

**STRINGASPIDIOTUS MACGILLIVRAY (HEMIPTERA: COCCOIDEA:
DIASPIDIDAE) A NEW SYNONYM OF PSEUDAONIDIA COCKERELL,
WITH A REDESCRIPTION OF THE TYPE SPECIES**

DOUGLAS J. WILLIAMS AND DOUGLASS R. MILLER

(DJW) Department of Entomology, The Natural History Museum, Cromwell Road, London SW7 5BD, U.K.; (DRM) Systematic Entomology Laboratory, PSI, Agricultural Research Service, U.S. Department of Agriculture, Building 005, BARC-West, Beltsville, MD 20705, U.S.A. (e-mail: douglass.miller@ars.usda.gov)

Abstract.—The genus *Stringaspidotus* MacGillivray, 1921 is synonymized with *Pseudaonidia* Cockerell, 1897 as a junior subjective synonym (**new synonymy**) and the type species of *Stringaspidotus* (*Aspidiotus* (*Pseudaonidia*) *curculiginis* Green) is redescribed and illustrated.

Key Words: armored scale, *Furcaspis*, synonym, *Pseudaonidia*, description

While writing a revision of the genus *Furcaspis* Lindinger (see Williams et al. 2006), we noted that the monotypic genus *Stringaspidotus* MacGillivray had been synonymized with *Furcaspis* by earlier authors. After examination of the type species, *S. curculiginis* (Green), we concluded that it is not a species of *Furcaspis* and should not be included in our study. However, it seems appropriate to present the results of our analysis concerning the placement of the genus and species in a separate publication. The purpose of this paper is to illustrate and redescribe the species *S. curculiginis* and to provide evidence supporting our hypothesis that *Stringaspidotus* is a junior synonym of *Pseudaonidia* Cockerell.

The genus *Stringaspidotus* MacGillivray (1921), at present includes the single species *S. curculiginis*, described originally as *Aspidiotus* (*Pseudaonidia*) *curculiginis* by Green (1904) from Java. MacGillivray also included *Aspidiotus articulatus* var. *celastri* Maskell described from South Africa by Maskell (1897)

(later included in the genus *Selenaspis* Cockerell by Fernald (1903)). At the same time MacGillivray synonymized *S. ferox* Lindinger with *S. celastri*. Mamet (1958) discovered that MacGillivray's concepts of *F. celastri* were not correct and redescribed *F. celastri* and *F. ferox* as separate species in *Selenaspis*, thus leaving *Stringaspidotus* as monotypic.

Lindinger (1909) included *A. (Pseudaonidia) curculiginis* in the genus *Furcaspis* Lindinger. Although Ferris (1937) listed the type species of *Stringaspidotus* as *Aspidiotus curculiginis*, he illustrated Green's species as *Stringaspidotus curculiginis* and remarked that *Stringaspidotus* was very doubtfully distinct from *Furcaspis*. When Balachowsky (1958) described the subtribe Furcadaspidina (of the tribe Aspidiotini Westwood), he included five genera: *Furcaspis* (type species *Aspidiotus biformis* Cockerell), *Neofurcaspis* Green (type species *N. andamanensis* Green), *Paraonidiella* MacGillivray (type species *Aspidiotus cladii* Maskell), *Separaspis* MacGillivray (type species *Furcaspis*

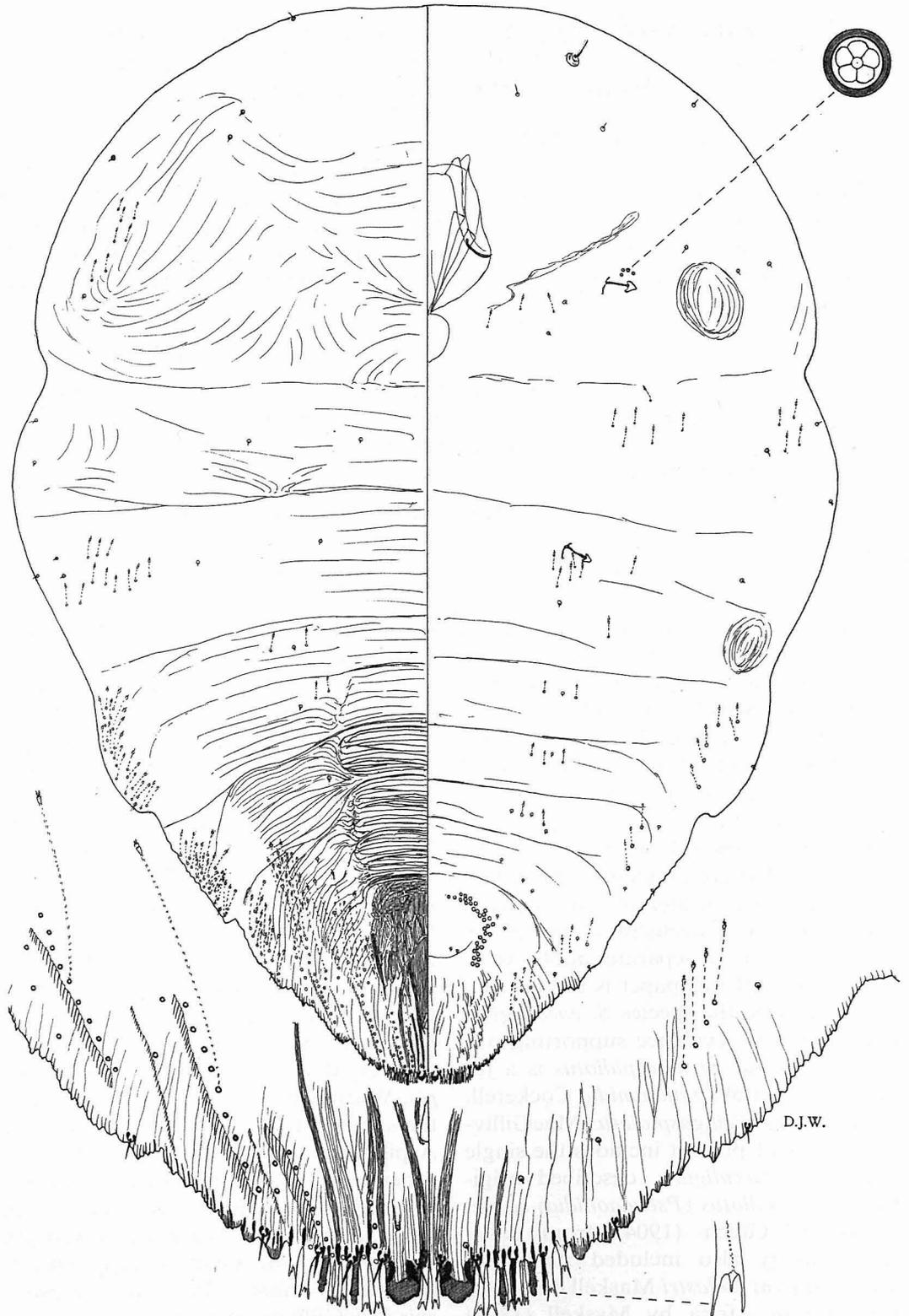


Fig. 1. Adult female *Pseudaonidia curculiginis*. Indonesia, Java, Buitenzorg (Bogor), on leaves of *Curculigo recurvata*.

proteae Brain) and *Tollaspidiotus* MacGillivray (as *Tallaspidiotus*) (type species *Aspidiotus (Chrysomphalus) mauritianus* Newstead). Borchsenius (1966) accepted the subtribe and added *Stringaspidiotus* to it, and Ben-Dov and German (2003) regarded *Stringaspidiotus* as a separate genus within the subfamily Aspidiotinae.

In a comprehensive study of the genus *Furcaspis*, Williams et al. (2006), regarded the genera *Neofurcaspis*, *Paronidiella*, *Separaspis* and *Tollaspidiotus* as being identical to *Furcaspis* and commented that *Stringaspidiotus* should be placed in the subtribe Pseudaonidiina Balachowsky because the lobes have lateral notches (rounded in *Furcaspis*) and the antennae have only a single long seta (usually 3–6 in *Furcaspis*). Furthermore, the plates in *Furcaspis* are bifurcate, or rarely trifurcate, and lack fringing but there is always a membranous area between the tines, described by Balachowsky (1958) as an intermediate hyaline membrane. In *Stringaspidiotus*, the tines of the plates are well separated without the inner membrane, and the outermost plates are sometimes fringed laterally.

MATERIALS AND METHODS

Terms used in the description are the same as those used in Williams et al. (2006) and Miller and Davidson (2005) where they are described in detail. The enlargements in the illustration are not to scale. Abbreviations of specimen depositories are: BMNH, The Natural History Museum, Cromwell Road, London SW7 5BD, UK; UPBL, Entomological Museum, Museum of Natural History, University of the Philippines at Los Baños, Laguna, Philippines; USNM, National Entomological Collection, National Museum of Natural History, scale collection at Beltsville, Maryland, U.S.A.

RESULTS

Pseudaonidia curculiginis (Green) (Fig. 1)

Common Name: Buli Scale

Aspidiotus (Pseudaonidia) curculiginis
Green 1904: 208; Ferris 1941: 42.

Pseudaonidia curculiginis (Green): Marlatt 1908: 137.

Furcaspis curculiginis (Green): Lindinger 1909: 110.

Pseudaonidia curculiginis (Green): Robinson 1917: 33.

Stringaspidiotus curculiginis (Green): MacGillivray 1921: 451.

Aspidiotus curculiginis (Green): Ferris 1937: 52.

Type material.—(Syntypes) Indonesia, Java, Buitenzorg (Bogor), on leaves of *Curculigo recurvata*, coll. N° 33 BMNH (4 mounted adult female specimens and 5 scale covers); same data except note indicating specimens received from Green 7-VIII-1905 USNM (4 first instars, 1 second instar, and 1 adult female on 3 slides).

Field characters.—According to Green (1904): “Female puparium [scale cover] superficially resembling that of *Asp. rossi*. Elliptical, flattish; dark blackish-brown. Pellicles [exuviae] fulvous, slightly raised, with inconspicuous boss and concentric ring, surrounded by a thin whitish line. Inner surface paler brown; ventral scale persisting along the margins. Length, 2–2.50 mm.; breadth, 1.25 to 1.50 mm.

Male puparium [scale cover] similar; but smaller; pellicle [exuviae] nearer the anterior extremity. Length, 1.50 mm.; breadth, 0.80 mm.”

Slide-examined characters.—Body of adult female, oval to turbinate, mature specimens moderately sclerotized with marginal indentation between prothorax and mesothorax. Anterior mediodorsal area of pygidium with an areolated pattern; dorsomedial areas of abdominal

segments III–V with sclerotized striations, other anterior segments with lightly sclerotized striations; head and prothorax with circular clear areas on dorsal submargin. Lobes numbering 4 pairs. Median lobes sometimes touching or separated by a space about 2 μm wide, each lobe about 15–20 μm wide, sometimes with parallel sides or sides becoming slightly narrower distally, notched singly at each side and with thick paraphyses at base. Second lobes each usually projecting beyond median lobes, noticeably slender, 12–15 μm long, about 2 μm wide at base, expanding distally to about 5 μm wide, notched singly on each side near rounded apex. Third lobes similar to second lobes, usually shorter, 12–15 μm long. Fourth lobes each short, almost triangular, sometimes with deep lateral notch or with only faint notch, apex rounded. Paraphyses short, longest about 10 μm long, between median lobes and lateral margin of fourth lobes. Plates longer than lobes, slender, each usually with 2 long outer tines and a short medial tine; sometimes each outermost plate next to fourth lobe fringed laterally; plate formula 2-3-3 or 2-3-2. Dorsal macroducts slender, decreasing in length anteriorly, sometimes absent or reduced in number in furrows between median and second lobes and between second and third lobes; numbering 37–73 in area forward to abdominal segment V. Anterior macroducts fairly numerous, present as far forward as segment I and others resembling microducts present on margins of prothorax and metathorax. A few dorsal submedial macroducts present on abdominal segments I and II. Ventral submarginal microducts present on segments I–IV and mesothorax and submarginally on thorax and abdominal segments I–III. Perivulvar pores usually in 2 lateral groups, occasionally a lateral group divided into 2 groups; with 22–32 pores on each side. Ventral setae

>representing segment VIII shorter than median lobes, those between second and third lobes and between third and fourth lobes, about as long as lobes and unusually thick. Eyes absent. Cicatrices sometimes absent or present on prothorax and abdominal segments I and III. Antennae each with single long seta, 15–20 μm long.

Other specimens examined.—INDONESIA, JAVA, Buitenzorg (Bogor), Botanical Garden, on *Magnolia* sp. (Magnoliaceae), ?-IX-1911, R.S. Woglum (USNM). PHILIPPINES, Palmera, Calabanga, on unknown plant, 19-IV-1969, F.J. Velasquez (BMNH, UPLB); Lanay Morong, Luzon, on *Pinanga barnesii* (Arecaceae), unknown date, A. Loher (USNM); Apayo, Luzon, on *Pinanga* sp., (Arecaceae), ?-V-1917, E. Fenix (USNM); Manila intercepted at San Francisco, on *Cymbidium atropurpureum* (Orchidaceae), 23-IX-1947, J. Foust (USNM); intercepted at San Francisco, on *Gramatophyllum speciosum* (Orchidaceae), 16-VII-1937, R.D. Clemens (USNM); intercepted at San Francisco, on *Cymbidium finlaysonianum* (Orchidaceae), 13-II-1951, 11-II-1948, and III-27-1940, McHatton, Thompson, and Ting (USNM). SINGAPORE, intercepted at Hawaii, on *Calathea* sp. (Marantaceae), 19-VIII-1976, M. Jodoi (USNM). THAILAND, intercepted at Miami, on palm leaf (Arecaceae), 18-III-1977, E.B. Lee (USNM). VANUATU, intercepted at England, Kew, on orchid, 1980 (BMNH). There is an additional slide from Puerto Rico, on *Cocos nucifera* (Arecaceae), 5-II-1997 in the USNM; we are uncertain if these data are correct and need corroboration with additional specimens before suggesting that the species occurs in the Caribbean area.

DISCUSSION

In addition to the specimens examined, Robinson (1917) recorded the species from the Philippines on *Corypha*

elata (Hypoxidaceae) and Velasquez and Rimando (1969) listed it also from the Philippines (as *Pseudaonidia curculiginis*) and gave it the name "Buli scale." Takahashi 1942 listed it from Malaya, "Fantung Squpah," on *Gardenia* sp. (Rubiaceae), and from Bangkok, Thailand without host data. Danzig and Konstantinova (1990) recorded this species from Vietnam on *Persimmon* sp. (Scrophulariaceae) (this record was listed by Ben-Dov and German (2003) from Mongolia but obviously should have been from Vietnam). Hunt (1939) indicated that the species was intercepted in San Francisco, U.S.A. on orchids from the Philippines.

Cockerell and Robinson (1915) compared *S. curculiginis* with their new species *Pseudaonidia obsita* from the Philippines, and Laing (1929) compared it with *P. baikeae* Newstead when re-describing that species from Sierra Leone.

In possessing slender second and third lobes, *P. curculiginis* is most similar to *P. duplex* (Cockerell) and *P. manilensis* Robinson but the medio-dorsal area in both these species is heavily reticulated. *Pseudaonidia manilensis* differs by having the second and third lobes without notches. *Pseudaonidia curculiginis* differs from all known species of *Pseudaonidia* in possessing heavily-sclerotized striations on abdominal segments III–V.

MacGillivray (1921) proposed the genus *Stringaspidiotus* in a key to genera of the tribe Aspidiotini. He characterized the genus by having the pygidium without [conspicuous] paraphyses; pygidium without lattice pattern on dorsum; mesothorax and metathorax separated by a transverse constriction. Other character states important in diagnosing *Stringaspidiotus* include 4 pairs of lobes, second and third lobes often conspicuously narrower than median lobes, lobes with notches, 1 large seta on each antenna, and clear circular areas present on the dorsal surface of the prothorax

and head. *Pseudaonidia* shares all of these character states with the exception of the lattice pattern on the dorsum of the pygidium which is well developed and conspicuous on most species in the genus. But even in this character most specimens of *S. curculiginis* have a weakly-developed lattice pattern on the anterior end of the pygidium. Therefore, we consider *Stringaspidiotus* MacGillivray, 1921 (type species *Aspidiotus (Pseudaonidia) curculiginis* Green 1904) to be a junior subjective synonym of *Pseudaonidia* Cockerell, 1897 (type species *Aspidiotus duplex* Cockerell, 1896), **new synonymy**.

ACKNOWLEDGMENTS

We are grateful to John Davidson (Department of Entomology, University of Maryland, College Park), Gary Miller and Norman Woodley (Systematic Entomology Laboratory, USDA, Beltsville, MD and Washington, DC, respectively) and Michael Williams (Department of Entomology/Plant Pathology, Auburn University, Alabama) for their useful comments and criticisms of the manuscript.

LITERATURE CITED

- Balachowsky, A. S. 1958. Les cochenilles du continent Africain Noir. v. 2 Aspidiotini (2me partie), Odonaspidini et Parlatorini. Annales du Musée Royal du Congo Belge (Sciences Zoologiques) 4: 149–356.
- Ben-Dov, Y. and V. German. 2003. A systematic catalogue of the Diaspididae (armoured scale insects) of the world, subfamilies Aspidiotinae, Comstockiellinae and Odonaspidinae. Intercept Ltd., Andover. 1,111 pp.
- Borchsenius, N. S. 1966. A catalogue of the armoured scale insects (Diaspidoidea) of the world. Moscow and Leningrad, Nauka. 449 pp.
- Cockerell, T. D. A. 1896. Preliminary diagnoses of new Coccidae. Psyche, Supplement 7: 18–21.
- . 1897. The San Jose scale and its nearest allies. United States Department of Agriculture, Division of Entomology, Technical Series 6: 1–31.

- Cockerell, T. D. A. and E. Robinson. 1915. Descriptions and records of Coccidae. Bulletin of the American Museum of Natural History 34: 105-113.
- Danzig, E. M. and G. M. Konstantinova. 1990. On the Coccid fauna (Homoptera, Coccinea) of Vietnam. Trudy Zoologicheskogo Instituta Akademiyi Nauk AN SSSR Leningrad 209: 38-52.
- Fernald, M. E. 1903. A catalogue of the Coccidae of the world. Bulletin of the Hatch Experiment Station of the Massachusetts Agricultural College 88: 1-360.
- Ferris, G. F. 1937. Contributions to the knowledge of the Coccoidea (Homoptera) V. Microentomology 2: 47-102.
- . 1941. The genus *Aspidiotus* (Homoptera: Coccoidea: Diaspididae). Microentomology 6: 33-70.
- Green, E. E. 1904. On some Javanese Coccidae: With descriptions of new species. Entomologist's Monthly Magazine 40: 204-210.
- Hunt, H. A. 1939. Plant quarantine. Annual Report California Agricultural Experiment Station 28: 548-566.
- Laing, F. 1929. Descriptions of new, and some notes on old species of Coccidae. Annals and Magazine of Natural History 4: 465-501.
- Lindinger, L. 1909. Beiträge zur Kenntnis der Schildläuse und ihrer Verbreitung. Zeitschrift für wissenschaftliche Insektenbiologie 5: 105-110.
- MacGillivray, A. D. 1921. The Coccidae. Tables for the identification of the subfamilies and some of the more important genera and species together with discussions of their anatomy and life history. Urbana Ill. Scarab Company, 502 pp.
- Mamet, J. R. 1958. The *Selenaspilus* complex (Homoptera, Coccoidea). Annales du Musée Royal du Congo Belge. Zoologiques, Miscellaneous Zoologica, Tervuren 4: 359-429.
- Marlatt, C. L. 1908. The genus *Pseudaonidia*. Proceedings of the Entomological Society of Washington 9: 131-141.
- Maskell, W. M. 1897 (1896). Further coccid notes: With descriptions of new species and discussions of points of interest. Transactions and Proceedings of the New Zealand Institute 29: 293-331.
- Miller, D. R. and J. A. Davidson. 2005. Armored Scale Insect Pests of Trees and Shrubs. Cornell University Press, Ithaca, New York. 442 pp.
- Robinson, E. 1917. Coccidae of the Philippine Islands. Philippine Journal of Science (Ser. D) 12: 1-47.
- Takahashi, R. 1942. Some injurious insects of agricultural plants and forest trees in Thailand and Indo-China. II. Coccidae. Report. Government Research Institute. Department of Agriculture. Formosa 81: 1-56.
- Velasquez, F. J. and L. Rimando. 1969. A check list and host index of the armored scale insects of the Philippines (Diaspididae: Homoptera). Philippine Entomologist 1: 195-208.
- Williams, D. J., D. R. Miller, and A. Rung. 2006. A systematic revision of the armored scale genus *Furcaspis* Lindinger (Diaspididae; Coccoidea; Hemiptera). Contributions of the American Entomological Institute 34(5): 1-86.