A Taxonomic Analysis of the Armored Scale Tribe Odonaspidini of the World
(Homoptera: Coccoidea: Diaspididae)
ABSTRACT


This study revises on a worldwide basis the genera and species of the tribe Odonaspini of armored scale insects. The characteristics of the tribe are discussed, and distinguishing features are elucidated with scanning electron microscope micrographs. Descriptions and illustrations are given for all taxa of the tribe. The following 5 genera are recognized, of which 1 is new, with a total of 41 species, including 17 new: BERLESASPIDIOTUS MacGillivray: B. bambusarum (Cockerell); B. crenulatus, n. sp.; CIRCULASPIS MacGillivray: C. bibursella Ferris; C. canaliculata (Green); C. fistulata (Ferris); C. fistulella Ferris; DICIRCULASPIS, n. gen.: D. bibursa (Ferris); D. philippina, n. sp.; FROGGATTIELLA Leonard: F. inusitata (Green); F. mcclurei, n. sp.; F. penicillata (Green); ODONASPIS Leonard: O. anneekei, n. sp.; O. arcusnotata, n. sp.; O. aristidae, n. sp.; O. australiensis, n. sp.; O. benardi Balachowsky; O. bromeliae, n. sp.; O. floridana, n. sp.; O. galapagoensis, n. sp.; O. graminis Bremner; O. greeni (Cockerell); O. lingnani Ferris; O. litorosa Ferris; O. minima Howell and Tippins; O. morrisoni Beardsley; O. oshimaensis Kuwana; O. pacifica, n. sp.; O. panic Hall; O. paucipora, n. sp.; O. phragmitis Hall; O. ruthae Kotinsky; O. sabulinica, n. sp.; O. saccharicaulis (Zehntner); O. schizostachyi Cockerell and Robinson; O. secreta (Cockerell); O. serrata, n. sp.; O. siamensis (Takahashi); O. stipagrostis, n. sp.; O. texana, n. sp.; O. transkeiensis, n. sp.; and O. tsinjoarivensis Mamet.

Keys are included for the five genera of the tribe and their species.

Two names are newly placed in synonymy: Aspidiotus (Odonaspis) janeirensis Hempel is a synonym of O. saccharicaulis (Zehntner) and O. pseudoruthae Mamet of O. ruthae Kotinsky.

Lectotypes have been designated for 12 species: B. bambusarum, C. bibursella, C. canaliculata, D. bibursa, F. inusitata, F. penicillata, O. greeni, O. lingnani, O. ruthae, O. schizostachyi, O. secreta, and O. siamensis. A neotype has been selected for O. saccharicaulis.

The species of the tribe are almost exclusively specific to host plants of the Gramineae and are distributed between the 45th northern and southern latitudes in all zoogeographical regions.

A list is included of 19 species of natural enemies that prey on or parasitize odonaspidine armored scales.

Two appendixes are given: (1) The species of Odonaspini with their host plants and (2) host plants with their species of Odonaspini.

KEYWORDS: Berlesaspidiotus, Circulaspis, Coccoidea, Diaspididae, Dicirculaspis, Froggattiella, Gramineae, Homoptera, host plants, key to genera, key to species, natural enemies, Odonaspini, Odonaspis, world distribution.
A Taxonomic Analysis of the Armored Scale Tribe Odonaspidini of the World
(Homoptera: Coccoidea: Diaspididae)

By
Yair Ben-Dov
PREFACE

This revision of the Odonaspidini was undertaken when I was curator of the Coccoidea at the National Collection of Insects, Plant Protection Research Institute, Pretoria, South Africa. While studying several collections of odonaspidine armored scale insects from southern Africa, I realized that they could not be named before the taxonomy of some of the older taxa was clarified. At that time no comprehensive treatise of the tribe was available, and some of the taxa were inadequately known. Therefore, a revision on a worldwide basis of the Odonaspidini was proposed.

My undertaking of this revision was encouragingly endorsed by the late Dave P. Annecke, Assistant Director, Plant Protection Research Institute, Pretoria, by the late A.S. Balachowsky, Museum National d'Histoire Naturelle, Paris, France, and by my colleagues Douglas J. Williams, Commonwealth Institute of Entomology, London, England, and Douglass R. Miller, U.S. Department of Agriculture, Beltsville, MD, U.S.A. The completion of the study had to be delayed for some time when I assumed duty at the Division of Entomology, Agricultural Research Organization, Bet Dagan, Israel. The revision was finalized during a sabbatical year that I was granted from this institute. I express my thanks to Eliahu Swirski, Head, Department of Entomology, and Shimon Ascher, Head, Plant Protection Institute, Agricultural Research Organization, Bet Dagan, for endorsing my plans to finalize this study during my sabbatical, and to Michael Kosztarab and Sidney L. Poe, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, VA, U.S.A., for use of their facilities during my sabbatical year.

This revision could not have been completed without the kind cooperation of many colleagues, who made available the scale insect material, reprints of publications, and who answered various questions: P.H. Arnaud, Jr., Department of Entomology, California Academy of Sciences, San Francisco, CA, U.S.A.; Ronald G. Baer, Department of Entomology, Mississippi State University, Mississippi State, MS, U.S.A.; A.S. Balachowsky, Museum National d'Histoire Naturelle, Paris, France; Cheryl B. Barr, Department of Entomology, Louisiana State University, Baton Rouge, LA, U.S.A.; J.W. Beardsley, University of Hawaii, Honolulu, HI, U.S.A.; Ramona J. Beshear, University of Georgia, Experiment, GA, U.S.A.; B.W. Blair, Plant Protection Branch, Salisbury, Zimbabwe (Rhodesia); W.A. Boedijono, Sugar Experiment Station, Pasuruan, Indonesia; S.A. Brink, Central Agricultural Library, Pretoria, South Africa; Helen M. Brookes, Department of Entomology, The University of Adelaide, Waite Agricultural Research Institute, Glen Osmond, South Australia; Clare Butcher, Entomology Division, Department of Scientific and Industrial Research, Auckland, New Zealand; A.J.M. Carnegie, South African Sugar Association, Mount Edgecombe, Natal, South Africa; Jennifer M. Cox, British Museum (Natural History), London, England; J.P. da Fonseca, Instituto Biologico, São Paulo, Brazil; Janny A. de Boer, formerly of DSIR, Auckland, New Zealand; J.P. Duffels, Instituut voor Taxonomische Zoologie, Universiteit van Amsterdam, Holland; Uri Gerson, Department of Entomology, Faculty of Agriculture, Rehovot, Israel; Pamela Gilbert, Library of the British Museum (Natural History), London, England; Ray J. Gill, California Department of Agriculture, Sacramento, CA, U.S.A.; Avas B. Hamon, Florida Department of Agriculture, Gainesville, FL, U.S.A.; B. Hauser, Department des Arthropodes, Museum National d'Histoire Naturelle, Geneve, Switzerland; F.W. Howard, University of Florida, Fort Lauderdale, FL, U.S.A.; James O. Howell, University
of Georgia, Experiment, GA, U.S.A.; Linda Huddleston, formerly of the British Museum (Natural History), London, England; Michael Kosztarab, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, VA, U.S.A.; P.A. Maddison, Entomology Division, Department of Scientific and Industrial Research, Auckland, New Zealand; Daniele Matile-Ferrero, Museum National d'Histoire Naturelle, Paris, France; Douglass R. Miller, U.S. Department of Agriculture, Beltsville, MD, U.S.A.; Steve Nakahara, U.S. Department of Agriculture, Beltsville, MD, U.S.A.; W. Nijveldt, Instituut voor Plantenziektenkundig Onderzoek, Wageningen, Holland; Gerhard L. Prinsloo, Plant Protection Research Institute, Pretoria, South Africa; Mary H. Rhoades, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, VA, U.S.A.; Claude Richard, Museum National d'Histoire Naturelle, Paris, France; G. Schmitz, Musée Royal de l'Afrique Centrale, Tervuren, Belgium; Robert O. Schuster, Museum of the Department of Entomology, University of California, Davis, CA, U.S.A.; Manya B. Stoetzel, U.S. Department of Agriculture, Beltsville, MD, U.S.A.; Tetsusaburo Tachikawa, Entomological Laboratory, Ehime University, Matsuyama, Japan; Sadao Takagi, Hokkaido University, Sapporo, Japan; Charles Chia-chu Tao, Taiwan Forestry Research Institute, Taipei, Republic of China; Hamlin H. Tippins, University of Georgia, Experiment, GA, U.S.A.; Douglas J. Williams, Commonwealth Institute of Entomology, London, England; and J. Zahradnik, Karlovy University, Prague, Czechoslovakia. My thanks and sincere appreciation are extended to all my colleagues for their kind and willing cooperation.

Last but not least my thanks are due Bill F. Ravlin, Boris C. Kondratieff, and John Deighan of the Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, VA, U.S.A., for their valuable guidance in the use of the word processor.
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A Taxonomic Analysis of the Armored Scale Tribe Odonaspidini of the World (Homoptera: Coccoidea: Diaspididae)

By Yair Ben-Dov

The odonaspidine armored scale insects (Homoptera: Coccoidea: Diaspididae) comprise a small suprageneric group of the family. Until 1978, only 24 valid species had been described. This group was first recognized as a tribe by Ferris (1937b), but students later differed from Ferris as to its composition and rank (Balachowsky, 1953; Borchsenius, 1965; Takagi, 1969; Tang, 1986).

This revision was undertaken to update information on the tribe on a worldwide basis. That purpose was achieved by elucidating the taxonomy of the 24 described species and describing 17 new species and 1 new genus. Consequently, characteristics of the tribe were redefined, and its composition and separation from other tribes of the family were established.

Slide-mounted specimens, and in part dry material, of all the species treated in this revision were from 19 collections of scale insects throughout the world. These depositories provided the type-series of almost all previously described species, material for the type-series of 17 new species described here, as well as extensive records of Odonaspidini species from all the distribution areas of the tribe.

The collections from which material was studied are indicated in the text by the following abbreviations. The name of the curator is in parentheses.

ANIC - Australian National Insect Collection, Canberra, Australia

BMNH - British Museum (Natural History), London, England (J.M. Cox)

CDA - California Department of Agriculture, Sacramento, CA, U.S.A. (R.J. Gill)

FDA - Florida Department of Agriculture, Gainesville, FL, U.S.A. (A.B. Hamon)

FRT - Taiwan Forestry Research Institute, Taipei, Taiwan, Republic of China (C. Chia-chu-Tao)

IB - Instituto Biológico, São Paulo, Brazil (J.P. da Fonseca)

ICR - Department of Entomology, Faculty of Agriculture, Rehovot, Israel (U. Gerson)

ICV - Coccoidea Collection, Department of Entomology, The Volcani Center, Bet Dagan, Israel (Y. Ben-Dov)

1Department of Entomology, Agricultural Research Organization, The Volcani Center, Bet Dagan, 50-250, Israel.

2The year in parentheses after the author's name refers to Literature Cited, p. 73.
LSU - Collection of the Department of Entomology, Louisiana State University, Baton Rouge, LA, U.S.A. (C.B. Barr)

MEM - Mississippi Entomological Museum, Mississippi State, MS, U.S.A.

MNP - Museum National d'Histoire Naturelle, Paris, France (D. Matile-Ferrero)

PPRI - National Collection of Insects, Plant Protection Research Institute, Pretoria, South Africa (G.L. Prinsloo)

ST - Collection of Sadao Takagi, Hokkaido University, Sapporo, Japan (S. Takagi)

UCD - Coccoidea Collection, Museum of the Department of Entomology, University of California at Davis, CA, U.S.A. (R.O. Schuster)

UG - Department of Entomology, University of Georgia, Experiment, GA, U.S.A. (H.H. Tippins and J.O. Howell)

UH - Department of Entomology, University of Hawaii at Manoa, Honolulu, HI, U.S.A. (J.W. Beardsley)


VPI - Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, VA, U.S.A. (M. Kosztaras)

ZC - Collection of J. Zahradnik, Prirodovedecke Fakulty University Karlovy, Prague, Czechoslovakia (J. Zahradnik)

The major source of material, in number of species and specimens, was the National Museum of Natural History, Washington, DC. This depository provided material of the American species and numerous collections of new species taken on various bamboos in the Oriental region, mainly by the distinguished botanists A.S. Hitchcock and F.A. McClure.

The Ferris and McKenzie collection (UCD) was of great importance as it provided many records from North and Latin America as well as from the Oriental region.

The best representation of African species was in the National Collection of Insects, Pretoria, South Africa, which included mainly records from southern Africa collected by J. Munting and Y. Ben-Dov.

The specimens from the British Museum (Natural History), London, and from the Museum of Natural History, Paris, were significant supplements for studying the African and Oriental species.

Other depositories, though with smaller collections of Odonaspisini, were most valuable, because they provided the type-series for some poorly known species. Type-series became available for almost all the described species, and a lectotype or neotype was designated where appropriate.

During this study, approximately 2,000 specimens mounted on about 1,500 slides were examined.

This systematic treatise of the Odonaspisini is based almost entirely on a study of the adult female and provides the taxonomic data of that stage as required for determining species in the tribe.

The taxonomic characters (see fig. 1) of each species are illustrated and supplemented by descriptions. Each drawing is of the entire body, as observed from a slide-mounted specimen, divided longitudinally, with the left half representing the dorsum and the right the venter. Detailed enlargements are included for structures of specific diagnostic significance. The dermal structures, such as pores, setae,
intersegmental lines, and crenulae, on each central illustration are not drawn to scale but rather show their approximate distribution and frequency. The size is indicated either in the text or in the illustrations for some detailed, enlarged structures.

Each species description begins with the general appearance of the scale cover as I saw it. If the scale cover was not available, this description is cited from the original description. Measurements are given in micrometers (μm) unless otherwise stated. Counts of structures are indicated by their range, followed by the average in parentheses. Measurements and counts are based on 10 specimens for species when large samples were available. If few specimens were studied, these quantitative data are based on all the specimens.

All records listed in "Material Examined" for each species are based on specimens examined. Other records are included under "Additional Records in Publications." Each record in the material examined is given in the following order: Country, location, date, host plant, collector, and depository abbreviation. Records intercepted by quarantine services are denoted by "at" between the country of origin and port of entry, for example, Mexico, at Brownsville.

Supplementary observations, using scanning electron microscopy and microscope photography, have been made on several species. The micrographs and photographs given here are valuable in showing the structure of some of the major taxonomic characters in the Odonaspidini.

Host plants are recorded in common or scientific names as given on the original labels. Except for corrections of obvious errors, no changes were made. All names are in accordance with Chase and Niles (1962) and Hitchcock (1971). The family name is given in parentheses only for host plants belonging to a nongramineous family; if a family name is not given, the host is in the Gramineae.
Tribe ODONASPIDINI Ferris

Ferris, 1937b: l; Ferris, 1942:446;
Balachowsky, 1942:47 (Odonaspidinae);
Balachowsky, 1948:261, 264
(Odonaspida); Balachowsky, 1949:109
(Odonaspidea); Balachowsky, 1953:729
(Odonaspidea); McKenzie, 1956:21;
Brown and McKenzie, 1962:164;
Borcherdenius, 1965:211 (Odonaspideinae);
Borcherdenius, 1966:223 (Odonaspideinae);
Takagi, 1969:7, 60; Williams, 1969:332;
Beardsley and Gonzalez, 1975:47;
Ben-Dov, 1980:71.

Type-genus: Odonaspis Leonardi, 1897a.
LITERATURE REVIEW

Odonaspidini was established as a tribe in the Diaspididae by Ferris (1937b). However, recognition that the species, now placed in this tribe, form a distinct group appears to date to the turn of the century. It was associated with the concurrent attempts of Leonardi and Cockerell to split the assemblage of species placed in Aspidiotus into more homogenous and natural genera.

Leonardi first established Odonaspis (type-species: Aspidiotus secretus Cockerell) in 1897. In 1900, he introduced two related genera—Froggattiella (type-species: Aspidiotus inusitatus Green) and Anoplaspis (type-species: Aspidiotus (Odonaspis) bambusarum Cockerell). In the following years until 1921, seven more species were described in Odonaspis from various parts of the world.

MacGillivray (1921) named four genera and placed in them part of these odonaspidine species. However, until the early 1930's, these genera of Leonardi and MacGillivray were still assigned in the Aspidiotini.

In 1936, Ferris suggested that "... the group of species of the general type of Odonaspis seem to be of doubtful position and are for the present left unplaced." A year later Ferris (1937b) established the tribe Odonaspini, to which he assigned the genera Bakeraspis, Berlesaspidiotus (=Anoplaspis), Chorizaspidiotus, Circulaspis, Froggattiella, Ligulaspis, Odonaspis (=Dycryptaspis; =Spatheaspis), Poliaspoides, Remotaspidiotus, Rhizaspidiotus, and Rugaspidiotus.

In 1938, Ferris described the genus Annulaspis and several new species in other odonaspidine genera. The tribe was redefined by Ferris (1942), who pointed out that several forms previously placed in Odonaspini were definitely referable to other tribes of the Diaspididae.

Balachowsky (1949, 1953) divided the tribe into two subtribes—Odonaspidina and Rugaspidiotina—which he considered to be phylogenetically distinct. The Odonaspidina comprised species with aspidiotine affinities, to which he assigned Odonaspis, Froggattiella, Circulaspis, and Berlesaspidiotus. In the Rugaspidiotina he placed the genera Rugaspidiotus, Osiraspis, Discodiaspis, Annullaspis, Rugaspidiotinus, and Nimbaspis—genera that possess diaspidine characters.

The splitting of Odonaspini of Ferris (1937b) into two groups by Balachowsky basically has been accepted by later students, who disagreed, however, in the rank of the groups as shown in table 1.

The cytological studies of Brown and McKenzie (1962) and Brown (1965) involved only two odonaspidine species, and they did not introduce changes in the status of the tribe.

Recent studies on immature stages in Odonaspini (Takagi, 1969; Howell and Tippins, 1978; Howell, 1980), though dealing with only three species, have shown that there is a significant difference between the second-instar male of Asian Odonaspini and the same instar of the North American species of Odonaspis.

In this revision, I concur with Balachowsky, Borchesius, and Takagi regarding the odonaspidine scale insects as a group distinct from the rugaspidiotines. Establishing the rank of the odonaspidines is beyond the scope of this study, and therefore it is regarded here as a tribe in the Diaspididae, as it currently is accepted in the systematics of armored scale insects (Takagi, 1969; Beardsley and Gonzalez, 1975).
### Table 1
Classification of odonaspidine armored scales by 4 authors

<table>
<thead>
<tr>
<th>Author</th>
<th>Odonaspidine classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferris, 1937b</td>
<td>Odonaspidini tribe</td>
</tr>
<tr>
<td>Balachowsky, 1949, 1953</td>
<td>Odonaspidina subtribe Rugaspidiotina subtribe</td>
</tr>
<tr>
<td>Borchsenius, 1965, 1966</td>
<td>Odonaspidinae subfamily Diaspidinae subfamily</td>
</tr>
<tr>
<td></td>
<td>Diaspidini tribe Rugaspidiotina subtribe</td>
</tr>
<tr>
<td>Takagi, 1969</td>
<td>Odonaspidini tribe Rugaspidiotini tribe</td>
</tr>
</tbody>
</table>

Since Odonaspidini was established, 39 species and subspecies and as many as 18 genera have been assigned to it. These taxa are given in the following list and table 2, showing those regarded as valid in the Odonaspidini, as well as the present status of those assigned to other tribes, following the redefinition of the Odonaspidini. The generic names used in the Odonaspidini are as follows:

<table>
<thead>
<tr>
<th>Generic name and type-species</th>
<th>Present assignment</th>
<th>Present assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANNULASPIS Ferris, 1938</td>
<td>Diaspididae, not</td>
<td></td>
</tr>
<tr>
<td>Annulaspis polygona Ferris, 1938</td>
<td>Odonaspidini</td>
<td></td>
</tr>
<tr>
<td>ANOPLASPIS Leonardi, 1900 (not Leonardi, 1898)</td>
<td>Objective synonym of Berlesaspidiotus</td>
<td></td>
</tr>
<tr>
<td>Aspidiotus (Odonaspis) bambusarum Cockerell, 1898</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAKERASPIS MacGillivray, 1921</td>
<td>Subjective synonym of</td>
<td></td>
</tr>
<tr>
<td>Odonaspis schizostachyi Cockerell and Robinson, 1914</td>
<td>Odonaspis</td>
<td></td>
</tr>
<tr>
<td>BERLESASPIDIOXUS² MacGillivray, 1921</td>
<td>Valid genus in</td>
<td></td>
</tr>
<tr>
<td>Aspidiotus (Odonaspis) bambusarum Cockerell, 1898</td>
<td>Odonaspidini</td>
<td></td>
</tr>
<tr>
<td>CHORIZASPIDIOXUS MacGillivray, 1921</td>
<td>Diaspididae, not</td>
<td></td>
</tr>
<tr>
<td>Aspidiotus (Targionia) gutierreziae Cockerell and Parrott, 1899</td>
<td>Odonaspidini</td>
<td></td>
</tr>
<tr>
<td>CIRCULASPIS² MacGillivray, 1921</td>
<td>Valid genus in</td>
<td></td>
</tr>
<tr>
<td>Odonaspis canaliculata Green, 1900</td>
<td>Odonaspidini</td>
<td></td>
</tr>
<tr>
<td>DYCRIPTASPIS Cockerell, in Leonardi, 1897b</td>
<td>Objective synonym</td>
<td></td>
</tr>
<tr>
<td>Aspidiotus secretus Cockerell, 1896</td>
<td>of Odonaspis¹</td>
<td></td>
</tr>
<tr>
<td>FROGGATTIELLA² Leonardi, 1900</td>
<td>Valid genus in</td>
<td></td>
</tr>
<tr>
<td>Odonaspis inusitatus Green, 1896</td>
<td>Odonaspidini</td>
<td></td>
</tr>
<tr>
<td>LIGULASPIS MacGillivray, 1921</td>
<td>Subjective synonym</td>
<td></td>
</tr>
<tr>
<td>Aspidiotus pimentae Newstead, 1917</td>
<td>of Odonaspis</td>
<td></td>
</tr>
<tr>
<td>LEONARDIANNA MacGillivray, 1921</td>
<td>Diaspididae, not</td>
<td></td>
</tr>
<tr>
<td>Aspidiotus (Odonaspis) janeirensis Hempel, 1900</td>
<td>Odonaspidini</td>
<td></td>
</tr>
<tr>
<td>ODONASPIS² Leonardi, 1897a</td>
<td>Valid genus in</td>
<td></td>
</tr>
<tr>
<td>Aspidiotus secretus Cockerell, 1896</td>
<td>Odonaspidini</td>
<td></td>
</tr>
</tbody>
</table>
OSIRASPIS Hall, 1923
Osiraspis balteata Hall, 1923

POLIASPOIDES
MacGillivray, 1921
Chionaspis simplex
Green, 1899

PYGALATASPIS Ferris, 1921b
Pygalataspis miscanthi
Ferris, 1921b

REMTASPIDIOTUS
MacGillivray, 1921
Aspidiotus (Targionia)
chenopodi Marlatt, 1908

RHIZASPIDIOTUS
MacGillivray, 1921
Aspidiotus (Targionia)
helianthi Parrott, 1899

RUGASPIDIOTUS
MacGillivray, 1921
Diaspis arizonicus
Cockerell, 1900a

SPATHEASPIS Leonardi,
1897c
Aspidiotus secretus
Cockerell, 1896

1For further explanation, see respective text.
2Valid genus.

Diaspididae, not Odonaspini

Rugaspidiotini

Diaspididae, not Odonaspini

Rugaspidiotini

Objective synonym of Odonaspis1
Table 2
Specific and subspecific names used in the Odonaspidini

<table>
<thead>
<tr>
<th>Species and subspecies</th>
<th>Original generic assignment</th>
<th>Present status</th>
</tr>
</thead>
<tbody>
<tr>
<td>arizonicus Cockerell, 1900a</td>
<td>Diaspis</td>
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<td>tsinjoarivensis Mamet, 1954</td>
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1Previously assigned to Odonaspidini but not considered members of this tribe.
2Synonym.
Habit. Most species of the Odonaspidini develop exclusively on gramineous host plants. A few species rarely have been found on plants of other families. One species, Odonaspis bromeliae, is known only from a nongramineous family, the Bromeliaceae. The odonaspidines develop mainly on leaves and stems. A few species, for example O. ruthae, also develop on underground stolons and rhizomes, but there is no record that it occurs on roots. Crowded infestations on gramineous plants are found on protected parts of the host, such as the inner side of leaf sheaths, at the base of the leaf blade, and around the stem nodes. The scale cover of most species is placed above the epidermis layer of the host. However, the female of O. secreta when developing on leaf sheaths of bamboo is completely buried beneath the epidermis layer (fig. 68).

Scale Cover. The scale cover of the adult female consists of well-developed ventral and dorsal parts that entirely envelop the body. Exuviae of the first instar are incorporated at the anterior part of the scale. The exuviae of the second instar split along the margin of the abdomen and the thorax, but the ventral and dorsal skins remain attached to each other at the cephalic apex and are incorporated in that form at the anterior part of the scale cover. The color of the secreted part of the scale varies. In most Odonaspis species the scale is white. In some of the bamboo-feeding species, for example Berlesaspidiotus bambusarum, Floggattiella penicillata, and Odonaspis schizostachyi, the scale is dark brown. The exuviae in most species of the tribe are yellow brown. The outline of the scale usually is elongate oval, but it may vary in size. In O. minima it is about 1 mm long, whereas in O. sabulincola, one of the largest species, it is up to 4 mm long.

Body Shape. The young female just after the final molt is almost circular, but on reaching the oviposition stage it becomes elongate oval. The cephalic margin is rounded, whereas the pygidial area is triangular, tapering apically at segment 8. The widest part of the body is at the level of the metathorax or first abdominal segment.

Intersegmental Folds. These structures, which are one of the unique features of the tribe, previously have been named "spicules" by Balachowsky (1953, 1958) and "intersegmental sutures" by Ben-Dov (1980). They are short, longitudinal folds (fig. 47) of the cuticle, disposed in a pattern conspicuously different from the cuticular striation of the body. They are set on the dorsum and venter along the intersegmental lines of the abdomen from the first to fourth and fifth segments. Usually they occur also on the thoracic segments. The folds are well stained by Fuchsin, and they can be observed in slide-mounted specimens as transverse lines of circular or elongate-oval spots. In general, the folds are arranged on each intersegmental line in a regular pattern consisting of a median part that is clearly separated from the submedian part on each side.

Crenulae. These are scalelike processes of the cuticle (figs. 48-50) that are common among insects (Snodgrass, 1935) and frequent in various families of scale insects, for example the Cerococcidae (Lambdin and Kosztarab, 1977), Lecanodiaspididae (Howell and Kosztarab, 1972), as well as in other tribes of the Diaspididae. Balachowsky (1953, 1958) named these processes "spicules ventrales," whereas Ben-Dov (1980) introduced the term "crenulae." Each crenula is roughly rectangular, 4-8 long, and the posterior margin is deeply serrated. In odonaspidine adult females,
as well as in second-instar females, the crenulae are only on the sternites. They are posterior to the mouth parts and are in transverse, segmental bands on the thorax and abdomen as far as the vulva (fig. 52). The abundance and segmental disposition of the crenulae are characteristic of the tribe but generally are not of significance in determining species.

Paratergal and Parasternal Areas. The ducts on the dorsum and venter of the abdomen and thorax are arranged in well-defined, segmental clusters on the marginal and submarginal areas and the paratergal and parasternal areas, respectively (figs. 53-55, 59). These areas usually are sclerotized and are well stained in Fuchsin. The paratergal clusters are contiguous with the duct clusters on the parasternal areas. The ducts on the paratergal areas are more numerous than on the parasternal areas. Each dorsal and ventral area is clearly bordered anteriorly and posteriorly by an intersegmental line of folds. The areas are of significance in interpreting the abdominal segmentation in females of the tribe but are of less value for the separation of species.

Intersegmental Lines and Furrows. The border between segments in the abdomen and thorax is distinctly marked either by the intersegmental folds (figs. 47, 53) or by deep, intersegmental furrows (figs. 54, 58). Marginally these lines terminate in distinct emarginations (fig. 59). The median part of the dorsal line between segments 5 and 6 generally is not formed of folds but appears in slide-mounted specimens as a dark, well-stained line. The line is variously shaped and is useful for specific determinations.

Segmentation of Abdominal Segments. The abdominal segmentation in the second-instar females and in the adult females of all species in the Odonaspodini exhibits a special pattern in the Diaspididae (Ben-Dov, 1980). For completeness it is redescribed here.

The separation between segments in females of the Odonaspodini is more distinct than in other tribes of the Diaspididae because of the conspicuous segmental disposition of the intersegmental folds, the intersegmental lines and furrows, the intersegmental emarginations, the crenulae, and the paratergal and parasternal areas. Using these features, the following pattern (fig. 2) is outlined. Each of the three anterior segments of the abdomen consists of a sternite and its respective tergite. The fourth and fifth segments each has a separate tergite distinctly defined by intersegmental folds, paratergal areas, and intersegmental emarginations (figs. 53, 55). The sternites corresponding to the fourth and fifth tergites are recognized separately only by their respective parasternal areas (figs. 54, 55). The median areas of the fourth and fifth sternites are fused into one "segment," which is defined anteriorly and posteriorly by an intersegmental line of folds, which has a single transverse band of crenulae (figs. 54, 55). This pattern of "separate tergites - fused sternites" is present also in the second-instar female of O. ruthae (fig. 56), F. penicillata, and O. minima. This suggests that the pattern is common to this instar of other odonaspidine species.

It should be noted that the enumeration of the abdominal segments here and throughout this revision refers merely to the way of counting, in which segment 1 is the first segment posterior to the metathorax. No interpretation is suggested as to whether segment 1 actually represents the primitive, first abdominal segment that has been retained in the reductive process of pygidium formation in the Diaspididae.

Antennal Tubercle. Females of all the species have a unisetose antennal tubercle (figs. 45, 46). Obviously this character is of no value in species recognition. However, in two species, placed here in Berlesaspidiotus, the tubercles are located in a cylindrical
invagination of the cuticle, a character unique to this genus in the tribe.

Postvulvar Sternite. This sternite lies longitudinally between the vulva and the apical margin of the pygidium (figs. 52, 54, 58) and represents segment 8. It is clearly defined on each side by intersegmental lines or furrows. The degree of sclerotization and the pattern of duct disposition on the sternite are useful characters for recognizing species.

Ducts. The ducts of the odonaspidine female vary considerably in size, shape, and type, but they are relatively consistent within a species and therefore provide a useful tool for separating species. The inner tube of all types of ducts is not cylindrical but rather flat, that is narrow oval in cross section. This morphological feature is especially noted and further illustrated for the various species to avoid misinterpretation. In mounted specimens the ducts are randomly fixed in different aspects and thus appear when observed under a microscope to include two different "types"—a broad and a narrow type. This shape of the inner duct is described here for the first time in the Odonaspidini. A similar structure of the duct was described earlier (Pesson and Foldi, 1978; Foldi, 1983) in other tribes of the Diaspididae, and thus it appears to be a common feature of the family. The orifices of all ducts are similar in shape. They are narrow, oval slits usually surrounded by a dark rim (figs. 56, 57, 64). This shape is further demonstrated by the ribbon shape of the wax secretions of the ducts (fig. 65).

There is a great diversity in the pattern (one- or two-barred types) of the inner extremity of ducts in the adult female. In some of the Odonaspis species, for example O. grammis and O. ruthae, the macroducts appear to be of the two-barred type, but this is not always as distinct as in some species of the Diaspidini. The inner end of macroducts in O. sabulincola appears in slide-mounted specimens to be of the two-barred type, but with the scanning electron microscope it appears to be one barred (figs. 66, 67). A comparison of these micrographs with the micrograph of a macroduct in Pseudaulacaspis pentagona (Foldi, 1983, fig. 11) shows the discrepancy of odonaspidine macroducts from the typical two-barred type. In species like O. secreta, B. bambusarum, and F. penicillata, the ducts are very thin and the pattern of the inner end is very obscure, showing sclerotization but no definite type.

The diversity in shape and size and the differential distribution of the ducts on the female cuticle are most useful characters for recognizing genera and species in the tribe.

Throughout this revision I have used the terms macroducts and microducts extensively. The differences between them are purely arbitrary. Often the difference is not clear, but rather there is a gradual decrease in the size of the macroducts, creating a problem in deciding whether the ducts are macro or micro. However, it is usually possible to see a marked difference between the two sizes (fig. 57).

Gland Tubercles. In species possessing these tubercles, they are located only in submarginal clusters on the venter, laterally to the anterior spiracles or mouth parts. The tubercles usually are rounded, at times only slightly projecting, and never as pointed as in many species of the Diaspidini.

Gland Spines. Similar structures are common in most tribes of the Diaspididae. In the Odonaspidini they are unique only to the genus Froggattiella. The secretionary function of the spines is shown in figures 61 and 62.

Invaginated Tubes. These are sclerotized tubes or pouches located marginally on the pygidial apex on segment 7 or 8. Each invagination functions as a common outlet for the secretion of numerous glandular ducts that discharge into the inner end of the tube or pouch. These tubes are characteristic of the genera Circulaspis and Dicirculaspis.
Scleroses. These are cuticular sclerotizations placed marginally at the ends of intersegmental furrows on pygidial segments. The presence or absence, size, shape, and distribution along the margin of the pygidium are reliable characters for identifying species in the tribe.

Cuticular Striation. In most species the cuticle, especially of the thorax, is distinctly striated (figs. 46, 60). Most of the bamboo-feeding species of Odonaspis, for example O. secreta and O. paucipora, have numerous circular sclerotizations along the striation lines. In several species of this group the sclerotizations are absent from two circular areas on the venter lateral to the spiracles. Along the margin of several species the striation is much more pronounced, appearing as very dark lines set at a right angle to the margin (fig. 63).

Apophyses. As previously mentioned, the median part of the dorsal intersegmental line between segments 5 and 6 is not formed of folds. At that site several apophyses are generally set transversely and are useful in characterizing species.

Dark-Rimmed Invaginations and Cicatrices. In a few species these structures are on the dorsum of the cephalic area. Although good quality, stained specimens are essential to clearly see these features, they are useful characters for species recognition.

Postvulvar Opening. This peculiar structure, when present, is located singly on the dorsal close to the pygidial margin (segment 8) or slightly anterior to the apex. Because of the heavy sclerotization of the area, it is difficult to adequately observe the opening. It was observed and illustrated for a few species, but I am doubtful that it is actually missing from those species where the opening was not observed. In two species of Berlesaspidiotus the opening is circular and surrounded by a dark rim. In a few species of Odonaspis it appears as a bright circular area. The function of this opening is not known; however, no ducts discharge into it.

Marginal Setae. One pair of marginal setae, ventral and dorsal, is located on each half of each pygidial segment. These setae are of great importance in interpreting abdominal segmentation. In addition, their location and relative size (ventral to dorsal) are useful specific characters.

Ventral Marginal Setae. Although these setae are of no taxonomic importance in this study, they are mentioned to avoid confusion with the marginal setae. The ventral marginal setae are on the ventral surface of the pygidium and usually in heavy rimmed sockets well removed from the body margin.

Perivulvar Pores. The perivulvar pores in all species of the Odonaspidini are quinquelocular (fig. 51). The basic pattern of their arrangement is in three groups—a median group anterior to the vulva and two lateral groups. In several species the groups are joined forming a contiguous arc of pores; in others the median group is missing. The perivulvar pores are reliable for identifying species in the Odonaspidini.

Spiracular Pores. The pores associated with the anterior and posterior spiracles are extensively used here in determining species. The pores are quinquelocular.

Vulva. The vulva (figs. 52, 54) is not important for determining species, but its placement in relation to the level of the anus is valuable in characterizing groups of species in Odonaspis.

Anus. In several species the anus is surrounded by variously shaped dark rims that might assist in final identification of species.
Scale cover of adult female oval or elongate oval. Ventral dorsal parts well developed and entirely enclosing female's body. First-instar exuvia placed at anterior area of scale. Ventral and dorsal parts of exuvia of second instar split from each other along margin of abdomen and thorax, joined at cephalic margin, and incorporated in that form in scale cover.

Female oval or elongate oval. Intersegmental folds disposed along dorsal and ventral intersegmental lines of abdomen and thorax. Crenulae numerous, arranged in distinct segmental bands across abdominal and thoracic sternites. Paratergal and parasternal areas of abdomen and thorax very conspicuous. Abdominal segmentation of segments 4 and 5 in pattern of "separate tergites - fused sternites." Antennal tubercle with one hair. Postvulvar sternite distinct. Perivulvar pores present or absent; if present, basically arranged in pattern of three groups.

Adult females of the Odonaspidiini are distinguished from females of the major tribes of the Diaspididae by a combination of nine characters as shown in table 3.

A remarkable biological characteristic of this tribe, besides its host specificity, is the fact that none of its species is parasitized by species of Aphytis (Hymenoptera: Aphelinidae), a genus specific to almost all major tribes of the armored scale insects (Rosen and DeBach, 1977, 1979; see Natural Enemies of Odonaspidiini Species, p. 71).

<table>
<thead>
<tr>
<th>Character</th>
<th>Odonaspidiini</th>
<th>Aspidiotini</th>
<th>Diaspidini</th>
<th>Leucaspidiini</th>
<th>Rugaspidiotiini</th>
<th>Paralatiorini</th>
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<td>-</td>
<td>-</td>
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<tr>
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<td>+ or -</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Pygidial plates</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
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<td>1 or more</td>
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Froggattiella species are exceptional in having pygidial gland spines.
KEY TO GENERA OF ODONASPIDINI

1. Pygidium with 1 or 2 invaginated tubes on segment 8 or 7---- 2
   Pygidium without invaginated tubes----------------------- 3

2. With 1 invaginated tube on mesal area of segment 8----------
   ---------------Circulaspis MacGillivray
   With 2 invaginated tubes, 1 on each side of segment 8-------
   ---------------Dicirculaspis, n. gen.

3. Apex of pygidium (segment 8) with tuft of gland spines-----
   ---------------Froggattiella Leonardi
   Apex of pygidium without gland spines------------------- 4

4. Cuticular striation of marginal and submarginal areas of head and thorax with small projections set at right angle to cuticle; antennal tubercles placed in cylindrical invagination in cuticle-------------------------------
   ---------------Berlesaspidotus MacGillivray

Cuticular striation without projections; antennal tubercles placed on flat surface of cuticle-------------------Odonaspis Leonardi
BERLESASPIDIOTUS MacGillivray


Type-species: Aspidiotus (Odonaspis) bambusarum Cockerell, 1898, by original designation and monotypy.

Leonardi (1900) described the genus Anoplaspis with Aspidiotus (Odonaspis) bambusarum Cockerell, 1898, as the type-species and rejected his 1898 usage of the same generic name for an entirely different taxon in the Diaspidini. MacGillivray (1921) proposed the generic name Berlesaspidiotus as a replacement for Anoplaspis Leonard, 1900.

Until now Berlesaspidiotus was not accepted as a valid genus in the Odonaspidini. Ferris (1937b), Balachowsky (1953), and Borchsenius (1966) synonymized it with Froggattiella, whereas Takagi (1959, 1969) placed it in synonymy with Odonaspis.

Berlesaspidiotus is regarded as a valid genus, including the type-species and a new species described from Southeast Asia.

Recognition Characters

Diaspididae conforming to tribal characters and distinguished by following combination of features: Pygidial margin with two or four pairs of long scleroses. Ducts of 1 size; length of duct 10 or more times width of inner end. Gland tubercles absent. Vulva placed at level of anus or slightly posterior. Perivulvar pores in one median and two lateral groups. Antennal tubercle with one hair, placed at inner end of cylindrical invagination in derm.

Key to Adult Females

1. Margin and submargin from segment 4 to head with dark lines set at right angle to margin; 1-2 perivulvar pores in median group———-crenulatus, n. sp.
   Margin and submargin of segments 3, 2, and 1 and metathorax with dark lines set at right angle to margin; 60-112 perivulvar pores in median group———-bambusarum (Cockerell)

Berlesaspidiotus bambusarum (Cockerell) (Fig. 3)

Aspidiotus (Odonaspis) bambusarum Cockerell, 1898:191; Ferris, 1937b:36.
Anoplaspis bambusarum (Cockerell); Leonard, 1900:345; Kuwana, 1933:37.
Spatheaspis bambusarum (Cockerell); Cockerell, 1900b:72.
Berlesaspidiotus bambusarum (Cockerell); MacGillivray, 1921:1423.
Froggattiella bambusarum (Cockerell); Borchsenius, 1966:227.

The original description of this species was based on specimens taken on stalks of bamboo from Japan, intercepted at San Francisco quarantine.

"Female scale 2 mm diam., very dark sepia brown, almost black, tolerably convex, dull; exuviae between the center and the side; first skin exposed, light orange; second large, brown, covered. A well-formed ventral scale." (Cockerell, 1898). The general appearance, shape, and color of the female scale are given in a photograph by Kawai (1980).
Males were not mentioned by Cockerell (1898). According to Kuwana (1933) "scale of male: similar to that of female but much smaller."

Mounted specimens of young females 1.0 mm long, 0.7 mm wide; fully grown, reproducing specimens up to 2.5 mm long, 1.9 mm wide. Margins of apex of pygidium, which includes segments 8 and 7 rounded and without projections. Pygidial margins of segments 6 and 5 serrated. Deep indentations at posterior ends of intersegmental furrows between 6-5, 5-4, and 4-3. Marginal setae, dorsal and ventral, of segment 8 do not project off margin. Posterior ends of intersegmental furrows between segments 8-7 and 7-6 with clavate sclerosis—210-344 and 103-206 long, respectively. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 formed of folds. Crenulae as figured. Ducts throughout body of one size, 25-30 long, 1.5-2.0 wide; orifice surrounded by dark rim; numerous on ventral and dorsal surfaces as figured. Postvulvar sternite well defined by intersegmental furrows; not sclerotized; ducts absent from area near vulva and from posterior end of sternite. Postvulvar opening distinct; ca. 10 in diameter; located at ca. 1/3 of distance from vulva to pygidium apex. Cuticular striation made of even lines; striation lines on margin and submargin of head and thorax bear circular projections at right angle to surface; projections heavily stained by Fuchsin. Ventral surface of margin and submargin of metathorax and abdominal segments 1, 2, and 3 with sclerotized lines set at right angle to margin. Dark boss situated dorsally on each side of submargin of metathorax and abdominal segments 1 and 2. Anus situated 21-26 times its diameter from apex of pygidium. Vulva placed slightly posterior to level of anus. Perivulvar pores set in median group of 60-112 (92) pores, and 2 lateral groups with 195-265 (231) pores in each. Anterior spiracle with 22-50 (30) spiracular pores; posterior spiracle with 9-25 (15) pores. Antennal spiracle with one hair; tubercle and hair situated within cylindrical invagination in derm.

Material Examined. JAPAN: Two slides each labeled "A. bambusarum, part of type, (Cockerell)"; one mounted with female, here designated lectotype, USNM; second mounted with female, here designated paralectotype, and second-instar exuvia, USNM; type slides I labeled, respectively. Additional material from Japan: Kiushu, Hitoyoshi, June 1900, Arundinaria simonii, USNM; locality unknown, October 1965, bamboo, D.M. Pike, USNM; locality unknown, bamboo, Coleman, UCD; Yokohama, bamboo, Kuwana, UCD; Idu-Osima, 25.V.1955, bamboo, S. Takagi, ST.

Berlesaspidiotus crenulatus, n. sp. (Fig. 4)

Scale covers of specimens from type-series not available. Scale covers of females of this species from Philippines (see Material Examined), circular, 3 mm in diameter; dorsal and ventral scales white; exuviae yellow, placed subcentrally.

Males not observed.

Slide-mounted female circular; holotype 1.0 mm long, 0.8 mm wide; fully grown female (from Philippines) 2.7 mm long, 2.0 mm wide. Margin of segment 8 with triangular projection, rounded apically. Margins of segments 7, 6, and 5 each with rounded projections. Marginal setae, dorsal, 8 and 7 placed submarginally; apices not reaching margin; marginal setae, ventral, of these segments placed marginally; apices projecting off margin. Posterior ends of intersegmental furrows 8-7, 7-6, 6-5, and 5-4 each with elongate, marginal sclerosis—64-70, 70-122, 57-64, and 40-50 long, respectively; anterior ends of scleroses indefinite in shape; scleroses more distinct on ventral surface than on dorsal. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds, but present as continuous dark line; submedian part formed of folds and distinctly separated from median part. Intersegmental folds as figured; folds circular in outline. Crenulae as figured. Ducts throughout body 25-30 long, 2-3 wide; inner end
dark, but with no distinct indication whether of one- or two-barred type; orifice oval surrounded by dark rim; distributed as figured; on dorsal surface on head, thorax, among submarginal dark lines from segment 4 to level of anterior spiracle, and in submedian clusters on abdominal segments 5, 4, and 3; on ventral surface on head, thorax, among submarginal dark lines from segment 4 to level of anterior spiracle, and in area enclosed by perivulvar pores. Postvulvar sternite distinct. Postvulvar opening ca. 10 in diameter, situated at ca. 1/13 of interval between margin and vulva; opening with bright center surrounded by sclerotized rim. Margin and submargin of body, ventral and dorsal surfaces, from abdominal segment 4 along thorax and head, with pattern of dark lines, ca. 100 long, arranged at right angle to margin. Anus situated 18-23 times its diameter from apex of pygidium. Vulva placed at level of anus. Perivulvar pores set in median group of 1-2 pores, distinctly separated from lateral groups; each lateral group with 125-184 pores. Anterior spiracle with 14-23 spiracular pores; posterior spiracle with 14-21 pores. Antennal tubercle with one hair; tubercle placed within cylindrical invagination in derm.

Material Examined. INDIA: Madras, Pulney, 18.XI.1913, Arundinaria walkeriana, A. Sauliere. Described from holotype and one paratype, USM. Additional material (not included in type-series): PHILIPPINES: Luzon, Antipolo, 9.VI.1921, Bambusa sp., Hitchcock, USNM; PHILIPPINES, at Washington, DC, 9.X.1937, Schizostachyum lumampao, USNM.

Etymology. The species name is from the Latin crena meaning "a notch," referring to the pattern of notches on the margin of the head, thorax, and abdomen.

Notes. This new species is characterized by a combination of several unique characters, for example, the marginal pattern of notches and dark lines, which might justify its placement in a separate genus. However, this is rejected at present, and it is placed in Berlesaspidiotus mainly because in this species and in the type-species the antennal tubercle is located in an invagination in the derm.
CIRCULASPIS MacGillivray


Type-species: Odonaspis canaliculata Green, 1900:72, by original designation and monotypy.

In the original description, Circulaspis was assigned to the Aspidiotini. Ferris (1937b, 1938) studied the type-species and transferred Circulaspis to the Odonaspidini, which he established. Since then this genus has been regarded as valid in the latter tribe (see Borchsenius, 1966).

Circulaspis is accepted in a restricted interpretation to accommodate the species with one invaginated tube in the apex of segment 8. The species with two invaginated tubes are placed in a new genus.

Recognition Characters

Diaspidae conforming to tribal characters and distinguished by following combination of features: Apex of pygidium (segment 8) with deep emargination. One invaginated tube placed marginally on emargination; numerous ducts discharge into inner end of tube. Pygidial margin with or without scleroses. Ducts of two or three sizes. Postvulvar sternite not sclerotized. Vulva placed at level of or slightly anterior to anus. Perivulvar pores present or absent. Antennal tubercle with one hair; placed on flat surface of derm.

Key to Adult Females

1. Perivulvar pores absent; segment 8 with 1 pair of marginal setae (dorsal) ------- canaliculata (Green)
   Perivulvar pores present; segment 8 with 2 pairs of marginal setae (dorsal and ventral) ------- 2

2. Ducts discharging only into inner apex of invaginated tube ------- fistulella Ferris
   Ducts discharging over apical half of invaginated tube ---------- 3

3. Pygidium with 1 pair of marginal scleroses; with 3-5 ducts discharging into opening laterad on each side of tube ---- bibursella Ferris
   Pygidium without marginal scleroses; without cluster of ducts on each side of tube ------- fistulata (Ferris)

Circulaspis bibursella Ferris (Fig. 5)


"Occurring exposed on the leaves and beneath the leaf sheaths. Scale of the female brown, sometimes slightly fluffy from unconsolidated wax threads, broadly oval; scale of the male similar in color, slender." (Ferris, 1938).

Slide-mounted female oval, 0.7-1.0 mm long, 0.6-0.8 mm wide. Margin of segment 8 moderately projecting. Invaginated tube extends from shallow emargination on apex of segment 8; tube conical, 30-40 long; extends 1/4-1/3 of interval between anus and apex of pygidium; orifice of tube opens submarginally on dorsal surface; 20-30 ducts placed over surface of inner half of tube. Marginal setae, dorsal, of segment 8 situated lateral to orifice of invaginated tube; each seta ca. 25 long. Marginal setae, ventral,
of segment 8 situated submarginally, halfway between invaginated tube and marginal scleroses. Marginal setae, dorsal, of segments 7, 6, 5, and 4 situated submarginally; their tips do not reach margin; placed on heavy rimmed sockets. Marginal setae, ventral, of segments 7, 6, 5, and 4 placed marginally. With one clavate sclerosis, ca. 1/2 as long as invaginated tube, placed marginally between segments 8 and 7. Medially to each sclerosis occurs on ventral surface circular opening into which discharge three to five ducts; ducts similar in size and shape to ducts of median tube. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Crenulae as figured. Ducts in three sizes. Macroducts ca. 14 long, 4 wide at inner end, distributed dorsally and ventrally as figured; dorsal and ventral ducts of pygidium of subequal size; absent on dorsal surface of median areas of segments 6 and 5. Microducts ca. 13 long, 2 wide, distributed on venter only, as figured. Ducts that discharge into invaginated tube and into lateral pouches ca. 25 long, 3 wide. Postvulvar sternite not distinct. Gland tubercles absent. Anus placed ca. 15 times its diameter from apex of pygidium. Vulva placed ca. anus diameter anterior to level of anus. Perivulvar pores in median group of 16-29 (21) pores, and 2 lateral groups each with 37-68 (48) pores. Anterior spiracle with 6-18 (11) spiracular pores; posterior spiracle with 4-11 (7) pores.

Material Examined. MEXICO: Colima State, Manzanillo, 1925, grass, G.F. Ferris (No. 145), lectotype (designated here) and nine paralectotypes, UCD; type slides, respectively, I labeled; specimens from original collection, data as lectotype, VPI.

Notes. This species is similar to C. fistulata, which also is known from Mexico. The presence of marginal scleroses and the small pouches lateral to the median tube in the females of C. bibursella clearly distinguish it from fistulata.

**Circulaspis canaliculata** (Green) (Fig. 6)

Odonaspis canaliculatus Green, 1900:72; Green, 1937:335.

Circulaspis canaliculata (Green); MacGillivray, 1921:449; Ferris, 1937b:37; Borchsenius, 1966:226.

The original description of this species was based on material from bamboo at Punduloya and Nuwara Eliya, Ceylon (Sri Lanka).

"Female puparium very dense and compact; irregularly circular; black; pellicle yellowish, the second often concealed beneath the black secretory area. From the surface proceed numerous curling white filaments, which give to the scale a slightly hoary appearance. Diameter 1.5 to 1.75 mm. Male puparium elongate; cuticle often sinuous; both pellicle and secretory area black, the pellicle situated at anterior margin. Length 1.5 mm. Breadth 0.5 mm." (Green, 1900).

Slide-mounted female oval, 1.0-1.4 mm long, 0.9-1.3 mm wide. Apex of segment 8 with deep emargination; median margin even, transverse; lateral margins even, oblique; emargination and margins belong to segment 8. Margins of segment 7 form broad, rounded, serrated projection, one on each side of apical emargination. Margins of segments 6, 5, and 4 serrated. Invaginated tube extends from apical emargination; tube 165-200 long (in type-series), 125 long (in specimen from China), diameter 15; orifice situated on margin of apical emargination; inner end bulbous, carrying 20-35 ducts, ca. 20 long, 4 wide, which discharge into all surface of that end. One pair of marginal setae of segment 8 present, apparently representing dorsal one; each seta ca. 40 long; situated on basal margin of apical emargination; longer than depth of apical emargination. Marginal setae, dorsal, of segments 7, 6, 5, and 4 situated far from margin; their tips do not reach margin; setae of segment 7 situated inward from margin at distance two to three times their length. Marginal setae, ventral, of segments 7, 6, 5, and 4 placed
marginally; their tips projecting off margin. With pointed indentations at posterior ends of intersegmental furrows between 7–6, 6–5, and 5–4. Clavate sclerosis situated at each indentation between segments 7 and 6. Margins of indentations between segments 6 and 5 with triangular sclerosis. Dorsal intersegmental furrow (median part) between 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Crenulae as figured. Ducts throughout body ca. 15 long, 2.0–2.5 wide; distributed as figured; absent from dorsal area anterior to anus; three to five ducts present on dorsal, median area of segment 5. Postvulvar sternite not distinct. Gland tubercles absent.

Dermal striation, ventral and dorsal, of head and thorax with circular sclerotizations. Anus bounded posteriorly by semicircular dark rim; placed 18–20 times its diameter from apex of pygidium. Vulva placed anterior to level of anus, at distance that equals diameter of anus. Perivulvar pores absent. Anterior spiracle with 20–42 spiracular pores (type-series), 6–8 pores in specimen from China; posterior spiracle with 20–46 pores (type-series), 6–8 pores in specimen from China.

Material Examined. SRI LANKA (CEYLON): Punduloya, May 1897, bamboo, E.E. Green, lectotype designated here, BMNH; two paralectotypes, similar collection data, but from Nuwara Eliya, USNM; type slides, respectively, I labeled; several specimens, collection data similar to paralectotypes but not included in type-series, UCD and VPI; Newara, Mt. Pedro, 25.I.1902, bamboo, C.L. Marlatt, USNM. CHINA: Kwan Ninq District, Tunq Hqunq, 25.IV.1925, Bambusa sp., F.A. McClure, USNM.

Circulaspis fistulata (Ferris) (Fig. 7)

Odonaspis fistulata Ferris, 1921a:121. Circulaspis fistulata (Ferris); Ferris, 1938:159; Borchsenius, 1966:226; McDaniel, 1974:419.

Originally described from Distichlis spicata, at Baja California, Mexico. Later records (McDaniel, 1974) indicate that this species occurs also in Texas, U.S.A.

"Occurring beneath the sheathing bases of the leaves or on the upper surface of the leaves near the base. Scale of female about 2.5 mm long, white, somewhat elongate with the exuviae near one end and naked; ventral scale thick, continuous with the dorsal scale, and composed in part of the ventral portion of the second exuvium as is common in this genus. Scale of male white, somewhat elongate, with the exuvium near one end." (Ferris, 1921a).

Slide-mounted female oval, 0.7–1.0 mm long, 0.6–0.7 mm wide. Apex of pygidium (segment 8) with broad emargination and triangular projection on each side; median margin of emargination even, transverse; lateral margins obliquely rounded. Margins of segments 7 and 6 each with triangular projection, rounded apically. Invaginated, sclerotized tube extends from apical emargination; tube 40–70 long, slightly tapering at inner end; extends ca. 1/2 distance to anal opening; orifice of tube placed submarginally on dorsal surface; ca. 40 ducts disposed on surface of inner half of tube. Marginal setae, dorsal, of segment 8 situated just laterad to orifice of invaginated tube; each seta ca. 20 long. Marginal setae, ventral, of segment 8 subequals length of dorsal; situated submarginally. Marginal setae, dorsal, of segments 7, 6, 5, and 4 situated submarginally; their tips do not reach margin; placed on heavy rimmed sockets. Marginal setae, ventral, of segments 7, 6, 5, and 4 placed marginally. Without marginal scleroses on pygidium. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Crenulae as figured. Ducts in three sizes. Macroducts ca. 13 long, 4 wide at inner end, distributed as figured; dorsal and ventral ducts of pygidium subequal in size; dorsal ducts of segments 8, 7, 6, and 5 outnumber
ventral ducts on same segments. Microducts ca. 12 long, 2 wide, distributed on venter as figured; ducts of similar size and shape, but with dark rims surrounding their orifice, occur dorsally on median areas of segments 6, 5, and 4. Ducts discharging into invaginated tube ca. 25 long, 3 wide. Postvulvar sternite not distinct. Gland tubercles absent. Anus placed 17-19 times its diameter from apex of pygidium. Vulva placed anterior to level of anus, at distance about anus diameter. Perivulvar pores in median group of 10-19 (16) pores, and 2 lateral groups each with 21-50 (38) pores. Anterior spiracle with 5-11 (7) spiracular pores; posterior spiracle with 3-7 (5) pores.

Material Examined. MEXICO: Baja California, Punta Pamilla, near San Jose del Cabo, July 1919, Distichlis spicata, G.F. Ferris, holotype and eight paratypes, UCD; specimens from original collection, collection data as holotype, VPI; north Lower California, Millers Landing, 1934, Monanthochloe sp., G.F. Ferris, UCD.

Circulaspis fistulella Ferris (Fig. 8)


Originally described from Point Isabel in Texas, U.S.A. Later records from Florida (Dekle, 1976), Georgia (Nakahara, 1982), and additional ones listed here indicate that this species occurs in more areas of Southern United States from Texas to Florida.

"Occurring on the upper surface of the strongly revolute leaves of the host. Scale of the female elongate oval, tapering posteriorly, brownish; that of the male slender, similar in color to the female." (Ferris, 1938).

Slide-mounted female oval, 0.7-1.0 mm long, 0.5-0.6 mm wide. Apex of pygidium (segment 8) forming pronounced projection, emarginated apically and with notch on each side. Invaginated tube extends from emargination on apex of segment 8; cylindrical, ca. 30 long; orifice of tube opens submarginally on dorsal surface; ca. 10 ducts discharge to tube only into its inner apex. Margin of segment 7 with triangular, rounded apically projection; margin of segment 6 with similar, but smaller projection. Marginal setae, dorsal, of segment 8 located submarginally, lateral to orifice of tube; their tips project off margin. Marginal setae, ventral, of segment 8 curved; placed submarginally; their tips project off margin. Marginal setae, dorsal, of segments 7, 6, 5, and 4 placed submarginally, their tips almost reaching margin. Marginal setae, ventral, of segments 7, 6, 5, and 4 placed marginally; well projecting off margin. Without distinct, marginal sclerosis on pygidium; with slight sclerotization at posterior end of intersegmental furrow between segments 7 and 6. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Crenulae as figured. Ducts present in three sizes. Macroducts ca. 12 long, 4 wide, distributed ventrally and dorsally as figured; dorsal and ventral ducts of pygidium subequal in size; few ducts situated singly on head. Microducts ca. 11 long, 2 wide, distributed on venter only as figured. Ducts discharging into inner end of invaginated tube, 20-23 long, ca. 2.5 wide; ducts of similar size and shape, discharge on margin of segment 7. Postvulvar sternite not distinct. Gland tubercles absent. Anus bounded posteriorly by semicircular, sclerotized area; placed 16-18 times its diameter from apex of pygidium. Vulva placed slightly posterior to level of anus. Perivulvar pores present in median group of 10-21 (16) pores, and 2 lateral groups each with 24-35 (31) pores; frequency for type-series from Texas. Anterior spiracle with two to five (three) spiracular pores; posterior spiracle with one to five (one) pores; frequency for type-series from Texas.
Material Examined. U.S.A.: TEXAS: Point Isabel, 1921, G.F. Ferris, holotype and 17 paratypes from Distichlis spicata, and 11 paratypes from Sporobolus sp., UCD. Additional material (not type-series):


Notes. C. fistulella resembles the American species of Circulaspis, namely C. bibursella and C. Fistulata. It can readily be separated from these species in having the invaginated tube with ducts only on its inner apex, whereas in these two species the ducts are on the inner apex as well as on the lateral walls of the tube.
DICIRCULASPIS, n. gen.

Type-species: Dicirculaspis philippina, n. sp.

Recognition Characters

Diaspididae referable to Odonaspidini and distinguished by following combination of features: Apex of pygidium with pair of invaginated tubes or pouches; each tube or pouch extends from marginal notch on each side of apex; numerous ducts discharge into inner end of tubes. Pygidial margin with scleroses. Ducts of three sizes. Gland tubercles present or absent. Vulva placed posterior to level of anus. Perivulvar pores absent in type-species; partly absent in second species. Antennal tubercle with one hair, placed on flat surface of derm.

This genus is established to accommodate the type-species described from the Oriental region and the North American species Circulaspis bibursa. The genus is related to Circulaspis, differing from it in having two invaginated tubes.

Etymology. The generic name is derived from Circulaspis, a related genus in the tribe. The addition of the Greek di meaning "two" refers to the two invaginated tubes on the pygidium, characteristic of the new genus.

Key to Adult Females

1. Inner end of invaginated tubes narrower than orifice; posterior spiracle without spiracular pores—philippina, n. sp.
2. Inner end of invaginated tubes wider than orifices; posterior spiracles with 3-9 spiracular pores—bibursa (Ferris), n. comb.

Dicirculaspis bibursa (Ferris), n. comb.


Originally described from various grasses in southern Texas, U.S.A.

"Occurring beneath the sheathing bases of the leaves. Scale of the female white, elongate oval, tapering posteriorly; that of the male white, slender, elongate." (Ferris, 1938).

Young, slide-mounted female circular, ca. 1 mm in diameter; fully grown female oval, 1.2 mm long, 0.7 mm wide. Apex of segment 8 with broad projection, truncated apically. With 2 invaginated tubes (20-30 long) each situated at lateral ends of segment 8; opening of tubes on ventral surface; inner end or each tube bears ca. 10 ducts. Marginal setae, ventral and dorsal, of segment 8 subequal in length, 20-25 long; situated submarginally. Marginal setae, ventral, of segments 7, 6, 5, and 4 as long as setae of 8; situated marginally. Marginal setae, dorsal, of 7, 6, 5, and 4 shorter than setae of 8; situated submarginally, their tips almost reaching margin; with heavily sclerotized sockets. Marginal sclerosis as long as invaginated tube, situated laterally to each tube. Intersegmental folds as figured. Without dorsal (median part) intersegmental line between segments 6 and 5; with dorsal apophysis set transversely on each side of body at site of this intersegmental line. Crenulae as figured. Ducts present in three sizes. Macroducts ca. 12 long, 3 wide at inner end; dorsal and ventral ducts on pygidium subequal in size; distributed as figured on dorsum and venter. Microducts ca. 12 long, 2 wide, distributed on venter only as figured. Microducts discharging into invaginated tubes, ca. 20 long, 2 wide. Gland tubercles in two clusters, one at level of clypeolabral shield, other at level of anterior spiracles. Postvulvar sternite distinct. Anus placed ca. 15 times its diameter from pygidium apex. Vulva placed slightly posterior to level
of anus. Perivulvar pores absent in all specimens from Fort Davis (T/695, T/278); one to three pores in lateral position in 30 percent of specimens from Eagles Pass (T/149, T/693) and Chisos Mountains (T/690). Anterior and posterior spiracles each with three to nine (five) spiracular pores.

Material Examined. U.S.A.: TEXAS: Lectotype (designated here) and 11 paralectotypes, cliffs at Fort Davis, grass, T/695; 7 paralectotypes, 35 miles west of Eagle Pass, 1921, grass, T/149; 9 paralectotypes, Fort Davis, 1921, Stipa sp., T/278; 4 paralectotypes, Chisos Mountains, grass, T/690; 11 paralectotypes, 35 miles west of Eagle Pass, 1921, Triodia pilosa, T/693; lectotype and paralectotypes in UCD; 1 paralectotype in each of ICV and USNM; type slides, respectively, I labeled.

Notes. The original description of this species was based on "Type from an undetermined grass on the cliffs behind the old fort at Fort Davis, Texas. Paratypes from another undetermined grass in the Chisos Mountains; from undetermined grass and from Triodia pilosa, 35 miles west of Eagle Pass; all in Texas." No slides labeled Circulaspis bibursa Ferris were found among the material available from CDA, UCD, and USNM. However, five collections were available (see above) of a species, whose characters agree with the original description of C. bibursa, and their collection data were identical to those given by Ferris (1938). These slides were labeled in Ferris' handwriting with a manuscript name that has never been published, followed by the inscription "n. sp." Therefore these slides are regarded here as the type-series of Circulaspis bibursa Ferris, 1938. They have been labeled, respectively, and a lectotype has been designated.

This species can be distinguished from the other member of Dicirculaspis by the absence of or small number of perivulvar pores. As shown in the previous redescription, the absence of these pores did not reach a definite state, and very few pores were observed in a small part of the type-series. It is interesting to note that similar findings regarding the partial absence of perivulvar pores were observed in another American species, namely Odonaspis texana described from Texas.

**Dicirculaspis philippina, n. sp.**

(Fig. 10)

No information is available on the scale of the female. Males are unknown.

Female holotype oval, 1.4 mm long, 0.9 mm wide; paratype ca. 2.7 mm long, 1.6 mm wide. Margin of segment 8 forming broad projection; apical margin transverse, with two to three minute emarginations; each lateral margin of projection oblique; with deep, rounded emargination on each side of segment 8. Margin of segment 7 triangular in shape; with pointed apex. With 2 invaginated tubes, each 50-70 long; each extends from lateral emargination of segment 8; ca. 50 ducts scattered over inner half of each tube; orifice of tubes placed submarginally on dorsal surface. Marginal setae, dorsal and ventral, of segment 8 subequal in size; each placed submarginally just median to invaginated tubes. Marginal setae, dorsal, of segments 7, 6, 5, and 4 placed submarginally; their tips not reaching margin; each seta located in heavy rimmed socket. Marginal setae, ventral, of segments 7, 6, 5, and 4 placed marginally. With club-shaped sclerosis attached to median wall of each invaginated tube; ca. 2/3 as long as tube. With clavate sclerosis placed marginally at posterior end of intersegmental furrow between 7 and 6. With sclerosis at posterior end of intersegmental furrow between 6 and 5. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Intersegmental folds as figured. Postvulvar sternite well separated from segment 7 by distinct intersegmental furrows. Postvulvar opening 3-4 in diameter, situated near posterior margin. Crenulae as figured. Margin and submargin of ventral surface of segments.
3, 2, and 1, metathorax and mesothorax with pattern of dark lines set at right angle to margin; margin of these segments with numerous notches; ducts distributed among dark lines. Ducts present in two sizes. Ducts ca. 15 long, 2 wide, distributed ventrally and dorsally as figured. Ducts discharging to invaginated tubes ca. 20 long, 2 wide. Gland tubercles absent. Anus bounded posteriorly by semicircular, sclerotized area; placed 22-28 times its diameter from pygidium apex. Vulva placed posterior to level of anus at distance ca. 0.2 times distance between anus and pygidium apex. Perivulvar pores absent. Anterior spiracle with 19-20 spiracular pores, placed anterior to spiracle in cluster, triangular in shape; posterior spiracle without pores.

Material Examined. PHILIPPINES: Luzon Island, holotype from Bikal, October 1925, Schizostachyum sp., F.A. McClure, USNM; paratype, Antipolo, 9.VI.1921, Bambusa sp., A.S. Hitchcock, USNM.

Etymology. The species name is Latin and is based on the type locality, the Philippines.
FROGGATTIELLA Leonard!

Targonia (Froggattiella) Leonardi, 1900:300.
Froggattiella Leonardi; Cockerell, 1900b:72; Fernald, 1903:299; MacGillivray, 1921:393; Ferris, 1937b:33; Borchsenius, 1966:227; Morrison and Morrison, 1966:81.

Type-species: Aspidiotus insititatus Green, 1896, by monotypy.

The name Froggattiella has been introduced by Leonard! (1900) as a subgenus of Targonia Signoret. Cockerell (1900b) referred also to Leonard's action and accepted Froggattiella as a good subgenus of Odonaspis. According to Morrison and Morrison (1966), the publication of Cockerell (1900b) predated Leonard! (1900). However, Cockerell (1900b:72) clearly credited Froggattiella to Leonard, and thus there is no doubt as to the authorship of the genus.

Froggattiella was raised to generic rank by MacGillivray (1921) and interpreted as such by Ferris (1937b), who later (Ferris, 1938) presumed there was no ground to separate it from Odonaspis. Balachowsky (1953) and Takagi (1959, 1969) concurred with Ferris and regarded Froggattiella as a synonym of Odonaspis.

The interpretation adopted in this revision is that Froggattiella is a valid genus differing from all other genera of Odonaspidini, mainly by the tuft of gland spines at the pygidium apex.

Recognition Characters

Diaspidae conforming to tribal characters and distinguished by following combination of features: Apex of pygidium with broad emargination. Gland spines situated marginally on emargination. Pygidial margin with two pairs of elongate, clavate scleroses. Ducts of 1 size; length of duct 10 or more times width of inner end. Gland tubercles absent. Vulva situated at level of anus. Perivulvar pores present or absent. Margin and submargin from abdominal segment 3 to level of anterior spiracles with pattern of marginal notches associated with dark lines disposed at right angle to margin. Dermal striation with small, circular sclerotizations. Antennal tubercle located marginally at level of anterior ridge of clypeolabral shield.

Notes. The adult female of this genus resembles the female of Berlesaspidiotus in having two pairs of clavate scleroses on the pygidium. The presence of the tuft of gland spines on the apex of the pygidium in females of Froggattiella differentiates the members of the latter from the species assigned to Berlesaspidiotus. The marginal and submarginal pattern of notches and sclerotized lines, which is characteristic of Froggattiella females, is a feature occurring also in species of other genera, for example Berlesaspidiotus crenulatus and Odonaspis siamensis.

Key to Adult Females

1. Microducts discharging into gland spines shorter than mesal pair of scleroses; posterior spiracles with spiracular pores----------------------inusitata (Green)
   Microducts discharging into gland spines longer than mesal pair of scleroses; posterior spiracles without spiracular pores-----------------------mcclurei, n. sp.
2. Perivulvar pores present---------------------penicillata (Green)
   Perivulvar pores absent----------------------

Froggattiella inusitata (Green)
(Fig. 11)
Aspidiotus inusitatus Green, 1896:66; Cockerell, 1897:27.
Targionia (Froggattiella) inusitata (Green); Leonard!, 1900:300.
Odonaspis (Froggattiella) inusitata (Green); Cockerell, 1900b:72.
Odonaspis inusitata (Green); Fernald, 1903:299.
Froggattiella inusitata (Green); MacGillivray, 1921:450; Ferris, 1937b:33; Borchsenius, 1966:227.

This species, the type-species of Froggattiella, was originally described from Arundinaria sp. at the Kelani Valley in Sri Lanka (Ceylon).

"Female puparium very large; flattish; at first oval, afterwards greatly elongated posteriorly, the supplemental portion usually narrower than the other. Pellicles yellow, always more or less concealed by secretion; approximately central in early adult stage, subsequently becoming eccentric by the backward extension of the scale. Ventral scale as well developed as dorsal, and bearing what appear to be the ventral halves of the pellicles. The two surfaces are so much alike that it is often difficult to decide which is the dorsal and which the ventral surface of the puparium after it has been detached from the stem. Colour brownish white or brownish fulvous. Length 3.5 mm to 7.5 mm. Greatest breadth about 3.5 mm. Male puparium unknown." (Green, 1896).

Slide-mounted specimens oval, 1.1-3.0 mm long, 0.8-1.6 mm wide. Apex of pygidium, segment 8, with broad notch. Margins of segments 7 and 6 each with rounded projection and two to four smaller projections. Gland spines (three to five in number) 10-15 long, placed marginally on notch; each gland spine with duct ca. 50 long. Marginal setae, dorsal, of segment 8 ca. 50 long, placed submarginally; marginal setae, ventral, of segment 8 ca. 1/2 as long as dorsal; placed submarginally. Marginal setae, ventral and dorsal, of 7, 6, 5, and 4 subequal in size; placed submarginally; ventral seta of 6 situated far from margin, its tip does not reach margin. With pair of clavate scleroses each placed at lateral end of mesal notch; 65-112 long; distance between bases of scleroses 14-28; scleroses longer than ducts of gland spines. Laterally to each mesal sclerosis, at distance of 42-62, placed clavate sclerosis, as long as former. Posterior end of intersegmental furrow between 6 and 5 with sclerosis and pointed indentation that extends about half length of sclerosis. Posterior end of intersegmental furrow between 5 and 4 with pointed indentation and faint sclerotization on margin. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between 6 and 5 not formed of folds; present as dark line that extends through median line. Crenulae as figured. Ducts throughout body of similar width, ca. 1.5; on pygidium ca. 15 long; on venter around mouth parts ca. 1/2 as long as ducts on pygidium. Margin and submargin, from segment 3 to level of antennal tubercle, with pattern of marginal notches associated with sclerotized lines arranged at right angle to margin; ducts distributed on pattern area. Postvulvar sternite distinct; without ducts; lateral margins of sternite parallel to each other. Gland tubercles absent. Dermal striation, ventral and dorsal, of thorax with numerous, rounded sclerotizations; at submargin sclerotizations less dark, larger, and not circular. Anus ca. 14 in diameter, bounded posteriorly by semicircular sclerotization; situated 16-23 times its diameter from apex of pygidium (not from tips of gland spines). Vulva placed at about level of anus. Perivulvar pores absent. Anterior spiracle with 14-33 (23) spiracular pores; posterior spiracle with 7-24 (12) pores. Antennal tubercle placed near margin, at level of anterior margin of clypeolabral shield; antennae separated from each other by space ca. 2.2 times distance between anterior spiracles.

Material Examined. SRI LANKA (CEYLON): On Arundinaria sp., coll. E.E. Green, lectotype (designated here) and two paralectotypes from Kelani Valley, BMNH; four paralectotypes from Yatiyantota, USNM; type slides, respectively, I labeled. Additional material, not
Notes. This species is very similar to its congener F. penicillata, both of which are characterized by the absence of perivulvar pores. It was considered conspecific with the latter by Balachowsky (1953). Moreover, from a study of several collections available for this study, these two species previously seem to have been misidentified for each other.

F. inusitata differs from penicillata in (1) the ducts of the gland spines are shorter than the mesal scleroses, whereas in penicillata they are longer than the scleroses, and (2) the presence of spiracular pores at the posterior spiracles, which are absent in penicillata.

**Froggattiella mcclurei**, n. sp. (Fig. 12)

Only slide-mounted specimens of females of this species were available.

Young female circular, 1.0 mm long, 0.8 mm wide; fully grown female oval, 2.1 mm long, 1.5 mm wide. Apex of pygidium, segment 8, with broad notch. Gland spines (7–11 in number) each ca. 20 long, placed marginally on notch; each gland spine with duct ca. 100 long. Marginal setae, dorsal, of segment 8 ca. 50 long, placed submarginally; marginal setae, ventral, of segment 8 about 2/3 as long as dorsal, situated submarginally. Marginal setae, dorsal, of 7, 6, 5, and 4 each with conspicuous, dark socket; setae placed submarginally; their tips do not project off margin. Marginal setae, ventral, of 7, 6, 5, and 4 placed marginally; their tips project off margin. With pair of clavate scleroses each situated at lateral end of mesal notch; 45–65 long; separated from each other in space ca. 25; scleroses shorter than ducts of gland spines. Laterally to each mesal sclerosis at distance of ca. 55, placed clavate sclerosis as long as mesal one. Posterior ends of intersegmental furrows between 6 and 5 and 5 and 4 with pointed indentations; margins of indentations slightly sclerotized. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between 6 and 5 not formed of folds; present as dark line that extends through median line. Crenulae as figured. Ducts throughout body subequal in size, 15–20 long, ca. 3 wide. Margin and submargin from segment 3 to about level of anterior spiracles with pattern of marginal notches, associated with dark lines placed at right angle to margin; ducts disposed among lines. Postvulvar sternite distinct; without ducts; lateral margins of sternite parallel to each other. Gland tubercles absent. Dermal striaion, ventral and dorsal, of thorax with circular sclerotizations; at submargin sclerotizations less dark and not circular. Anus ca. 15 in diameter, bounded posteriorly with semicircular sclerotization; placed 15–22 times its diameter from apex of pygidium (not tips of gland spines). Vulva placed at about level of anus. Perivulvar pores present in contiguous cluster lateral and anterior to vulva; 60–110 pores in each lateral position; 20–26 pores in anterior position. Anterior spiracle with two to five spiracular pores; posterior spiracle without pores. Antennal tubercle situated marginally at level of anterior ridge of clypeolabral shield; separated from each other by space 1.4–1.5 times distance between anterior spiracles.


Etymology. This species is named for F.A. McClure, the American botanist (see...
McClure, 1967), who collected the type-series as well as many more records of odonaspidine scale insects of significance to this revision.

**Froggattiella penicillata** (Green) (Fig. 13)


Originally described from bamboo, namely Gigantochloa aspera in Paradeniya, Sri Lanka (Ceylon). Since then it has been recorded only from bamboo in various territories of Asia, Africa, and the Americas (see Borchsenius, 1966; Nakahara, 1982; and Material Examined).

Female scale oval, 1.5-2.0 mm long, 1.0-2.0 mm wide; dorsal scale brown; larval exuviae yellow placed at anterior part of scale. Shape and color of scale given in a photograph by Kawai (1980).

Males present. Scale cover similar in shape and color to that of female; smaller and narrower.

Slide-mounted female oval, 0.8-1.2 mm long, 0.6-0.8 mm wide. Apex of pygidium, segment 8, with broad notch. Margin of segment 7 with projection, pointed apically, and few rounded projections. Gland spines (five to six in number) each ca. 25 long, placed marginally on notch; each gland spine with duct ca. 100 long. Marginal setae, dorsal, of segment 8 ca. 35 long, placed submarginally; marginal setae, ventral, of segment 8 shorter than dorsal, placed submarginally. Marginal setae, ventral and dorsal, of 7, 6, 5, and 4 subequal in length, placed submarginally. With pair of scleroses each placed at lateral end of mesal notch; 31-58 long; distance between bases of scleroses 10-41; scleroses shorter than microducts of gland spines. Laterally to each mesal sclerosis, at distance of 27-48, situated clavate sclerosis, 20-40 long. Posterior ends of intersegmental furrows between 6-5, 5-4, and 4-3 with pointed indentations. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Crenulae as figured. Ducts throughout body subequal in width, ca. 2; ducts on pygidium ca. 12 long, ca. 8 long on venter around mouth parts. Margin and submargin from segment 3 to level of antennal tubercles with pattern of marginal notches associated with sclerotized lines disposed at right angle to margin; ducts distributed among lines. Postvulvar sternite distinct; without ducts; lateral margins of sternite parallel to each other. Gland tubercles absent. Dermal striation, ventral and dorsal, of thorax with numerous rounded sclerotizations; at submargin sclerotizations are less dark, bigger, and of irregular shape. Anus ca. 10 in diameter, bounded posteriorly by semicircular sclerotization; placed 18-22 times its diameter from apex of pygidium (not from tips of gland spines). Vulva placed at about level of anus. Perivulvar pores absent. Anterior spiracle with 11-17 spiracular pores (type-series); in specimens from Japan 4-10 pores; posterior spiracle without pores. Antennal tubercle situated near margin, at level of anterior margin of clypeolabral shield; antennae separated from each other by space 1.2-1.3 times distance between anterior spiracles.

Material Examined. ASIA: SRI LANKA (CEYLON): Paradeniya, May 1900, bamboo, E.E. Green, lectotype (designated here) and four paralectotypes, BMNH; type slides, respectively, I labeled. Additional material (not part of type-series): SRI LANKA: Paradeniya, 13.I.1902, bamboo, USNM. CHINA: Canton, XI.1912, bamboo, UCD; at San Francisco, 30.VIII.1921, bamboo, CDA; at Washington, DC, 14.IX.1921, bamboo, W.B. Wood USNM; at Washington, DC, 23.XII.1921, Phyllostachys pubescens, USNM; Canton, at Washington, DC, 14.X.1921, bamboo; Canton, 23.V.1923, bamboo, R.D. Kennedy, USNM;

HONG KONG: At Washington, DC, 29.1.1941, Bambusa pervariabilis, Gouldman, USNM.

INDIA: Coimbatore, bamboo, Ramakrishna, BMNH.

JAPAN: Kokura, bamboo, UCD; bamboo, 28.V.1908, Bremner, UCD; at Philadelphia, 19.XII.1932, bamboo, A.B. Wells, USNM; Amami-Osima, Ryuku, 17.V.1957, bamboo, S. Takagi, ST.

PAKISTAN: Lahore, V.1911, bamboo, P.S. Woglum, USNM; Lahore, 23.XI.1961, bamboo, M.A. Ghani, BMNH; Peshawar, 11.XII.1960, bamboo, BMNH.


AFRICA: SOUTH AFRICA: Natal, Pietermaritzburg, Botanic Gardens, 28.VIII.1964, bamboo, J. Munting, PPRI; Esmeranza District, 27.VIII.1964, bamboo, J. Munting, PPRI; Durban, VIII.1964, large bamboo, G. DeLotto, PPRI.


ODONASPIS Leonardi


Dycryptaspis Cockerell, in Leonardi, 1897b:375; Morrison and Morrison, 1966:64. (Objective synonym by community of type-species.)

Spatheaspis Leonardi, 1897c:115; Morrison and Morrison, 1966:186. (Objective synonym by community of type-species.)

Type-species: Aspidiotus secretus Cockerell, 1896, by monotypy.

Odonaspis was introduced by Leonardi as a new genus of the Aspidioti in an article issued March 1897. A month later Leonardi (1897b) published a note in which he quoted the name "Dycryptaspis Cockerell," mentioned to him in a letter from Cockerell, with Aspidiotus secretus Cockerell as type-species. Since Odonaspis Leonardi antedated Dycryptaspis Cockerell, the synonymy of the latter with Odonaspis is evident. In a third paper that year Leonardi (1897c) presumed that Odonaspis was preoccupied by Odontaspis Agassiz, and he introduced Spatheaspis as a replacement name. According to Article 56(a) of the International Code, Odonaspis Leonardi is not a homonym; therefore, Spatheaspis is an objective synonym of Odonaspis.

Leonardi's error was raised again by Lindinger (1937), who considered Odonaspis Leonardi a preoccupied name, replaced it with Dycryptaspis, and transferred to the latter all the odonaspidine species described to that date. Lindinger's conclusions do not conform with the International Code (see Ferris, 1937c) and were rejected by all later workers. Lindinger's nomenclatural changes regarding the Odonaspidini are therefore omitted from the synonymy lists in this revision.

Earlier workers (Ferris, 1937b; Balachowsky, 1953; Takagi, 1959, 1969) interpreted Odonaspis in a broad sense, assembling in it also Progattelia and Berlesaspidotus. This revision increased the number of species in the Odonaspidini from 24 to 41, and thus it was possible to better evaluate some of the morphological characters at the generic level. Consequently, it seems justified to split these genera from Odonaspis.

However, even as interpreted here the 30 species placed in Odonaspis do not form a homogenous group, appearing to have been derived from several phylogenetic stocks. One group includes the species arcusnotata, greeni, lingnani, paucipora, schizostachyi, secreta, serrata, and siamensis, which are known almost exclusively from bamboos. Morphologically the females of these species are characterized in having a well-developed, sclerotized postvulvar sternite and in the slender size of pygidial ducts. Besides their host specificity, these species are distributed mainly in the Oriental region, although several, for example secreta and greeni, were dispersed on their bamboo hosts to other regions. The rest of the species, though being a heterogenous group, can be characterized by the unsclerotized postvulvar sternite and a more robust size of pygidial ducts. These species are known from the tropics and subtropics of all regions, developing mainly on plants of the various subfamilies of Gramineae, including Bambusaceae. Few of them, for example bromeliae and saccharicaulis, are known also from nongramineous host plants.
Besides the objective synonyms of *Odonaspis* listed here, I regard the following as subjective synonyms of this genus: *Bakeraspis* MacGillivray, 1921 (type-species: *Odonaspis schizostachyi* Cockerell and Robinson, 1914) and *Ligulaspis* MacGillivray, 1921 (type-species: *Aspidiotus (Odonaspis) janeirensis* Hempel, 1900). These available names should be considered if in the future *Odonaspis* needs to be split further.

**Recognition Characters**

Diaspididae conforming to tribal characters and distinguished by following combination of features: Pygidial margin with or without scleroses; generally with scleroses. Ducts of one, two, three, or four sizes. Gland tubercles present or absent. Vulva placed anterior at level or posterior to level of anus. Perivulvar pores present or absent. Antennal tubercles with one hair placed on flat surface of derm; generally located at level well in front of anterior ridge of clypeolabral shield.

**Key to Adult Females**

1. Perivulvar pores absent 1.__________ 2
   Perivulvar pores present 2.__________ 8
2. Antennal tubercles located very close to margin in line with anterior ridge of clypeolabral shield 3.__________ *siamensis* (Takahashi)
   Antennal tubercles located submarginally at level distinctly anterior to clypeolabral shield 3.__________
3. Vulva placed anterior to level of anus 4.__________
   Vulva placed at level of or posterior to level of anus 5.__________
4. Margin and submargin of head, thorax, and abdomen with pattern of dark lines set at right angle to margin; marginal scleroses absent 3.__________ *lingnani* Ferris
   Margin and submargin of head, thorax, and abdomen without pattern of dark lines; marginal scleroses present 3.__________ *pacific*, n. sp.
5. Ducts present on dorsum of head and thorax 6.__________ *graminis* Bremner
   Ducts absent on dorsum of head and thorax 6.__________
6. Gland tubercles present submarginally on venter of thorax 7.__________
   Gland tubercles absent 2.__________
7. Margin of segment 8 with 2 triangular projections, separated from each other by pointed emargination; dorsum of segment 8 with 4-7 (6) ducts 2.__________
   Margin of segment 8 with 2 triangular projections, separated from each other by straight, transverse margin; dorsum of segment 8 with 13-23 (17) ducts 2.__________ *sabulincola*, n. sp.
8. Vulva placed anterior to level of anus; postvulvar sternite very distinct, sclerotized 9.__________
   Vulva placed at level or posterior to level of anus; postvulvar sternite not sclerotized 9.__________
9. Marginal setae of head and thorax ca. 75 μm long 10.__________
   Margin and submargin of head and thorax 10.__________
10. Ducts present on all area of postvulvar sternite 11.__________
   Ducts placed in single row on each side of postvulvar sternite 11.__________
11. Pygidial margin with 1 pair of scleroses; posterior spiracle with 10-25 spiracular pores 12.__________
   Pygidial margin with 2 pairs of scleroses; posterior spiracle with 0-5 spiracular pores 12.__________
12. Spiracular pores in compact group in front of anterior spiracle, and additional 6-14 pores in loose grouping median to spiracle 13.__________
   Spiracular pores placed in compact group in front of or in front and lateral to anterior spiracles 13.__________

1See notes under *Odonaspis texana* about absence of perivulvar pores.
13. Gland tubercles present submarginally on venter of thorax; spiracular pores disposed in semicircular cluster anterior and lateral to each anterior spiracle ——-arcusnotata, n. sp.
Gland tubercles absent; spiracular pores disposed in cluster anterior to each anterior spiracle ——-14

14. Perivulvar pores placed in median and 2 lateral groups ———-secreta (Cockerell)
Perivulvar pores placed in 2 lateral groups ———-15

15. Perivulvar pores placed loosely, 1-4 pores in each lateral position; posterior spiracle without spiracular pores ———-paucipora, n. sp.
Perivulvar pores in lateral groups placed in compact clusters, 55-96 (78) pores in each; posterior spiracle with 1-22 spiracular pores ———-greeni (Cockerell)

16. Ventral macroducts on all abdominal segments, or only on segments 1 to 6; 1/2 to 2/3 as wide as dorsal macroducts ———-17
Ventral macroducts on all abdominal segments; as wide as dorsal macroducts ———-21

17. Gland tubercles absent from thorax ———-aristidae, n. sp.
Gland tubercles present on thorax ———-18

18. Pygidial margin without scleroses ———-minima Howell and Tippins
Pygidial margin with scleroses ———-19

19. Macroducts constricted at middle part of duct; with 1 cicatrix placed dorsally on each side of mouth parts ———-galapagoensis, n. sp.
Macroducts with parallel-sided ducts; dorsal cicatrices absent ———-20

20. Anterior spiracle with 2-6 spiracular pores; perivulvar pores with 5-16 (12) pores in median group ———-anneckei, n. sp.
Anterior spiracle with 24-45 spiracular pores; perivulvar pores with 14-39 (27) pores in median group ———-benardi Balachowsky

21. Gland tubercles present on thorax ———-22
Gland tubercles absent from thorax ———-26

22. Gland tubercles present in 1 cluster at level of clypeo-labral shield; with 124-179 (153) perivulvar pores in each lateral group ———-phragmitis Hall
Gland tubercles present in 2 clusters; with 90 or less perivulvar pores in each lateral group ———-23

23. With dorsal intersegmental line (median part) between segments 5-6; ducts present dorsally on submedian area of segment 4 ———-transkeiensis, n. sp.
Without dorsal intersegmental line (median part) between segments 5-6; without ducts on dorsum in submedian area of segment 4 ———-24

24. With 1 pair of marginal scleroses ———-bromellae, n. sp.
With 2 pairs of marginal scleroses ———-25

25. Emargination on apex of segment 8 without marginal microducts; inner ends of marginal scleroses with no definite shape ———-saccharicaulis (Zehntner)
Emargination on apex of segment 8 with 2-5 marginal microducts; inner ends of marginal scleroses rounded ———-litorosa Ferris

26. Pygidial margin without scleroses ———-floridana, n. sp.
Pygidial margin with scleroses ———-27

27. Pygidial margin with 1 pair of scleroses ———-ruthae Kotinsky
Pygidial margin with 2 or 3 pairs of scleroses ———-28

28. Margin of segment 8 with 1 notch on each lateral margin; perivulvar pores placed in contiguous band anterior and lateral to vulva ———-australiensis, n. sp.
Margin of segment 8 without notches; perivulvar pores placed in median and 2 lateral groups ———-29

29. Margin and submargin from abdominal segment 3 to mesothorax with sclerotized lines set at right angle to margin; anterior spiracle with 30-53 (43) spiracular pores ———-tsinjoarivensis Mamet
Margin and submargin with sclerotized lines set at right angle to margin, only on abdominal segment 2, 1, and metathorax, or without lines; anterior spiracle with less than 10 spiracular pores ———————————-panici Hall

**Odonasps anneecei**, n. sp.  
(Fig. 14)

Female scale oval elongate, ca. 2 mm long, 1 mm wide; white yellowish; larval exuviae brown placed at anterior part of scale.

Male scale oval and narrow, ca. 1.0 mm long, 0.3 mm wide; white; larval exuviae brown placed at anterior part of scale.

Slide-mounted female oval in outline, 0.5-0.9 mm long, 0.4-0.6 mm wide. Margin of segment 8 with broad, rounded projection; with shallow emargination at apex and at level of marginal setae. Margins of segments 7, 6, and 5 not even, with variously shaped, minute indentations. Marginal setae, ventral and dorsal, of segments 8, 7, 6, and 5 situated near margin, apices exceeding margin; dorsal setae of 8 longer than ventral. With deep indentations at posterior ends of intersegmental furrows between 8-7, 7-6, 6-5, and 5-4. With marginal scleroses at posterior ends of intersegmental furrows between 8-7, 7-6, and 6-5. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between 8 and 5 not made of folds; present as dark, transverse line which is interrupted medially. Crenulae as figured. Width of ventral ducts ca. 2/3 of dorsal ducts. Ducts in four sizes. Macroducts, dorsal, ca. 14 long, 3 wide, distributed as figured; present on median area of dorsum of segment 5. Macroducts, ventral, ca. 14 long, 2 wide, distributed as figured; their number on pygidial segments smaller than on dorsal ducts; ducts absent from area surrounded by perivulvar pores. Microducts ca. 10 long, 2 wide, situated only on venter; laterally to mouth parts, in transverse clusters extending from spiracles, and submedially on abdominal segments 1, 2, and 3. Microducts ca. 25.0 long, 1.5 wide, situated along margin of segments 8, 7, 6, and 5. Gland tubercles present ventrally on head (0-3 tubercles on each side) and prothorax (2-11 tubercles). Anus situated 15-18 times its diameter from apex of pygidium. Vulva placed at about level of anus. Perivulvar pores in median group of 5-16 (12) pores, and 2 lateral groups each with 36-54 (47) pores. Anterior spiracle with two to six (three) spiracular pores; posterior spiracle with one to three (two) pores.

Material Examined. SOUTH AFRICA: Cape Province, Tradouw Pass, 11.I.1969, Ehrharta cf. ramosa, J. Munting. Described from holotype and 24 paratypes; holotype and paratypes in PPRI; paratypes in BMNH, CDA, FDA, ICV, MNP, UG, and USNM.

Etymology. The patronym honors the late Dave P. Annecke of the Plant Protection Research Institute, Pretoria, South Africa, in respect and recognition of his contributions to the study of scale insects and their parasites.

Notes. This species comes close to another South African species, namely O. transkeiensis. The distinguishing characters between these species are given under the description of the latter.

**Odonasps arcusnotata**, n. sp.  
(Fig. 15)

Only slide-mounted females of this species were available for study.

Female oval in outline, 0.8-2.0 mm long, 0.7-1.3 mm wide. Margin of segment 8 with distinct projection, truncated apically; without lateral notches. Margins of segments 7, 6, and 5 each with triangular, sclerotized projection. Marginal setae of segments 8, 7, 6, 5, and 4 with apices exceeding margin; ventral setae longer than dorsal. With clavate sclerosis, ca. 50 long, at posterior end of intersegmental furrow 8-7, and shorter one at end of furrow 7-6. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between 6 and 5 not made of folds; present as dark line that is continuous
through median area. Crenulae as figured. Postvulvar sternite very distinct, slightly sclerotized; with longitudinal row, one duct wide, of ducts on each side of sternite. Ducts of four sizes. Macroducts ca. 15 long, 3 wide, on ventral and dorsal surfaces of pygidium and on marginal and submarginal areas of prepygidial segments; on thoracic segments ducts gradually become shorter and wider; on cluster laterally to anterior spiracle measure ca. 12 long, 5 wide. Microducts ca. 15.0 long, 1.5 wide, occur on venter, laterad to mouth parts, laterad to each spiracle, and on median area of metathorax. Microducts ca. 30.0 long, 1.5 wide, present on margin of segments 8, 7, and 6. Gland tubercles on prothorax, mesothorax, and metathorax in submarginal clusters; base of each tubercle surrounded by conspicuous, circular row of minute black dots. Cuticular striation of median and submedian areas of dorsum of thoracic segments with fine granulation, whereas on venter of same areas granulation is absent. Anus situated ca. 30 times its diameter from apex of pygidium; bordered posteriorly with semicircular sclerotization. Vulva placed slightly anterior to level of anus. Peritubular pores in loose median group of 3–6 pores, and 2 lateral groups, 56–75 pores in each. Anterior spiracle with 37–41 spiracular pores disposed in arclike cluster laterally to peritreme; posterior spiracle without pores.


Etymology. The species name is from the Latin arcus meaning "an arch" and notat meaning "marked." It refers to the arc-shaped disposition of the spiracular pores of the anterior spiracles.

Notes. This new species might be confused with two related congeners, namely O. greeni and O. secreta, which develop on bamboo in the Oriental region. However, it is clearly separable from these species in the truncated margin of segment 8, the absence of lateral notches, as well as the arc-shape disposition of the anterior spiracular pores.

Takagi (1969) mentioned an Odonaspis sp. taken from bamboo in Taiwan. A study of the material from this record (see Material Examined) proved that it belongs to O. arcusnotata.

Odonaspis aristidae, n. sp. (Fig. 16)

Female scale elliptical in outline, 2.0–3.5 mm long, 1.0–1.3 mm wide; white brownish; larval exuviae brown placed at anterior part of scale.

Male scale oval and narrow, 0.8–1.0 mm long, 0.4–0.5 mm wide; white; larval exuviae brown placed at anterior part of scale.

Slide-mounted female oval, 0.9–1.7 mm long, 0.7–1.2 mm wide. Margin of segment 8 circular, without projections. Margins of segments 7, 6, and 5 without projections. Marginal setae, dorsal, of segment 8 slender, their tips exceeding margin; ventral setae slender, their tips not exceeding margin. Marginal setae, dorsal, of segments 7, 6, 5, and 4 slender, placed far from margin; apices exceed margin. Marginal setae, ventral, of segments 7, 6, 5, and 4 slender, placed marginally; apices exceed margin. Deep indentations at posterior ends of intersegmental furrows between 8–7, 7–6, 6–5, and 5–4. With marginal scleroses at posterior ends of intersegmental furrows between 8–7, 7–6, and 6–5. Interssegmental folds as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark
line, interrupted medially. Crenulae as figured. Dorsal ducts of pygidium ca. two times as wide as ventral. Ducts in four sizes. Macroducts, dorsal, ca. 12 long, 4-5 wide; present as figured; four to six ducts present on dorsomedial area of segment 5; two to three ducts situated dorsally on submedian area of segment 4. Macroducts, ventral, ca. 12 long, 2 wide; ca. 1/2 as wide as dorsal ducts; their number on pygidial segments smaller than dorsal ducts; distributed as figured; absent from area enclosed by perivulvar pores. Microducts ca. 10.0 long, 1.5 wide, distributed on venter only, laterally to mouth parts, in transverse band laterally to each spiracle, and in submedian cluster on each of three anterior abdominal segments. Microducts ca. 20 long, 2 wide, present marginally on segments 8, 7, 6, and 5. Gland tubercles absent. Anus situated 23-28 times its diameter from apex of pygidium. Vulva placed at about level of anus. Perivulvar pores in single row, median group of 8-14 pores, and 2 lateral groups, 32-53 pores in each. Anterior spiracle with two to four spiracular pores; posterior spiracle with one to two pores.

Material Examined. SOUTH AFRICA: Cape Province, 70 miles northwest of Vryburg, 12.IX.1968, Aristida diffusa var. burkei, J. Munting. Described from holotype and 20 paratypes; holotype and paratypes in PPRI; paratypes in BMNH, CDA, FDA, ICV, MNP, PPRI, UG, and USNM.

Etymology. The species name is derived from the host plant on which the type-series was found.

Notes. This species very much resembles another South African congener, namely O. anneckeii, in the width of dorsal macroducts of the pygidium being bigger than that of the ventral ducts and in the similar frequency of spiracular pores. The absence of gland tubercles on the venter of the head and prothorax in O. aristidae distinguishes it from anneckeii.

Odonaspis australiensis, n. sp. (Fig. 17)

Only slide-mounted females of this species were available for study.

Female oval, 0.8-1.2 mm long, 0.6-0.9 mm wide. Margin of segment 8 forms rounded projection, with notch on each lateral margin. Margins of segments 7 and 6 each with broad projection. With distinct indentations at posterior ends of intersegmental furrows between 8-7, 7-6, 6-5, and 5-4. Dorsal intersegmental furrows between 8-7 and 7-6 not distinct; ventral furrows between these segments distinct. Scleroses present at posterior ends of intersegmental furrows between 8-7 and 7-6. Marginal setae, ventral and dorsal, of segment 8 slender; tips exceeding margin. Marginal setae, dorsal, of segments 7, 6, 5, and 4 slender, placed submarginally; apices not exceeding margin. Marginal setae, ventral, of segments 7, 6, 5, and 4 longer than respective dorsal ones, placed marginally. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median and submedian parts) between 6 and 5 not made of folds; present as dark line. Crenulae as figured. Ducts in three sizes. Macroducts ca. 15 long, 3 wide; orifices surrounded by dark rim; dorsal and ventral ducts of pygidium subequal in size; distributed ventrally and dorsally as figured; one to five ducts placed submedially on each side of dorsum of segment 5; four to eight ducts placed ventrally within area enclosed by perivulvar pores. Microducts ca. 10 long, 1.5 wide, placed only ventrally as figured. Microducts 20-30 long, ca. 2 wide, placed marginally on segments 8, 7, 6, and 5. Gland tubercles absent. Anus placed about 18 times its diameter from apex of pygidium. Vulva placed slightly posterior to level of anus. Perivulvar pores in contiguous cluster anterior and lateral to vulva; total number of pores 94-130 (114). Anterior spiracle with 4-12 (8) spiracular pores; posterior one with 4-7 (5) pores.
Material Examined. AUSTRALIA: SOUTH AUSTRALIA, Glen Osmond, Waite Agricultural Research Institute, on stolons of Cynodon dactylon, H.M. Brookes. Described from holotype and six paratypes collected June 1952 and eight paratypes collected June 1962; holotype and paratype in ANIC; paratypes in BMNH, CDA, FDA, ICV, MNP, PPRI, ST, UG, UH, and USNM. Additional material (not included in type-series): NEW SOUTH WALES, Sydney, on jointgrass, George Compere, No. 322, UCD and USNM; Sydney, seashore, 20.XII.1899, couchgrass, Koebele, USNM.

Etymology. The species name was selected to denote the first species originally described as new in Odonaspis from Australia.

Notes. Morphologically the females of this species resemble those of O. panici in having two pairs of pygidial scleroses and in the absence of gland tubercles. O. australiensis differs from panici in the shape of the margin of segment 8 and in having the perivulvar pores in a continuous cluster rather than separated into anterior and lateral groups.

Odonaspis benardi Balachowsky (Fig. 18)

Odonaspis ruthae Kotinsky; Ferris, 1938:165 (misidentification in part).

This species was originally described from the holotype only, taken from Paspalum sp. in Martinique. No additional material was available from the type locality. The redescription is based on the holotype and on several series of specimens (see Material Examined) from various countries in the West Indies, Central America, and North America.

"Female scale wrinkled, bright brown, circular, larval exuviae slightly subcentral. 2.2 mm. Male unknown." (Translated from Balachowsky, 1957).

Slide-mounted young female circular, ca. 0.8 mm in diameter; fully grown female oval, up to 1.8 mm long, 1.2 mm wide. Margin of segment 8 well or slightly projected; with notch on each side; occasionally with slight emargination on apex. Margins of 7 and 6 each with small, rounded projection. With shallow indentations at posterior ends of intersegmental furrows between 8-7 and 7-6; with pointed indentations at posterior ends of furrows between 6-5 and 5-4. Two pairs of marginal scleroses present; each at posterior ends of intersegmental furrows between 8-7 and 7-6, respectively; median pair longer than outer one. Marginal setae, dorsal, of segment 8 placed submarginally; ca. two times as long as respective ventral setae. Marginal setae, ventral, of 7, 6, 5, and 4 placed marginally. Marginal setae, dorsal, of 7, 6, 5, and 4 located submarginally; tips not projecting off margin, or almost reach it. Intersegmental folds as figured. Dorsal intersegmental line (median part) between 6 and 5 absent; two transverse apophyses separated from each other, placed at site of this line. Crenulae as figured. Ducts in four sizes. Macroducts ca. 12 long, 5 wide; orifice surrounded by circular to oval dark rim, which equals size of perivulvar pores; distributed only on dorsum; in holotype, ducts absent from median and submedian areas of segment 5, that is anterior to apophyses, and from same areas of segments 4 and 3; however, ducts present on those areas in part of specimens from other records. Macroducts ca. 12 long, 2-3 wide, placed only on venter; resemble in shape to dorsal ducts, but 0.5-0.6 as wide as those ducts. Microducts ca. 12 long, 1-2 wide, located only on venter as figured. Microducts ca. 20 long, 2 wide, placed along margin of 8, 7, 6, and 5; apex of segment 8 without or with one to two marginal ducts. Gland tubercles located ventrally in two clusters on each side; one lateral to clypeolabral shield, other lateral to anterior spiracle. Anus situated ca. 20 times its diameter from pygidial apex. Vulva placed at level of anus. Perivulvar pores in three groups. The numbers of perivulvar and anterior and posterior spiracular pores are given in table 4.
Table 4
Perivulvar and spiracular pores in *O. benardi* (holotype)
and in specimens from 3 localities in America

<table>
<thead>
<tr>
<th>Item</th>
<th>Perivulvar pores</th>
<th>Spiracular pores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Lateral</td>
</tr>
<tr>
<td>Holotype</td>
<td>39</td>
<td>98-102</td>
</tr>
<tr>
<td>Specimens from—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texas</td>
<td>14-26</td>
<td>37-76</td>
</tr>
<tr>
<td></td>
<td>(21)</td>
<td>(58)</td>
</tr>
<tr>
<td>Guatemala</td>
<td>18-30</td>
<td>58-83</td>
</tr>
<tr>
<td></td>
<td>(24)</td>
<td>(74)</td>
</tr>
<tr>
<td>Panama</td>
<td>15-32</td>
<td>57-110</td>
</tr>
<tr>
<td></td>
<td>(25)</td>
<td>(73)</td>
</tr>
</tbody>
</table>

1Averages in parentheses.


Notes. *O. benardi* was described only from the holotype, providing therefore little data about the intraspecific variations in its major taxonomic characters. The taxonomic interpretation of *benardi*, as introduced here, differs from the original description in accepting a wider range in the distribution and frequency of some characters. The holotype does not have macroducts on median and submedian areas of the dorsum of segments 5, 4, and 3. However, additional series studied (see Material Examined) include specimens with ducts placed as in the holotype, whereas in others from the same collection they occur also on the same areas of segments 5 and 4 and as anterior as segment 3. The numbers of perivulvar and spiracular pores, as counted in additional examples (see table 4), indicate that the range is wider than that of the holotype.

This species and *O. annekei*, *O. aristidae*, *O. galapagoensis*, and *O. minima* are alike in having the dorsal macroducts about twice as wide as the ventral macroducts. The distinguishing characters between these species are indicated in the key to *Odonaspis* species.

*Odonaspis bromeliae*, n. sp.
(Fig. 19)

Only slide-mounted females of this species were available.
Young female circular, 1.8 mm in diameter; fully grown females up to 3.2 mm long, 2.0 mm wide. Margin of segment 8 slightly projected; with apical emargination and one to two notches on each side. With broad, rounded indentation at posterior end of intersegmental furrow between 8 and 7; with pointed indentations at ends of furrows between 7-6, 6-5, and 5-4. With one pair of marginal scleroses at posterior ends of furrow between 8 and 7. Marginal setae, ventral, of 8, 7, 6, 5, and 4 placed marginally; subequal in length. Marginal setae, dorsal, of 8 placed submarginally; project beyond margin; longer than their respective ventral setae. Marginal setae, dorsal, of 7, 6, 5, and 4 placed submarginally, not reaching margin. Dorsal intersegmental line (median part) between 6 and 5 absent; two transverse apophyses, separated from each other, located at site of this line. Intersegmental folds as figured. Crenulae as figured. Ducts in three sizes. Macroducts ca. 14 long, 5 wide; orifice surrounded by oval, dark rim; distributed on dorsum and venter as figured. Microducts ca. 12 long, 1.5 wide, located only on venter as figured. Microducts ca. 23 long, 2 wide, placed along margin of 8, 7, 6, and 5; two or three ducts discharge to emargination on apex of segment 8. Gland tubercles ventrally in two clusters on each side; one lateral to clypeolabral shield; second lateral to anterior spiracle. Anus situated ca. 20 times its diameter from pygidial apex. Vulva placed slightly posterior to level of anus. Perivulvar pores in median group of 13-31 (22) pores, and 2 lateral groups each with 47-70 (58) pores. Anterior spiracle with 8-17 (13) spiracular pores; posterior spiracle with 5-15 (11) pores.


Etymology. The species name denotes the host specificity of this new Odonaspis.

Notes. O. bromeliae is the only species in the Odonaspidini that is known only from nongramineous host plants. Morphologically it very much resembles O. litorosa in the shape of the margin of segment 8, distribution of macroducts, and numbers of perivulvar and spiracular pores. O. bromeliae differs from litorosa in having only one pair of marginal scleroses.

Odonaspis floridana, n. sp. (Fig. 20)

Only slide-mounted females of this species were available for study.

Female oval, 0.6-0.7 mm long, 0.4-0.5 mm wide. Margin of segment 8 present as pronounced projection; apex transverse, with two notches; each lateral margin with one notch. Margin of segment 7 with triangular projection. With deep, rounded emargination at posterior end of intersegmental furrow between 8 and 7. Margin at posterior ends of intersegmental furrows between 7-6, 6-5, and 5-4 with shallow, pointed emarginations. Dorsal intersegmental furrows between 8-7 and 7-6 not distinct; ventral furrows between these segments distinct. Pygidium without marginal scleroses. Marginal setae, ventral and dorsal, of segment 8 subequal in length, placed submarginally; each seta as long as transverse, apical margin of segment 8. Dorsal marginal setae of 7, 6, 5, and 4 placed submarginally in heavy rimmed sockets; tips not exceeding margin. Ventral marginal setae of segments 7, 6, 5, and 4 placed marginally; tips project off margin. Pair of slender setae placed subapically on dorsum of segment 8; each located in heavy rimmed socket. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow...
(median and submedian parts) between 6 and 5 not made of folds; present as dark line. Crenulae as figured. Ducts in three sizes. Macroducts ca. 10 long, 3 wide; orifices surrounded by dark rims; dorsal and ventral ducts of pygidium subequal in size; distributed ventrally and dorsally as figured. Microducts ca. 8 long, 2 wide, disposed only on venter as figured. Ducts ca. 15 long, 2 wide, distributed on margin of segments 7, 6, and 5. Gland tubercles absent. Anus placed 14–17 times its diameter from apex of pygidium. Vulva at about level of anus. Perivulvar pores in median group of 6–17 (11) pores, and 2 lateral groups each with 20–38 (30) pores. Anterior spiracle with one to six (three) spiracular pores; posterior one with zero to four (three) pores.


Etymology. The specific name was selected for the State in the U.S.A. where this species was described.

Notes. Based on the external morphology of the female, O. floridana belongs in a group of American species that are characterized by the absence of thoracic gland tubercles. It differs from other species in this group by lacking marginal scleroses on the pygidium and in the pronounced shape of the margin of segment 8.

Odonaspis galapagoensis, n. sp. (Fig. 21)

Only slide-mounted females and males of this species were available for this study.

Young female turbinate, 0.6 mm long, 0.5 mm wide; fully grown female oval, up to 1.8 mm long, 1.1 mm wide. Margin of segment 8 with distinct projection; apex truncated transversely. Margins of 7, 6, and 5 each with one small, rounded projection. Without marginal indentations at posterior ends of intersegmental furrows between 8–7 and 7–6; with indentations at posterior ends of furrows between 6–5 and 5–4. Two pairs of marginal scleroses present; each at posterior end of intersegmental furrows between 8–7 and 7–6, respectively; each sclerosis 15–20 long, with rounded inner end. Marginal setae, ventral, of 8, 7, 6, 5, and 4 placed marginally. Marginal setae, dorsal, of 8, 7, 6, 5, and 4 placed submarginally; tips reach or slightly project off margin; thinner and slightly shorter than respective dorsal setae. Intersegmental folds as figured. Dorsal intersegmental line (median part) between 6 and 5 absent; two transverse apophyses separated from each other, placed at site of this line. Crenulae as figured. Ducts in four sizes. Macroducts ca. 16 long, 4–5 wide, distributed only on dorsum as figured; inner end of duct wider than orifice; duct constricted at middle part and thus resembles shape of a vase; orifice surrounded by circular or oval dark rim, which equals size of perivulvar pore. Macroducts ca. 10 long, 2–3 wide, distributed only on venter as figured; shape of ducts similar to that of dorsal but are 0.5–0.6 as wide and as long as dorsal. Microducts ca. 10 long, 1–2 wide, distributed only on venter as figured; ducts of same size and shape discharge into gland tubercles. Microducts 20–23 long and 1–2 wide, placed along margin of segments 8, 7, 6, and 5; absent from median part of apex of 8. Gland tubercles ventrally in submarginal cluster between anterior and posterior spiracles; one to three tubercles occur also in second cluster (only in 1/5 of type-series) at level of anterior ridge of clypeolabral shield. With one oval cicatrix, ca. 5 long, located submarginally on dorsum, on each side of mouth parts. Anus situated 14–16 times its diameter from pygidium apex. Vulva placed posterior to level of anus.
ca. two times diameter of anus. Perivulvar pores in median group number 13-23 (17), and 2 lateral groups each with 34-70 (53) pores. Anterior spiracle with 10-28 (19) spiracular pores; posterior spiracle with 12-24 (17) pores.

Material Examined. ECUADOR: Galapagos, Santa Cruz Island, on Sporobolus virginicus; holotype and 17 paratypes from Academy Bay, 24.VI.1977, coll. T. Kono; 2 paratypes, Darwin Research Station, 24.I.1964, coll. R.O. Schuster; holotype and paratype in USNM; paratypes in ANIC, BMNH, CDA, FDA, ICV, MNP, UCD, UG, UH, and VPI.

Etymology. The species name is based on the Galapagos Islands where it is described.

Notes. The females of this Odonaspis species belong in a group that has the dorsal macroducts 1.5-2.0 times as wide as the ventral macroducts and that possesses ventral gland tubercles. O. galapagoensis is characterized by vase-shaped macroducts and by dorsal cicatrices.

Odonaspis graminis Bremner
(Fig. 22)


"Scale of the female brown, broadly oval, exuviae apical. Scale of the male not seen." (Ferris, 1938). "The ventral scale is nearly as well developed as the dorsal, and has what appears to be the ventral half of the exuvia at the anterior end." (Bremner, 1907).

Mounted specimens of young females circular, ca. 0.5 mm in diameter; fully grown females oval, 1.3 mm long, 1.0 mm wide. Margin of segment 8 with rounded, median projection; apex of projection sometimes with shallow emargination. Marginal setae of segment 8 exceeding margin of segment. Without marginal scleroses on pygidium. Dorsal marginal setae of segments 7, 6, and 5 slender, situated away from margin; ventral marginal setae of these segments long, placed marginally. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; line continuous through median area. Crenulae as figured. Ducts in three sizes. Macroducts ca. 10 long, 3 wide, distributed as figured; ventral and dorsal ducts of pygidium subequal in size; orifices surrounded by dark rim; ducts in wide cluster on dorsal surface of thorax and head. Microducts ca. 10.0 long, 1.5 wide, present on venter of head and thorax as figured. Microducts ca. 15 long, 2 wide, situated marginally along segments 8, 7, 6, and 5. Gland tubercles submarginally on venter of prothorax and head. Anus situated ca. 16 times its diameter from apex of pygidium. Vulva placed slightly posterior to level of anus. Perivulvar pores absent. Anterior and posterior spiracles each with 11-21 (14) spiracular pores.


Notes. The four syntypes available for the study are in poor condition; therefore a lectotype was not selected. The present redescription is based on the syntypes and supplemented by study of specimens from several topotypic collections.

Odonaspis greeni (Cockerell)
(Fig. 23)

Aspidiotus secretus Cockerell; Green, 1896:64 (misidentification). Odonaspis secretus greenii Cockerell, 1902:25.
Odonaspis secreta greenii Cockerell; Fernald, 1903:300.
Odonaspis greenii (Cockerell); Zimmerman, 1948:428; Ferris, 1950:75; Beardsley, 1966:525; Borchsenius, 1966:224.

Cockerell (1902) described the variety Odonaspis secretus greenii, noting that this name is given to the Ceylonese material that was named Odonaspis secretus Cockerell by Green (1896). The present redescription is based on the original material of Green (see Material Examined).

Slide-mounted young female circular, ca. 0.7 mm in diameter; fully grown female oval, up to 1.5 mm long, 1.0 mm wide. Head, thorax, and the three anterior abdominal segments with five lateral indentations, thus forming four lateral "lobes"; second "lobe," at level of metathorax and first abdominal segment, without additional emargination. Margin of segment 8 forming protuberant projection, rounded apically and with one notch on each lateral margin. Margin of segment 7 with triangular projection, smaller than that of segment 8, and four to five smaller projections. With deep indentation at margin between segments 8 and 7, where is located a stout seta, ca. 35 long. With clavate sclerosis, ca. 30 long, at posterior end of intersegmental furrow 8-7; with clavate sclerosis, ca. 15 long, at posterior end of furrow between segments 7 and 6. Marginal setae, ventral, of 8 placed ca. two times seta length from margin; much smaller than stout, marginal setae. Marginal setae, ventral and dorsal, of 7, 6, 5, and 4 placed marginally; ventral setae longer than dorsal. Dorsal intersegmental line (median part) between segments 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Crenulae as figured. Ducts, throughout body, subequal in width, ca. 2, and shape; ca. 30 long on pygidium, shorter on thoracic segments. Postvulvar sternite very distinct; ducts placed in single row on each side of sternite; absent from median area of sternite.

Dermal striation of ventral and dorsal surfaces of head and thorax with numerous, rounded sclerotizations, ca. 1 in diameter; sclerotizations absent on two circular areas placed ventrally on each side of metathorax. Anus placed ca. 20 times its diameter from apex of pygidium. Vulva placed anterior to level of anus at distance ca. 0.3 times interval between anus and pygidium apex. Perivulvar pores in 2 lateral groups, 55-96 (78) pores in each; no perivulvar pores in position of median group. Anterior spiracle with 3-8 spiracular pores (in type-series), placed in compact cluster anterior to spiracle; up to 23 pores observed in specimens from Taiwan. Posterior spiracle with 1-4 spiracular pores (in type-series); up to 22 pores observed in specimens from Taiwan.


Notes. This species is morphologically close to O. secreta, exhibiting like the latter a host specificity to various species of bamboos. It was regarded by Balachowsky (1953) as a synonym of secreta, whereas other students (Ferris, in Zimmerman, 1948; Beardsley, 1966; Borchesenius, 1966) accepted it as a distinct species.

From a study of the type-series, as well as material from other regions, it is concluded that O. greeni differs from secreta in (1) presence of spiracular pores at the posterior spiracles; (2) absence of perivulvar pores in the median position; and (3) the lateral "lobe" at the broadest part of the body (metathorax and segment 1) complete, without an indication of an additional emargination.

Odonaspis lingnani Ferris

(Fig. 24)


Originally described from China, where it was collected on Bambusa multiplex in the Old Bamboo Garden at Lingnan University, Canton.

"Occurring massed in the closely crowded axils of the branches, so crowded that it has proved impossible to secure a scale by itself alone without destroying it and consequently no habit sketch can be given. Scale of the female white." (Ferris, 1955).

Slide-mounted female oval, 1.0-1.5 mm long, 0.8-1.0 mm wide. Margin of segment 8 forming broad, rounded protuberance; slightly projecting from margin. Margins of segments 7, 6, 5, and 4 with small notches, without projections. Marginal setae, dorsal and ventral, placed marginally; subequal in size. Margin and submargin of segments 8, 7, 6, and 5 highly sclerotized; without marginal scleroses. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as transverse, faint line. Intersegmental folds present as figured. Postvulvar sternite distinct; ducts situated on all areas of sternite. Crenulae as figured. Margin and submargin of ventral and dorsal surfaces of head, thorax, and abdomen segments 1, 2, 3, and 4 with pattern of dark lines at right angle to margin. Ducts of one size and one shape; ca. 20 long, 3 wide; placed dorsally on paratergal areas of metathorax and abdominal segments; absent from dorsomedian areas of segments 4 and 5; placed ventrally on head, thorax, parasternal areas of abdominal segments, and among crenulae of segments 4+5 and 6. Anus surrounded by dark rim; rim ca. 35 wide; placed four to six times width of rim from apex of pygidium. Vulva placed anterior to level of anus at distance ca. 0.4 times interval between anus and pygidium apex. Perivulvar pores...
absent. Anterior and posterior spiracles each with 21-40 (33) spiracular pores.

Material Examined. CHINA: Canton, Lingnan University, 16.XI.1948, Bambusa multiplex, G.F. Ferris, No. 82; 13 females on 5 slides, 1 of these on separate slide, here designated lectotype; lectotype in USNM; paralectotypes in UCD; type slides, respectively, I labeled. Additional material (not type-series): INDONESIA: 20.VII.1974, bamboo, R. Reiser, USNM.

Notes. O. lingnani is readily distinguished from other Odonaspis species known from bamboo in the Oriental region by the absence of marginal scleroses in the pygidium, the absence of perivulvar pores, and the presence of the marginal pattern of sclerotized lines. In the last character it resembles another Oriental species, namely Berlesaspidiotus crenulatus; however, these two species are placed in different genera and are clearly separable from each other.

Odonaspis litorosa Ferris
(Fig. 25)


Originally described from Rhachidospermum mexicanum on the beach at Eureka Ranch, La Rivera, Baja California, Mexico.

"Occurring beneath the sheathing base of the leaves. Scale of female 2.5 mm long, elongate oval, white. First exuvium naked, second white. Ventral scale continuous with the dorsal scale, thick, composed in part of the ventral portion of the second exuvium. Scale of the male of the type common to the genus." (Ferris, 1921a).

Slide-mounted young female circular, ca. 1 mm in diameter; fully grown female elongate oval, up to 1.8 mm long, 1.0 mm wide. Apex of segment 8 slightly projecting; with median emargination; two to five ducts discharge along margin of emargination. Margins of segments 7 and 6 each with small, apically rounded projection. With minute indentations at posterior ends of intersegmental furrows between 8-7 and 7-6; with deeper indentations at margin between 7-6, 6-5, and 5-4. With marginal sclerosis, rounded at inner end, at each of posterior ends of intersegmental furrows between 8-7 and 7-6. Marginal setae, ventral, of 8, 7, 6, 5, and 4 placed marginally; tips project off margin. Marginal setae, dorsal, of 8, 7, and 6 placed marginally; tips project off margin; dorsal setae of 5 and 4 placed submarginally; tips not projecting off margin; dorsal setae thinner and slightly shorter than ventral. Intersegmental folds as figured. Dorsal intersegmental line between 6 and 5 absent; with pair of transverse apophyses separated from each other at site of this line. Crenulae as figured. Ducts in three sizes. Macroducts ca. 14 long, 3 wide; dorsal and ventral ducts subequal in size; distributed dorsally and ventrally as figured; ducts present or absent dorsally on median and submedian areas just anterior to apophyses of segment 5. Microducts ca. 11 long, 1 wide, distributed only ventrally as figured. Microducts ca. 17 long, 2 wide, discharge along margin of segments 8, 7, 6, and 5. Gland tubercles placed ventrally in two submarginal clusters; one lateral to each anterior apophysis, second lateral to anterior ridge of clypeolabral shield. Anus situated 20-21 times its diameter from apex of pygidium. Vulva placed posterior to level of anus, ca. three times diameter of anus. Perivulvar pores in median group of 8-23 (15) pores, and 2 lateral groups each with 32-70 (54) pores. Anterior spiracle with 5-17 (11) spiracular pores; posterior spiracle with 5-19 (10) pores.

Material Examined. MEXICO: Baja California, La Rivera, July 1919, Rhachidospermum mexicanum, G.F. Ferris, holotype and paratypes, UCD; specimens mounted from original collection, VPI; intercepted at California, 29.III.1940, grass, Churchman, CDA. U.S.A.: ARIZONA: Elfrida, 17.VII.1940, Sporobolus airoides, G.F. Ferris, UCD; Red Lake
South of Araibo, 1940, Sporobolus aroides, G.F. Ferris, UCD. COLORADO: Montezuma County, 15 miles south of Cortez, 4.VII.1970, Graminaeae, D.R. Miller, CDA. TEXAS: Point Isabel, grass, G.F. Ferris, UCD.

Odonaspis minima Howell and Tippins (Fig. 26)


"Adult female on outer surface of leaf, usually below soil surface. Scale cover white, narrowing posteriorly, ca. 1 mm long, 0.5 mm wide, exuviae terminal, yellow. Covering of male similar but smaller." (Howell and Tippins, 1978).

Slide-mounted female oval, 0.6-1.0 mm long, 0.5-0.6 mm wide. Margins of segments 8, 7, and 6 forming triangular shape, without projections or indentations. With indentations at posterior ends of intersegmental furrows between 6-5, 5-4, and 4-3. Marginal setae, dorsal, of 8, 7, 6, 5, and 4 placed marginally; marginal setae, ventral, of these segments shorter than respective dorsal placed marginally. Pygidial margin without marginal scleroses. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median and submedian part) between 6 and 5 absent. Crenulae as figured. Ducts in three sizes. Macroducts ca. 17 long, 4 wide; orifice surrounded by dark rim; rim as wide as or slightly wider than perivulvar pore; distributed on dorsum of segments 8, 7, 6, 5, 4, 3, and 2; on venter only of segments 8 and 7. Macroducts ca. 10 long, 2 wide; ca. 1/2 as wide as dorsal macroduct; placed ventrally on segments 6, 5, 4, 3, 2, and 1, on metathorax, and on segments 8 and 7 only marginally; orifice surrounded by dark rim; rim slightly smaller than rim of dorsal duct. Microducts ca. 5.0 long, 0.5 wide, only on venter lateral to mouth parts; in transverse bands medially and laterally to spiracles; on median areas of segments 2 and 1; on submedian areas of 3, 4, 5, and 6; four to six ducts located on area enclosed with perivulvar pores. Gland tubercles ventrally in two clusters on submargin of mesothorax and prothorax. Anus placed ca. 13 times its diameter from apex of pygidium. Vulva placed posterior to level of anus. Perivulvar pores in contiguous band on each side and anterior to vulva; with 47-89 (65) pores. Anterior spiracle with 8-21 (12) spiracular pores; posterior spiracle with 5-18 (10) pores.

Material Examined. U.S.A.: GEORGIA: Charlton County, State Route 94, 8 km W of Saint George, 5.IV.1972 and 14.XI.1977, Aristida sp., R. Beshear; holotype and paratypes in USNM; paratypes in UG and VPI.

Notes. This unique species is distinguished by the absence of pygidial scleroses, absence of intersegmental line (median part) between 6 and 5, and dorsal macroducts of pygidium being about twice as wide as ventral ones.

Odonaspis morrisoni Beardsley (Fig. 27)


This species was originally described from a series taken from various graminaceous host plants in Micronesia and in the Philippines. Additional records (see Material Examined) suggest that it is more widely distributed in Southeast Asia and in southern Pacific islands.

Only slide-mounted specimens available for study.

Male not mentioned in original description.

Slide-mounted female broadly oval, 0.8-1.3 mm long, 0.6-1.0 mm wide. Margin of segment 8 forming protuberant projection, rounded apically; lateral margin with two pointed notches on each side. Pygidial margin with marked indentations at posterior ends of intersegmental furrows between 8-7, 7-6, 6-5, and 5-4. Marginal setae, dorsal, of segment 8 ca. 30 long, placed marginally. Marginal setae, dorsal, of 7, 6, 5, and 4 placed submarginally; apices reaching or slightly projecting off margin. Marginal setae, ventral, of
8 situated ca. two times its length from margin; apex not reaching margin. Marginal setae, ventral, of 7, 6, 5, and 4 placed marginally; longer than respective dorsal setae. With clavate marginal sclerosis ca. 60 long at posterior end of intersegmental furrow between 8 and 7. Intersegmental folds as figured; submedian parts of ventral furrow between segment 6 and segments 5+4 with conspicuous "swellings" posterior to folds. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark line, which is continuous through median line. Crenulae as figured. Ducts of one size, ca. 15 long, 3 wide; orifice surrounded by dark rim; ducts of same size and shape discharge into gland tubercles and along margin of segments 8, 7, 6, and 5; ducts present on ventral area enclosed by perivulvar pores. Gland tubercles ventrally in clusters on submargin of head, prothorax, and mesothorax. Anus situated 20-25 times its diameter from pygidium apex. Vulva placed anterior to level of anus at distance 0.3-0.4 times distance between anus and pygidium apex. Perivulvar pores in contiguous band on each side of and anterior to vulva; 6-15 pores in anterior position; 40-80 pores on each lateral position; total number 90-180 (139). Anterior spiracle with 18-50 (30) spiracular pores; posterior spiracle with 10-25 (16) pores.


Odonaspis oshimaensis Kuwana
(Fig. 28)

Originally described from Amami-Oshima Island, at Ryuku Island, in southern Japan, where it was taken on "Kankaya" and on Panicum sanguinale. Type material was not available for this revision. The present redescription is based on a later collection of totopotypic material and on material from Taiwan.

The general appearance of the scale cover is given in a photograph by Kawai (1980).

Slide-mounted female oval, 0.7-1.4 mm long, 0.6-0.9 mm wide. Margin of segment 8 forming protuberant projection rounded apically; lateral margins with one notch on each side. Marginal setae, dorsal, of segment 8 ca. 35 long, placed marginally. Marginal setae, dorsal, of 7, 6, 5, and 4 placed submarginally; tips of setae projecting off margin. Marginal setae, ventral, of 7, 6, 5, and 4 placed marginally; longer and stouter than respective dorsal setae. Clavate sclerosis 30-40 long, placed at posterior end of intersegmental furrow between segments 8 and 7. Sclerosis placed at posterior end of intersegmental furrow between 7 and 6; circular, shorter than former scleroses. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark line, which is continuous through median line. Crenulae as figured. Ducts of one size, ca. 13 long, 3 wide; orifice surrounded by dark rim; ducts discharging into gland tubercles and on margin of segments 8, 7, and 6, of same size; ducts present ventrally on area enclosed by perivulvar pores. Gland tubercles ventrally in clusters; one at level of mouth parts, other between spiracles. Anus bounded posteriorly by semicircular sclerosis; placed ca. 25 times its diameter from pygidium apex. Vulva placed anterior to level of anus, at distance two to four times anus diameter. Perivulvar pores in median


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group of 3-16 (12), and 2 lateral groups each with 59-73 (64) pores - in specimens from Japan; in material from Taiwan frequency is 11-16 (13) and 32-72 (55), respectively. Anterior spiracle with 24-46 (34) spiracular pores and posterior spiracle with 0-5 (1) pores in specimens from Japan; in specimens from Taiwan frequency is 30-70 (41) and 0-4 (0.3), respectively.


Notes. This species very much resembles O. morrisoni in the clavate scleroses placed at the intersegmental furrow between segments 8 and 7. O. oshimaensis is readily separable from morrisoni in fewer spiracular pores at the posterior spiracles, in the larger size of mesal scleroses, and in the presence of a second pair of pygidial scleroses.

**Odonaspis pacifica**, n. sp. (Fig. 29)

Only slide-mounted females of this species were available.

Female oval, ca. 2.2 long, 1.5 mm wide. Margin of segment 8 forms pronounced projection, rounded apically; with notch on each lateral margin. With pointed indentation on margin between segments 8 and 7; one stout seta, ca. 18 long, located at each indentation. With two pairs of marginal scleroses; one at end of intersegmental furrow between 8 and 7, ca. 35 long; second located between 7 and 6, ca. 28 long. Marginal setae, ventral, of 7, 6, 5, and 4 placed marginally; longer and thinner than setae of 8. Marginal setae, dorsal, of 7, 6, 5, and 4 placed submarginally; tips not reaching margin. Interssegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median part) between 6 and 5 not formed of folds; present as dark line that extends through median line. Crenulae as figured. Ducts in three sizes. Macroduts ca. 7 long, 2 wide, discharge into thoracic gland tubercles. Gland tubercles in two clusters on each side; one laterally to mouth parts, second laterally to anterior spiracle. Postvulvar sternite distinct; macroducts in single row on each side of sternite; no ducts on median area. Dermal striation throughout body of similar pattern, with numerous, rounded sclerotizations. Anus situated ca. 25 times its diameter from pygidial apex; bounded posteriorly with semicircular, sclerotized rim. Vulva placed anterior to level of anus at distance 0.2-0.3 times interval between anus and pygidial apex. Perivulvar pores absent. Anterior spiracle with three to five (four) spiracular pores; posterior spiracle with zero to two (1.5) pores.

Material Examined. MICRONESIA: Mariana Islands, Guam, intercepted at Hawaii, 7.V.1946, bamboo, Courtney. Described from holotype and three paratypes, USNM.

Etymology. This species is named after the geographical region where it is described.

**Odonaspis panici** Hall (Fig. 30)

Originally described from Egypt, where it was taken on *Panicum turgidum*. Later records (Balachowsky, 1953; Seghatoleslami, 1977; and see Material Examined) indicate that O. panici is distributed in regions from North Africa to Iran.

Female scale elongate oval, 2.0-3.0 mm long, ca. 1.5 mm wide; white; exuviae bright brown placed at anterior part of scale.

"Male scale smaller, elongate with subparallel sides. Pellicule orange."
Length of scale of male 1 mm." (Hall, 1926).

Mounted specimens of adult female oval, 0.9-1.8 mm long, 0.6-1.3 mm wide. Margin of segment 8 in form of triangular projection, truncated apically; projection terminates on each side by small indentation. Segment 7 with broad, triangular projection. Margin of segment 6 variously indentated. Dorsal intersegmental furrows between 8-7 and 7-6 not distinct; ventral furrows between these segments distinct. With two pairs of marginal scleroses; rounded apically; one pair at posterior ends of intersegmental furrows between segments 8 and 7; second at ends of furrows between 7 and 6. Marginal setae, ventral and dorsal, of segment 8 long, apices exceeding margin; with heavily sclerotized sockets. Marginal setae, dorsal, of segments 7, 6, 5, and 4 slender, placed submarginally; apices not exceeding margin. Marginal setae, ventral, of segments 7, 6, 5, and 4 placed marginally; apices projecting off margin. Intervertebral folds, dorsal and ventral, as figured. Dorsal intersegmental furrow between 6 and 5 (median and submedian parts) not made of folds; present as two dark lines subparallel to each other. Crenulae as figured. Ducts in three sizes. Macroducts 16-18 long, 3-4 wide; orifice surrounded by dark rim; distributed ventrally and dorsally as figured; dorsally situated as high as metathorax; 1-2 ducts occur medially, and 2-8 submedially on dorsum of segment 5; ventrally, 6-10 ducts situated within area enclosed by perivulvar pores; on venter of segment 6, ducts extend to crenulae. Microducts ca. 10 long, 1-2 wide, placed ventrally only, as figured. Microducts 20-30 long, ca. 1.5 wide, placed marginally on segments 8, 7, 6, and 5. Gland tubercles absent. Anus placed 19-21 times its diameter from apex of pygidium. Vulva placed slightly posterior to level of anus. Perivulvar pores in median group with 4-19 (12.4) pores; in 1 specimen of type-series, no pores are present in this position; 2 lateral groups, 52-76 (60) pores in each. Anterior spiracle with one to eight (four) spiracular pores; posterior with one to four (two) pores.


Odonaspis paucipora, n. sp. (Fig. 31)

Crowded populations of this scale insect occur on the underside of the leaf sheaths.

Female scale oval, 1-2 mm long, 0.8-1.5 mm wide; white; larval exuviae yellow brown placed at anterior end of scale.

Male scale elongate, parallel-sided, ca. 1 mm long, 0.5 mm wide; white; larval exuviae yellow brown placed at anterior end of scale.

Slide-mounted young female circular, ca. 0.5 mm in diameter; fully grown female elongate oval, up to 1.3 mm long, 0.7 mm wide. Margin of segment 8 forms pronounced projection rounded apically; each lateral margin with one notch. Margin of segments 7 and 6 each with rounded projection. Margin between segments 8 and 7 with pointed indentation where is located single stout seta, ca. 25 long. With clavate sclerosis ca. 25 long at posterior end of intersegmental furrow between segments 8 and 7; with clavate sclerosis ca. 20 long at posterior end of intersegmental furrow between 7 and 6. Marginal setae, ventral, of 7, 6, 5, and 4 stout placed marginally. Marginal setae, dorsal, of 7, 6, 5, and 4 shorter than respective ventral ones; tips slightly projecting.
off margin. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median and submedian part) between 6 and 5 not formed of folds; present as dark line that extends through median line.

Crenulae as figured. Ducts of one size and shape; ca. 18 long, 2 wide. Postvulvar sternite very distinct; ducts disposed in single row on each side of sternite, close to intersegmental furrow; no ducts on median area of sternite. Dermal striation on head in form of transverse, dark lines; different from striation on thoracic segments. Dermal striation on thoracic segments with numerous, rounded sclerotizations. Anus situated 11-13 times its diameter from apex of pygidium; bounded posteriorly with semicircular, sclerotized rim. Vulva placed anterior to level of anus at distance 0.2-0.3 times interval between anus and pygidium apex. Perivulvar pores placed loosely only in lateral positions; one to four (three) pores in each side. Anterior spiracle with one to four (three) spiracular pores; posterior spiracle without pores.


Etymology. The species name is from the Latin pauc meaning "few" and por meaning "a pore." It refers to the small numbers of perivulvar and spiracular pores characterizing the female of this species.

Notes. This species comes very close to the following species: 0. greeni, 0. morrisoni, 0. oshimaensis, 0. secreta, and 0. serrata. These species resemble each other in the protuberant, apically rounded margin of segment 8 and in the stout marginal setae of that segment. 0. paucipora is easily separated from these species in the reduced number of perivulvar pores and the absence of marginal ventral setae on segment 8.

Odonaspis phragmites Hall
(Fig. 32)


The original description of this species was based on material taken from Phragmites communis in Zimbabwe (Rhodesia).

Female scale broadly oval; white; exuviae brown placed subcentrally; fully grown female with scale up to 3.5 mm long.

Male scale, narrow, elongate oval; white; exuviae brown; 0.7-1 mm long.

Slide-mounted young female oval, 1.4 mm long, 1.2 mm wide; fully grown female up to 2.4 mm long, 1.5 mm wide. Margin of segment 8 well projecting; apex blunted; with one lateral notch on each side of projection at level of dorsal marginal setae. Margins of segments 7 and 6 each with rounded projection. Posterior ends of intersegmental furrows 8-7 and 7-6 with pointed emarginations. With two pairs of marginal scleroses, one at end of intersegmental furrow between 8 and 7, other at end of furrow between 7 and 6; inner ends of scleroses with no definite shape. Marginal setae, dorsal, of segment 8 placed at inner ends of lateral notches; apices well projecting off margin. Marginal setae, ventral, situated submarginally; apices not reaching margin. Marginal setae, dorsal, of segments 7, 6, 5, and 4 situated inward from margin, at distance about their length; apices reach margin. Marginal setae, ventral, of segments 7, 6, 5, and 4 placed marginally; apices project off margin. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 absent. Segment 5 (dorsal median area) with pair of apophyses, variously shaped; apophyses situated among macroducts. Crenulae as figured; on median areas of sternites 2 and 3, placed in transverse bands that
are two crenulae wide. Ducts in three sizes. Macroducts ca. 15 long, 3 wide, distributed as figured; ventral and dorsal ducts of pygidium subequal in size; orifices surrounded by dark rim; 5-10 ducts present ventrally on each side of area enclosed by perivulvar pores; 6-13 ducts arranged on sternite 6 on each side of lateral group of perivulvar pores. Microducts 10-12 long, ca. 2 wide, arranged ventrally on head and thorax as figured. Microducts 15-20 long, ca. 1.5 wide, situated marginally on segments 8, 7, and 6. Gland tubercles submarginally in 1 cluster of 6-12 tubercles, at level of clypeolabral shield. Anus situated ca. 20 times its diameter from apex of pygidium. Vulva placed slightly posterior to level of anus. Perivulvar pores (frequency given for type-series) in median group of 21-50 (41) pores, and 2 lateral groups with 124-179 (153) pores in each; total number of pores 306-387 (347). Anterior spiracle with 19-42 (28) spiracular pores; posterior spiracle with 17-51 (30) pores.


Notes. O. phragmitis resembles O. saccharicaulis in the shape of the projected, laterally notched margin of segment 8, as well as by the presence of thoracic gland tubercles. The former differs from saccharicaulis in the following combination of characters: (1) Larger number of perivulvar pores; (2) gland tubercles in only one cluster, whereas in two clusters in saccharicaulis; and (3) crenulae on abdominal segments 2 and 3 in bands two crenulae wide, as compared with one crenula wide in saccharicaulis.

Odonaspis ruthae Kotinsky

(Fig. 33)


Odonaspis ruthae Ehrhorn; Balachowsky, 1953:743; Balachowsky, 1958:300.


NEW SYNONYMY.

The binomen Odonaspis ruthae was published for the first time in a report of Ehrhorn (1907), who just mentioned a grass pest by this name among interceptions by the San Francisco quarantine, not stating that it was a scale insect. No taxonomic description was included there, and thus this name as published by Ehrhorn should be regarded a nomen nudum. Therefore, in accordance with the International Code and as explained by Kotinsky (1915), there is no basis for crediting the authorship of ruthae to Ehrhorn as was done by Balachowsky (1953, 1958).

The original description of Odonaspis ruthae by Kotinsky (1915) was from Hawaii on Bermuda grass.

Scale of female elongate oval, 2.0-2.5 mm long, 1.0-1.5 mm wide; white; larval exuviae brown placed at anterior part of scale.

The occurrence of males was indicated in the original description. Later the male scale was illustrated by Ferris (1938) and by Balachowsky (1953, 1958); the latter also gave a brief description of the scale. However, the following information suggests that O. ruthae is rather a parthenogenetic species. Brown (1965) cytologically examined samples of O. ruthae from Bermuda grass in Hawaii.
and California and concluded that they came from parthenogenetic populations. J.W. Beardsley, Hawaii, informed me (in lit., 1973) that "...I have never found males here, and the Hawaiian population appears to be parthenogenetic." I have examined samples from Israel, Zimbabwe (Rhodesia), and South Africa in which no males were observed.

Body of slide-mounted female oval, 0.7-1.1 mm long, 0.5-0.7 mm wide. Margin of segment 8 moderately projected; apex with shallow, rounded emargination. Intersegmental furrows indistinct on pygidium dorsum between 8-7 and 6-5. With slight indentation on margin between 8 and 7. Pygidium margin between 7 and 6 with indentation. With marginal sclerosis ca. 15 long at indentation between 8 and 7. Without marginal sclerosis at indentation between 7 and 6. Marginal setae, dorsal and ventral, projecting off margin. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow between 6 and 5 (median and submedian parts) made of variously shaped dark spots, which differ in shape from intersegmental folds; furrow interrupted medially; these dark spots may be difficult to observe in very young or understained specimens; they overstay in old specimens; they might be confused with inner extremities of dorsal macroducts. Crenulae as figured. Ducts present in three sizes. Macroducts 10-14 long, 3.0-3.5 wide, distributed ventrally and dorsally as figured; dorsal and ventral ducts on pygidium subequal in size; orifice surrounded by dark rim; 14-20 macroducts posterior to vulva within area marked by perivulvar pores; ducts on median and submedian areas of dorsum of segment 6, absent from same areas of 7. Microducts ca. 10.0 long, 1.5 wide, only on venter as figured. Ducts ca. 15 long, 1 wide, distributed along margins of segments 8 to 5, with orifices discharging on margin; two ducts are typically discharging at shallow emargination of segment 8. Gland tubercles absent. Anus situated 20-25 times its diameter from apex of pygidium. Vulva slightly posterior to level of anus. Perivulvar pores in median groups with 8-15 pores (type-series), up to 20 in specimens from other regions; 2 lateral groups with 33-37 pores (type-series), 26-45 pores in specimens from other regions. Anterior spiracle with 17-23 spiracular pores (type-series), 13-28 in other specimens. Posterior spiracle with 11-18 pores (type-series), 7-18 pores in specimens from other regions.


Notes. The Bermuda grass scale is one of the most cosmopolitan species of the Odonaspini, widely distributed in the tropical and subtropical regions of Africa, Asia, Australia, and the Americas (see Material Examined; Borchsenius, 1966; Nakahara, 1982). It likely has been widely dispersed through the extensive propagation, use, and distribution of Bermuda grass, which is the major host plant of O. ruthae.

Odonaspis pseudoruthae Mamet, 1954, is synonymized here with O. ruthae, because the differences given by Mamet (1954) were found to fall within the intraspecific variation of ruthae as observed in its type-series and additional series from Hawaii.

Odonaspis sabulincola, n. sp. (Fig. 34)

Dense populations of this species occur on stems and beneath leaf sheaths of several species of Stipagrostis in the Namib Desert of South-West Africa (Namibia). It shares this infestation site with populations of the acerdid Aclerda namibensis Ben-Dov, 1977.

Scale cover of female circular in young female, elongate oval in fully grown female; white; larval exuviae yellow brown placed centrally; up to 4 mm long in reproducing females.

Scale cover of males similar in color and shape but smaller.

Slide-mounted young female circular, ca. 1 mm in diameter; fully grown female elongate oval, up to 3.0 mm long, 1.5 mm wide. Margin of segment 8 with two triangular projections, separated from each other by straight margin, ca. two times diameter of anus. Margins of segments 7 and 6 each with a triangular projection. Pygidial margin with minute emarginations at posterior ends of intersegmental furrows between 8-7 and 7-6. Clavate sclerosis at posterior end of each intersegmental furrow between 8-7 and 7-6. Marginal setae slender; projecting off margin. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental line between segments 6 and 5 not formed of folds; continues through median area. Crenulae as figured. Ducts in two sizes. Macroducts ca. 15 long, 3 wide; orifice surrounded by dark rim; ventral and dorsal macroducts of pygidium subequal in size; placed on venter and dorsum as figured; ducts absent from median area of dorsum of segment 5; frequency of macroducts on segments 8 and 7 given in table 5. Microducts ca. 10 long, 1-2 wide; present ventrally on thorax and head as figured. Anus situated ca. 20 times its diameter from apex of pygidium. Vulva at about level of anus. Perivulvar pores absent. Anterior spiracles with one to six (four) spiracular pores. Posterior spiracle with two to seven (five) pores.

Material Examined. SOUTH-WEST AFRICA (NAMIBIA): Namib Desert, Gobabeb, 28.II.1975, Stipagrostis sp., S. Endrody-Younga. Described from holotype and 27 paratypes; holotype and paratypes
in PPRI; paratypes in ANIC, BMNH, CDA, FDA, ICV, MNP, ST, UG, UH, and USNM. Additional material (not type-series) all from Namib Desert as follows: Gobabeb (Homab), 5.IX.1975, Stipagrostis sp., S. Endrody-Younga, PPRI; Miss Checkie Flay, X.1981, Stipagrostis namaquensis, B. Curtis, ICV; F.E. Station, II.1982, Stipagrostis sabulincola, B. Curtis, ICV; Noctivaga, I.1982, Stipagrostis namaquensis, B. Curtis, ICV.

Etymology. The species name is from the Latin sab meaning "sand" and col meaning "to dwell." It refers to the sand dunes habitat in the Namib Desert from which it is described.

Notes. This species and O. stipagrostis are known from similar host plants in adjacent regions in southern Africa, and both are characterized by the absence of perivulvar pores. O. sabulincola differs from stipagrostis in the straight and wider margin between the triangular projections on segment 8 and in the greater number of dorsal and ventral macroducts on segments 7 and 8.

Table 5
Frequency of pygidial macroducts on segments 8 and 7 in Odonaspis species.1/

<table>
<thead>
<tr>
<th>Odonaspis species</th>
<th>Dorsal macroducts on segments 8</th>
<th>Ventral macroducts on segments 8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>sabulincola</td>
<td>13-23 (17)</td>
<td>27-60 (39)</td>
</tr>
<tr>
<td></td>
<td>40-81 (51)</td>
<td>34-61 (47)</td>
</tr>
<tr>
<td>stipagrostis</td>
<td>4-7 (6)</td>
<td>14-27 (18)</td>
</tr>
<tr>
<td></td>
<td>10-22 (17)</td>
<td>14-29 (20)</td>
</tr>
</tbody>
</table>

1/Macroducts for 8 are on postvulvar sternite and postanal tergite, respectively; those for 7 are on half body between respective inter-segmental furrows. Averages in parentheses.

Odonaspis saccharicaulis (Zehntner) (Fig. 35)

Aspidiotus saccharicaulis Zehntner, 1897a:36; Zehntner, 1897b:1.
Odonaspis secreta saccharicaulis Cockerell, 1899:274; Fernald, 1903:300.
Odonaspis saccharicaulis (Zehntner);
Aspidiotus (Odonaspis) janeirensis Hempel, 1900:500. NEW SYNONYMY.

Originally described from Pasoeroean in Java, Indonesia, where it was taken on "Glonggong" (a common name for Saccharum arundinaceum and S. spontaneum; see De Clercq, 1927). Since later redescriptions (Green and Laing, 1923; Balachowsky, 1953, 1958) of this species were based on material from the Madeira Island and São Thomé Island, it was doubted whether their interpretations of O. saccharicaulis agreed with those of the species from Java. The present redescription is based on the neotype designated here, as well as on topotypic material.

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Female scale circular to oval, 1.6-2.6 mm long, ca. 1.0 mm wide; white; larval exuviae yellow brown placed subcentrally.

Male unknown.

Slide-mounted young female circular, 0.9 mm long, 0.8 mm wide; fully grown female oval, up to 1.8 mm long, 1.2 mm wide. Margin of segment 8 forming protuberant projection; apex with rounded, shallow emargination; with one lateral notch on each lateral margin of projection, at level of marginal setae, dorsal, of segment 8; notches vary from pointed to shallow. Margins of segments 7 and 6 each with rounded projection, followed by smaller, variably shaped projections. Posterior ends of intersegmental furrows 8-7 and 7-6 with pointed indentations. With two pairs of marginal scleroses; one at end of intersegmental furrow between segments 8 and 7; second at end of furrow between 7 and 6; inner ends of scleroses with no distinct shape. Marginal setae, dorsal, of segment 8 placed marginally, tips projecting off margin; marginal setae, ventral, of 8 placed submarginally, tips slightly projecting off margin. Marginal setae, dorsal, of segments 7, 6, 5, and 4 placed submarginally, tips not reaching margin. Marginal setae, ventral, of 7, 6, 5, and 4 placed marginally, their tips projecting off margin. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median part) between 6 and 5 absent. Median area, dorsal, of segment 5 with pair of apophyses, varying in shape as figured; apophyses situated among ducts. Crenulae as figured; on median areas of sternites 2 and 3, placed transversely in bands one crenula wide. Ducts in three sizes.  


AUSTRALIA: NEW GUINEA: At Washington, DC, 7.XII.1937, Saccharum, Limber, USNM.

Notes. No types of A. saccharicaulis are available in the collections of BMNH, MNP, UCD, or USNM. In reply to a query referred to Holland, I was informed by J.P. Duffels, Instituut voor Taxonomische Zoologie, Amsterdam, that no types are available there, neither in Rijkmuseum van Natuurlijk Historie, Leiden, nor in Laboratorium voor Entomologie, Wageningen. A request was referred also to the Geneve Museum, Switzerland, where Zehntner was studying after returning from Java (see Zehntner, 1954), but no material was available there. It is assumed therefore that the types of saccharicaulis were lost in a fire in 1902, which destroyed Zehntner's collection, as reported by Zehntner (1954) and Hauser (1972).

Considering this information on the types of A. saccharicaulis, the revisionary scope of this study, and the availability of proper material, I suggest that these are qualifying conditions for designating a neotype, under Article 75 of the International Code. The neotype was selected from a lot of seven females mounted on two slides (Nos. 60 0081) at USNM. According to a letter (dated 18.III.1938, in USDA files) from P.C. Bolle, Sugar Experiment Station, Pasoeroean, Java, to H. Morrison, this material was collected at Pasoeroean in 1895-96, when Zehntner was working there.

The synonymy of Aspidiotus (Odonaspis) janeirensis (Hempel, 1900) with O. saccharicaulis is introduced here because no morphological differences were observed between a type of the former (see Material Examined) and types of O. saccharicaulis.

Odonaspis schizostachyi Cockerell and Robinson (Fig. 36)

Originally described from Los Banos in the Philippines, where it was collected from a bamboo, Schizostachyum sp.

"Female scale circular, little over 1 mm diam., dull white, concentrically wrinkled, the large first skin very pale yellowish." (Cockerell and Robinson, 1914).

Slide-mounted specimen of young female circular or slightly oval, ca. 1.0 mm long, 0.9 mm wide; fully grown female oval, up to 2.5 mm long, 2.0 mm wide. Margin of segment 8 forming rounded projection; without notches on lateral margins of projection. With pointed indentation on each side of projection of segment 8; two stout setae, as long as projection, situated marginally at each indentation. Margins of segments 7 and 6 each with two rounded projections; median larger than lateral. Marginal setae, dorsal and ventral, of 7 and 6 subequal in size to setae of 8. Marginal setae, from segment 5 to head, progressively increase in length; setae on head up to 75 long. With one clavate sclerosis ca. 45 long, situated at each indentation between segments 8 and 7. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark line that extends continuously through median line. Crenulae as figured; present medially to perivulvar pores; on each of segments 6, 5+4, 3, 2, and 1 disposed in one crenula-wide band. Ducts in two sizes. Macroducts ca. 30 long, 4 wide, distributed dorsally and ventrally as figured; ventrally present as high as lateral to mouth parts; cluster of ducts discharge at margin of each indentation of segment 8. Microducts ca. 20 long, 2 wide, distributed on venter only in transverse bands on mesothorax and metathorax; on metathorax, orifice of each duct is surrounded by dark lines in form of polygon; polygons disposed close to each other, thus forming continuous pattern across ventral surface of metathorax. Postvulvar sternite very distinct; narrow at anterior end; posterior end about twice as wide as anterior one; ducts disposed on each side of sternite in single row, close to intersegmental furrow. Gland tubercles absent. Anus bounded posteriorly by horseshoe-like sclerotization; situated ca. 20 times its diameter from pygidium apex. Vulva anterior to level of anus at distance 0.3–0.4 times distance between anus and pygidium apex. Perivulvar pores in 2 lateral groups, each with 160–200 (175) pores; without pores in position of median group. Anterior spiracle with 24–33 (26) spiracular pores; posterior spiracle with 5–10 (7) pores. Antennal tubercle with one hair.

Material Examined. All material from type locality. PHILIPPINES: Luzon, Los Banos, XII.1913, Schizostachyum sp., C.F. Baker, lectotype (designated here) and four paralectotypes, on three slides, collected December 1913, USNM; type slides, respectively, I labeled. Additional material (not included in type-series) with similar collection data collected in 1912 and 1914, UCD and USNM.

Notes. O. schizostachyi belongs in a group of bamboo-inhabiting species of Odonaspis known from the Oriental region. This species is easily distinguished from other species of the group by the very long marginal setae on the head and the thorax and by the absence of perivulvar pores in the median group position.

This species develops on its host plant in association with the fungi Septobasidium bakeri Pat., a species described from the type locality of O. schizostachyi (see Couch, 1938).

Odonaspis secreta (Cockerell) (Fig. 37)

Odonaspis secreta (Cockerell); Leonardi, 1897a:286.
Aspidiotus (Odonaspis) secretus Cockerell; Cockerell, 1897:14.
Aspidiotus (Dycryptaspis) secretus Cockerell; Leonardi, 1897b:375.
Spatheaspis secreta (Cockerell); Leonardi, 1897c:115.
Aspidiotus secretus lobulata Maskell, 1897:241.
Odonaspis secreta (Cockerell); Fernald, 1903:300; Ferris, 1938:166; Balachowsky, 1953:733; Borchsenius, 1966:226; Kawai, 1980:201.

Originally described from bamboo in Tokyo, Japan. Later records indicate that this species develops on various species of bamboo in Africa, America, Asia, and Europe (see Borchsenius, 1966; Nakahara, 1982; Material Examined).

This redescription is based on the lectotype (designated here) and additional topotypic material from Japan.

These scale insects occur beneath the bases of the leaf sheaths. During their development they become buried under the thin epidermis layer of the leaf, which lies over their scale cover (fig. 68).

Scale cover of young female circular, 1.5-2.0 mm in diameter; that of fully grown female elongate, up to 4 mm long, 2 mm wide; white; larval exuviae brown placed on anterior part of scale.

Male scale narrow elongate, ca. 1.0 mm long, 0.3 mm wide.

Slide-mounted young female circular, 0.7-0.8 mm in diameter; fully grown female 3.5-3.7 mm long, 2.5 mm wide. Head, thorax, and three anterior abdominal segments with five lateral indentations, thus forming four "lobes"; second "lobe" between second and third indentations, with shallow indentation at about level of intersegmental furrow between metathorax and first abdominal segment. Margin of segment 8 forming conspicuous projection, with rounded apex and one notch on each lateral margin. Margin of segment 7 with rounded projection, much smaller than that of segment 8. Margin between segments 8 and 7 with deep indentation, where is placed single, stout seta ca. 25 long. With clavate sclerosis, ca. 50 long, at posterior end of intersegmental furrow between 8 and 7; with clavate sclerosis, ca. 25 long, at posterior end of furrow between 7 and 6; with short sclerosis, ca. 13 long, at posterior end of furrow between 6 and 5. Marginal setae, ventral, of 8 ca. 7 long, placed ca. two times its length from margin. Marginal setae, ventral and dorsal, of 7, 6, 5, and 4 placed marginally; ventral longer than dorsal. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental line (median part) between segments 6 and 5 not formed of folds; present as dark line, which is continuous through median line. Crenulae as figured. Ducts throughout body subequal in shape and width, ca. 2; 15-18 long on pygidium, ca. 12 long on thorax. Postvulvar sternite very distinct; ducts on each side of sternite in single row, close to intersegmental furrow; absent from median area of sternite. Dermal striaion of ventral and dorsal surfaces of head and thorax with numerous, rounded sclerotizations, ca. 1 in diameter; sclerotizations absent on two circular areas placed ventrally on each side of metathorax. Anus situated 20-24 times its diameter from apex of pygidium. Vulva placed anterior to level of anus at distance about 0.3 times interval between anus and pygidium apex. Perivulvar pores in contiguous band on each side of and anterior to vulva; 56-130 pores in each lateral position; 6-23 pores in median position; total number of pores 140-280 (237). Anterior spiracle with 4-10 (7) spiracular pores; posterior spiracles without pores.

Material Examined. JAPAN: Two slides each mounted with second instar labeled "5944, bamboo, Japan, Takahashi, Aspidiotus secreta Ckll., Cotype, det. Ckll.," USNM; slide mounted with female and second-instar female, and labeled "5944, A. secreta, bamboo, Japan, Takahashi," female here designated lectotype, USNM; type slides, respectively, I labeled; three slides labeled "Type material, Odonaspis secreta var. lobulata Maskell, on Bambusa tessellata, Minanoshita, Japan, Koebele collection No. 1513," UCD; five slides labeled "Aspidiotus secreta lobulatus Ckll., Japan, Mask. coll. No. 552," USNM; Yeddo, 1875, Arundinaria japonica, USNM; Klushu, I.1900, Arundinaria simonii, USNM; Japan, intercepted at Hamburg, 28.III.1905, Bambusa veitchi-argenta, P. Manskopf, USNM; Yokohama, XII.1911, Sasa.

Additional Records in Publications.


Notes. The characters that distinguish this species from its allied congener, O. greeni, are discussed under the latter species.

Odonaspis serrata, n. sp.
(Fig. 38)

Only slide-mounted females were available for the study.

Males present.

Young female circular, ca. 0.9 mm in diameter; fully grown female broadly oval, up to 2 mm long, 1.3 mm wide. Margin of segment 8 forms pronounced projection, rounded apically; with one notch on each lateral margin. One stout seta, ca. 30 long, at each marginal indentation between segments 8 and 7; tips of setae in line with apex of segment 8. Margins of segments 6 and 5 with 4-6 and 8-10 triangular projections, respectively. With three pairs of marginal scleroses; one between segments 8 and 7, ca. 45 long; second between 7 and 6, ca. 20 long; third between 6 and 5, ca. 20 long. Marginal setae, ventral, of 7, 6, 5, and 4 as long as but thinner than setae of 8; placed marginally. Marginal setae, dorsal, of 7, 6, 5, and 4 shorter than respective ventral; placed marginally. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median part) between 6 and 5 not formed of folds; present as dark line extending across median line. Crenulae as figured. Ducts throughout body ca. 30 long, 2 wide, distributed on dorsum and venter as figured; absent from margin of segment 8 between lateral notches. Gland tubercles absent. Postvulvar sternite distinct; ducts located in single row on each side of sternite; ducts absent from median area. Dermal striation on middle areas of dorsum and venter with numerous, rounded sclerotizations; on marginal and submarginal areas striation without sclerotizations. Anus situated ca. 27 times its diameter from pygidial apex; bounded posteriorly by semicircular, sclerotized rim. Vulva anterior to level of anus ca. 0.2 times interval between anus and pygidial apex. Perivulvar pores in 2 lateral groups; 65-130 (107) pores in each. Anterior spiracle with compact group of 2-7 (4) spiracular pores in front of spiracle and additional 6-14 (9) pores in loose grouping median to spiracle; posterior spiracle with 2-8 (5) pores.

Material Examined. SRI LANKA: Punduloya, March 1897, Arundinaria sp., E.R. Green, Cooley Collection No. 579. Described from holotype and 10 paratypes; holotype and paratypes in USNM; paratypes in BMNH, ICV, MNP, and ST. Additional material (not included in type-series): INDOCHINA: 29.IX.1921, Bambusa sp., F.A. McClure, USNM.

Etymology. The specific name is from the Latin serr meaning "a saw." It refers to the serrated margin of pygidial segments 6 and 5.

Notes. The shape of margin of segment 8, the stout marginal setae of segment 8, the anterior placement of the vulva, and the distinct postvulvar sternite are the
main features joining 0. serrata to the secreta group of species. It resembles 0. greeni in having only the two lateral groups of perivulvar pores, but it differs in the additional loose grouping of spiracular pores median to the anterior spiracles and in the triangular projections on the pygidial margin of segments 6 and 5.

**Odonaspis siamensis** (Takahashi)  
(Fig. 39)

**Froggattiella siamensis** Takahashi, 1942:50; Borchsenius, 1966:228.  
**Odonaspis siamensis** (Takahashi); Ferris, 1955:33.

Originally described from a bamboo in Bangkok, Thailand. This redescription is based on the type-series and on additional material from the Philippines and China.

"Adult female scale white, with yellowish larval skins. Body dark brown in dried specimens, variable in shape...."  
(Takahashi, 1942).

No information available on the occurrence of males.

Slide-mounted female oval; young female 0.9 mm long, 0.7 mm wide; fully grown female up to 2.3 mm long, 1.1 mm wide. Margin of segment 8 with shallow emargination, bordered on each side by small, triangular projection. Margins of segments 7 and 6 variously curved, with conspicuous, rounded projection on margin of segment 7 and segment 6. With pointed indentation at posterior end of intersegmental furrow between segments 6 and 5. Two clavate scleroses, 30-60 long, on each half of pygidium; one placed laterally to marginal setae of 8, second laterally to marginal setae of 7. Ventral marginal setae of 8 placed ca. 1/3 length of sclerosis; tip projecting off margin. Dorsal marginal setae of 8 shorter than ventral, placed marginally. Marginal setae, ventral and dorsal, of 7, 6, 5, and 4 subequal in length, placed marginally. Intersegmental folds as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 not distinct; there is distinct difference along site of this furrow between dermal pattern of these segments. Crenulae as figured. Postvulvar sternite distinct; well defined laterally by intersegmental furrows; ducts present on all areas of sternite. Ducts of one size, ca. 15 long, 2 wide. Ducts on all dorsal areas of segments 8, 7, and 6; on segment 5, ducts occur dorsally on submargin and few on submedian and median areas; on rest of abdominal segments, ducts occur dorsally only on submargin. On venter, ducts occur in continuous band, on margin and submargin, from pygidium to head; on submargin of abdominal segments 3, 2, and 1 and thorax, located among sclerotized lines. Gland tubercles absent. Anus surrounded by wide, sclerotized rim; situated 18-22 times its width (ca. 10) from apex of pygidium. Vulva at about level of anus. Perivulvar pores absent. Anterior spiracle with 3-14 (7) spiracular pores; posterior spiracles without pores. Antennal tubercle with one hair; situated very close to margin, at level of anterior margin of clypeolabral shield; tubercle separated from margin by space ca. four times length of hair; distance between bases of tubercles 1.1-1.6 times distance between anterior peritremes.

Material Examined. THAILAND: Lectotype (designated here) and 10 paralectotypes, on slide labeled "Odonaspis (Froggattiella) siamensis Tak., 3.IV.1940, Chiangmai, Siam, R. Takahashi"; each specimen of type-series I remounted and labeled on separate slide; lectotype and paralectotypes in FRT; paralectotype in ICV. CHINA (all following records listed below collected by F.A. McClure, deposited in USNM): Kwangtung Province: Pinq Shi, 20.IV.1925, Bambusa; Tunq Heunq, 25.IV.1925, Bambusa; Ts'inq Uen District, 20.VIII.1926, Bambusa; Ts'inq Uen District, 20.VIII.1926, Bambusa; Canton, Lingnan University, 3.IX.1926, Dendrocalamus latiflorus; Tong Ho-Tung Yow-Hui Yowng Hong, 18.XII.1931, Bambusa. PHILIPPINES:
Location not recorded, IX.1925, Bambusa nana.

Notes. This is a unique species among the Odonaspis species in that both antennal tubercles of the adult female are widely separated from each other and placed very close to the margin at level across the anterior ridge of the clypeolabral shield, whereas in other species of the genus, these are located well in front of the shield. In this feature O. siamensis resembles the species of Froggattiella.

Odonaspis stipagrostis, n. sp. (Fig. 40)

Scale cover of female oval, 1.0-1.6 mm long, 0.8-1.1 mm wide; white; larval exuviae brown placed centrally.

Scale of male similar in shape and color to that of female but smaller.

Slide-mounted young female circular, ca. 0.8 mm in diameter; fully grown female oval, up to 1.5 mm long, 1.0 mm wide. Margin of segment 8 with two triangular projections separated from each other by pointed emargination. Margins of segments 7 and 6 each with triangular projection. Pygidium margin with small indentations at posterior ends of intersegmental furrows between segments 8-7 and 7-6. With faint scleroses, of no definite shape, at posterior ends of intersegmental furrows between 8-7 and 7-6. Marginal setae, dorsal and ventral, subequal in size; placed submarginally; apices projecting off margin. Intersegmental folds as figured. Dorsal intersegmental line (median part) between segments 6 and 5 not formed of folds; present as dark, transverse line interrupted medially by broad separation. Crenulae as figured. Ducts in two sizes. Macroducts ca. 14 long, 3 wide; orifices surrounded by dark rim; ventral and dorsal macroducts of pygidium subequal in size; disposed on venter and dorsum as figured; macroducts absent from median area of dorsum of segment 5; frequency of macroducts on segments 8 and 7 given in table 5, page 56. Microducts ca. 10 long, 1-2 wide, disposed only on venter laterally to mouth parts and spiracles. Anus situated 18-20 times its diameter from apex of pygidium. Vulva at level of anus. Perivulvar pores absent. Anterior spiracle with two to eight (four) spiracular pores; posterior spiracle with one to four (two) pores.

Material Examined. SOUTH AFRICA: Cape Province, 65 km west of Upington, at highway to Karasburg, 10.IX.1974, Stipagrostis cf. namaquensis, Y. Ben-Dov. Described from holotype and 13 paratypes; holotype and paratypes in PPRI; paratypes in BMNH, ICV, MNP, and USNM.

Etymology. The species name is the genus name of the host plant on which the type-series was collected.

Notes. This species is closely related to O. sabulincola from southern Africa and is characterized also by the absence of perivulvar pores. However, O. stipagrostis is clearly separable by the pointed emargination between the triangular projections on the margin of segment 8, by the faint marginal scleroses at the pygidium margin, as well as by the frequency of macroducts on segments 8 and 7.

Odonaspis texana, n. sp. (Fig. 41)

Only slide-mounted females of this species were available for the study.

Smallest specimen circular, 0.7 mm long, 0.6 mm wide; largest specimen oval, 1.3 mm long, 0.9 mm wide. Margin of segment 8 with broad, rounded projection with median shallow emargination on projection. Margins of segments 6 and 7 each with rounded projection. Posterior ends of intersegmental furrows of 8-7 and 7-6 with small, pointed emarginations and two pairs of marginal scleroses, 15-18 long; one at end of intersegmental furrow between segments 7 and 8; second at end of furrow between 7 and 6. Marginal setae, ventral and dorsal, of segment 8 exceeding apical margin of segment. Marginal dorsal setae of segments 7, 6, 5, and 4 slender, situated inward from
margin; marginal ventral setae of these segments longer, placed marginally.

Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 absent. Pair of sclerotizations placed transversely on submedian area of dorsum of segment 5. Crenulae as figured. Ducts in three sizes. Macroducts ca. 13 long, 3 wide, distributed as figured; ventral and dorsal ducts of pygidium subequal in size; orifices surrounded by dark rim. Microducts ca. 12 long, 2 wide, distributed ventrally on head and thorax as figured. Microducts ca. 15 long, 1.5 wide, placed marginally along segments 8, 7, 6, and 5. Gland tubercles present submarginally on venter of prothorax and head. Anus ca. 20 times its diameter from apex of pygidium. Vulva slightly posterior to level of anus. Perivulvar pores absent or very few present (see discussion on presence of pores under Notes). Anterior spiracle with 4-11 (7) spiracular pores; posterior spiracle with 3-7 (5) pores.


Etymology. The species name was formed to denote the wide distribution of this armored scale insect in southwestern Texas.

Notes. This species, as indicated by the collection data of the type-series, appears to be widely distributed in southwestern Texas. Together with O. graminis it differs from other Odonaspis species in North America by the absence of perivulvar pores. This character is frequently used in the systematics of the Diaspididae in two definite states—presence or absence. However, in O. texana the absence of perivulvar pores is apparently not a definite character. Only half the specimens of the type-series are devoid of perivulvar pores, whereas in the remainder, one to five pores (average two) are in the lateral groups.

**Odonaspis transkeiensis**, n. sp. (Fig. 42)

Female scale oval elongate, ca. 2 mm long, 1 mm wide; white grayish; larval exuviae brown placed at anterior part of scale.

Male scale oval and narrow, ca. 1 mm long, 0.4 mm wide; white grayish; larval exuviae brown placed at anterior part of scale.

Slide-mounted female oval, 0.7-1.0 mm long, 0.5-0.7 mm wide. Margin of segment 8 with distinct projection; apex of projection with shallow, rounded emargination; lateral margins with one to two rounded notches; projection ends on each side with distinct, pointed indentation. Margins of segments 7 and 6 each with rounded projection and variously shaped emarginations. With pointed indentations at posterior ends of intersegmental furrows between 8-7, 7-6, and 6-5. Marginal setae, ventral and dorsal, of segments 8, 7, 6, and 5 placed close to margin; apices exceeding margin. With marginal scleroses at posterior ends of intersegmental furrows between 8-7 and 7-6. Intersegmental folds present as figured. Dorsal intersegmental furrow (median part) between segments 6 and 5 not formed of folds; present as dark, transverse line interrupted medially. Crenulae as figured. Ducts in three sizes. Macroducts ca. 15 long, 3 wide, distributed on venter and dorsum as figured; dorsal and ventral macroducts of pygidium subequal in size; present dorsally on submedian areas of segment 4 and ventrally on area enclosed by perivulvar pores. Microducts ca. 10 long, 2 wide, only on venter; laterally...
to mouth parts, in transverse clusters at levels of anterior and posterior spiracles, and in submedian clusters on segments 1, 2, and 3. Microducts ca. 30 long, 1.5 wide, situated along margins of 8, 7, 6, and 5. Gland tubercles ventrally on submargin of prothorax (1-5 tubercles per cluster) and submargin of mesothorax (2-10 tubercles per cluster). Anus ca. 16-18 times its diameter from apex of pygidium. Vulva slightly posterior to level of anus. Perivulvar pores in median group of 13-26 (18) pores and 2 lateral groups each with 47-70 (61) pores. Anterior spiracle with 17-34 (25) spiracular pores; posterior spiracle with 5-12 (9) pores.

Material Examined. TRANSKEI (Africa): Port St. Johns, 2.VII.1973, holotype and 16 paratypes, Dactyloctenium australe, Y. Ben-Dov; holotype and paratypes in PPRI; paratypes in BMNH, CDA, FDA, ICV, MNP, UG, UH, and USNM. Additional material (not included in type-series) with collection data as type-series was taken on Stenotaphrum secundatum and Digitaria sp. More records from South Africa, C.P.: Knysna Lagoon, 25.XII.1973, grass, Y. Ben-Dov, PPRI; South Africa, at Washington, DC, 19.IV.1971, grass, J. Lightfield, USNM.

Etymology. This species name is derived from Transkei, the country in southern Africa from which it is described.

Notes. This species closely resembles O. anneckei, also described here from South Africa. It differs from the latter by the subequal size of dorsal and ventral macroducts on the pygidium, by more spiracular pores, and by dorsal macroducts on submedian areas of segment 4.

Odonaspis tsinjoarivensis Mamet
(Fig. 43)


Only slide-mounted females available for the study. No description of scale cover given in the original description. "Female puparium occurring on stem of host; of the type common to the genus." (Mamet, 1954).

Slide-mounted young female circular, ca. 1.2 mm in diameter; fully grown female oval, 1.5 mm long, 1.2 mm wide. Margin of segment 8 forms prominent, rounded projection; margin without notches; apex of projection without ducts; lateral areas with ducts. Margins of segments 7 and 6 each with rounded projection, smaller than that of segment 8. Posterior ends of intersegmental furrows between 8-7 and 7-6 with very small indentations. With deeper indentations at posterior ends of intersegmental furrows between 6-5 and 5-4. Marginal setae, dorsal and ventral, of 8 subequal in size; placed submarginally; tips project off margin. Marginal dorsal setae of 7, 6, 5, and 4 placed marginally; subequal in size to marginal setae of 8. Marginal ventral setae of 7, 6, 5, and 4 shorter than dorsal; located on sockets placed inward from margin three to four times length of setae. With marginal sclerosis placed marginally at each end of intersegmental furrows between segments 8-7 and 7-6. Intersegmental folds, dorsal and ventral, as figured. Dorsal intersegmental furrow (median and submedian parts) between 6 and 5 not formed of folds; present as dark line extending through median line. Crenulae as figured. Ducts in two sizes. Macroducts ca. 25 long, 3 wide; dorsal and ventral ducts subequal in size; distributed ventrally and dorsally as figured; present along margin of 7, 6, 5, and 4; absent from apex of segment 8. Microducts ca. 15 long, 2 wide, only on venter of segments 3, 2, and 1 and in transverse bands extending from each spiracle and laterally to mouth parts. Margin and submargin from segment 3 to mesothorax with sclerotized lines at right angle to margin; macroducts distributed among lines. Dermal striation of thorax and cephalic area thinner than sclerotized lines of abdomen and thorax; striation absent from oval area located lateral to each spiracle. Sclerotized invagination ca. 12 long, 8 wide, placed submarginally on dorsum, on each side of anterior ridge of...
clypeolabral shield. Anus placed 20-23 times its diameter from apex of pygidium; bounded posteriorly by semicircular, sclerotized rim. Vulva at about level of anus. Perivulvar pores in median group of 44-68 (57) pores, and 2 lateral groups of 142-178 (161) pores in each; in half of specimens of type-series each lateral group is subdivided transversely into 2 groups. Anterior spiracle with 30-53 (43) spiracular pores; posterior spiracle with 29-49 (36) pores.

Material Examined. MADAGASCAR: Tsinjoarivo, 25.V.1950, climbing bamboo, R. Mamet, No. 225, holotype and six paratypes, MNP.

Notes. This species resembles several Odonaspis species in having sclerotized lines set at right angle to margin of abdominal and thoracic segments. It is separated from these species as follows: (1) from O. lingnani and O. texana in the presence of perivulvar pores; (2) from O. panic in more perivulvar and spiracular pores; (3) from O. phragmitis in the absence of thoracic gland tubercles; and (4) from O. saccharicaulis in the unnotched margin of segment 8.
ECONOMIC IMPORTANCE

Odonaspidine scale insects are extensively distributed in the world on a wide range of plants, but only a few have been recorded as pests.

The sugarcane scale, *O. saccharicaulis*, occurs in the major sugarcane growing areas of the world, but it has been recorded as a pest of this crop only from India and the Philippines (Rao and Sankaran, 1969; Kalshoven, 1981). This species is reported here to be common in southern Africa on sugarcane as well as on other grasses; however, Carnegie et al. (1974) did not record it among the coccoids that infest sugarcane in southern Africa.

The Bermuda grass scale, *O. ruthae*, which is the most polyphagous species among the Odonaspidini, was reported to damage lawn grasses in Israel (Halperin, 1971; Berlinger and Barak, 1981) and to be a common pest of forage and turf grasses in the Southern United States (Dale and McCoy, 1964; Tippins and Martin, 1982).

It is likely that because of the cryptic nature of the Odonaspidini—usually occurring under the leaf sheaths—their presence is not always recorded and their economic importance is underestimated. Their hidden infestation site should be carefully considered when gramineous plants are deliberately being introduced between countries.
ZOOGEOGRAPHICAL CONSIDERATIONS

The large number of new species added in this revision (from 24 to 41) very likely indicates that the world fauna of this tribe is still not well known. Nevertheless, sufficient records of odonaspidine armored scales are available to outline some preliminary conclusions regarding their geographical distribution.

These records (appendixes 1, 2, and table 6) show that odonaspidine species are distributed in the tropics and subtropics of all zoogeographical regions, apparently not extending beyond the 45th northern and southern latitudes (fig. 44).

Thirty-one species are known from only 1 region and 5 from 2 adjacent regions. Five widely distributed species are recorded from three to six zoogeographical regions. The cosmopolitan species likely have been dispersed as a result of extensive plant introductions by persons around the world. To support this hypothesis, we note that the widespread species are those occurring on such economic grasses as sugarcane or Bermuda grass or on ornamental bamboos, for example O. ruthae, O. greeni, O. saccharicaulis, O. secreta, and F. penicillata.

The disjunct distribution of O. paucipora, described here from India and recorded also from Guyana in South America, is apparently an example of an inadvertent introduction of a bamboo-feeding species from the Oriental region to the South American continent.

Species of the tribe appear to have evolved in all zoogeographical regions as indicated in table 6 by the numbers of "indigenous" species for each region. These numbers are the remainder in each region after deducting the five cosmopolitan species, namely F. penicillata, O. greeni, O. ruthae, O. saccharicaulis, and O. secreta, from the total number of species in each region.

Southeastern Asia and the islands of the Pacific and Indian Oceans have the greatest diversity of indigenous species, especially bamboo-feeding species (fig. 44). This region is the center of distribution of the more primitive types of species of the subfamily Bambuseae (Gould and Shaw, 1983). The bamboo specificity among species of Odonaspidini apparently developed in these areas during their coevolution with their bamboo hosts. Morphological studies on two bamboo-feeding species of that region (Takagi, 1969; Howell and Tippins, 1978; Howell, 1980) appear to support this suggestion, since they showed a great morphological difference between the Asian Odonaspidini, which are bamboo-feeding species, and their American congeners.

The total numbers of species known from each region differ considerably. Nevertheless, it seems premature to suggest which odonaspidine species is most abundant or the probable center of its evolution. It is more likely that these numbers indicate the amount of survey and collecting efforts in each region. The Nearctic fauna comprises nine indigenous species, three of which are described here as new. Three new species are among the six indigenous Neotropical species. The collecting efforts in the Ethiopian region (mainly in southern Africa) have yielded five new species out of the eight indigenous ones. Extensive collections of bamboos in the Oriental region by the botanists F.A. McClure and A.S. Hitchcock were the primary source of the extensive amount of material for the descriptions of 6 new species out of 14 indigenous species.
Table 6
Distribution of Odonaspini species in 6 main zoogeographical regions

<table>
<thead>
<tr>
<th>Odonaspini species</th>
<th>Nearctic</th>
<th>Neotropic</th>
<th>Palearctic</th>
<th>Ethiopian</th>
<th>Oriental</th>
<th>Australian</th>
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HOST PLANT SPECIFICITY IN THE ODONASPIDINI

Until this study, it was assumed that species of the Odonaspidini were limited in their host range to the grass family, Gramineae. The findings here (appendix 2) substantiate that the members of the tribe are basically host specific to the Gramineae; nevertheless, there are a few exceptions. During this study, about 550 host records were studied, and only 13 of these (listed here) were taken from host plants that belong to nongramineous families.

Bromeliaceae - Odonaspis bromeliae; on bromeliad, Tillandsia sp., Tillandsia circinnata; Guatemala, Honduras; 6 records

Crassulaceae - Odonaspis benardi; on Echeveria sp.; Mexico; 1 record

Cyperaceae - Circulaspis fistulella; on Cladium jamaicense; U.S.A., Florida; 1 record

Odonaspis saccharicaulis; on Scleria canescens; Puerto Rico; 1 record

Euphorbiaceae - Odonaspis ruthae; on Euphorbia heterophylla; Cook Islands; 1 record

Juncaceae - Odonaspis graminis; on Juncus sp.; U.S.A., California; 1 record

Musaceae - Odonaspis saccharicaulis; on Heliconia sp.; Costa Rica; 1 record

Orchidaceae - Odonaspis ruthae; on Cattleya sp.; Panama; 1 record

Except the record from Euphorbiaceae, which is a dicotyledon plant, all other records were taken from family hosts that belong in the monocotyledons division of the angiospermes (Bailey and Bailey, 1978), which are close to the Gramineae. On graminaceous hosts the species of Odonaspidini have been found so far only on perennial plants of all Gramineae subfamilies.

No reliable conclusion can be suggested as to polyphagy or monophagy among species, because most of the scale species are known from a small number of collections. Nevertheless, numerous records were available for seven species that infest a wide range of hosts. The Bermuda grass scale, O. ruthae, which is the most cosmopolitan species, is also the most polyphagous, recorded from about 30 hosts, including bamboo, an orchid, and an euphorbiaceous plant.

As many as 20 host species are infested by O. saccharicaulis, including 2 from nongramineous families.

The species O. greeni, O. secreta, and F. penicillata are known only from bamboos. However, within the Bambuseae each occurs on a wide range of host species.
This study of the Odonaspini is based mainly on slide-mounted material; however, natural enemies were reared from all available live material of some odonaspine species. Such records are listed here as "unpublished data," together with credit to the colleague who identified the natural enemy. The data for other records listed here were compiled from Burks (1958), Peck (1963), De Santis (1979, 1980), and other authors cited under the respective species.

Obviously most slide-mounted diaspidids were prepared from unparasitized specimens. However, within a specimen of Odonaspis siamensis I found a well-developed adult aphelinid, which proved to be a new species (Tachikawa, 1984).

Inasmuch as hymenopterous parasites are concerned, this list together with previous observations (Rosen and DeBach, 1977, 1979) demonstrates that none of the Odonaspini species are parasitized by any species of the genus Aphytis (Hymenoptera: Aphelinidae), which are common parasites of armored scales of other major tribes in the Diaspididae.

The following list includes only 19 species of natural enemies, 5 of which are recorded here for the first time for the Odonaspini. The Odonaspini is one of the small tribes of the Diaspididae, which may be one of the reasons for the small number of parasite species recorded from its species as compared to the diversity of parasites known from other tribes of the Diaspididae. The considerable increase (three new records) contributed by this revision suggests that further exploration for parasites of this tribe is needed.
**Encarsia citrina** (Crawford)
Host: *Odonaspis secreta* (Cockerell)
Distribution: U.S.S.R.
References: Chumakova, 1965; Hadzibejli, 1983

**Physcus** sp.
Host: *Odonaspis panici* Hall
Distribution: Egypt (Sinai)
Reference: Rivnay, 1983

Notes. *Odonaspis* sp. was given (Rivnay, 1983) as host of this aphelinid. However, material of the above record was available and identified (see under *O. panici*).

**Physcus odonaspidis** Tachikawa
Host: *Odonaspis secreta* (Cockerell)
Distribution: Japan
Reference: Tachikawa, 1964

**Proaphelinoides bendovi** Tachikawa
Host: *Odonaspis siamensis* (Takahashi)
Distribution: China
Reference: Tachikawa, 1984

**Proaphelinoides elongatiformis** Girault
**Proaphelinoides mirus** (Nikolskaya)
Host: *Odonaspis secreta* (Cockerell)
Distribution: Africa (Ivory Coast), Australia, Guam, Japan, Sri Lanka, U.S.S.R.
References: Hayat, 1980; Rosen, 1980; Tachikawa, 1984

Notes. There is some disagreement among students of the Aphelinidae as to whether *P. elongatiformis* and *P. mirus* are conspecific. Rosen (1980) and Hayat (1980) synonymized *P. mirus* (= *Bestiola mira*) (Nikolskaya) with *P. elongatiformis* Girault and recorded the latter from Japan, Sri Lanka, and U.S.S.R. (Georgia). Tachikawa (1984) regarded them as distinct species and noted that *P. elongatiformis* occurs in Australia, Guam, and Sri Lanka, whereas *P. mirus* is in Japan and U.S.S.R.

**Proaphelinoides elongatiformis** is recorded here (identification by T. Rivnay, 1985) for the first time from Africa (Ivory Coast). It is likely that this parasite was accidentally introduced to the Ivory Coast from the Oriental region together with its bamboo-specific host, *O. secreta*.

**Encyrtidae**

**Adelenyrtus sp.**
Host: *Froggattiella penicillata* (Green)
Distribution: South Africa
Reference: G.L. Prinsloo (unpub. data, 1982)

**Adelenyrtus odonaspidis** Fullaway
Host: *Odonaspis* sp.
Distribution: U.S.A., Japan
References: Tachikawa, 1963; Gordh, 1979

Host: *Odonaspis ruthae* Kotinsky
Distribution: Hawaii
Reference: Beardsley, 1976

**Anabrolepis japonica** Ishii
Host: *Berlesaspidiotus bambusarum* (Cockerell)
Distribution: Japan (Kyushu and Shikoku)
References: Fulmek, 1943; Tachikawa, 1963; Yasumatsu and Watanabe, 1964

**Caenohomalopoda guamensis** (Fullaway)
Host: *Odonaspis greeni* (Cockerell)
Distribution: Guam and Hawaii
References: Beardsley, 1976; Tachikawa, 1979

**Caenohomalopoda koreana** Tachikawa, Paik, and Paik
Host: *Odonaspis secreta* (Cockerell)
Distribution: Korea
Reference: Tachikawa et al., 1981

**Caenohomalopoda shikokuensis** (Tachikawa)
Host: *Froggattiella penicillata* (Green)
Distribution: Japan and South Africa
References: Tachikawa, 1966; Prinsloo, 1979

**Signiphoridae**

**Signiphora sp.**
Host: *Circulaspis fistulella* Ferris
Distribution: U.S.A. (Florida)
Reference: G.L. Prinsloo (unpub. data, 1983)

**Signiphora insularis** (Dozier)
Host: *Odonaspis* sp.
Distribution: Guatemala and Haiti
Reference: De Santis, 1979
LITERATURE CITED


1898. Two new scale-insects quarantined at San Francisco. Psyche 8:190-191.


_____ 1900b. Some Coccidae quarantined at San Francisco. Psyche 9:70-72.


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_____ 1900b. Some Coccidae quarantined at San Francisco. Psyche 9:70-72.


Halperin, J. 1971. The occurrence of scale insects on lawns and their control (preliminary trials). Gan Vanof (Garden and Landscape) 27:141-147. [In Hebrew.]


APPENDIX 1. SPECIES OF ODONASPIDINI AND THEIR HOST PLANTS

Under each odonaspidine species are listed all the host plants on which it was recorded and the countries where it was found. The family name is given (in parentheses) only for host plants that do not belong to the Gramineae.

BERLESASPIDIOTUS MacGillivray

bambusarum (Cockerell)
- Arundinaria simonii
  - Bamboo
  - Japan

crenulatus, n. sp.
- Arundinaria walkeriana
  - Bambusa sp.
- Schizostachyum lumampao
  - India, Philippines

CIRCULASPIS MacGillivray

bibursella Ferris
- Grass
  - Mexico

canaliculata (Green)
- Bamboo
  - Bambusa sp.
- China, Sri Lanka

fistulata (Ferris)
- Distichlis spicata
  - Monanthochloe sp.
  - Mexico

fistulella Ferris
- Cladium jamaicense (Cyperaceae)
- Cynodon dactylon
- Distichlis sp.
- Distichlis spicata
- Grass
- Spartina sp.
- Spartina bakeri
- Spartina patens
- Sporobolus sp.
- Sporobolus indicus
  - U.S.A.: Florida, Georgia, Texas

DICIRCULASPIS, n. gen.

bibursa (Ferris), n. comb.
- Grass

Stipa sp.
- Tridria pilosa
  - U.S.A.: Texas

philippina, n. sp.
- Bambusa sp.
- Schizostachyum sp.
  - Philippines

FROGGATTIELLA Leonardi

inusitata (Green)
- Arundinaria sp.
  - Sri Lanka

mcclurei, n. sp.
- Bambusa sp.
- Bambusa nana
  - Grass
  - China, Hong Kong, Indonesia, Philippines

penicillata (Green)
- Arundinaria sp.
- Arundinaria hindsii
  - Bamboo
  - Bambusa sp.
- Bambusa argentea-striata
- Bambusa multiplex
- Bambusa nana
- Bambusa pervariabilis
- Bambusa stenostachya
- Bambusa vulgaris
- Dendrocalamus merrilliana
- Gigantochloa aspera
  - Gramineae
  - Lemongrass
  - Phyllostachys sp.
  - Phyllostachys aurea
  - Phyllostachys pubescens
  - Africa: South Africa. Americas:
    - Guyana, Jamaica, Mexico, Puerto Rico, U.S.A.: Alabama, California, Florida, Georgia, Hawaii, Louisiana, Mississippi, Texas.
    - Asia: China, Hong Kong, India, Iran, Japan, Pakistan, Philippines, Sri Lanka, Taiwan. Australia: Fiji Islands. U.S.S.R.: Georgia
ODONASPIS Leonard! annecki, n. sp.
Ehrharta cf. ramosa
South Africa

arbusnotata, n. sp.
Arundinaria hindsii
Bamboo
Bambusa sp.
China, Japan, Taiwan (Formosa)

aristidae, n. sp.
Aristida diffusa var. burkei
South Africa

australiensis, n. sp.
Couchgrass
Cynodon dactylon
Jointgrass
Australia: New South Wales, South Australia

benardi Balachowsky
Andropogon sp.
Bamboo
Echeveria sp. (Crassulaceae)
Grass
Johnson grass
Lemongrass
Maranta sp. (Marantaceae)
Paspalum sp.
Paspalum notatum
Sugarcane
Costa Rica, Cuba, Guatemala,
Honduras, Martinique, Mexico,
Panama, U.S.A.: Texas

bromeliae, n. sp.
Bromelia (Bromeliaceae)
Tillandsia sp. (Bromeliaceae)
Tillandsia circinnata (Bromeliaceae)
Guatemala, Honduras

floridana, n. sp.
Large grass
Spartina patens
U.S.A.: Florida

galapagoensis, n. sp.
Sporobolus virginicus
Ecuador: Galapagos Islands

graminis Bremner
Danthonia americana
Grass

Juncus sp. (Juncaceae)
Mexico, U.S.A.: California

greeni (Cockerell)
Arundinaria sp.
Bamboo
Bambusa sp.
Bambusa dissemulator
Bambusa nana
Bambusa pervariabilis
Bambusa vulgaris
Dinochloa scandens
Gigantochloa verticillata
Grass

Yellow bamboo
Africa: Tunis. Americas: Guadeloupe, Guayaquil, Martinique, Surinam, U.S.A.: California, Hawaii. Asia: China, Guam, Hong Kong, India, Indochina, Japan, Philippines, Samoa, Sri Lanka, Sumatra, Taiwan, Thailand, West Samoa, Windward Islands: St. Lucia. Europe: Czechoslovakia (in greenhouse)

lingnani Ferris
Bamboo
Bambusa multiplex
China, Indonesia

litorosa Ferris
Gramineae
Grass
Rhachidospermum mexicanum
Sporobolus airoides
Mexico, U.S.A.: Arizona, Colorado, Texas

minima Howell and Tippins
Aristida sp.
U.S.A.: Georgia

morrisoni Beardsley
Cynodon dactylon
Distichlis sp.
Grass
Zoysia matrella
Fiji Islands, Hong Kong,
Micronesia, Philippines

oshimaensis Kuwana
Grass
Panicum sanguinale
Japan, Taiwan

81
pacific, n. sp.
Bamboo
Micronesia: Guam

panici Hall
Gramineae
Panicum turgidum
Pennisetum ciliare
Egypt, Iran, Israel, Morocco

paucipora, n. sp.
Bamboo
Bambusa tulda
Guyana (British Guiana), India

phragmitis Hall
Hemarthria altissima
Phragmites sp.
Phragmites communis
Malawi, South Africa, Zimbabwe

ruthae Kotinsky
Andropogon sp.
Axonopus compressus
Bamboo
Bambusa sp.
Bermuda grass
Blue panicum grass
Brachypodium distachyum
Cattleya sp. (Orchidaceae)
Cenchrus pauciflorus
Chloris sp.
Chloris gayana
Cortaderia selloana
Couchgrass
Crabgrass
Crowfoot
Cymbopogon citratus
Cynodon sp.
Cynodon dactylon
Cynodon transvaalensis
Digitaria milanjiana
Digitaria sanguinalis
Distichlis sp.
Eleusine indica
Eremochloa ophiuroides
Euphorbia heterophylla (Euphorbiaceae)
Gramineae
Grass
Johnson grass
Lemongrass
Lepturus sp.
Lepturus repens
Panicum sp.
Panicum maximum
Paspalum distichum

Sawgrass
Setaria geniculata
Sorghum halepense
Spartina patens
Sporobolus indicus
Stenotaphrum secundatum
Witchgrass
Americas: Argentina, Bermuda, Bolivia, Brazil, Chile, Cuba, Guadeloupe, Mexico, Panama, Peru, Puerto Rico, U.S.A.: Arizona, California, Florida, Georgia, Hawaii, Kansas, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Virgin Islands.
Asia: Israel, Pakistan, Sri Lanka.
Australia: New South Wales, Queensland, South Australia, West Australia. Christmas Island, Cook Islands, Kiribati (=Gilbert Islands), Tahiti, Tuvalu (=Ellice Islands)
sabulicina, n. sp.
Stipagrostis sp.
Stipagrostis namaquensis
Stipagrostis sabulicola
South-West Africa

saccharicaulis (Zehntner)
Anadelphia arrecta
Capim angolinha
Chloris gayana
Cymbopogon citratus
Digitaria decumbens
Distichlis spicata
Gramineae
Grass
Heliconia sp. (Musaceae)
Johnson grass
Napier grass
Panicum barbinode
Paragrass
Paspalum distichum
Pennisetum sp.
Pennisetum purpureum
Phragmites communis
Phragmites karka
Saccharum sp.
Saccharum arundinaceum
Saccharum officinarum
Saccharum spontaneum
Schizachyrium sp.
Scleria canescens (Cyperaceae)
Sorghum halepense
Sorghum vulgare
Sugarcane
Uniola paniculata
Variegated grass
Zoysia matrella

gockerelli Cockerell and Robinson
Schizostachyum sp.
Philippines

secreta (Cockerell)
Arundinaria sp.
Arundinaria japonica
Arundinaria simonii
Bamboo
Bambusa sp.
Bambusa fastuosa
Bambusa metake
Bambusa tesselata
Bambusa veitchi-argenta
Phyllostachys hindsii
Sasa paniculata
China, France, Ivory Coast, Japan, Malaya, Pakistan, U.S.A.: Louisiana, New Jersey; U.S.S.R.: Caucasus, Georgia

serrata, n. sp.
Arundinaria sp.
Bambusa sp.
Indochina, Sri Lanka

siamensis (Takahashi)
Bamboo
Bambusa sp.
Bambusa nana
Dendrocalamus sp.
Dendrocalamus latiflorus
China, Philippines, Thailand

stipagrostis, n. sp.
Stipagrostis cf. namaquensis
South Africa

texana, n. sp.
Bouteloua sp.
Gramineae
Grass
U.S.A.: Texas

transkeiensis, n. sp.
Dactyloctenium australale
Digitaria sp.
Grass
Stenotaphrum secundatum
South Africa, Transkei

tsinjoarivensis Mamet
Bamboo
Madagascar
Under each host plant are listed all the Odonaspidini species where they were recorded and the countries where found. Since these plant names are given as labeled on collection data, several are listed under two names, for example, *Sorghum halepense* and Johnson grass. The family name is given (in parentheses) only for host plants that do not belong to the Gramineae.

**Anadelphia arrecta**
- *saccharicaulis* Guinea

**Andropogon sp.**
- *benardi* Panama
- *ruthae* U.S.A.: Florida, Georgia

**Aristida sp.**
- *minima* U.S.A.: Georgia
- *Aristida diffusa var. burkei* South Africa

**Arundinaria sp.**
- *greeni* China, Sri Lanka
- *inusitata* Sri Lanka
- *penicillata* U.S.A.: California
- *secreta* U.S.S.R.
- *serrata* Sri Lanka

**Arundinaria hindsii**
- *arcusnotata* China
- *penicillata* China

**Arundinaria japonica**
- *secreta* Japan

**Arundinaria simonii**
- *bambusarum* Japan
- *secreta* Japan

**Arundinaria walkeriana**
- *crenulatus* India

**Axonopus compressus**
- *ruthae* Brazil

**Bambusa argentea-striata**
- *penicillata* U.S.A.: Louisiana

**Bambusa dissemulator**
- *greeni* China

**Bambusa fastuosa**
- *secreta* France

**Bambusa metake**
- *secreta* U.S.A.: New Jersey

**Bambusa multiplex**
- *lingnani* China
- *penicillata* U.S.A.: Florida

**Bambusa nana**
- *greeni* China
Bambusa pervariabilis
  greeni  Hong Kong
  penicillata  Hong Kong
Bambusa stenostachya
  penicillata  Taiwan
Bambusa tesselata
  secreta  Japan
Bambusa tulda
  paucipora  India
Bambusa veitchi-argenta
  secreta  Japan
Bambusa vulgaris
  greeni  Guadeloupe, Guyana, Sri Lanka, West Samoa, Windward Islands
  penicillata  U.S.A.: Florida
Bermuda grass (see Cynodon dactylon)
  ruthae  Australia: Queensland, South Australia, West Australia; Bolivia, Brazil, Cuba, Israel, Mexico, Sri Lanka, Tahiti, U.S.A.: Arizona, California, Florida, Georgia, Hawaii, Kansas, Louisiana, Mississippi, North Carolina, South Carolina, Texas
Blue panicum grass
  ruthae  U.S.A.: Texas
Bouteloua sp.
  texana  U.S.A.: Texas
Brachypodium distachyum
  ruthae  South Africa
Bromeliad (Bromeliaceae)
  bromeliae  Guatemala, Honduras
Capim angolinka
  saccharicaulis  Brazil
Cattleya sp. (Orchidaceae)
  ruthae  Panama
Cenchrus pauciflorus
  ruthae  U.S.A.: Florida
Chloris sp.
  ruthae  Tuvalu (=Ellice Islands)
Chloris gayana
  ruthae  Israel
  saccharicaulis  South Africa
Cladium jamaicense (Cyperaceae)
  fistulella  U.S.A.: Florida
Cortaderia selloana
  ruthae  U.S.A.: Florida
Couchgrass
  australiensis  Australia
  ruthae  U.S.A.: Mississippi
Crownfoot
  ruthae  U.S.A.: South Carolina
Cymbopogon citratus
  ruthae  U.S.A.: Florida
  saccharicaulis  Philippines
Cynodon sp.
  ruthae  Ethiopia, South Africa, Zimbabwe
Cynodon dactylon
  australiensis  Australia
  fistulella  U.S.A.: Florida
  morrisoni  Micronesia
  ruthae  Australia: Queensland, South Australia, West Australia; Bermuda, Chile, Egypt, Israel, Kenya, Pakistan, U.S.A.: Arizona, Florida, Georgia, Hawaii, North Carolina, South Carolina, Texas; Zimbabwe
Cynodon transvaalensis
  ruthae  Israel
Dactylolctenium australe
  transkeiensis  Transkei
Danthonia americana
  graminis  U.S.A.: California
Dendrocalamus sp.
  siamensis  China
  latiflorus  China
  merrilliana  Philippines
Digitaria sp.
  transkeiensis  Transkei
  decumbens  U.S.A.: Florida
Digitaria milanjiana
  ruthae  South Africa
Digitaria sanguinalis
  ruthae  U.S.A.: Florida
Dinochloa scandens
  greeni  Philippines
Distichlis sp.
  fistulella  U.S.A.: Florida, Georgia
  morrisoni  Hong Kong
  ruthae  U.S.A.: Florida
Distichlis spicata
  fistulata  Mexico
  fistulella  U.S.A.: Texas
  saccharicaulis  U.S.A.: Florida
Echeveria sp. (Crassulaceae)  
  *benardi*  
  Mexico

*Ehrharta* cf. *ramosa*  
  *anneckeii*  
  South Africa

*Eleusine indica*  
  *ruthae*  
  Guadeloupe, U.S.A.: Florida

*Eremochloa ophiuroides*  
  *ruthae*  
  U.S.A.: Florida

*Euphorbia heterophylla* (Euphorbiaceae)  
  *ruthae*  
  Cook Islands

*Gigantochloa aspera*  
  *penicillata*  
  Sri Lanka

*Gigantochloa verticillata*  
  *greenii*  
  Sumatra

*Gramineae*  
  *litorosa*  
  U.S.A.: Colorado

  *panici*  
  Egypt, Iran

  *penicillata*  
  Taiwan

  *ruthae*  
  Madagascar

  *saccharicaulis*  
  Thailand

  *texana*  
  U.S.A.: Texas

*Grass*  
  *benardi*  
  Cuba, Mexico, Panama

  *bibursa*  
  U.S.A.: Texas

  *bibursella*  
  Mexico

  *fistulella*  
  U.S.A.: Florida

  *floridana*  
  U.S.A.: Florida

  *graminis*  
  Mexico, U.S.A.: California

  *greenii*  
  Taiwan

  *mcclurei*  
  Indonesia

  *morrisoni*  
  Fiji Islands, Micronesia

  *oshimaensis*  
  Japan, Taiwan

  *ruthae*  
  Argentina, Australia, Cook Islands, Mauritius, Mexico, Peru, Puerto Rico, South Africa, Tanzania, U.S.A.: California, Florida, Georgia, Hawaii, Louisiana, North Carolina, Texas, Virgin Islands

  *saccharicaulis*  
  India, Philippines, Uganda, U.S.A.: Florida, Hawaii

  *texana*  
  U.S.A.: Texas

  *transkeiensis*  
  South Africa

*Heliconia* sp. (Musaceae)  
  *saccharicaulis*  
  Costa Rica

*Hemarthria altissima*  
  *phragmites*  
  South Africa

*Johnson grass*  
  *benardi*  
  U.S.A.: Texas

  *ruthae*  
  U.S.A.: California, Georgia, Mississippi, South Carolina, Texas

  *saccharicaulis*  
  U.S.A.: Texas

*Jointgrass*  
  *australiensis*  
  Australia

*Juncus* sp. (Juncaceae)  
  *graminis*  
  U.S.A.: California

*Lemongrass*  
  *benardi*  
  Guatemala

  *penicillata*  
  Mexico

  *ruthae*  
  U.S.A.: California

*Lepturus* sp.  
  *ruthae*  
  Christmas Island

*Lepturus repens*  
  *ruthae*  
  Kiribati (=Gilbert Islands)

*Maranta* sp. (Marantaceae)  
  *benardi*  
  Guatemala

  *Monanthochloa* sp.  
  *fistulata*  
  Mexico

*Napier grass* (see *Pennisetum purpureum*)

*Panicum* sp.  
  *ruthae*  
  South Africa

*Panicum barbinode*  
  *saccharicaulis*  
  Puerto Rico, U.S.A.: Virgin Islands; Venezuela

*Panicum maximum*  
  *ruthae*  
  South Africa

*Panicum sanguinale*  
  *oshimaensis*  
  Japan

*Panicum turgidum*  
  *panici*  
  Egypt, Israel

*Paragras*  
  *saccharicaulis*  
  U.S.A.: Florida

*Paspalum* sp.  
  *benardi*  
  Martinique

*Paspalum dissectum*  
  *saccharicaulis*  
  U.S.A.: Florida

*Paspalum distichum*  
  *ruthae*  
  South Africa

*Paspalum notatum*  
  *benardi*  
  Costa Rica

*Pennisetum* sp.  
  *saccharicaulis*  
  Cameroons

*Pennisetum ciliare*  
  *panici*  
  Morocco

*Pennisetum purpureum*  
  *saccharicaulis*  
  Mauritius, South Africa, U.S.A.: Florida
Phragmites sp.  
phragmitis Malawi, South Africa
Phragmites communis  
phragmitis South Africa, Zimbabwe
saccharicaulis U.S.A.: Florida
Phragmites karka  
saccharicaulis India
Phyllostachys sp.  
penicillata China
Phyllostachys aurea  
penicillata U.S.A.: Alabama, California, Florida
Phyllostachys hindsii  
secreta Japan
Phyllostachys pubescens  
penicillata China
Rhachidospermum mexicanum  
litorosa Mexico
Saccharum sp.  
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Saccharum arundinaceum  
saccharicaulis Indonesia
Saccharum officinarum  
saccharicaulis Brazil, Cuba, Puerto Rico
Saccharum spontaneum  
saccharicaulis Indonesia
Sasa paniculata  
secreta Japan, U.S.S.R.
Sawgrass  
ruthae U.S.A.: Florida
Schizacirium sp.  
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philippina Philippines
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Schizostachyum lumampao  
crenulatus Philippines
Scleria canescens (Cyperaceae)  
saccharicaulis Puerto Rico
Setaria geniculata  
ruthae U.S.A.: South Carolina
Sorghum halepense  
ruthae Australia, Israel, U.S.A.: Louisiana
saccharicaulis Madeira Island
Sorghum vulgare  
saccharicaulis Pakistan
Spartina sp.  
fistulella U.S.A.: Florida, Georgia, Texas
Spartina bakeri  
fistulella U.S.A.: Florida
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fistulella U.S.A.: Texas
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ruthae U.S.A.: Florida
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