Immediately distinguishable from *fusca* by its pale body and venation.

The following three closely related species are grey with prominent stigmas, and look much alike.

Pimachrysa albicostales sp. n.

Figures 27, 28

Holotype. Male from Mexico; Baja Calif., 22 mi. N. of Punta Prieta, 9-XII-58, H. B. Leech, col., in the California Academy of Sciences. The specific name refers to the white costal veinlets.

Description. Eight or nine black spots on apical subcostal crossveins of fore wing, six or seven in hind wing. Intramedian cell of fore wing about four times as long as high, branches of Rs + MA more sharply inclined to Psm than in *fusca*, and cells between Rs and Psm longer. MPI of hind wing merely touches Rs + MA, not coalesced over a long distance, as in *fusca*. Wing setae black; on dorsum of fore wing equal to length of longest costal veinlet.

Abdomen pale, tergites 2-8 with triangular dark marks (apices anterior); 9 with small mediodorsal dark rectangle, ectoprocts fuscous. Sternites light fuscous, paler medially; ninth dark-lineate basally, dark apically. Apical beak-like extension of ninth sternite longer than in *fusca*. Cuticular glands of basal segments sparser than in

fusca. Gonarcus shorter, mediuncus (Figs. 27, 28) longer, spoon-shaped distally, with apical tooth.

Measurements (mm). Fore wing 10.0–11.3 (10.6).

Diagnosis. Head and thorax marked similarly to *fusca*, but paler. Wing veins colored as in *fusca*, but costal veinlets of fore wing pale. Membrane not brown in center of cells as in *fusca*.

Record (Paratype). ARIZONA, Tucson, Tumamoc Hill, week ending 5-XII-61, ♂, in ethylene glycol pollen trap, Sandra Ray Johnson, col. (MCZ, in alcohol).

Pimachrysa fusca sp. n.

Figures 1, 7, 11–13, 21, 24

Holotype. Male from L. Covington Flat, Joshua Tree Nat. Mon., Riverside Co., Calif., 19-III-61, E. L. Sleeper, col. In the California Academy of Sciences. The name refers to the dark appearance of this species.

Description. Head pale, marked with black (Fig. 7); scape pale with medial and lateral black stripes; pedicel and flagellum fuscous. Pronotum about as long as broad, lateral margins strongly deflexed; no transverse groove; pale ivory with fuscous median and marginal stripes; a short narrow longitudinal black stripe each side between the fuscous bands, connected to the median stripe posteriorly by a narrow transverse black band; black spot in posterolateral corner. Meso- and metanota with median and lateral fuscous stripes; mesoscutum pale near wing base, with black spots (areas devoid of microtrichia) on inner and outer margins of lateral stripe. Pleurae fuscous. Membrane anterior to prosternum pale. Legs pale, femora with dark preapical band; tibiae with dark bands at base, about two-fifths of distance to apex, and at apex. Tarsi fuscous.

Wing venation as in Figure 1. Fore wing: veins black except for C, apex of Sc, R, and bases of Cu and anal, white. Stigma pale, with 4–6 apical subcostal crossveins conspicuously black-bordered. Marginal area posterior to 3A black; membrane

hyaline, usually brown-tinted in central portion of all cells. Intramedian cell about 3 times as long as high. Setae on upper surface black, long, stiff, sparse. Hind wing: veins, except Sc, all pale; posterior marginal black at intersections of marginal veinlets. MP1 coalesced with MA + Rs for a short distance. Macrotrichia about one-third length of those of fore wing.

Abdomen in male dark fuscous. Ninth sternite with a beak-like posterior projection, fused with eighth sternite medially (Fig. 11). Pores of cuticular glands sparse on apical segments, on ninth sternite confined to anterolateral area. Mediuncus (Figs. 12, 13) widened between attachment of membrane and apical tooth. Female abdomen mostly fuscous; ninth tergite pale laterally. Ninth gonocoxites (Fig. 21) not so large as in *P. grata*, and with fewer hooked setae. Eighth sternite (Fig. 24) with blunt, anterodorsally directed horn; a basal fragment present, shaped as a narrow transverse band. Ninth valvulae appear as slender rods. Spermatophore (Fig. 21, sp) ovoid, with cuplike apical indentation, and tubular process extending into genital opening.

Measurements (mm). Fore wing length 8.8–11.1 (10.3); maxillary palpus (apical three segments) 0.67–0.83 (0.73); scape 0.24–0.32 (0.28).

Diagnosis. In shape of head and wings, and in venation, this species is closer to *P. grata* than to *P. nigra*. It may be recognized by the gray-pruinose body, smoky wings, prominent dark pterostigma, dark costal veinlets of fore wings, and pale veins in the hind wing.

Records (Paratypes). CALIFORNIA: Riverside Co., Joshua Tree National Monument, L. Covington Flat #1, 19-III-61 ♂; #2, 5-III-61 ♀; #4, 25-XI-60 ♂, 5-XI-60; U. Covington Flat #1, 5-XI-60 ♂; Smithwater Wash #1, 25-XI-60 ♀, 4-III-61 ♀; all collected by E. L. Sleeper in molasses bait traps (Long Beach State College, MCZ, Adams Collection). Los Angeles Co.: Aliso Can. chapparal, 26-X-58 ♀, R. X. Schick (UCLA).

Pimachrysa intermedia sp. n.

Figures 2, 20, 25

Holotype. Female from Snow Creek, 1500', White Water, Riverside Co., Calif., 8-III-1955, W. R. M. Mason, col. Canada Department of Agriculture, Ottawa. The name means intermediate.

Description. Head marked with black similarly to *fusca*, but dark border of antennal socket not connected to lateral vertex stripe, median vertex mark larger, and genae black-bordered posteriorly. Maxillary palpi and scape both shorter than in *fusca*. Pronotum longer than in *fusca*, pale, with lateral and median red-fuscous stripes, broader posteriorly; between these each side a brown stripe, extending to furrow (which is barely perceptible). Meso- and metanota dark; yellow spots laterally on prescuta and scuta. Propleura and cervical sclerites pale fuscous, prosternum dark-fuscous; membrane anterior to sternum pale, with median and lateral fuscous stripes, overlaid with a rufous transverse band. Meso- and metapleurae fuscous. Legs pale, femora with a broad preapical dark band; tibiae with thin dark band at about one-third distance from base to tip; fore and mid tibiae slightly infuscated, hind with two narrow dark stripes on ventral surface.

Wing venation as in Figure 2; few marginal veinlets forked. R (basal two-thirds) and 3A in both wings, and bases of 1A, 2A, and Cu in hind wing, pale; other veins all dark. Stigma white, with dark clouds on apical subcostal crossveins; membrane proximal to end of 3A in fore wing fuscous.

Abdomen fuscous, segments narrowly pale at anterior and posterior margins; muscle scars on tergites black, surrounded by pale areas. Female external genitalia similar to those of *fusca*; subgenital plate bears knob on basal margin, basal fragment much wider, and less sclerotized than in *fusca* (Fig. 25).

Measurements (mm). Fore wing 9.2; apical three segments, maxillary palpus, 0.49; scape 0.21.

Diagnosis and discussion. In the features

by which this species differs from typical *fusca*—dark venation, smaller number of gradate cells, fewer forked marginal veinlets, short palpi, color and shape of pronotum—it grades toward *nigra*. Furthermore, it was taken geographically close to a *nigra* locality. It may be a unique hybrid individual, or a representative of an introgressed population.

Biology. The crop of the type is filled with *Salix* pollen (identified by D. Walkington, California State College, Fullerton).

Pimachrysa nigra sp. n.

Figures 6, 14–16, 26, 34

Holotype. Male from Gavilan, Riverside Co., Calif. 19-III-36, on *Ceanothus crassifolius*, Timberlake, col. (California Academy of Sciences). The name is descriptive of the dark coloration.

Description. Head long, eyes small; color shades from ivory anteriorly, to orange on vertex; dark-fuscous markings as in Figure 6; mark between antennae extending anteriorly to frontal suture, and broadly over antennal sockets and vertex. Maxillary palpi short, dark, pale at joints. Occipital foramen broadly dark-margined. Scape pale, broad medial and lateral dark stripes; pedicel and flagellum dark. Pronotum long, brown-fuscous with two narrow submedian pale stripes. Meso- and metanota dark, two disconnected yellow stripes. Propleurae, sternum, and cervical sclerites dark; rufous median area on membrane anterior to prosternum. Meso- and metapleurae dark. Legs dark; femora pale basally and apically; tibiae (especially metathoracic) paler exteriorly, with apical dark band.

Fore wing veins dark; bases of C, R, 3A, and marginal vein in jugal area, pale. Stigma black; conspicuous ivory spots on membrane, between apical subcostal crossveins. Hind wing similar, but R pale for two-thirds length.

Venation (Fig. 4): A break in alignment of inner gradates and Psm in both wings; weak pseudomedian fold in both wings (especially hind), but no definite articula-

tions, as are found in *Nothochrysa*; usually only 1 or 2 branches of Rs forked marginally (3 and 4 in hind wings of one female).

Abdomen dark, segments narrowly pale-banded posteriorly. Male 8th and 9th sternites, and 9th tergite-ectoproct more strongly fused than in *fusca* (Fig. 14). Many cuticular gland openings, except on ectoproct. Margin of mediuncus between apical tooth and attachment of membrane, nearly straight (Figs. 15, 16). Female terminalia similar to those of *fusca*; 8th sternite (Fig. 26) preceded by broad basal fragment, ventrally with blunt horn. Ninth valvulae reduced to dotlike sclerites.

Measurements (mm). Fore wing 7.5–9.0 (8.0) long; apical three segments, maxillary palpi, 0.48–0.53 (0.51); antennae 7–8 (7.5).

Diagnosis. This small species may immediately be distinguished from all other species of *Pimachrysa* by its brown-black and orange markings. It strikingly resembles *Nothochrysa californica* Banks, for which it has been mistaken by several workers, including the writer. In shape of head, and condition of pseudomedia, it is closer to *Nothochrysa* than is any other species of *Pimachrysa*. However, these genera are structurally so different that the colorational resemblance is undoubtedly coincidental.

Records (Paratype). CALIFORNIA: Gavilan, I-IV-38, ♀, on *Ceanothus crassifolius*, Timberlake, col. (MCZ). Pinnacles, San Benito Co., 23-III-40, R. L. Usinger, col. (CIS). Lebec, Kern Co., I-IV-39, ♀, E. S. Ross (CAS).

DYSPETOCHRYSA gen. n.

Figure 42

Type species. *Tribochrysa vetuscula* Scudder. The feminine name means "difficult-chrysopid," referring to the intricacy resulting from the superimposition of fore and hind wings in the fossil.

Description. Basal subcostal crossvein distal to origin of Rs, opposite MF; Rs + MA originates far basal of MF. First sectorial crossvein intersects MP1 very near

MF. Intramedian cell long. Proximal branch of Rs + MA coalesces with MP1, and second branch coalesces with proximal branch, so that basal portion of Psm contains no crossveins. Psc strongly developed, two marginal veinlets from third medial cell, basal one forked; at least four additional non-forked marginal veinlets from Psc. Hind wing with zig-zagged Psc.

Discussion. The fore wing base is similar to that of *Archaeochrysa*, except for the overlap of branches of Rs + MA forming Psm. It is most interesting that the wing should demonstrate such a generalized structure of Rs + MA and the intramedian cell, while having a pseudomedia which, at least basally, resembles that of *Nothochrysa*. In this regard, *Dyspetochrysa* is more advanced than all other Nothochryssinae, save *Nothochrysa* itself.

Dyspetochrysa vetuscula Scudder

Figure 42

Tribochrysa vetuscula Scudder, 1890, U. S. Geol. Geogr. Survey Terr., Rept., 13: 170, pl. 14, fig. 9. Holotype: Florissant, Colorado, Miocene; MCZ No. 245, tip of abdomen and distal half of fore wing missing; hind wing venation mostly not visible, examined.

Paleochrysa vetuscula: Cockerell, 1908, Canad. Entomol. 40: 90.

Paleochrysa stricta: Carpenter, 1935, J. Paleontol. 9: 263 (not Scudder).

Description. Head large, interocular width 1.0 mm, eye 0.5 mm. Scape short, flagellar segments 0.2×0.1 mm. Pronotum wide, anterior margin straight, corners slightly angulate; dark, a four-lobed pale central area; width 1.44 mm; length, extreme 1.0 mm, midline 0.7 mm. Costal area narrow, tallest cell 0.63×0.55 mm. Intramedian cell 0.35×1.5 mm, pseudomedial area as wide as pseudocubital area.

ARCHAEOCHRYSA gen. n.

Figures 40, 41, 46, 47

Type species. *Paleochrysa creedei* Carpenter. The feminine name means "old-chrysopid" referring to the archaic venation.

Description. Fore wing: Basal subcostal crossvein distal to origin of Rs + MA opposite MF. Rs + MA arises nearer to basal medial crossvein than to MF. Sectorial crossvein intersects MP1 slightly distally to MF. Proximal branch of Rs + MA not coalesced with MP1, but connected by a gradate crossvein; Psm strongly zig-zagged. Psc well developed.

Hind wing: Base of Rs + MA moderately long; not coalesced with MP1. Psm zig-zagged, with no overlap of veins. Psc poorly developed, strongly zig-zagged, so that the gradate series apparently extends to MP2; marginal veinlets from Psc all forked.

Pronotum broad, squarish; cervical sclerites and prosternum as in *Pimachrysa*. Terminal abdominal segments of male broad, short; ectoprocts forcipate (Fig. 46).

Discussion. This is the most archaic of the Miocene genera. It is unique in its lack of fusion of MP1 and Rs + MA in the hind wing. The unspecialized Psc of the hind wing is found elsewhere only in *Paleochrysa wickhami* Cockerell.

Archaeochrysa creedei (Carpenter)

Figures 41, 46, 47

Paleochrysa creedei Carpenter, 1935, J. Paleontol. 9: 265, fig. 3; 1938, Psyche 45: 108. Holotype: Creede, Colorado, Miocene, A. Caplan, coll.; MCZ No. 4316, examined.

Paleochrysa stricta: Carpenter, 1938, Psyche 45: 108, fig. 1.

Description. Costal area narrow, 0.25 mm wide, cells about as high as long. Ten branches of Rs + MA in fore wing, and 7-8 in hind wing. Gradate cells about twice as long as wide. Intramedian cell narrow, about 0.375×1.5 mm. Flagellar segments 0.13×0.21 mm. Pronotum (Fig. 47) squarish, anterior margin not clear; 0.94 mm wide, 0.91 mm (0.625 mm on midline) long. Ectoprocts (Fig. 46) lateral, forcipate; gonarcus small.

Discussion. The lateral margins of the conspicuous cervical sclerites apparently correspond to the pronotal margins in Carpenter's (1935) figure.

The prosternum apparently was unsclerotized. The basal Banksian cell is normal for *Archaeochrysa*; on the type, the proximal branch of Rs + MA is very indistinct, and was not shown by Carpenter, but is present on all the other specimens of this species.

Records. Creede, Colorado, Miocene; MCZ No. 4462-4471.

Archaeochrysa paranervis sp. n.

Figure 40

Paleochrysa vetuscula Cockerell, 1908, Canad. Entomol. 40: 90. (Erroneous identification.)

Paleochrysa stricta: Carpenter, 1935, J. Paleontol. 9: 263, fig. 1. (Erroneous identification.)

Holotype. Univ. Colo. Mus. No. 4419, Florissant, Colorado, Miocene, expedition 1907, examined. The name means "beside-vein," referring to the juxtaposition of the radial crossveins and the branches of the radial sector.

Description. Venation as in Figure 40; fore wing broad; costal area broad; Sc approaches C near stigmal base; 12 branches of Rs + MA, several branches opposite radial crossveins; longest gradate cell 2.5 times as long as broad. Fore wing length: 14.2 mm.

Diagnosis. Differs from *creedei* in the length and arrangement of branches of Rs, and in width of the costal space. This specimen was the basis for Carpenter's (1935) figure and redescription of *Paleochrysa stricta*.

Archaeochrysa fracta (Cockerell)

Paleochrysa fracta Cockerell, 1914, J. Geol. 22: 716, fig. 2. Holotype: Florissant, Colorado, Miocene, H. F. Wickham, col.; MCZ No. 4501 (formerly No. 3349), isolated fore wing, examined. Carpenter, 1935, J. Paleontol. 9: 264, fig. 7, p. 268.

Description. Costal area moderately wide, the cells $0.95 \text{ mm} \times 0.5 \text{ mm}$; veinlets inclined about 10° , 17 branches of Rs + MA. Rs hardly zig-zagged. Longest gradate cells 3.1 times as long as wide; intramedian cell $2.0 \times 0.5 \text{ mm}$, acute proximally, distal crossvein oblique. 1A forked.

Diagnosis. This species differs from *creedei* in the shape of the subcostal area, more branches of Rs + MA, longer gradate cells, and forked 1A.

Carpenter's figure of this specimen was inadvertently transposed with that of *Tribochrysa firmata*, and appeared on page 268, as his Figure 7.

Genus PALEOCHRYSA Scudder

Figures 38, 39

Paleochrysa Scudder, 1890, U. S. Geol. Geogr. Survey Terr., Rept., 13: 166. Type species (by monotypy): *Paleochrysa stricta* Scudder, Cockerell, 1908, Canad. Entomol., 40: 90. Carpenter, 1935, J. Paleontol. 9: 262.

Lithochrysa Carpenter, 1935, J. Paleontol. 9: 265. Type species (by original designation) *Paleochrysa wickhami* Cockerell. NEW SYNONYMY.

Description. Basal subcostal crossvein distal to origin of Rs + MA; opposite MF. Rs + MA arises near MF; proximal branch of Rs + MA not coalesced with MP1, hence no overlapping veins in Psm. Gradate series run into Psm and Psc in an even curve in both wings. Psc of hind wing either regularly zig-zagged with forked marginal veinlets basally (*P. wickhami*), or with furcations more proximal, so zig-zagging is irregular, as in *Pimachrysa*, *Hypochrysa*, etc. (*P. stricta*).

Discussion. The type of *P. stricta* has all four wings superimposed, making interpretation excessively difficult. But the short distal stem of Rs + MA, in the fore wing and the coalescence of Rs + MA with MP1, forming a quadrangular Banksian cell in the hind wing, are clear; thus this species has the essential characteristics of *Lithochrysa* Carpenter. *Paleochrysa wickhami*, the type of *Lithochrysa*, does not differ from *stricta* in any important respect save the more archaic structures of Psc in the hind wing. The species of *Pimachrysa* show such variation in the site of furcation of the marginal veinlets (e.g., cf. Figs. 1 and 2) that I do not consider this difference in structure of Psc of sufficient importance to warrant maintaining a generic distinction.

Paleochrysa stricta Scudder

Figures 38, 39

Paleochrysa stricta Scudder, 1890, U. S. Geol. Geogr. Survey Terr., Rept., 13: 166, pl. 14, figs. 13, 14. Holotype: Florissant, Colorado, Miocene, S. H. Scudder; MCZ No. 242 a-b, examined.

(not) *Tribochrysa vetuscula*: Cockerell, 1908, Canad. Entomol. 40: 90. Carpenter, 1935, J. Paleontol., 9: 263.

Description. Costal area moderately wide, cells 0.69 mm long, 0.875 mm tall. Twelve branches of Rs + MA. Gradate cells 0.5×1.0 mm; intramedian cell 0.35×1.25 mm; 8 unbranched veinlets from Psc in fore wing. In hind wing, 5 unbranched veinlets from Psc to wing margin; CuA 3-branched, the distal branch with a marginal fork. Fore wing length, 16.0 mm, width 5.0 mm.

Paleochrysa wickhami (Cockerell)

Paleochrysa wickhami Cockerell, 1914, J. Geol. 22: 717, fig. 3. Holotype: Florissant, Colorado, Miocene, H. F. Wickham, col.; MCZ No. 4499, examined.

Lithochrysa wickhami: Carpenter, 1935, J. Paleontol., 9: 265, fig. 4.

Description. Costal area moderately broad, cells about 0.46×0.5 mm. Veinlets inclined about 15 degrees. Nine branches of Rs + MA in fore wing, and hind wing. Intramedian cell 0.313×0.88 mm. Gradate cells 5.25×0.75 mm. Costal space narrows abruptly before stigma, as in *Hypochrysa nobilis*; C and Sc may be coalesced for a short distance. Radius runs in a smooth curve at wing apex, not angulate near stigma as in *Hypochrysa*.

Eye fairly large (0.44 mm diam.). Pronotum rounded anteriorly, sides straight, parallel.

Paleochrysa concinnula Cockerell

Paleochrysa concinnula Cockerell, 1909, Canad. Entomol. 41: 218, fig. 5. Holotype: Florissant, Colorado, Miocene; Colo. Univ. Mus., not examined.

Lithochrysa concinnula: Carpenter, 1935, J. Paleontol. 9: 266, fig. 5.

Paleochrysa ferruginea Cockerell, *ibid.*: 218, fig. 6. Holotype: Florissant, Colorado, Miocene; Colo.

Univ. Mus., not examined. Carpenter, *loc. cit.*: 266–267.

Genus *TRIBOCHRYSA* Scudder

Tribochrysa Scudder, 1885, in Zittel-Barrois, *Traité Paléont.* 1: 777. Type species (by monotypy): *Tribochrysa inaequalis* Scudder. Scudder, 1890, U. S. Geol. Geogr. Surv. Terr., Rept. 13: 168.

Description. Eyes large (0.5 mm); scape large, flagellar segments 0.15×0.25 mm. Pronotum short, broad, margin arcuate. Subcostal crossvein obscured in all specimens. Rs + MA arises slightly basally to MF. No overlap of veins in Psm. Inner gradates in two series, so that the fourth gradate (numbered from base) is much closer to Rs than is the second or third. Psc well developed in fore wing. In hind wing, Rs + MA coalesces with MP1, and Psc is less well developed than in fore wing.

Discussion. The irregularity in the inner gradate series is a necessary precondition for separation from Psm, as has taken place in many Chrysopinae. It is, therefore, not surprising that several other taxa exhibit a similar, but less emphasized break in the inner gradate series [*Pimachrysa nigra* (Fig. 4), *Hypochrysa* (Fig. 5), *Nothochrysa californica* (Fig. 3)].

Tribochrysa inaequalis Scudder

Tribochrysa inaequalis Scudder, 1885, in Zittel-Barrois, *Traité Paléont.* 1: 777, fig. 982. Holotype: Florissant, Colorado, Miocene; MCZ No. 243, examined. Scudder, 1890, U. S. Geol. Geogr. Surv. Terr., Rept. 13: 170. Cockerell, 1908, *Canad. Entomol.* 40: 90. Carpenter, 1935, *J. Paleontol.* 9: 267, fig. 6.

Tribochrysa firmata Scudder

Tribochrysa firmata Scudder, 1890, U. S. Geol. Geogr. Surv. Terr., Rept. 13: 172, pl. 14, figs. 6, 7, 10, 11. Cotypes: Florissant, Colorado, Miocene; MCZ No. 241, No. 4127, examined. Carpenter, 1935, *J. Paleontol.* 9: 267, fig. 7.

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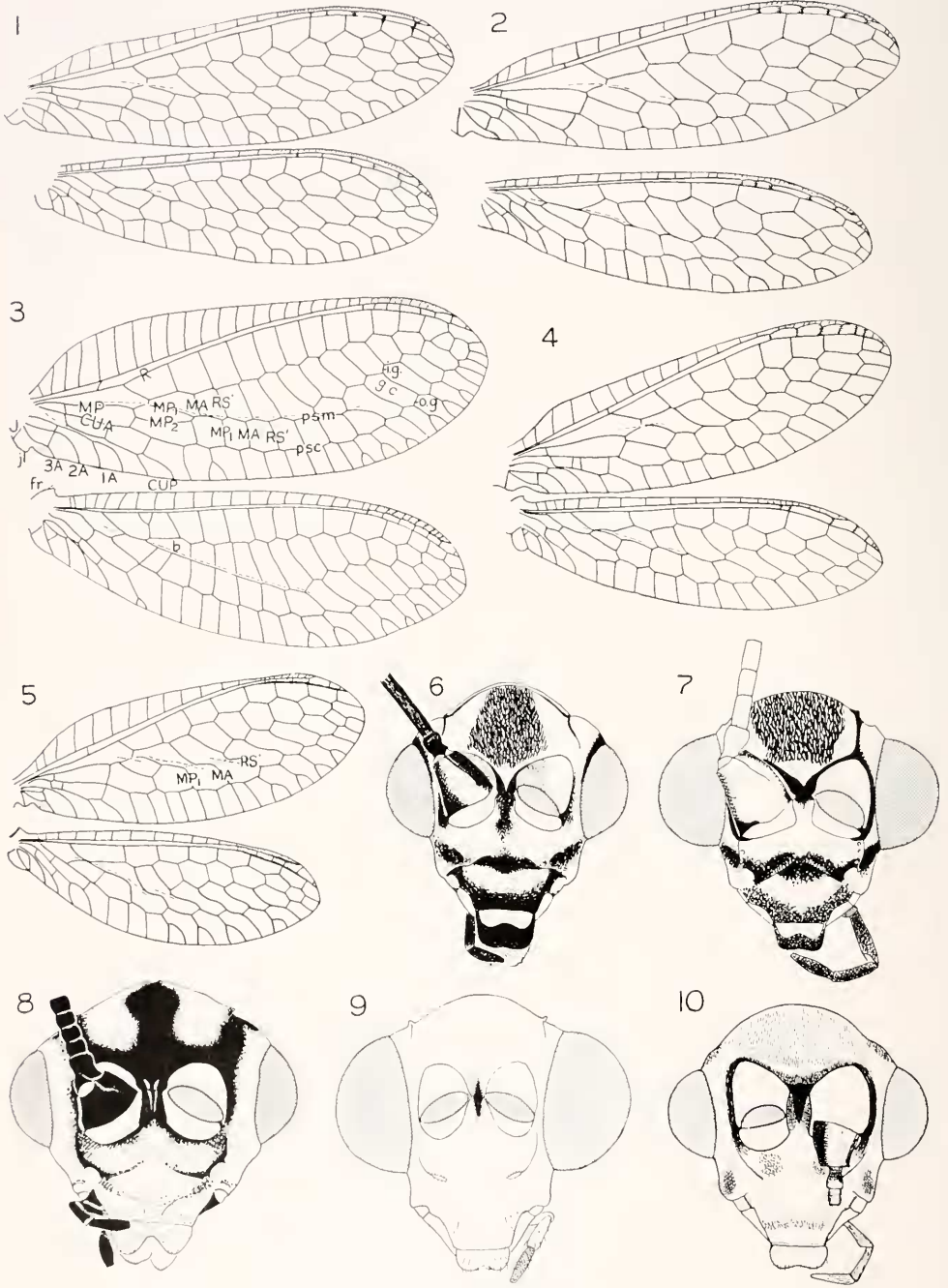
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(Received 21 October 1965)

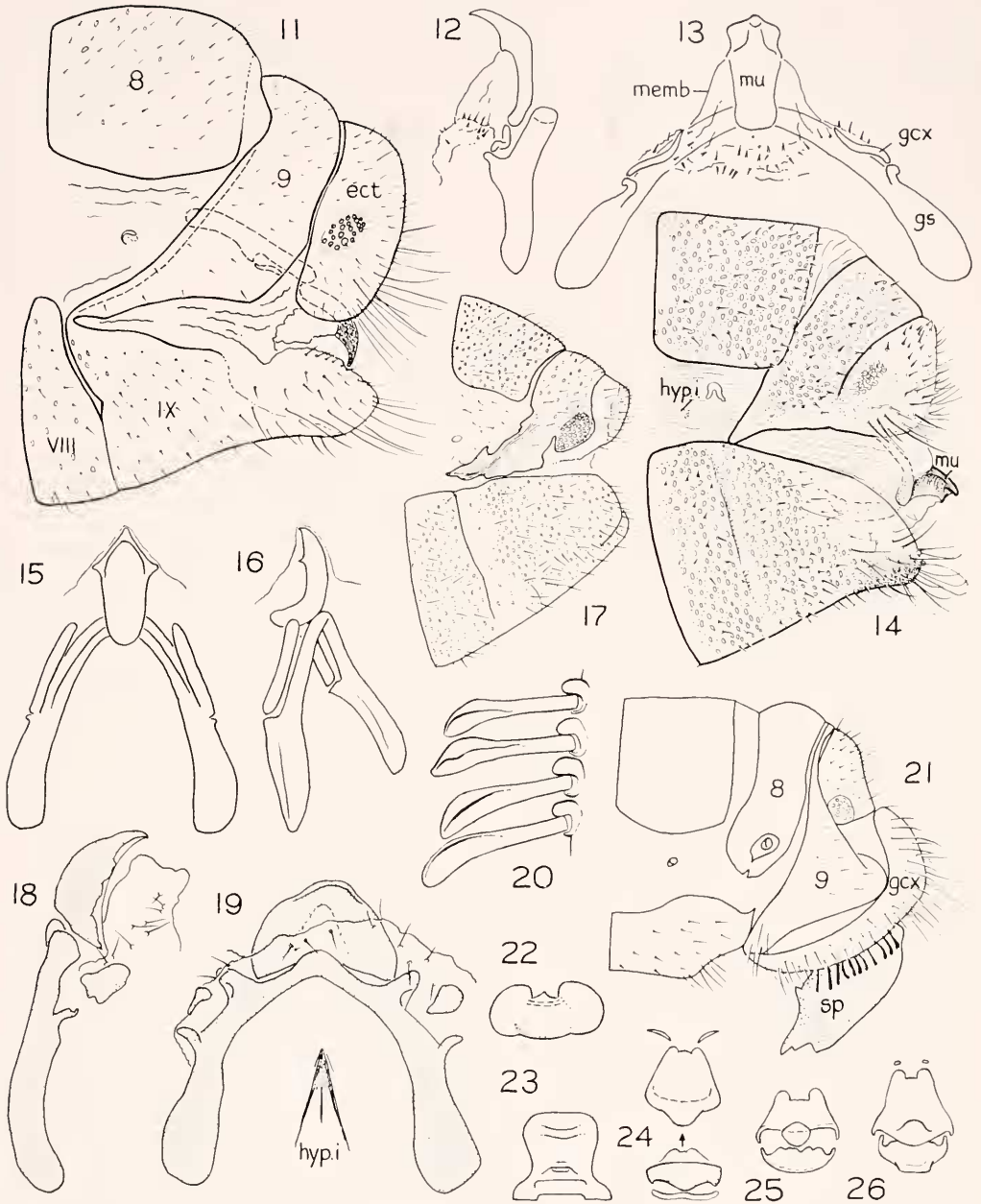
ABBREVIATIONS USED IN FIGURES

b—basal Banksian cell; CUA—cubitus anterior; CUP—cubitus posterior; CV—cervical sclerite; CX—coxa; ect—ectoproct; fr—frenulum; g.c.—gradate cell; gcx—♀, ninth gonocoxite (gonopophyses laterales), ♂, gonocoxites (= "parameres," "entoprocessus"); gs—gonarcus; hyp. i.—hypandrium

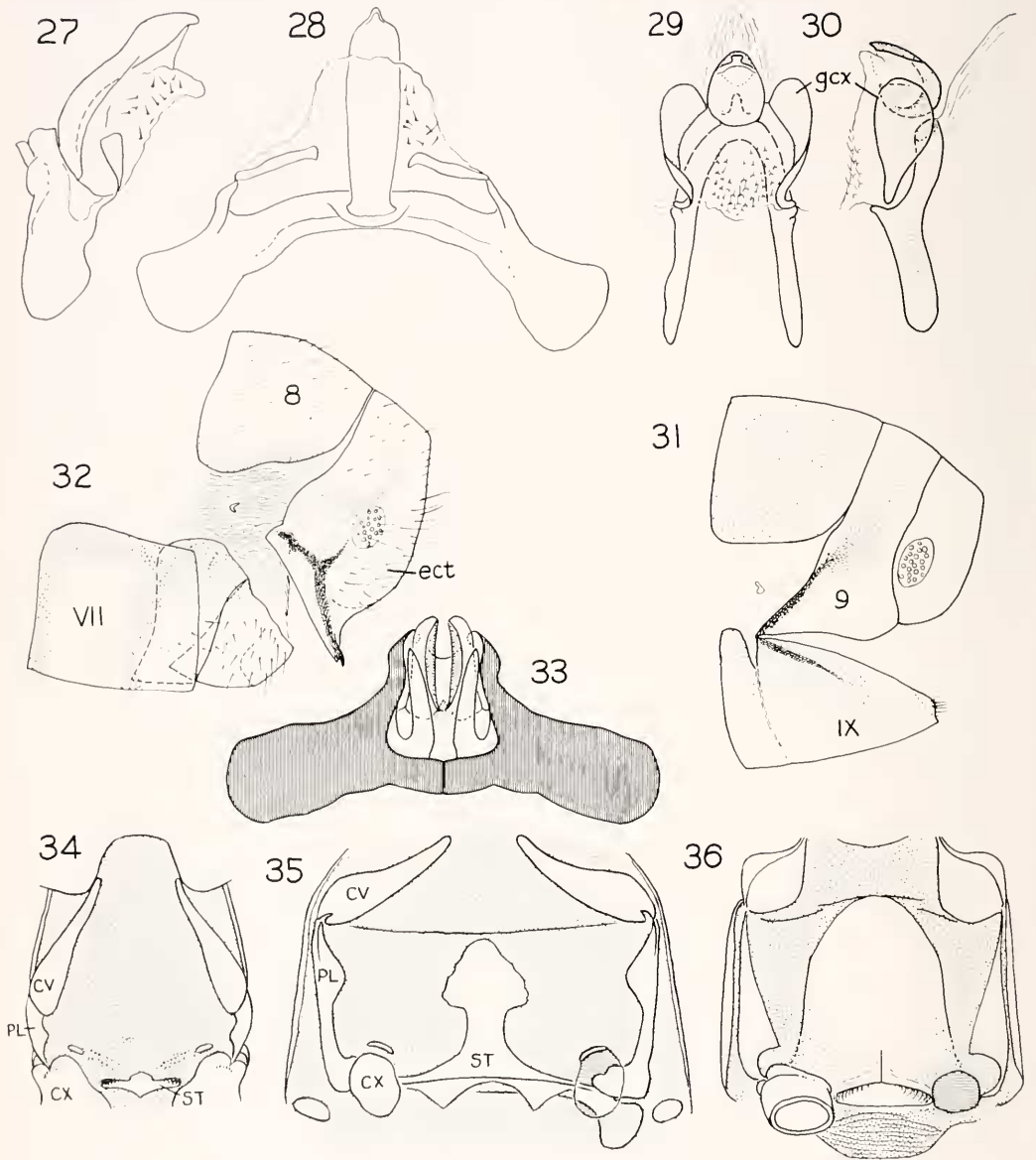
internum; i.g.—inner gradate crossvein; im—intra-median cell; J—jugal vein; jl—jugal lobe; MA—the proximal branch of the fused media anterior and Rs, presumably media anterior; memb—membrane; MF—medial fork, fork of MP; MP—media posterior; mu—mediuncus; o.g.—outer gradate crossvein; PL—propleuron; pm—paramere; pse—pseudocubitus; psu—pseudomedia; R—radius; RS'—proximal branch of radial sector; sp—spermatophore; ST—sternum; SXV—first sectorial crossvein; 1A, 2A, 3A—anal veins; 1m—first medial crossvein.



Wings: Fig. 1. *Pimachrysa lusca* sp. n. Fig. 2. *P. intermedia* sp. n. Fig. 3. *Nothachrysa californica*. Fig. 4. *P. nigra* sp. n. Fig. 5. *Hypachrysa nobilis*. Heads: Fig. 6. *P. nigra*. Fig. 7. *P. lusca*. Fig. 8. *N. californica*. Fig. 9. *P. grata*. Fig. 10. *X. raphidioides*.



Figs. 11-13. *Pimachrysa fusca*. Fig. 11. Male abdomen, lateral view. Fig. 12. Gonarcus, lateral view. Fig. 13. Some, posterior view. Figs. 14-16. *P. nigra*. Fig. 14. Male abdomen, lateral view. Fig. 15. Gonarcus, posterior view. Fig. 16. Same, lateral view. Figs. 17-19. *Notochrysa californica*. Fig. 17. Male abdomen, lateral view. Fig. 18. Gonarcus, lateral view. Fig. 19. Some, posterior view, and hypandrium internum. Fig. 20. *P. intermedia*, setae on margin of right gonocoxite, lateral view. Fig. 21. *P. fusca*, female abdomen, with spermatophore. Figs. 22-26. Female eighth sternum or subgenital plate. Fig. 22. *N. californica*. Fig. 23. *P. grata*. Fig. 24. *P. fusca*, anterior view below, posteroventral above. Fig. 25. *P. intermedia*, anteroventral view. Fig. 26. *P. nigra*, anteroventral view.



Figs. 27, 28. *Pimachrysa albicastales*, gonarcus, lateral and ventral views. Figs. 29–31. *Kimachrysa africana*. Fig. 29. Gonarcus, ventral view; Fig. 30. Same, lateral view. Fig. 31. Male abdomen, lateral view. Figs. 32, 33. *H. nabilis*. Fig. 32. Male abdomen, lateral view. Fig. 33. Gonarcus, dorsal view. Figs. 34–36. Prothorax, ventral view, membranous areas stippled. Fig. 34. *P. nigra*. Fig. 35. *N. californica*, left coxa removed to show sternal apophysis. Fig. 36. *Chrysapiella* sp. (Chrysapinae).

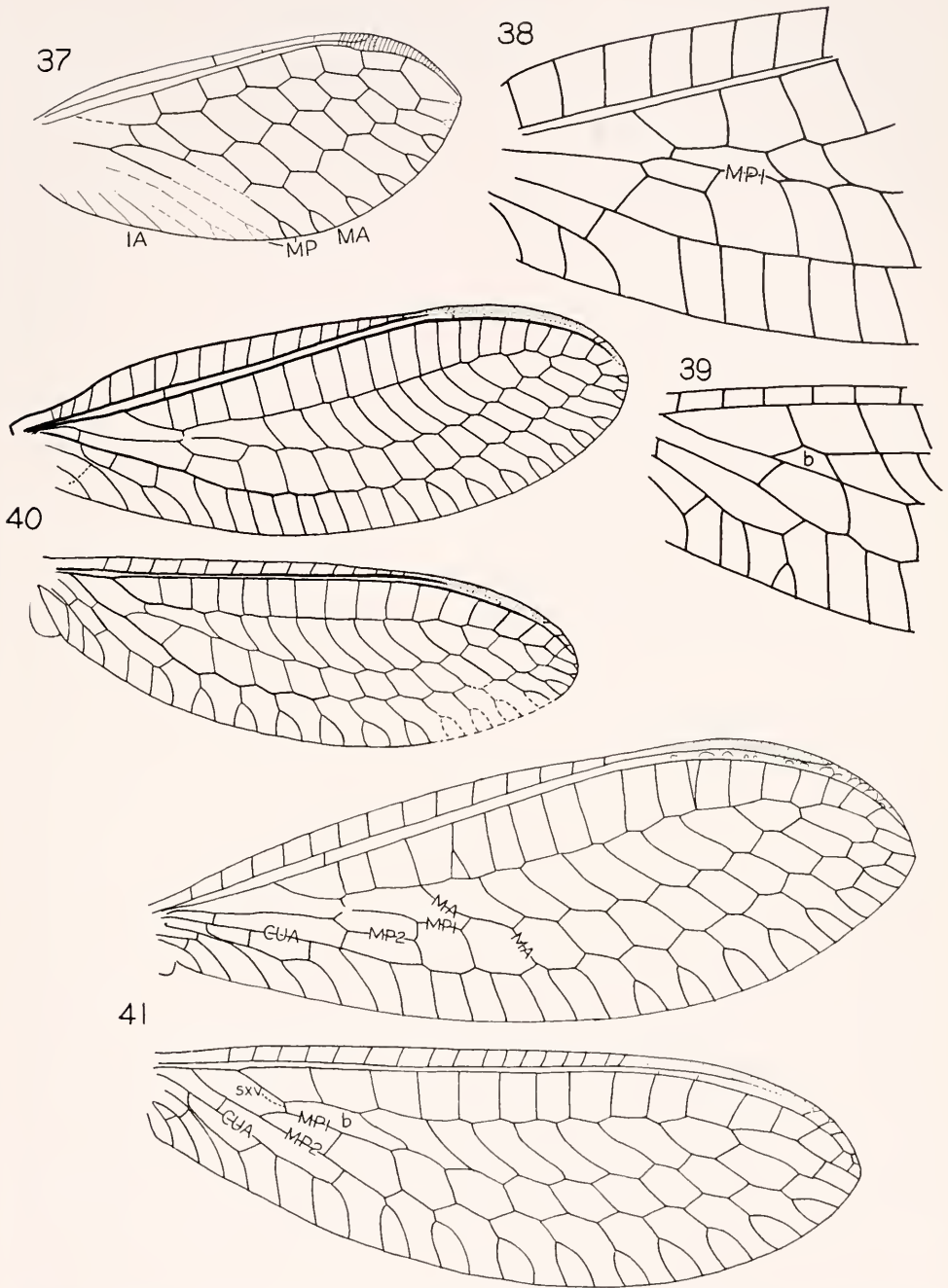


Fig. 37. *Mesypachrysa*, hind wing (after Martynov). Figs. 38, 39. *Paleachrysa stricta*, fore and hind wing bases. Fig. 40. *Archaeachrysa paranervis* type, wings. Fig. 41. *A. creedei*, wings (from type, and from MCZ specimens No. 4464 and No. 4462).

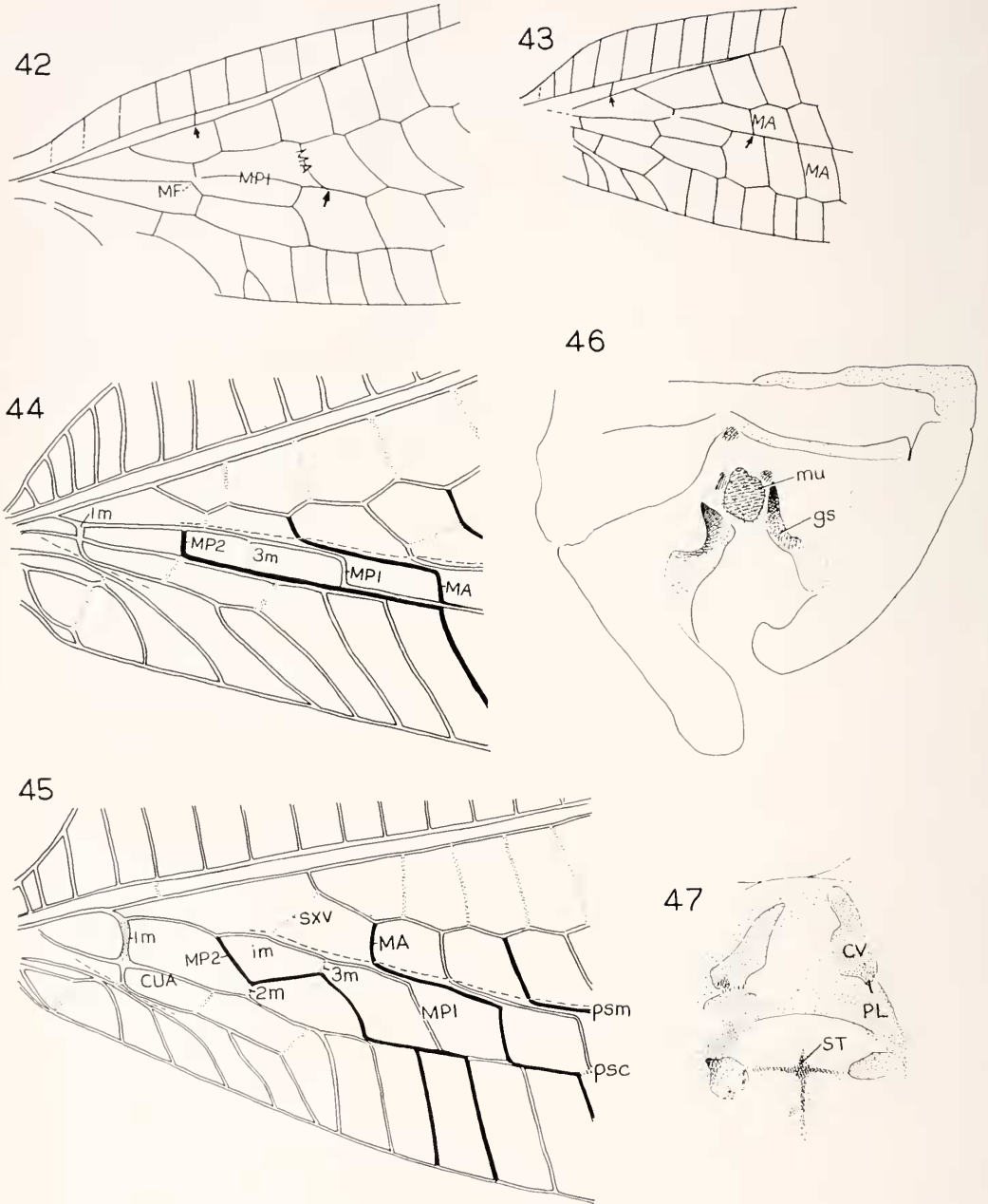


Fig. 42. *Dyspetachrysa vetuscula*, type, fore wing base; arrows indicate position of basal subcostal crossvein, and point of fusion of MPI and MA. Fig. 43. *Nothachrysa praeclara*, fore wing base. Fig. 44. *Synthachrysa* (Apachrysinæ), fore wing base, showing overlap of veins at Psm, probable overlap at Psc and probable course of MP2 (modified from Kimmins, 1952b). Fig. 45. *Gonzaga* (Chrysopinæ), fore wing base, showing overlap of veins at Psm, and course of MP2. Fig. 46. *Archæochrysa creedei*, tip of male abdomen, showing forcipate gonorcus (from MCZ specimen No. 4466). Fig. 47. *A. creedei* type.