History of Diaspididae

Evolution of Nomenclature for Diaspids

1. 1758: Linnaeus assigned 17 species of “Coccus” (the nominal genus of the Coccoidea) in his Systema Naturae: 3 of his species are still recognized as Diaspids (*aonidum, ulmi, and salicis*).

2. 1828 (circa) Costa proposes 3 subdivisions including Diaspis.

3. 1833, Bouche describes the Genus Aspidiotus

4. 1868 to 1870: Targioni-Tozzetti.

5. 1877: The Signoret Catalogue was the first compilation of the first century of post-Linnaeus systematics of scale insects. It listed 9 genera consisting of 73 species of the diaspididae.

6. 1903: Fernaldi Catalogue listed 35 genera with 420 species.

7. 1966: Borschenius Catalogue listed 335 genera with 1890 species.

8. 1983: 390 genera with 2200 species.

9. 2004: Homptera alone comprised of 32,000 known species. Of these, 2390 species are Diaspididae and 1982 species of Pseudococcidae as reported on Scalenet at the Systematic Entomology Lab.

CREDITS & REFERENCES

- G. Ferris Armored Scales of North America, (1937)
- “A Dictionary of Entomology” Gordh & Headrick
- World Crop Pests: Armored Scale Insects, Volume 4A and 4B 1990.
- Scalenet (http://198.77.169.79/scalenet/scalenet.htm)
  - Latest nomenclature changes are cited by Scalenet.
- Crop Protection Compendium

Diaspididae

Distinct sexual dimorphism

Immatures:

- Nymphs (mobile, but later stages sessile and may develop exuviae).
- Pupa & Prepupa (sessile under exuviae, Males Only).

Adults

- Male (always mobile).
  - **Legs.**
  - **2 pairs of Wing.**
  - **Divided head, thorax, and abdomen.**
  - **Elongated genital organ (long style & penal sheath).**
- Female (sessile under exuviae).
  - **Legless (vestigial legs may be present) & Wingless.**
  - **Flattened sac-like form (head/thorax/abdomen fused).**
  - **Pygidium present (Conchaspids also have exuvia with legs present).**
  - **Vulva.**

External Morphology
Immature stages

Three instars occur in the female while 5 occur in the male. Description in "Armored Scale Insects" Volume 4A (1990) edited by David Rosen

- **Group I**
  - **Aspidiotinae**
    - **Aspidiotini & Pseudaonidiini/Pseudaonina**
  - **Odonaspidinae**
  - **Leucaspidinae**
    - **Leucaspitini & Parlatoriini/Parlattorina**
- **Group II**
  - **Diaspidinae**
    - **Diaspidini**
    - **Chionaspidini**
    - **Fioriniini**
    - **Lepidosaphidini**
- **Group III**
    - **Comstockiella**

External Morphology

Exuvia Traits

Cover (exuvia): protective dorsal cover constructed from wax that is produced by the various dorsal & ventral ducts for all female stages except crawlers and all male stages except crawlers and adults. Only the Conchaspidae, a minor Coccoidea family, also erects waxy covers, but these are more cone-shaped and all stages possess legs.

- **Absent in the gall-forming species such as:**
  - **Gall forming *Maskiella globosa*** Fuller.
  - **Ant attended species: *Morganella pseudospinigera*** Balachowsky, ***M.conspicua*** (Brain), **and *Andaspis formicarum*** Ben-Dov.

External Morphology
Exuvia Traits

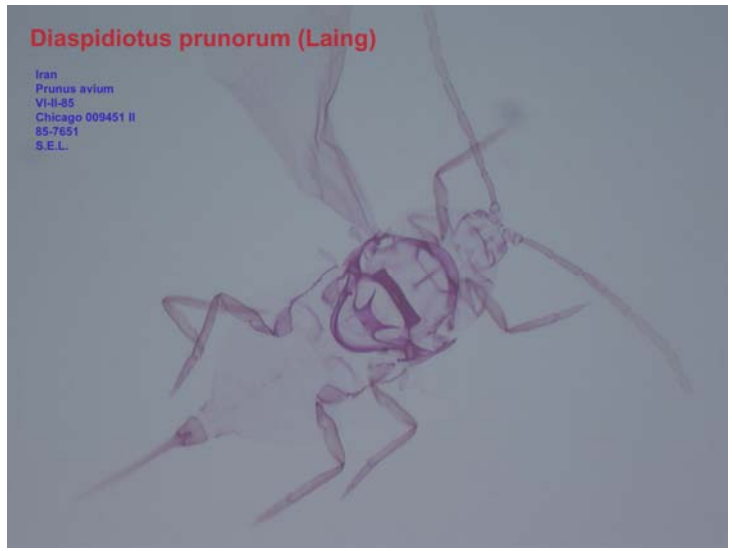
Cover (exuvia)

- **Female**
  - **Located dorsally, dorsally and ventrally (bivalve like), or dorsally with a thin ventral protective cover.**
  - **Shaped circular, oval, elongate, threadlike, and oyster shell shape.**
  - **Pupillarial (totally enclosed by cover) represented by pests within the following tribes: Ancepaspidini, Fioriniini, Diaspidini, Parlatorini, Leucaspidini, and Aspidiotini**
- **Male:**
  - **Formed only during stages I & II.**
  - **Smaller than the female scale with an elongated oval shape.**

External Morphology

Adult Male

Little is known because males were unavailable or unknown (some females are known as parthenogenetic), difficult to obtain, homologies of many structures uncertain, and proper mounting techniques unknown.



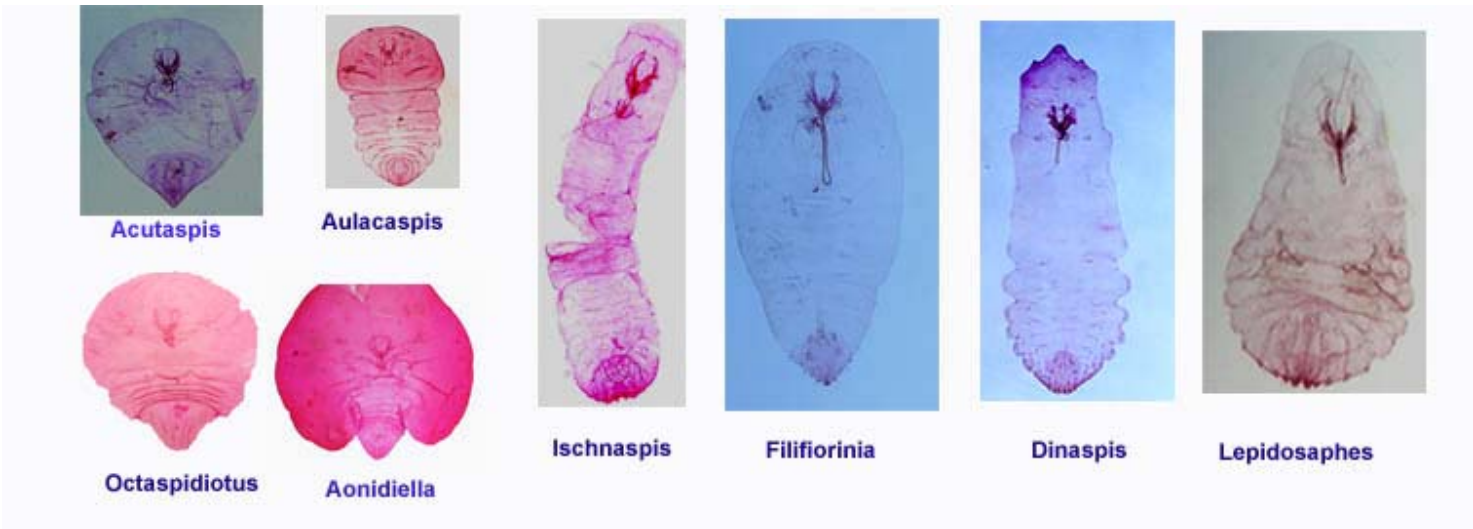
- **Body**
  - **General Structures**
    - **Head.**
      - **Dorsal & ventral pair of simple eyes.**
      - **Distinct ridges.**
    - **Thorax.**
      - **Prothorax, Mesothorax, Metathorax.**
    - **Wings: two pair (forewing and haltere-like hind wing).**
    - **Legs**
    - **Abdomen terminating in style comprising a penal sheath.**

External Morphology

Adult Female

Most species identifications are based on the adult female stage (sessile making them easy to collect) since more definitive structures are present. Few can be identified by the mature exuvia (cover) or by the immature stages.

- **General structure:**
  - **Flattened dorsoventrally but may be swollen when gravid. Always under, or enclosed (partially or completely) by the exuvia (cover).**
  - **Diverse body shape: elongate, fusiform, oval, subcircular.**



External Morphology

Adult Female

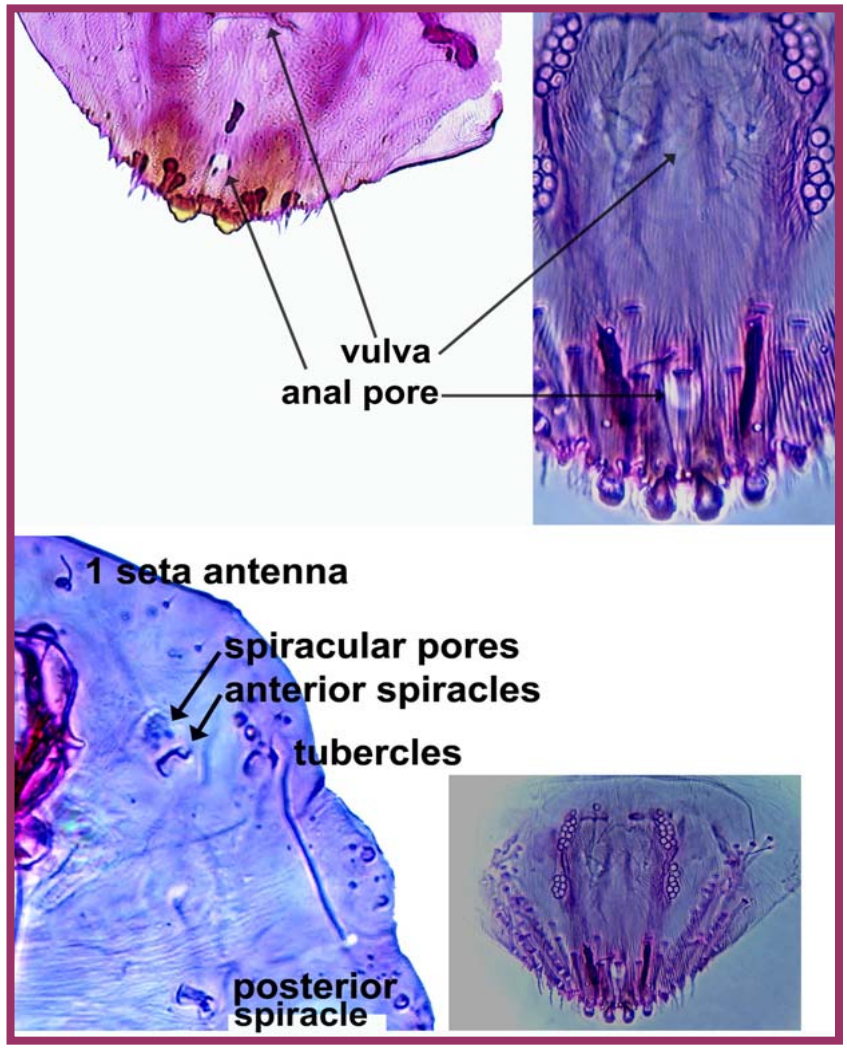
General structure Con't:

- **The Selenaspidus complex is comprised of several genera occuring worldwide. Most of the genera are separated by a thoracic indentation at the prothorax, mesothorax, or metathorax. Most often intercepted in quarantine are:**
  - ***Paraselenaspidus*** (Africa)**,** ***Selenaspidus*** (worldwide)**,** and ***Selenaspidopsis*** (Mexico).

External Morphology
Adult Female

General structure:

- **Antenna and mouth parts.**
  - **(ventral prothorax).**
- **Anus (dorsal).**
- **Perivulvar pores present or absent.**
  - **If present, then adult stage.**
  - **If absent, adult (vulva present) or immature (vulva absent).**
- **Spiracles (ventral thorax only).**
  - **lacking on the thorax.**
  - **With or without disk pores in atrium**
- **Vulva (ventral).**
  - **immature if lacking.**



EXTERNAL MORPHOLOGY

Adult Female-con't

General Structure Con't:

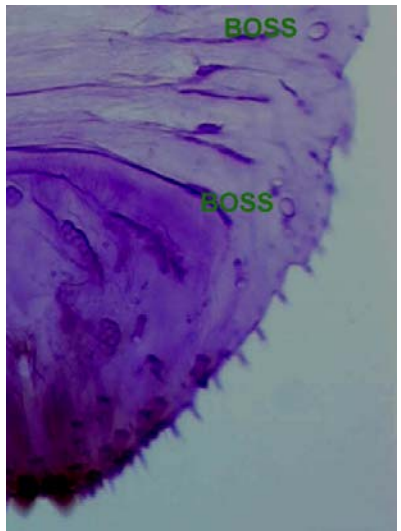
- **Membranous to sclerotized.**
  - **Sclerotized derm, if present, normally fully developed in a mature adult stage. The derm may be sclerotized partially, marginally, in bands, or completely depending on the species: more often with Acutaspis, Howardia (right image), and Mycetaspis (lower image).**
  - **Heavily sclerotized region on the head also is characteristic of some species of *Mycetaspis*, such as *M. personata* (Comstock).**

EXTERNAL MORPHOLOGY

Adult Female-con't

General Structure Con't:

- **Bosses are sclerotized globular structures occuring submarginally.**
  - May be single or double and occur most often in the ***Diaspis*** or ***Lepidosaphes*** (right image) genera.
  - ***Lepidosaphes beckii*** Newman has the double boss on the submarginal area at the level of the the anterior spiracles (image below).
  - ***Diaspis gilloglyi*** McKenzie has abdominal bosses (lower right).

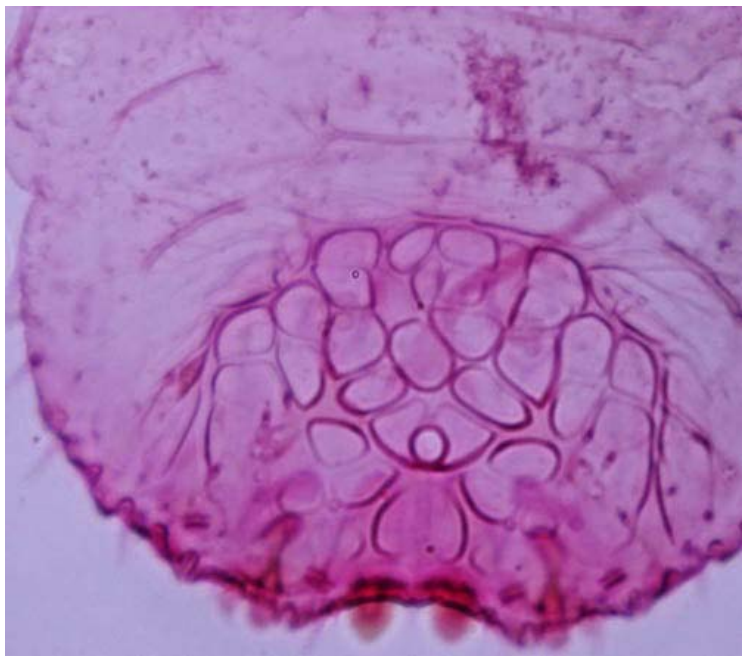


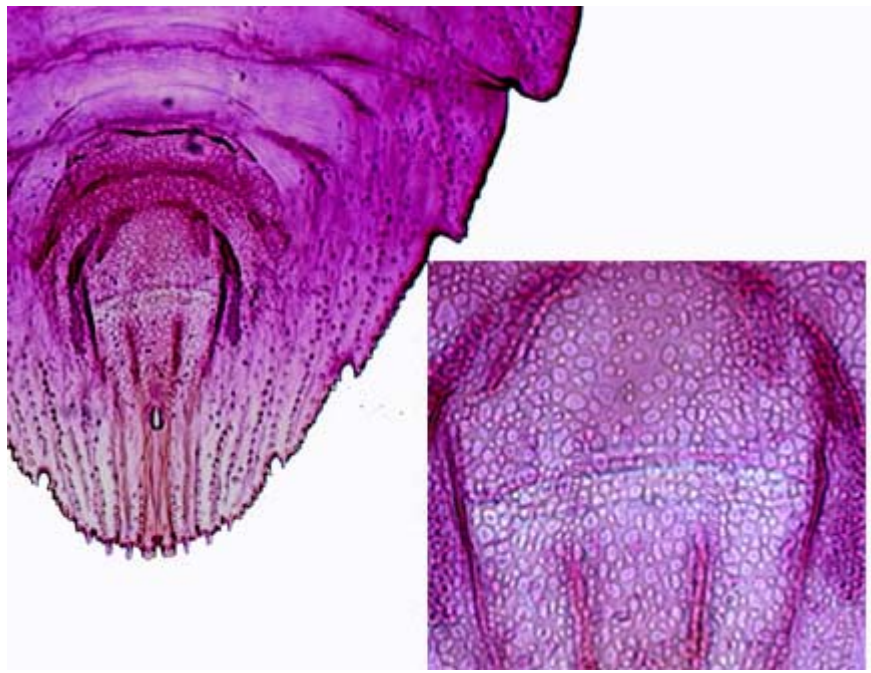
EXTERNAL MORPHOLOGY

Adult Female-con't

Pygidium traits:

- **Aerolated (lattice-type) areas absent or present. Aerolations composed of dorsal reticulated cells formed by many small areas of weaker sclerotization**
  - Represented by the following genera: *Duplaspidiotus*, *Ischnaspis* (below left), and *Pseudaonidia* (below right).

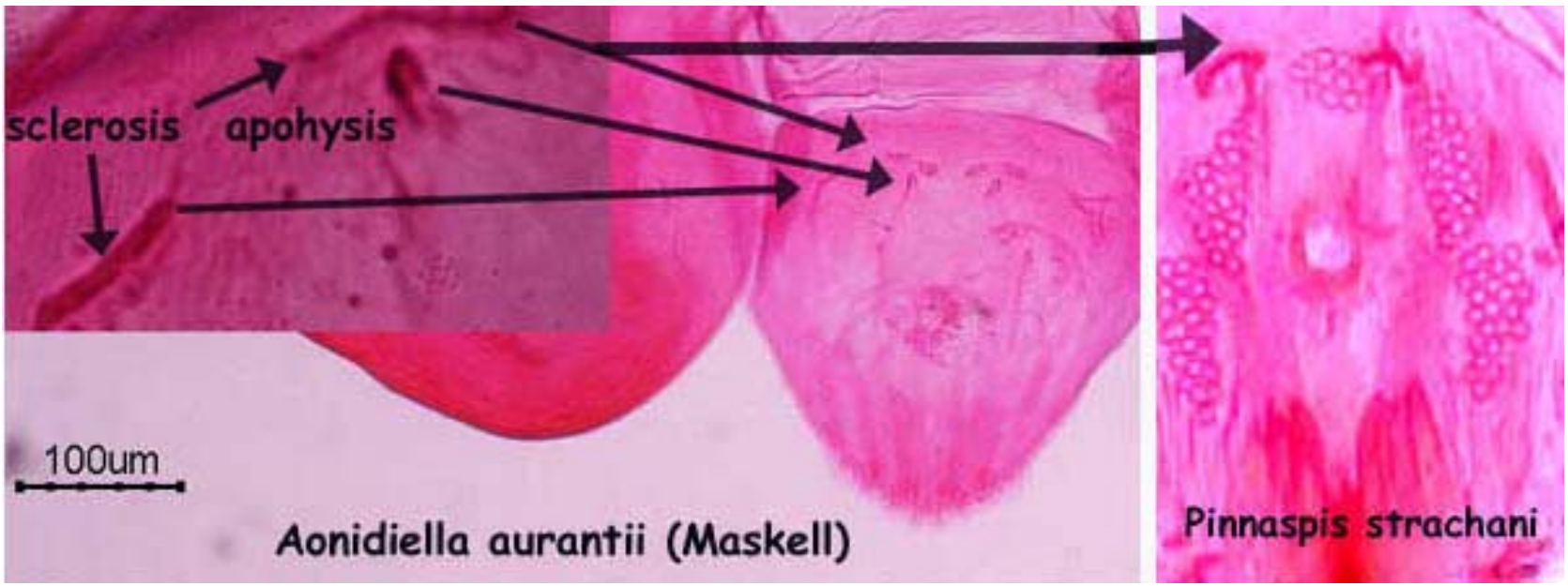




External Morphology
Adult Female-con't

Derm characteristics Con't:

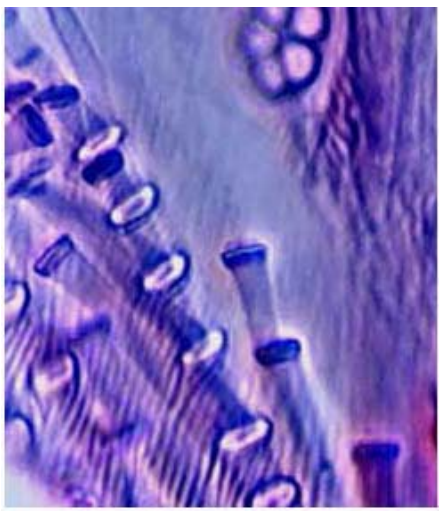
- **Apophysis and sclerosis: ventral prevulvar structures usually found in Aonidiella and Pinnaspis:**
  - ***Apophysis:*** **(Greek apo=away and Phyein to grow) "Any tubercular or elongate process that projects internally or externally from the body wall."**
  - ***Sclerosis*** **(Greek skleros=hard) "hardened in definite areas".**



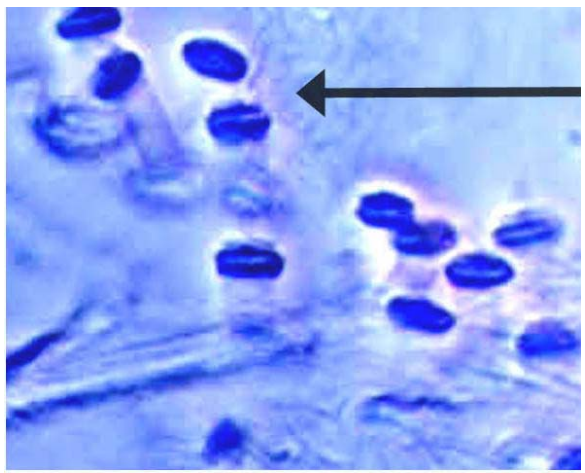
External Morphology
Adult Female-con't

Pygidium Traits:

- **Dorsal ducts produce the wax that forms the scale covers for 2nd instar immatures through the adult female. The may also take specialized shape, such as the mitercap-like or funnel-like.**
  - Macroducts (usually dorsal) are large ducts terminating into a gland-like structure with 1 or 2 transverse bars ("one barred" or" two barred") or specialized shape (e.g. mitre shape in the genus ***Mitraspis*** (lower right image).
  - Microducts (usually ventral) are small ducts like macroduct structures.



One-barred ducts

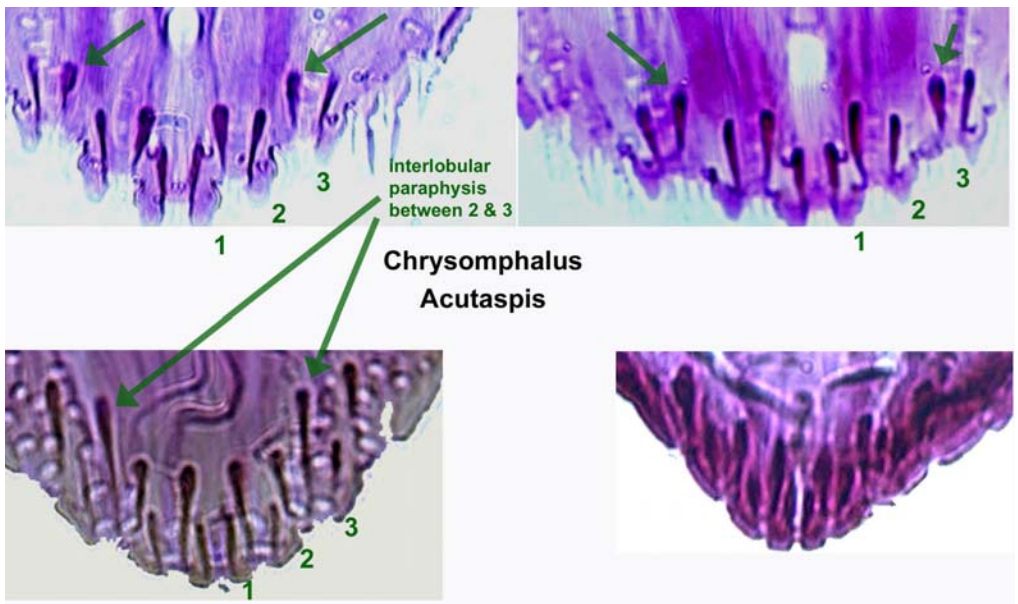


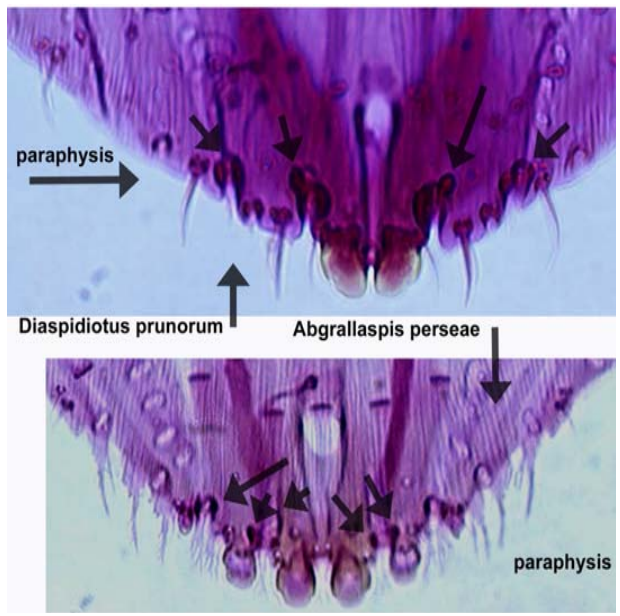
2 barred macroducts

External Morphology
Adult Female-con't

Derm Characteristics Con't:

- **Paraphysis are internal rod or club structures extending anteriorly between or from the pygidial lobes. Their length varies from smaller than that of the median lobes (such as *Aonidiella* & *Diaspidiotus*) to much longer.**
  - **Paraphysis (Greek para= beside and physis= growth) "Chitinized thickenings or marginal projections on the pygidium of the insect".**





External Morphology
Adult Female-con't

Secretion Organs forming the exuvia Con't.

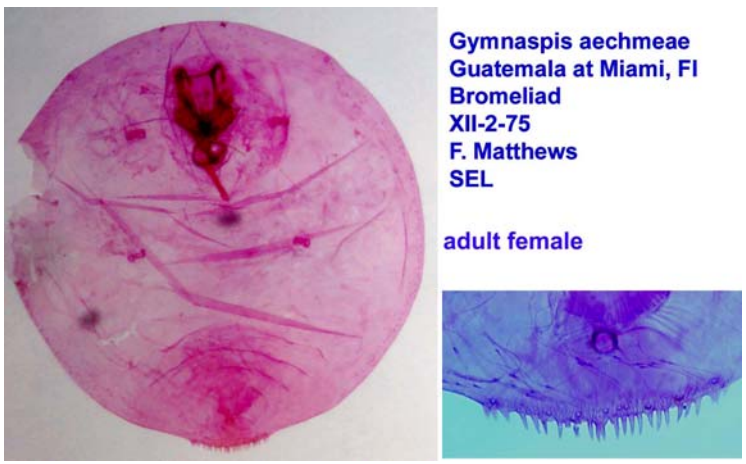
- **Discoidal pores: simple structures (present or absent).**
- **Ventral loculate-style pores (usually quinquelocular and ventral)**
  - Perivulvular pores below right (associated with the vulva). May vary from from one pore to seven groups .
  - Spiracular pores below left (associated with the spiracles). Spiracle absent or present around anterior or both spiracles.

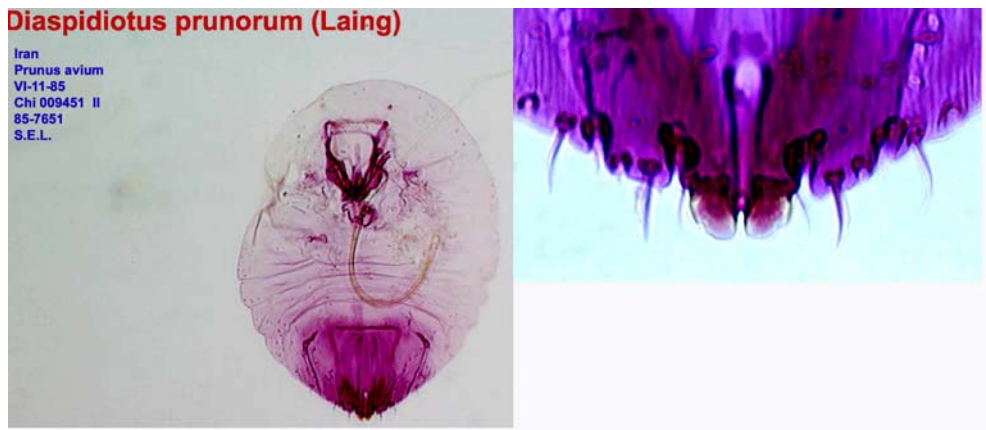
External Morphology

Adult Female-con't

Marginal appendages: pygidial lobes vary from absent to four pairs that are either bilobate or single-lobed.

- **Bilobate (double-lobed) refers to 2nd thru 4th lobe**
  - **Diaspidini (also include simple lobes from L2 to L4).**
- **Single lobes from L2 thru L4 present**
  - **Aspidiotini and the Parlatoriini.**



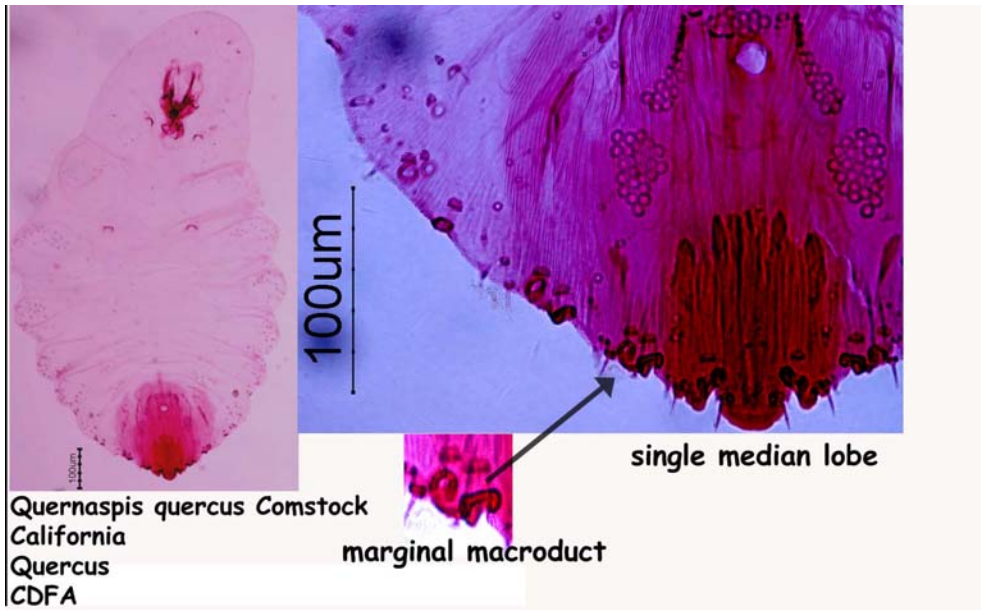


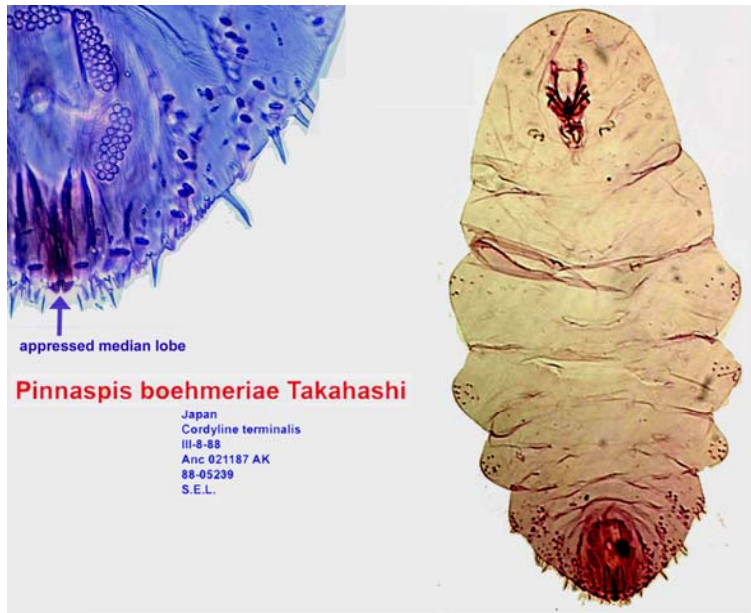
External Morphology

Adult Female-con't

Marginal appendages (Con't): Median Lobes (L1).

- **Paired lobes exist in most genera.**
  - **Separated appearing as two separate lobs**
  - **Appressed median lobe appears as a fused lobe with a slight to complete separation of the median lobes (e.g. *Pinnaspis).***
- **Fused as one lobe lobe.**



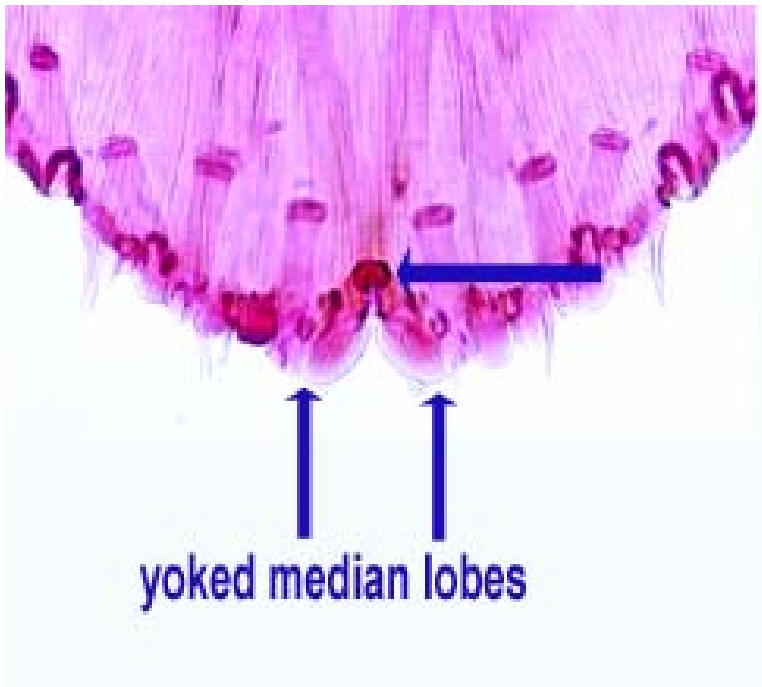


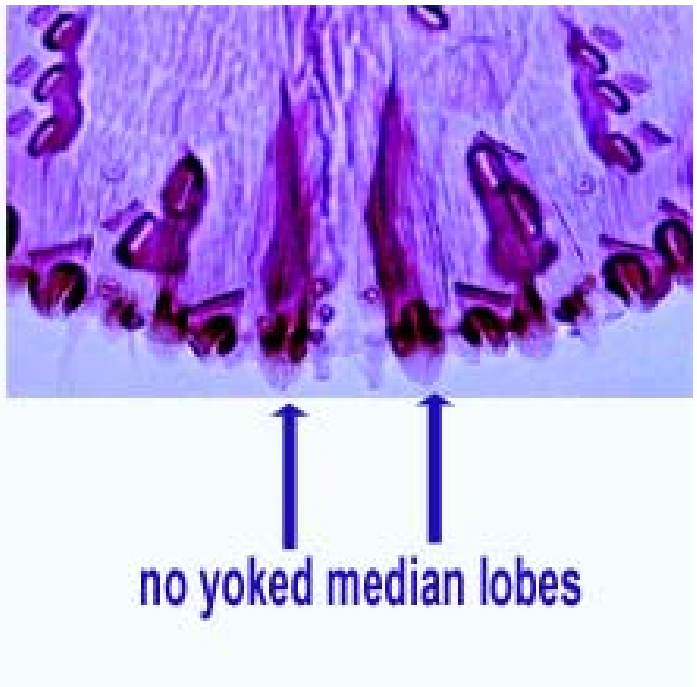
External Morphology

Adult Female-con't

Marginal appendages (Con't): Median Lobes (L1).

- **If paired, then either zygotic (yoked) or non-zygotic (not yoked):**
  - **Non-zygotic**
  - **Zygotic (yoked)**



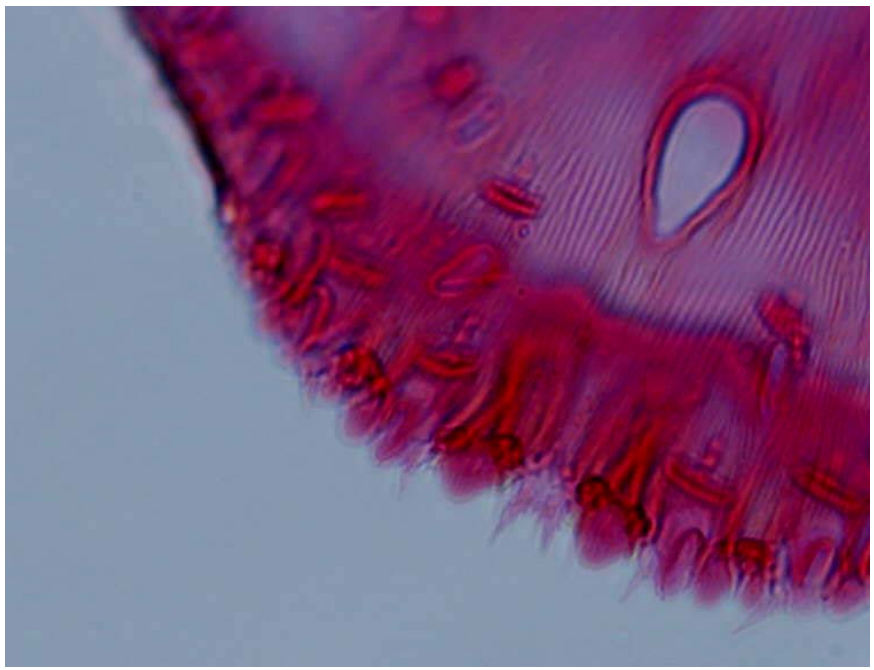


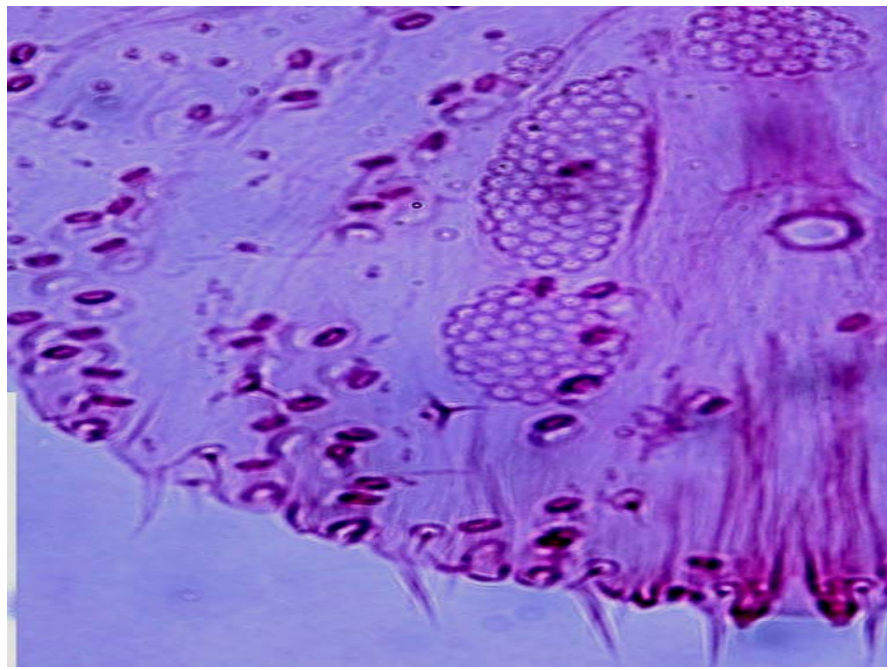
External Morphology

Adult Female-con't

Marginal appendages Con't: gland spines and setae.

- **Gland spines appear as duct bearing slender or robust cones between the lobes of the pygidium.**
  - **May appear as a simple pair or as a specialized "fishtail-like" structure between the median lobe pair (L1) (such as *Pseudoparlatoria*).**



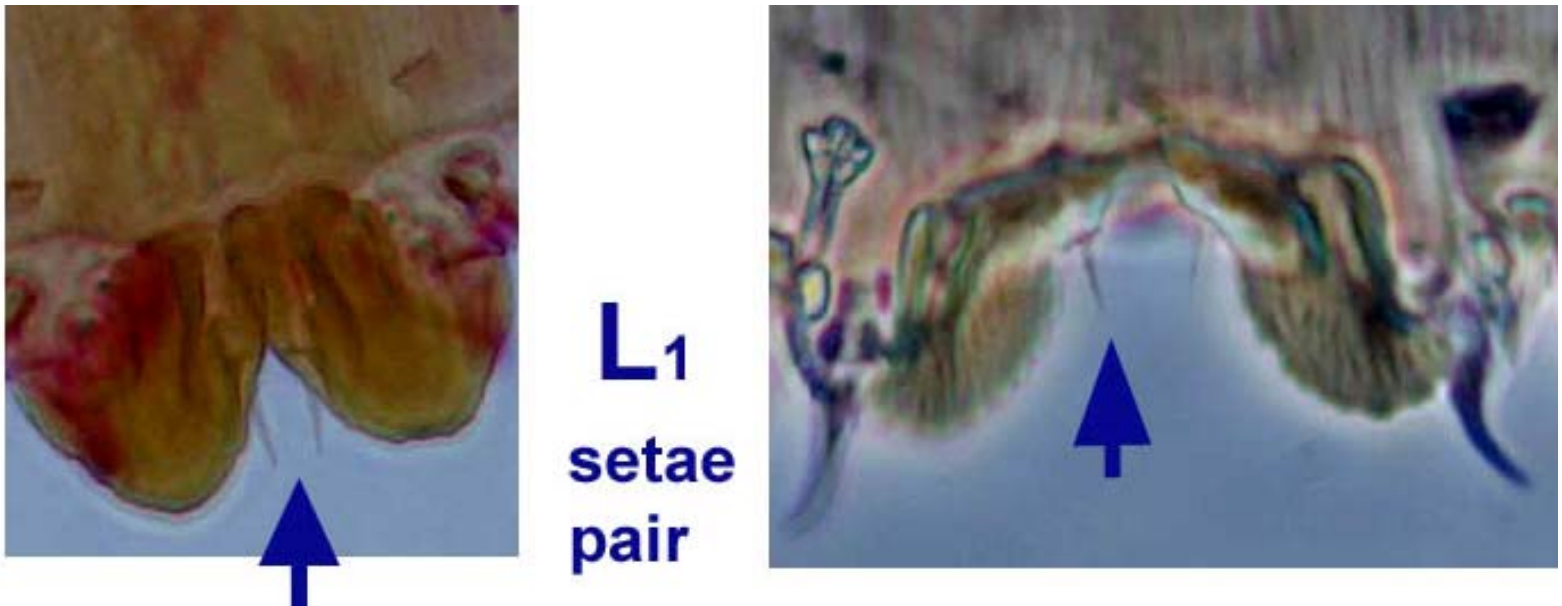


External Morphology

Adult Female-con't

Marginal appendages Con't: gland spines and setae.

- **Setae also exist throughout the body. They also mark the positions of the various lobes of the pygidium. The presence or absence of a pair of setae between the median lobes will separate some related genera:**
  - **Pair of setae present, e.g. *Pseudaulacaspis and Chionaspis* (polyphagus)**
  - **Pair of setae absent in Duplachionaspis (known on grasses only)**

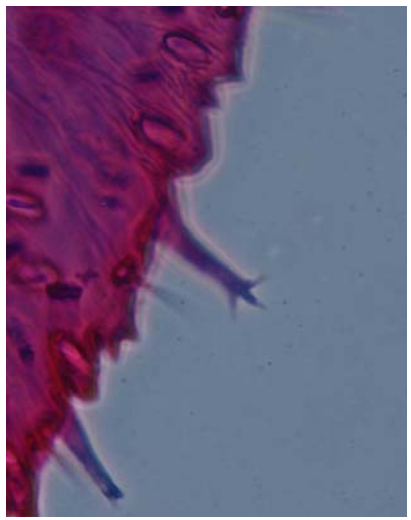
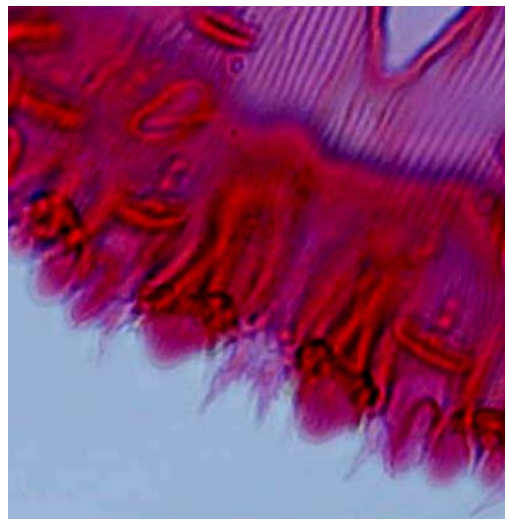
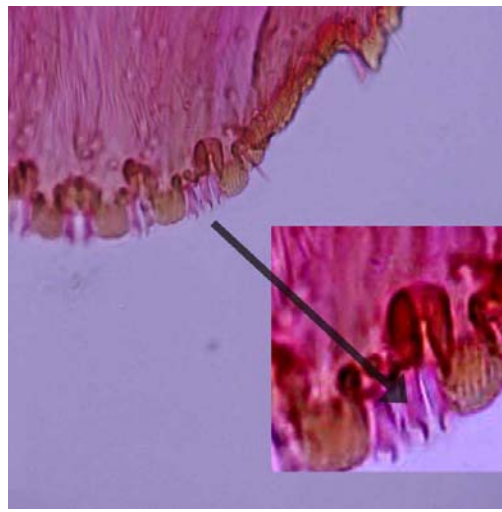


External Morphology

Adult Female-con't

Marginal appendages: plates.

- **Pygidium plates appear ductless, flattened, branched and sometimes fringed structures.**
  - **Simply branched (below left).**
  - **Elaborately branched *(Hemiberlesia palmae, Morganella longispina & Parlatoria spp.),* furcate *(below right) as in Furcaspis*, bifucate or fishtail like structure between L_1 pair as in Malleoaspis and Pseudoparlatoria (3rd from left), or trifurcate as in *Pseudaulacaspis pentagona*** (2nd from left)***.***

External Morphology
Adult Female-con't

Other structures:

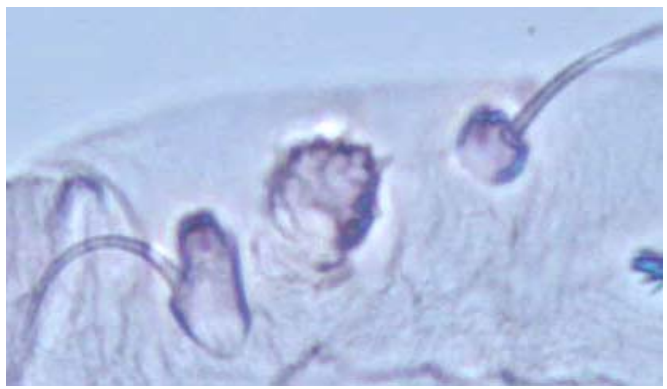
- **Antenna with specialized structures**
  - **Plate-like, club-shape, or elongated.**
- **Eyespots with specialized structures**
  - **Star- or spine-like**
- **prepygidial abdominal projections**
  - **Finger- or spine-like**
- **reduced (vestigial) Legs**
  - **One or two segmented**
- **Tubercles**
  - **Cephalothoracic or abdominal segments (marginal to median areas)**

External Morphology

Adult Female-con't

Other structures Con't:

- **Antennae sometimes developed with a specialized process between the antennae or such processes lacking. Do not confuse with modified antennae or eyespots.**
  - **May be shaped like a plate, club, rounded or elongated structure.**

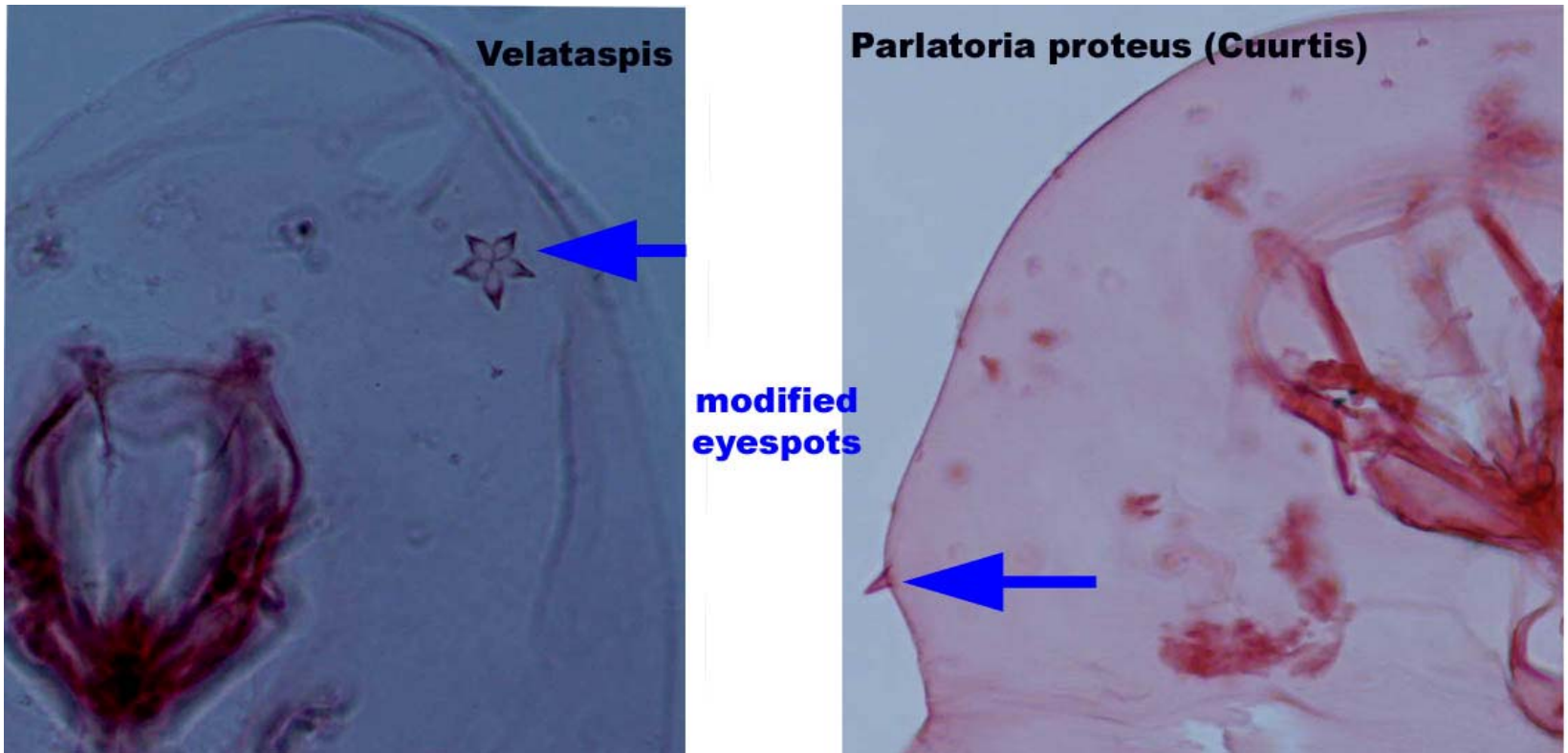


External Morphology

Adult Female-con't

Other structures: Con't:

- **Eyespots sometimes developed into a marginal spur or other specialized structure.**
  - **Some species of *Parlatoria, Velataspis***

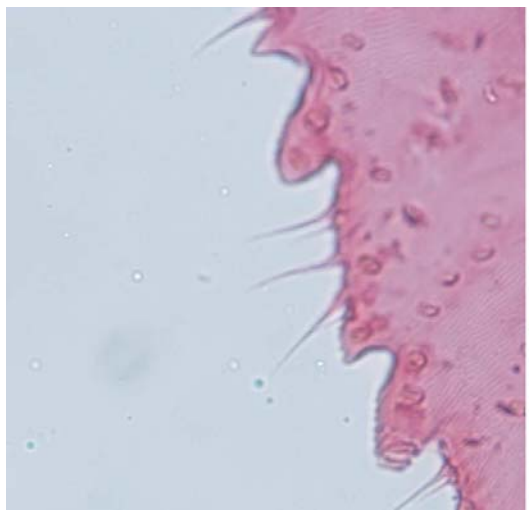


External Morphology

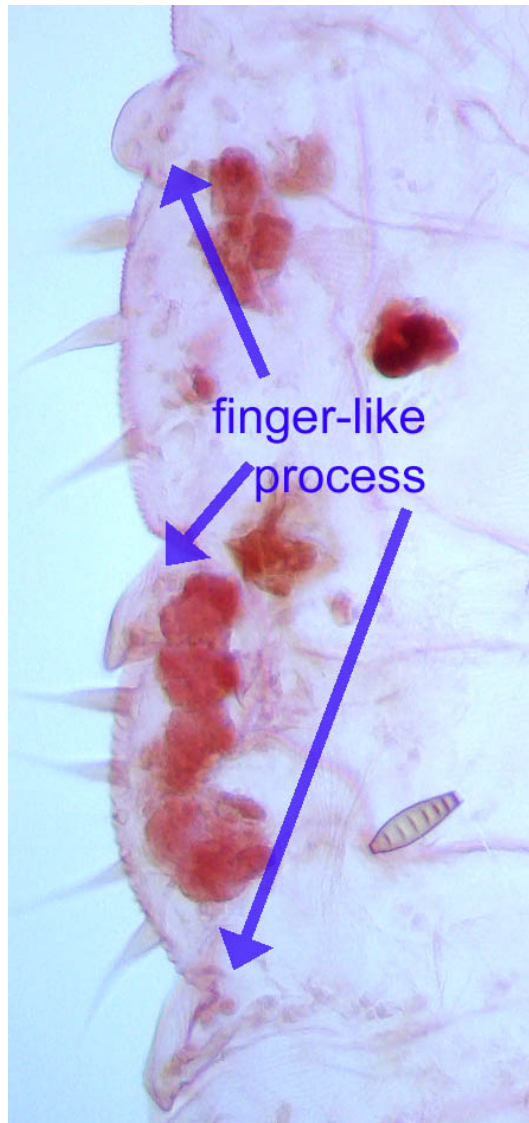
Adult Female-con't

Other Structures Con't:

- **Prepygidial abdominal marginal spurs form spine or finger like projections.**
  - **Abdominal fingerlike projections or spurs occur in some species:**
    - ***Dactylaspis, Lepidosaphes, Opuntiaspis, Unaspis.***



Opuntiaspis (left)
Lepidosaphes (right)



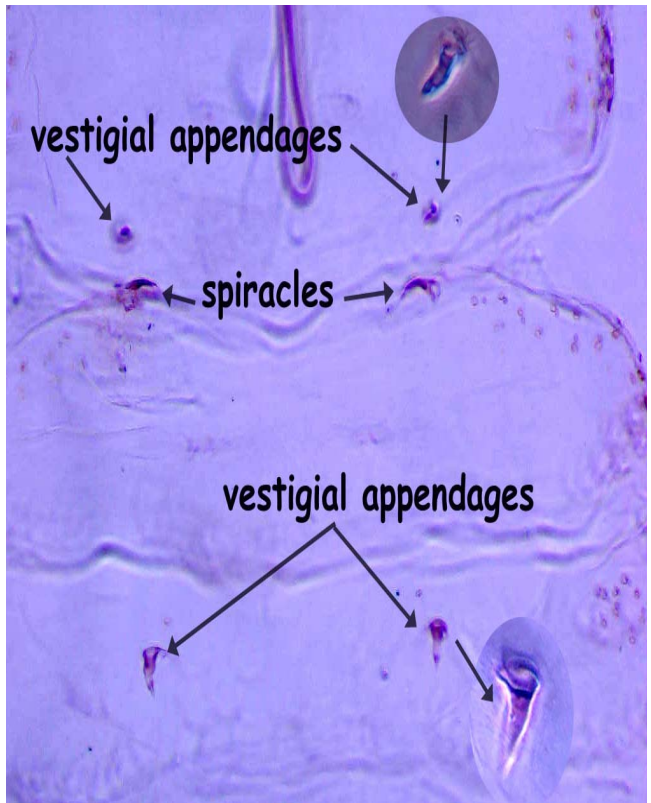
External Morphology

Adult Female-con't

Other Structures Con't : reduced (vestigial) legs.

- **vestigial legs are reduced with one or more segments**

  ***Dactylaspis* and *Opuntiaspis*.**

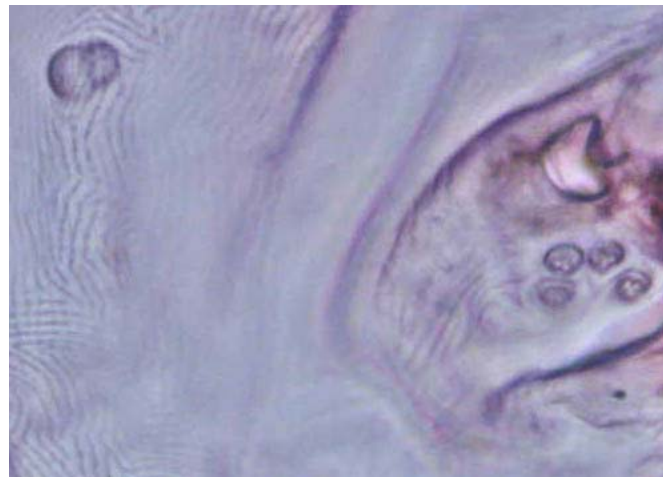


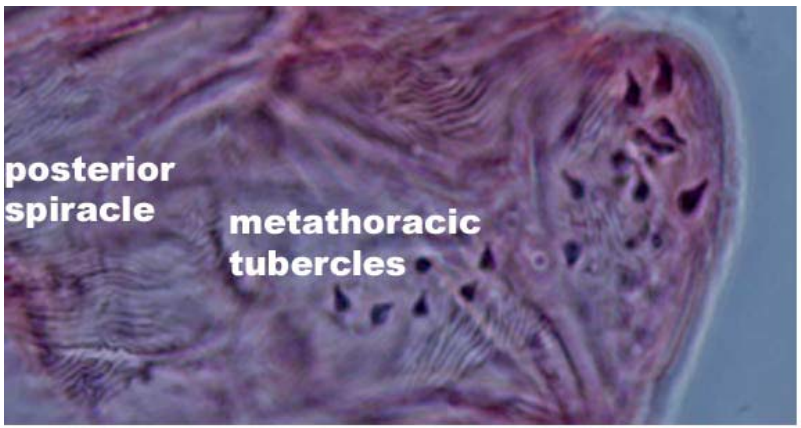
External Morphology

Adult Female-con't

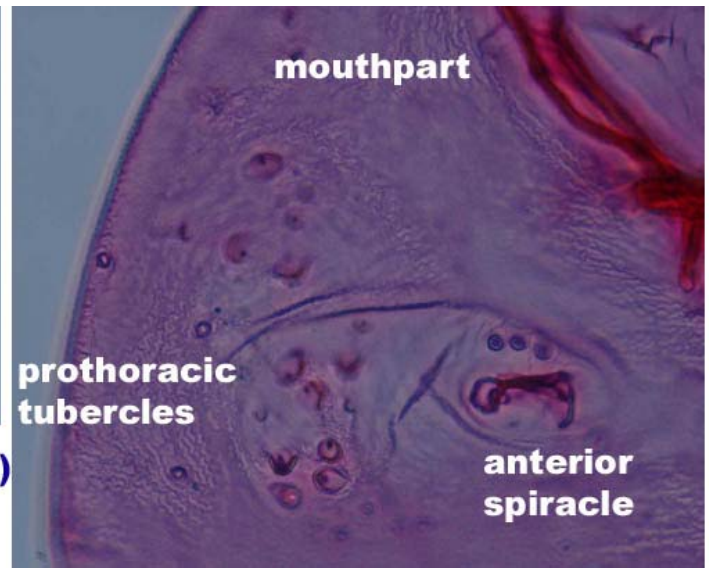
Other Structures Con't :

- **Tubercles may exist on the thoracic and/or the abdominal segments, in groups, rows, or scattered: Do not confuse with abdominal or cephalothoracic bosses.**
  - ***Parlatoria & Lepidosaphes*** (***L. beckii*** has double boss across the anterior spiracles-right image) **.**





Lepidosaphes simmilis **Beardsley (above)**
Parlatoria (right)

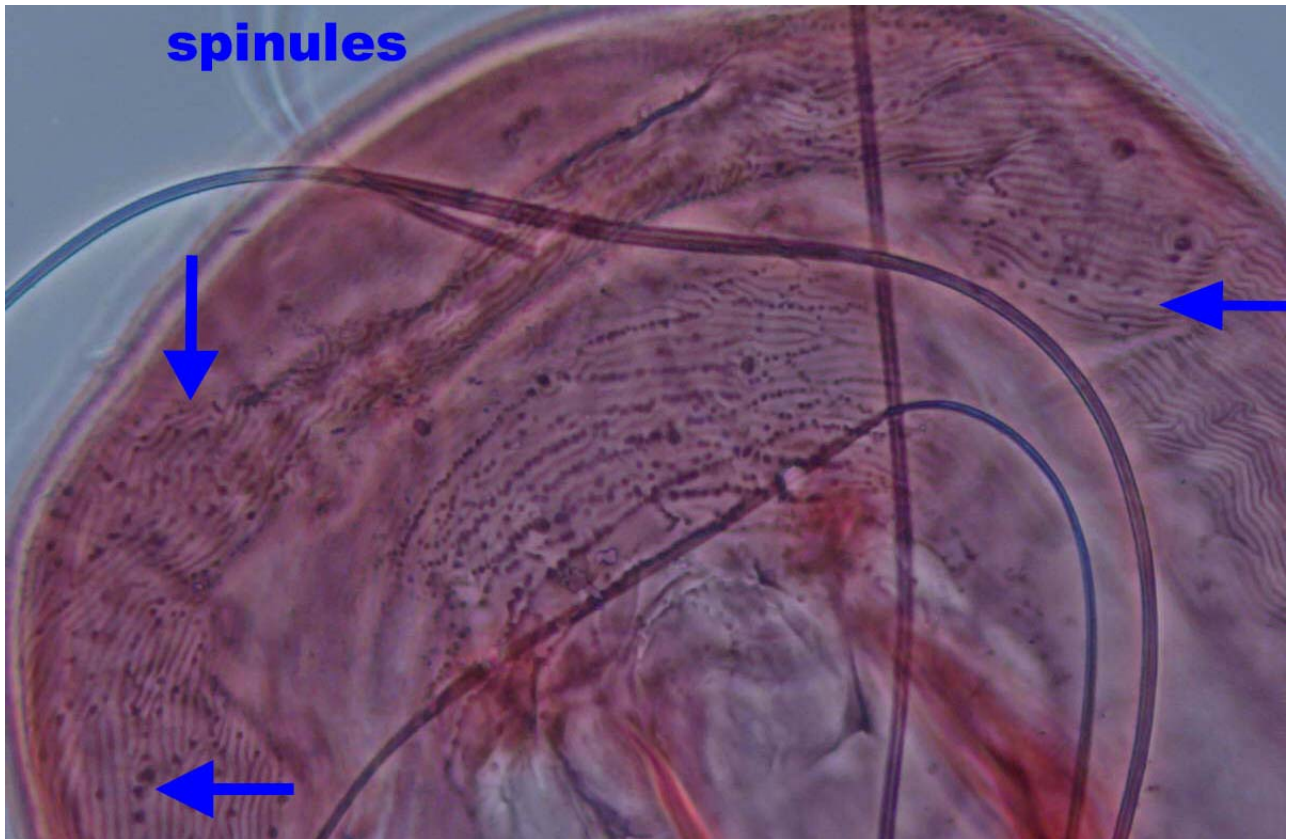


External Morphology

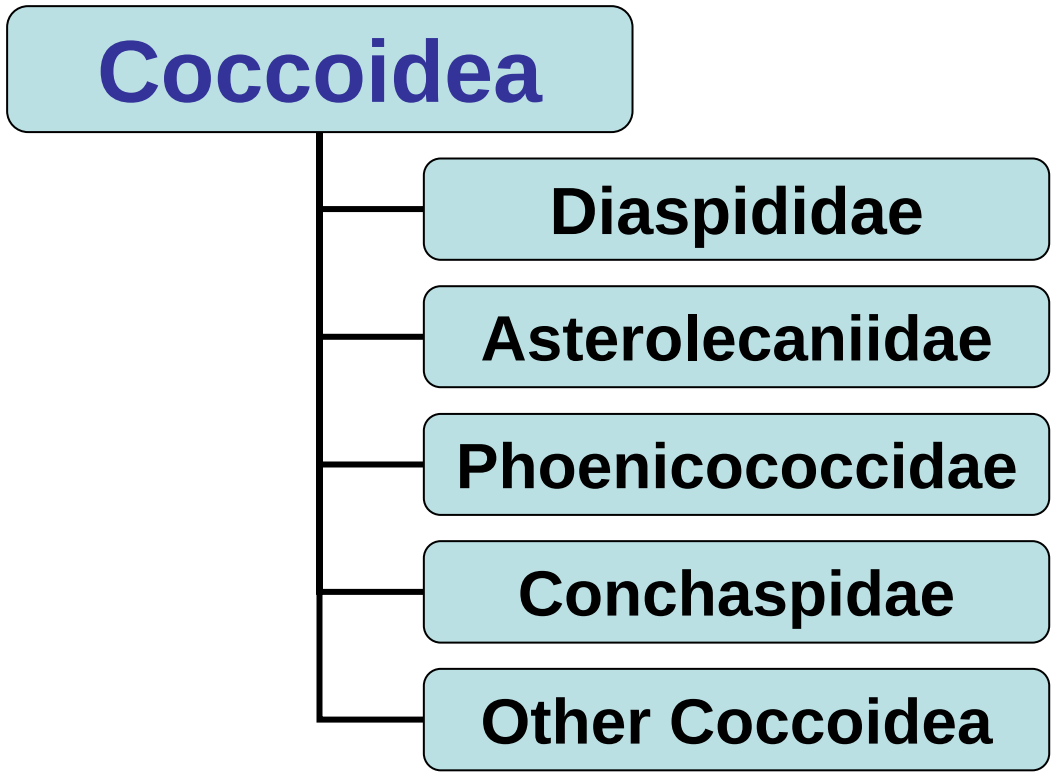
Adult Female-con't

Other structures: Con't:

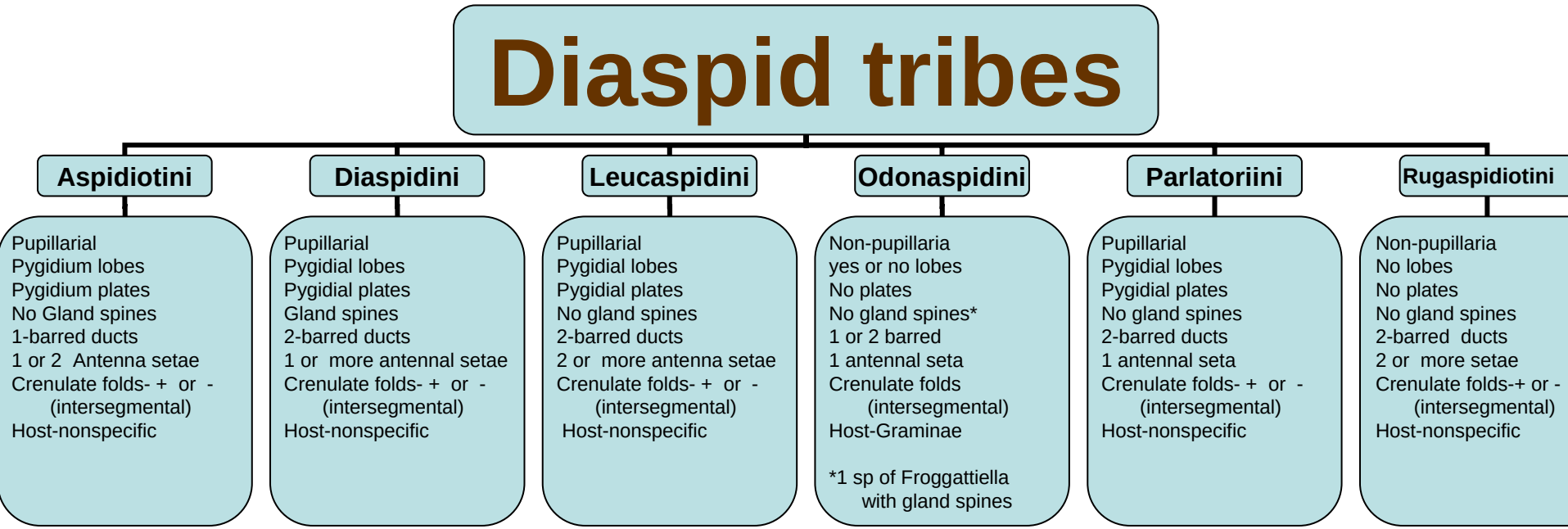
- **Dorsal and/or ventral microspines on cephalic area.**
  - **Large or small spines may occur scattered on the cephalic area or along the margin or submargin (such as in *Lepidosaphes* and *Velataspis)***

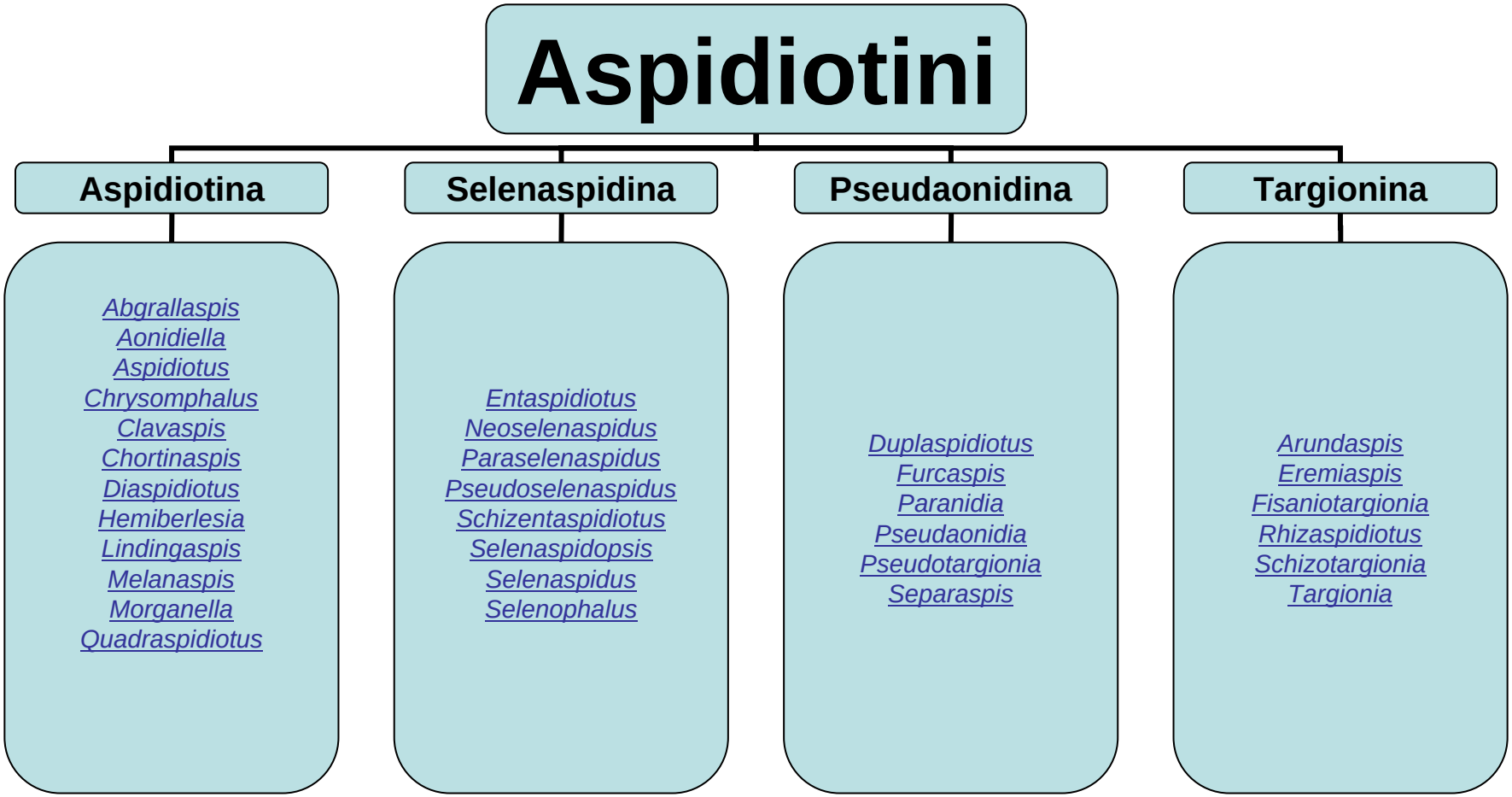


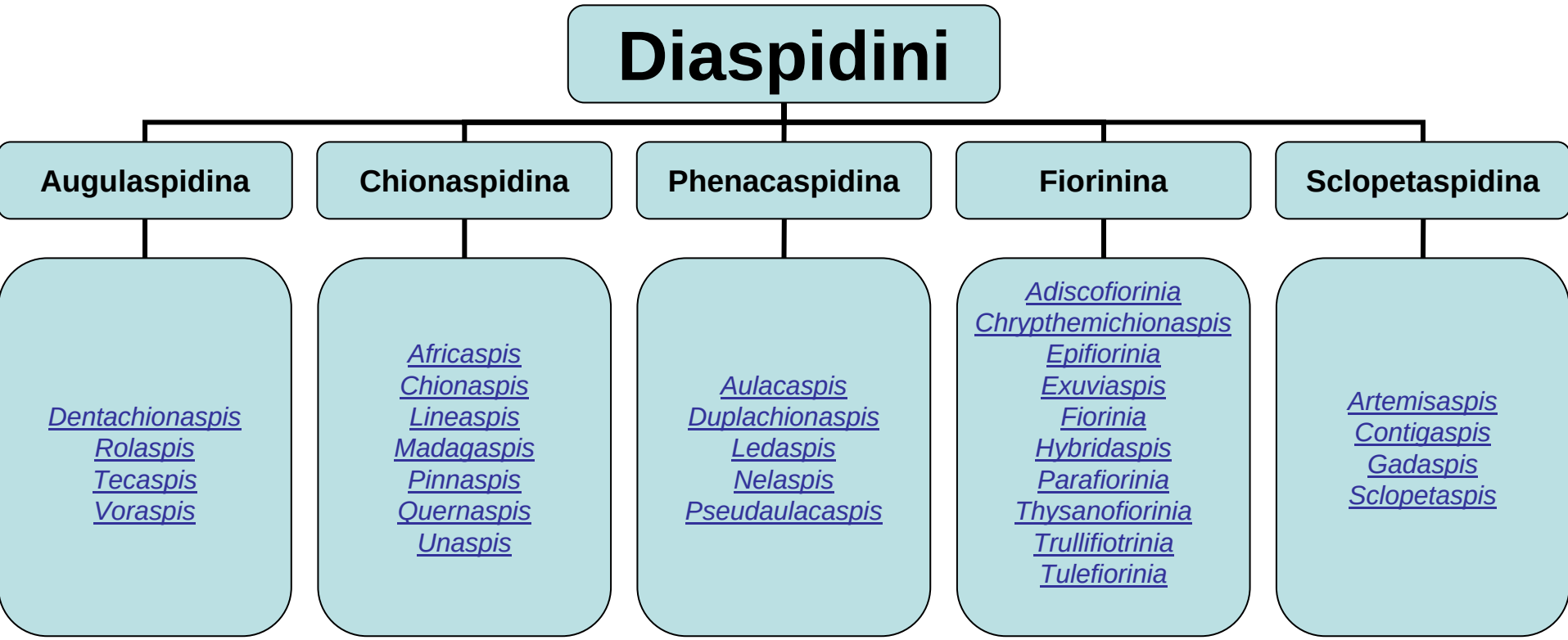
Related Coccoidea & Diaspididae

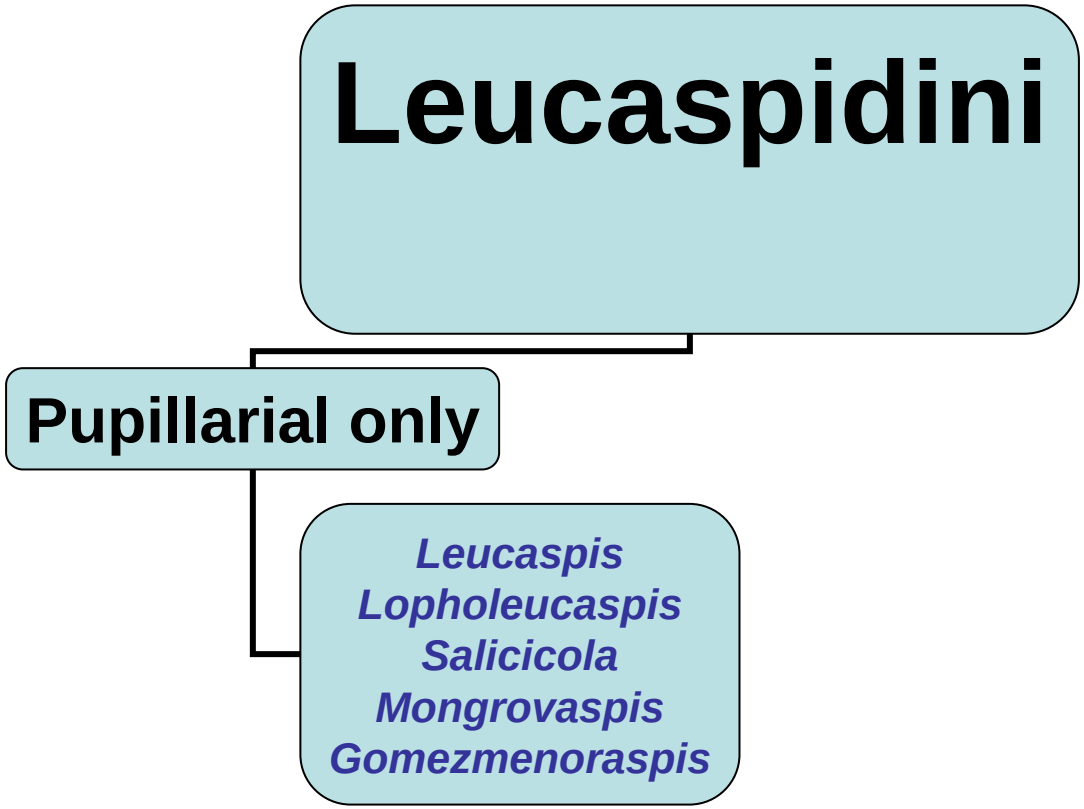


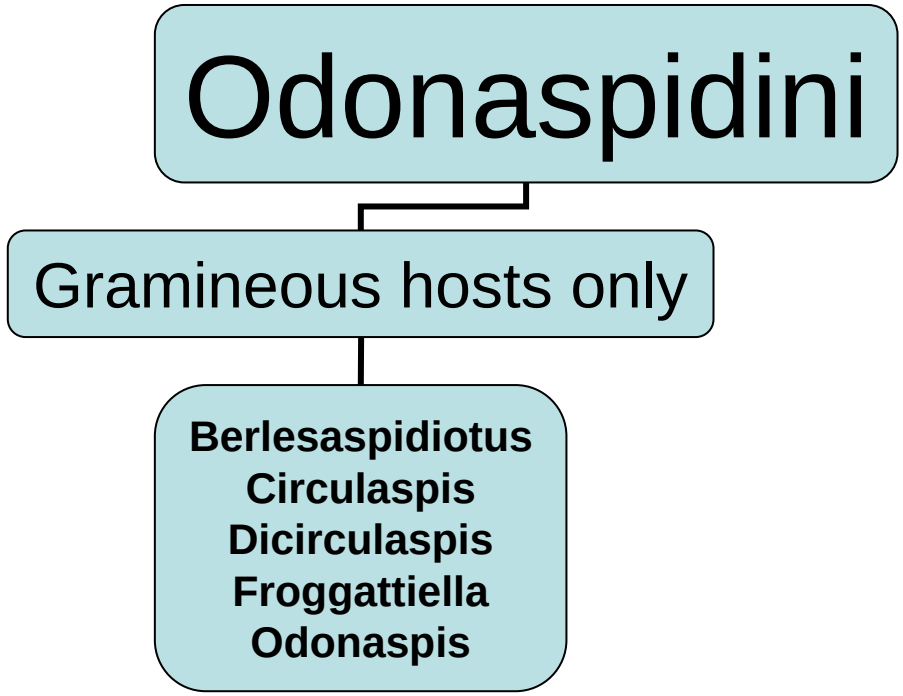
6 Diaspid Tribes




Aspidiotini
Aspidiotina
Abgrallaspis
Aonidiella
Aspidiotus
Chrysomphalus
Clavaspis
Chortinaspis
Diaspidiotus
Hemiberlesia
Lindingaspis
Melanaspis
Morganella
Quadraspidiotus
Selenaspidina
Entaspidiotus
Neoselenaspidus
Paraselenaspidus
Pseudoselenaspidus
Schizentaspidiotus
Selenaspidopsis
Selenaspidus
Selenophalus
Pseudaonidina
Duplaspidiotus
Furcaspis
Paranidia
Pseudaonidia
Pseudotargionia
Separaspis
Targionina
Arundaspis
Eremiaspis
Fisaniotargionia
Rhizaspidiotus
Schizotargionia
Targionia


Diaspidini
Augulaspidina
Chionaspidina
Phenacaspidina
Fiorinina
Sclopetaspidina
Dentachionaspis
Rolaspis
Tecaspis
Voraspis
Africaspis
Chionaspis
Lineaspis
Madagaspis
Pinnaspis
Quernaspis
Unaspis
Aulacaspis
Duplachionaspis
Ledaspis
Nelaspis
Pseudaulacaspis
Adiscofiorinia
Chrypthemichionaspis
Epifiorinia
Exuviaspis
Fiorinia
Hybridaspis
Parafiorinia
Thysanofiorinia
Trullifiotrinia
Tulefiorinia
Artemisaspis
Contigaspis
Gadaspis
Sclopetaspis


Leucaspidini
Pupillarial only
Leucaspis
Lopholeucaspis
Salicicola
Mongrovaspis
Gomezmenoraspis


Odonaspidini
Gramineous hosts only
Berlesaspidiotus
Circulaspis
Dicirculaspis
Froggattiella
Odonaspis

Parlatoriini

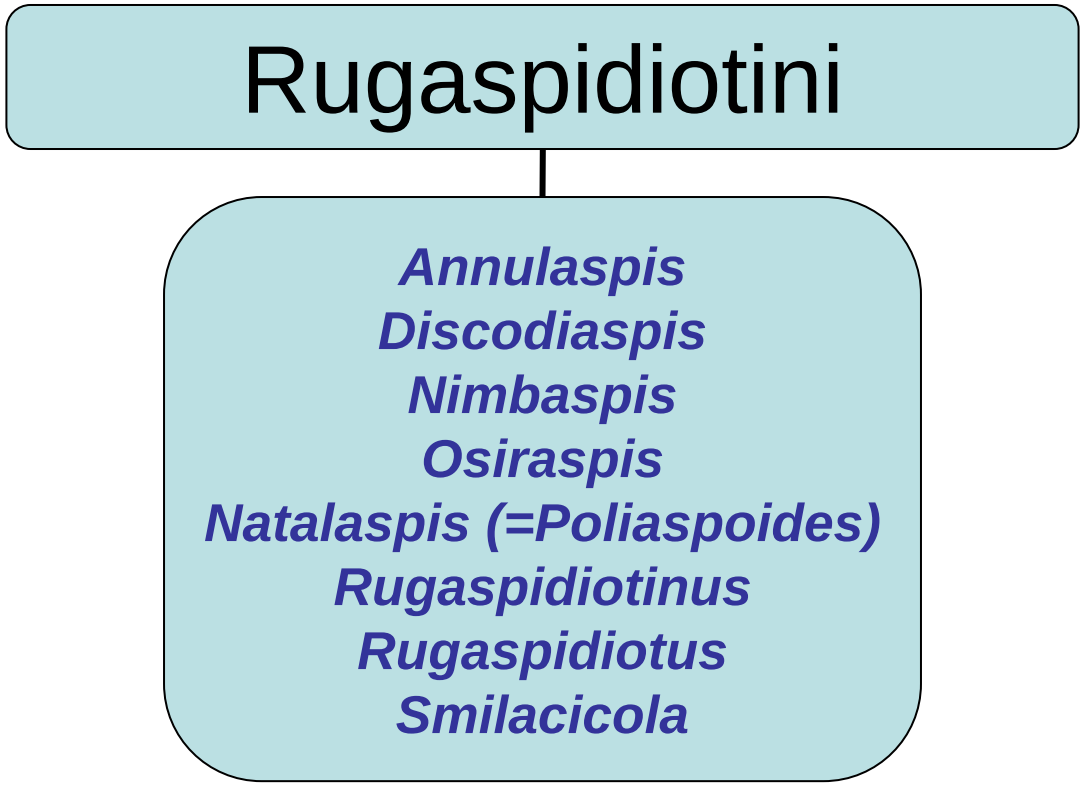
Parlatorina

“Gymnaspidine”: pupillarial species

Aghrophaspis
Bigymanspis
Cryptoparlatoreopsis
Eugreeniella
Greeniella
Gymnaspis
Myxaspis
Neoleucaspis
Neoparlatoria
Porogymnaspis
Sishanaspis

Non-pupillarial species:

Parlagena
Parlaspis
Parlatoria
Parlatoreopsis


Rugaspidiotini
Annulaspis
Discodiaspis
Nimbaspis
Osiraspis
Natalaspis (=Poliaspoides)
Rugaspidiotinus
Rugaspidiotus
Smilacicola

Key separating Diaspidid Atypical Forms & Tribes from related groups

1. All stages mobile (legs present); with or without a test cover, a pygidium present or absent.....other Homoptera (not Diaspididiae)

1’ Adult female sessile (legs absent, although “vestigial” legs may be present); a pygidium present or absent; normally with a test cover (exuvia)……2

2 Pygidium absent (terminal abdominal segments not fused into a pygidium); on Acrocomia and Cocos from Mexico, Panama, Trinidad & Tobago….....Xanthophthalmini (***Xanthophthalma***)

2 Terminal abdominal segments fused into a pygidium…….....3

Key separating Diaspidid Atypical Forms & Tribes from related groups con't

3 Second stage with a bulbous abdominal apex with a flat dorsal plate surrounding the anus; or, second stage with terminal abdominal segments pygidiform and adult female with pygidium with deep longitudinal clefts and ……..12

3' Not as above ……..4

4 Adult female without plates, or segmentally arranged gland spines (except *Froggattiella*); no paired lobes but commonly with a single median lobe; macroducts usually small and short, never segmentally arranged rows usually on dorsum and venter; second exuviae bivalve shape ……..5

4' Adult female or second stage with plates or segmentally arranged gland spines; pygidial lobes usually present rarely the median lobes as a single lobe; macroducts commonly in series or segmental rows……..6

Key separating Diaspidid Atypical Forms & Tribes from related groups con't

5. 1 or 2 barred macroducts; antenna with only one setae; graminae only…….. Odonaspidini

5' 2 barred macroducts only; antenna with 2 or more setae; non host specific…….. Rugaspidiotini

6. With gland spines ……7

6' With fringe plates; ……8

Key separating Diaspidid Atypical Forms & Tribes from related groups con't

7. Marginal pygidial macroducts with the axis of their orifices set longitudinally or diagonally so, each with the orifice surrounded by a transversely oval, sclerotized rim……...Diaspidini (in part)

7' Marginal pygidial macroducts with the axis of their orifices set transversely or essentially so, each with the orifice surrounded by a transversely oval, sclerotized rim..……..Parlatoriini (in part)

8. 2-barred type macroducts; one antennal segment seta; at least three pairs of pygidial lobes present with the second pygidial lobe never bilobate; anterior spiracles with associated disc pores; gland tubercles present ..……Parlatoriini (in part)

8' 1 or 2-barred type macroducts; one or more antennal setae; second lobe bilobate or not; anterior spiracles with or lacking associated disc pores……...9

Key separating Diaspidid Atypical Forms & Tribes from related groups con't

9. 1-barred type macroduct; normally one antennal setae; second lobe never bilobate; anterior spiracles without associated disc pores; gland tubercles rare……..…Aspidiotini

9' 2-barred type macroducts; 1 or more antennal setae present……10

10. Non pupillarial (adult female not enclosed entirely by a second exuvia from the previous stage)……Diaspidini (in part)

10' Pupillarial (adult female *enclosed entirely* by a second exuvia-from the previous stage) ……..11

Key separating Diaspidid Atypical Forms & Tribes from related groups con't

11 Adult female with disc pores present on at least one segment anterior and in addition to the usual perivulvular pores; form elongate & slender; 2nd stage with well-developed lobes and large macroducts...Leucaspidini

11' Adult female with only the usual perivulvular group or transverse row of pores anterior to the vulva; or such pores absent……Diaspidini (***Fiorinia*** & others)

12 Second stage with terminal abdominal segments pygidiform; adult female with pygidium with deep longitudinal clefts; on Casuarinaceae, Fabaceae from Australia, Mexico, & USA (Arizona)……***Ancepaspis***

12' Second stage with a bulbous abdominal apex; with a flat dorsal plate surrounding the anus; on palms from Argentina, Australia, Cuba, Mexico, New Zealand,Norfolk Islands, United Kingdom, USA (Hawaii)……..……***Colobopyga***, formerly ***Palmaricoccus*** (now in the Halimococcidae)