

**AN ANNOTATED KEY TO THE FAMILIES OF SCALE INSECTS  
(HOMOPTERA: COCCOIDEA) BASED ON THE CHARACTERS  
OF THE ADULT MALE**

J.H. GILIOMEЕ

*Department of Entomology and Nematology, University of Stellenbosch,  
Stellenbosch, 7600 South Africa*

**ABSTRACT**

An illustrated key to the families of scale insects, based on the morphological characters of the adult male, is presented. Several taxa of lower rank, of which the status or position is uncertain, are included.

KEY WORDS: Coccoidea, scale insects, male, key.

**INTRODUCTION**

Keys for distinguishing between most of the families of the Coccoidea, based on female characteristics, have been available for some time (e.g. Williams, 1970; Howell and Williams, 1976; Ben-Dov, 1985). However, no key is available to separate the males of scale insects, although modern descriptions of the males of most families have been published. Male scale insects are often trapped in the course of surveys investigating biodiversity of habitats, or while monitoring insect populations for pest management purposes, and questions about their identity arise.

The present key has therefore been constructed in an attempt to provide a useful tool for the identification of male scale insects to the family level. In the case of the Margarodidae (*sensu* Morrison, 1928 and Miller, 1984), some genera and subfamilies of which males have been described are included in the key as distinct couplets. This was done because the differences between the males of some of these taxa are comparable to the differences between those of other families in the Coccoidea (Giliomee, 1965, 1967a). Moreover, several authors (e.g. Koteja, 1974) have regarded some of these taxa of the Margarodidae as representing distinct families. In addition, several genera of other groups of which the relationships are unclear have been included as separate couplets. Keys to species level are available for males of the large families, e.g. Diaspididae (Ghuri, 1962), Coccidae (Giliomee, 1967a) and Pseudococcidae (Afifi and Kosztarab, 1967; Afifi, 1968).

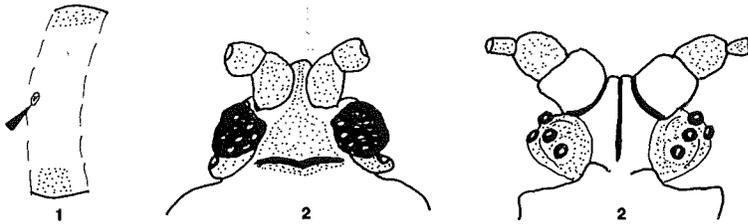
Apterous forms of males have not been considered. The key was constructed while using only the more conspicuous and dorsal characters. References are given in the key to publications that might be consulted for additional information on specific taxa. The illustrations were

redrawn from the papers referred to in the key. **The figure number of each illustration corresponds to the relevant couplet in the key.** The pointed arrow in the illustration indicates the distinctive character which is employed in a certain couplet.

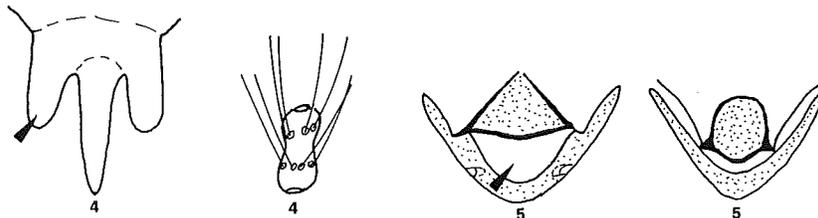
The structure of the key should not be interpreted as reflecting phylogenetic relationships of the taxa. The families Stictococcidae, Cryptococcidae, Kerriidae, Cerococcidae and Phoenicococcidae (= Halimococcidae) have not been included since insufficient information is available on male morphology of these taxa.

**KEY TO THE FAMILIES OF SCALE INSECTS  
BASED ON THE CHARACTERS OF THE ADULT MALE**

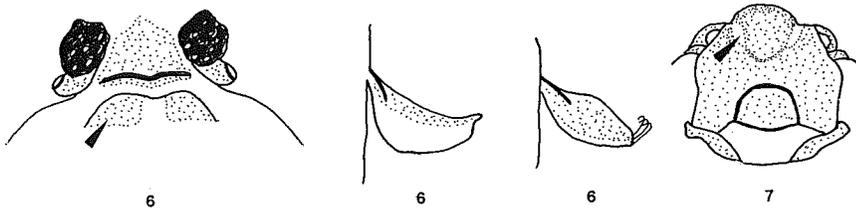
- 1. Abdominal spiracles present . . . . . 2
- Abdominal spiracles absent . . . . . 9
- 2(1). Head with two compound eyes . . . . . 3
- Head with a row of simple unicorneal eyes on each side . . . . . 8



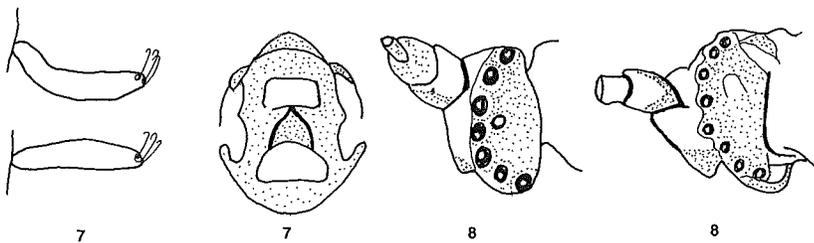
- 3(2). Pronotal ridge present (Beardsley, 1968) . . . . . *Xylococcus*
- Pronotal ridge absent . . . . . 4
- 4(3). At least one of the posterior abdominal segments with lateral fleshy protuberances; flagellar segments usually irregularly nodulose, often binodose or trinodose, with setae in whorls (Morrison, 1928; Morales, 1991) . . . . . *Monophlebinae*
- Abdominal segments without fleshy protuberances; flagellar segments not nodulose, setae not in whorls . . . . . 5
- 5(4). Scutellum and mesopostnotum broadly separated by triangular membrane; postnotal apophyses present . . . . . 6
- Scutellum and mesopostnotum not broadly separated; postnotal apophyses not developed (Beardsley, 1968) . . . . . *Matsucoccus*



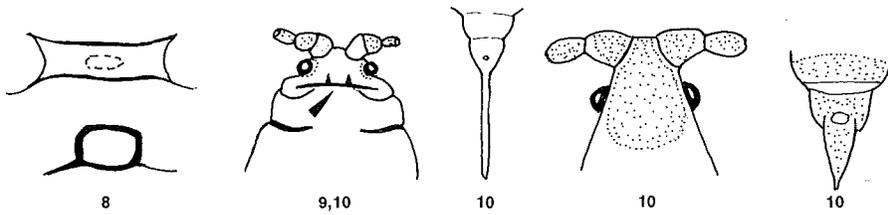
- 6(5). Pronotum well developed, represented by two sclerotized prominences; halteres with single, blunt apical projection (Theron, 1958) . . . . . *Margarodes*
- Pronotum absent; halteres, when present, with one or more hooked setae (hamuli) at apex . . . . . 7
- 7(6). Lateral membranous patches present between prescutum and scutum of mesothorax; scutum without membranous area; halteres, when present, hooked or sickle-shaped (Koteja, 1986) . . . . . Ortheziidae
- No lateral patches between prescutum and scutum of mesothorax; scutum medially with large membranous area; halteres, when present, not hooked (Morales, 1991) . . . . . Coelostomidiinae



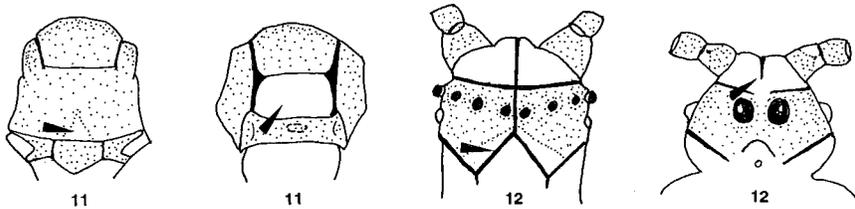
- 8(2). Head with seven simple unicorneal eyes present on each side; dorsal surface of head membranous between ocular sclerites, except for midcranial ridge; scutellum tubular (Theron, 1958) . . . . . *Steingelia*
- Head with eight simple unicorneal eyes present on each side; dorsal surface of head with transverse sclerotized areas between ocular sclerites; scutellum not tubular (Theron, 1962) . . . . . Phenacoleachiidae



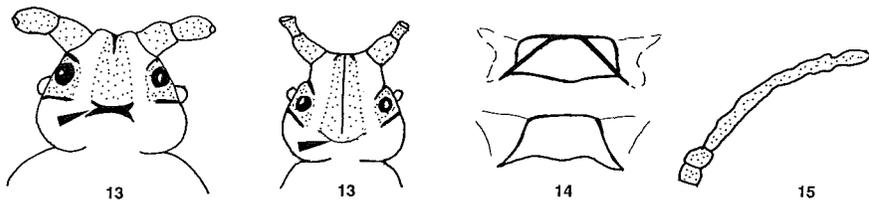
- 9(1). Head intimately associated with prothorax; tentorium absent (Diaspididae) or presumably present (*Rhizoecus*) . . . . . 10
- Head separated from thorax by a distinct cervical groove or “neck”; tentorium present . . . . . 11
- 10. Head almost completely desclerotized, apart from the ridges; postoccipital ridge present; penial sheath produced distally into a long thin style (Ghuri, 1962) . . . . . Diaspididae
- Head with well developed dorsomedial and ventral sclerites; postoccipital ridge absent; penial sheath tapering to a short style (Beardsley, 1962) . . . . . *Rhizoecus*



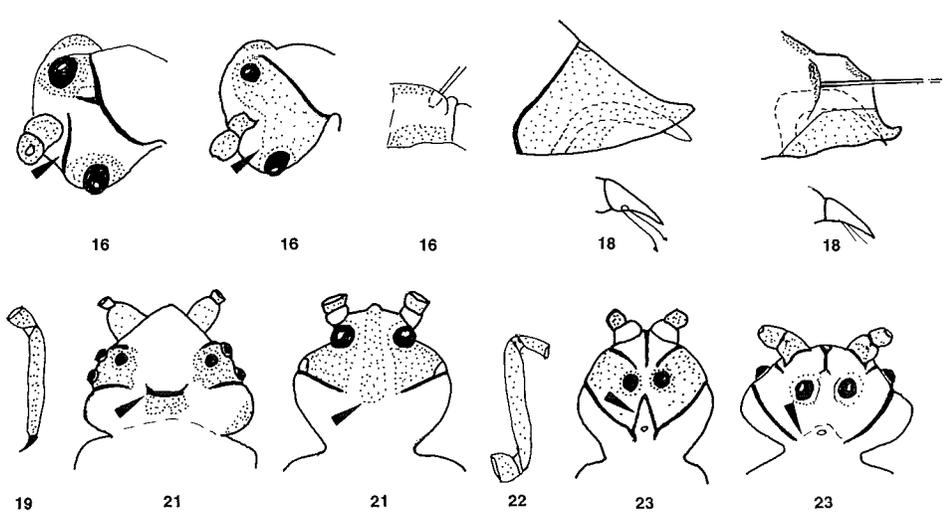
- 11(10). Mesothoracic scutum uniformly sclerotized or with median triangular or longitudinal membranous area . . . . . 12
- Mesothoracic scutum medially with large square, rounded or transverse membranous area . . . . . 18
- 12(11). Head with a row of seven unicorneal eyes present on each side; ventral arm of midcranial ridge posteriorly reaching the preoral ridge; halteres with more than one hooked seta (Beardsley, 1962) . . . . . *Puto*
- Head with two pairs of unicorneal eyes present on each side; ventral arm of midcranial ridge, when present, not reaching the preoral ridge; halteres, when not atrophied or absent, with one hooked seta . . . . . 13



- 13(12). Postoccipital ridge strongly developed, usually forked laterally . . . . . 14
- Postoccipital ridge weak, slender, or absent . . . . . 18
- 14(13). Scutellum obliquely traversed on each side by a scutellar ridge (Afifi, 1968) . . . . . *Eriococcidae*
- Scutellum without scutellar ridge . . . . . 15
- 15(14). Antennae with three segments (Raman and Takagi, 1992) . . . . . *Beesoniidae*
- Antennae with more than three segments . . . . . 16



- 16(15). Antennae ten-segmented; preocular ridge present; eighth abdominal segment with a funnel-shaped pouch on each side (Theron, 1968) . . . . . *Apiomorpha*  
 — Antennae nine-segmented, preocular ridge absent; eighth abdominal segment without a pouch . . . . . 17
- 17(16). Dorsal, ventral and lateral arms of midcranial ridge joined to form a cruciform structure; attenuated segments of abdomen well sclerotized (Gullan, 1978) . . . . . *Cylindrococcus*  
 — Ventral arm of midcranial ridge obliterated by heavily sclerotized area; attenuated segments of abdomen almost completely membranous (Theron, 1968) . . . . . *Opistoscelis*
- 18(13). Genital segment almost entirely sclerotized, without separate dorsal and ventral sclerites (i.e. 9th tergum not distinct); unguinal digitules apically knobbed . . . . . 19  
 — Genital segment with separate dorsal and ventral sclerites; unguinal digitules apically acute (Afifi, 1968) . . . . . Pseudococcidae



- 19(18). Tibia and tarsus fused; genital segment very long, about one-third of total body length (Afifi, 1969) . . . . . Conchaspidae  
 — Tibia and tarsus not fused; genital segment short, about one-tenth of total body length (Loubser, 1966) . . . . . Dactylopiidae
- 20(11). Ocellus present . . . . . 21  
 — Ocellus absent . . . . . 22
- 21(20). Postoccipital ridge present; tarsus one- or two-segmented (one-segmented, McConnell and Davidson, 1959; Hamon et al., 1976; two-segmented, Borchsenius, 1960; Sternlicht, 1969; Koteja and Zak-Ogaza, 1972) . . . . . Kermesidae  
 — Postoccipital ridge absent; tarsus one-segmented (Giliomee, 1967a) . . . . . Coccidae

- 22(20). Trochanter and femur fused (Giliomee, 1967b) . . . . . Lecanodiaspididae  
 — Trochanter and femur not fused . . . . . 23
- 23(22). Preoral ridge well developed; tibia with apical spur (Howell, 1976) . . . . . Aclerididae  
 — Preoral ridge absent; tibia without apical spur (Giliomee, 1968) . . . . . Asterolecaniidae

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