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A NEW SPECIES OF ARMORED SCALE (HEMIPTERA: COCCOIDEA: DIASPIDIDAE) PREVIOUSLY CONFUSED WITH *HEMIBERLESIA DIFFINIS* (NEWSTEAD)

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Abstract.—A new species of armored scale, ***Hemiberlesia neodiffinis*** **Miller and Davidson,** is described and illustrated. It occurs in the eastern and midwestern United States and parts of Mexico and has been reported as a pest of tulip poplar and lilac. It previously has been misidentified as *H. diffinis* (Newstead), which is a tropical species from the Caribbean Islands, Central America, South America, and Mexico. Lectotypes are designated for *Aspidiotus diffinis* Newstead, *A. jatrophae* Townsend and Cockerell, and *A. jatrophae* var. *parrotti* Newell. *Aspidiotus fabernii* Houser is transfered to *Quadraspidiotus* (**new combination**).

Key Words: Armored scale, Coccoidea, Diaspididae, pest, tulip poplar, lilac, *Liriodendron, Syringa*

We currently are working on a book on the ecomonic armored scales of the United States. While analyzing the morphological and biological characteristics of *Hemiberlesia diffinis* (Newstead), it became obvious that two distinct species were involved. *Hemiberlesia diffinis* is a tropical species that does not occur in the United States; a second undescribed species is strictly temperate in distribution, occurring in the eastern and midwestern United States and northern Mexico. Although Borchsenius (1966) lists three junior synonyms of *H. diffinis* (*Aspidiotus jatrophae* Townsend and Cockerell, *A. jatrophae* var. *parrotti* Newell, and *A. fabernii* Houser), none are conspecific with the new species. Therefore, a new name must be provided.

The objectives of this paper are: 1) to provide a description and illustration of the new species (*Hemiberlesia neodiffinis* Miller and Davidson), 2) to redescribe and illustrate *H. diffinis* and provide a comparison of the two species, 3) to clarify the status of the three junior synonyms listed by Borchsenius (1966), and 4) to draw attention to a possible third species from Ontario, Canada.

METHODS

Terminology in the descriptions follows McKenzie (1956) and Miller et al. (1984). Measurements and numbers are from 10 representative specimens and are given in parentheses followed by the range. Enlargments on illustrations are not proportional. Specimens were examined and illustrated using a Leica DMRB compound microscope using 10× eyepieces and 20× and 40× objectives. Depositories of specimens are: The Natural History Museum, London (BMNH); California Department of Food

and Agriculture, Sacramento (CDA); Florida State Collection of Arthropods, Gainesville (FSCA); Muséum National d'Histoire Naturelle, Paris (MNHN); University of California, Davis (UCD); National Museum of Natural History, Beltsville, MD (USNM).

The authors have contributed equally to the research effort for this paper and should be considered coauthors.

Results

Hemiberlesia neodiffinis Miller and Davidson, new species

(Fig. 1)

Previous citations: *Aspidiotus diffinis* Newstead; Marlatt, 1899:75, 1900:425–427; Ferris, 1921:125; Bibby, 1931:191; Couch, 1935:16, 1938:107; Westcott, 1973: 411.

Hemiberlesia diffinis (Newstead); MacGillivray, 1921:437; Ferris, 1938:238; Schmidt, 1940:193; Ferris, 1942:446; Kosztarab, 1964:34; Dekle, 1965:69, 1976:71; McDaniel, 1969:107; Tippins and Beshear, 1970:9; Beshear et al., 1973:6; Stoetzel and Davidson, 1974:501; Stoetzel, 1976; Lambdin and Watson, 1980:80; Miller and Howard, 1981:166; Mead, 1982:4; Nakahara, 1982:41; MacGowan, 1983:7; Mead, 1984: 2; MacGowan, 1987:9; Miller and Davidson, 1990:302.

Type data.—The adult female holotype is mounted with a paratype on a microscope slide; the right specimen on the slide is the holotype. The slide is labelled as follows: Left label "*Hemiberlesia/neodiffinis*/on Liriodendron/tulipifera/Simpson, Ill./Aug. 7, 1969/J. E. Appleby"; right label "*Hemiberlesia/neodiffinis*/Miller & Davidson/HOLOTYPE &/PARATYPE" and includes a map of the location of the holotype (USNM). In addition, there are 47 paratypes on 17 slides deposited in BMNH, CDA, FSCA, MNHN, UCD, USNM.

Slide-mounted characters.—Adult female (Fig. 1) with 3 pairs of definite lobes, fourth lobes, when present, represented by small sclerotized swellings; paraphysis formula usually 2-2-0, with paraphyses in space between lobe 2 and median lobe, attached to medial margin of lobe 2, medial margin of lobe 3, and in space between lobes 2 and 3. Median lobes separated by space 0.1–0.2(0.2) times width of median lobe, with small paraphysis attached to medial margin, without basal sclerotization or yoke, medial margin usually slightly converging apically, lateral margins converging, with 1 lateral notch and 0–1(0) medial notch; second lobes sclerotized, pointed, usually with lateral notch, about one-third to one-quarter size of median lobes; third lobes sclerotized, pointed, without notches, or with weakly indicated lateral notch, lobe equal to or smaller than second lobe. Plates between median lobes and second lobe, between second lobes and third lobes, and between third lobes and fourth lobes with increasingly larger tines, sometimes with 2 or more simple plates anterior of fourth lobes, plates in first and second spaces apparently without microducts; plates in third space distinctly shaped, each with 1 microduct, plates anterior of seta marking segment 5 with single microduct; plate formula 2-3-3; median lobes each with 2 slender plates between them about 0.8–1.1(1.1) times as long as median lobes. Macroducts of 1 size, on segments 5 to 7 in marginal and submarginal areas, duct between median lobes absent, with 10–15(12) macroducts on each side of pygidium on segments 5–8, some macroduct orifices anterior of anal opening. Pygidial microducts on venter in submarginal and marginal areas of segment 5 and 6, with 6–13(9) ducts; prepygidial ducts of 2 sizes, longer size in submarginal and marginal areas of segments 1 to 3, also present submedially near spiracles, shorter size present along body margin from segment 3 or 4 to head; pygidial ducts absent on dorsum; prepygidial microducts of 2 sizes, larger size in submedial areas of any or all of mesothorax to 4, smaller size in submarginal areas of head or prothorax to segments 2 or 3. Perivulvar pores absent. Pores

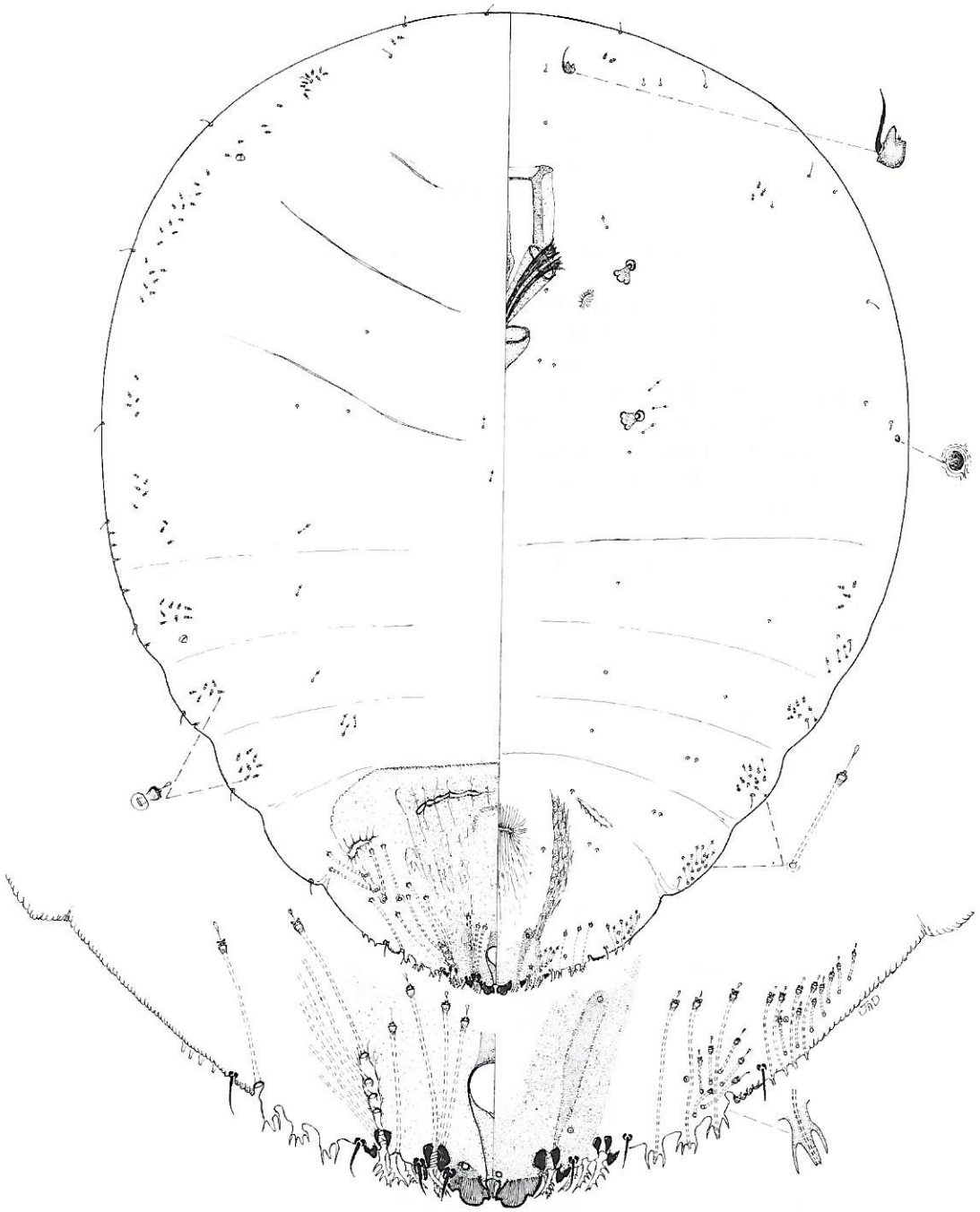

Fig. 1. Adult female holotype *Hemiberlesia neodiffinis.* Simpson, Illinois, August 7, 1969, on *Liriodendron tulipifera,* J. E. Appleby.

absent near spiracles. Anal opening located 1.1–1.6(1.3) times length of anal opening from base of median lobes, anal opening 17–30(23) μ long. Dorsal seta laterad of median lobes 1.0–1.4(1.2) times length of median lobe. Eyes usually represented by small sclerotized spur or dome on mesothorax. Antennae with 1 seta. Cicatrices usually present on prothorax and segment 1. Body pear shaped.

Specimens examined.—PARATYPES: USA—DISTRICT OF COLUMBIA: Southern Railway, IX-29-1929, no host, G. E. Murrell (3 ad ♀)USNM. FLORIDA: St. Petersburg, I-16-1964, *Persea* sp., E. W. Miller (1 ad ♀) FSCA. GEORGIA: Albany, I-25-1929, *Celtis* sp., J. B. Gill (3 ad ♀) CDA; No specific locality, IV-17-1987, *Carya illinoensis,* W. L. Tedders (3 ad ♀, 3 second-instar ♀) FSCA, USNM. ILLINOIS: Simpson, VIII-7-1969, *Liriodendron tulipifera,* J. E. Appleby (8 ad ♀) BMNH, MNHN, USNM. LOUISIANA: Baton Rouge, IV-14-1953, *Magnolia* sp., C. E. Smith (2 ad ♀) USNM. MISSISSIPPI: Pass Christian, IX-27-1922, *Ficus* sp., E. K. Bynum and K. Harnon (3 ad ♀) UCD. MISSOURI: Grayridge, Stoddard County, IX-3-1976, on "buttonbush," L. R. Hanning (1 ad ♀) USNM; Sikeston, City Park, VIII-11-1976, *Fraxinus* sp., L. R. Hanning (1 ad ♀) USNM. NEW JERSEY: Springfield, VII-26-1950, *Syringa* sp., S. W. Bromley (4 ad ♀) USNM. SOUTH CAROLINA: St. Helena's Island, III-21-1930, on "bay," J. H. Couch (5 ad ♀) USNM. TENNESSEE: McMinniville, V-18-1965, near Hammonton, *Liriodendron tulipifera,* B. Kemper (2 ad ♀) USNM. MEXICO—No locality, taken in quarantine at Nogales, VI-30-1960, *Spondias* sp., R. W. Beardmore (8 ad ♀) BMNH; no locality, taken in quaratine at Brownsville, XII-7-1954, *Persea* sp., "various collectors," (2 ad ♀) USNM.

Additional specimens examined.—(NOT PARATYPES) (All deposited in USNM unless otherwise indicated): USA—ALABAMA: Mobile, VII-13-1923, *Ficus* sp., J. S. Callaghan (1 ad ♀); Mobile, II-29-1932, *Ficus* sp., J. S. Callaghan (4 ad ♀); near Mobile, VI-21-1923, on "twig," A. E. Grontham (1 ad ♀, 1 second instar ♀). ARKANSAS: North Little Rock, VI-28-1930, host unknown, P. H. Millar (2 ad ♀). DISTRICT OF COLUMBIA: U.S. Department of Agriculture grounds, XI-4-1899 and V-12-1902, *Syringa* sp., C. L. Marlatt (5 ad ♀); U.S. Department of Agriculture grounds, V-17-1901, *Syringa* sp., Kotinsky (4 ad ♀); no locality, VII-6-1894, *Syringa* sp., Pergande (29 ad ♀, 3 scale covers); U.S. Department of Agriculture, no date, *Syringa* sp., no collector (5 ad ♀, 1 second ♀)(BMNH). FLORIDA: Tampa, 1920, host unknown, E. T. Spear (2 ad ♀). GEORGIA: Athens, X-20-41, *Ulmus americana,* B. S. Crandall (5 ad ♀); Fort Valley, IV-5-1921, *Nerium oleander,* O. I . Snapp (4 ad ♀); Macon, IV-17-1909, on "sugar berry," H. Burns (3 ad ♀); Savannah, X-31-1950, *Pterocarya steoptera,* N. Y. Gouldman (2 ad ♀); no locality, IV-17-1987, *Carya illinoensis,* W. L. Tedders (1 ad ♀, 3 second instar ♀). LOUISIANA: Alexandria, II-27-1909, *Phoradendron* sp., Tucker (2 ad ♀); New Orleans, Spanish Fort, III-9-1919, *Quercus* sp., E. R. Sasscer (3 ad ♀); New Orleans, IV-1921, *Cinnamomum camphora,* H. Morrison (3 ad ♀); New Orleans, VI-22-1933 and VI-23-1933, *Magnolia grandiflora, Salix* sp., and *Ulmus* sp., E. Latt (12 ad ♀). MARYLAND: College Park, III-16-1928, *Liriodendron tulipifera,* collector unknown (1 ad ♀, 1 second instar ♀). MISSISSIPPI: Baldwin Lodge, V-9-1925, *Ficus* sp., E. K. Bynum (1 ad ♀); Pass Christian, IV-4-1929, *Ficus* sp., E. K. Bynum and C. Lyle (2 ad ♀); Yazoo City, III-29-1929, *Syringa* sp., C. Hines (4 ad ♀). NEW YORK: Syracuse, V-1-1928, host unknown, A. H. MacAndrews (6 ad ♀). NORTH CAROLINA: Aberdeen, II-6-1904, on "shade tree," F. Sherman (6 ad ♀); Raleigh, VIII-10-1903, *Liriodendron* sp., F. Sherman (2 ad ♀); Raleigh, VIII-21-1903, on "shade tree," F. Sherman (8 ad ♀). OHIO: Clifton, VII-1956, *Tilia americana,* C. A. Reese (2

ad ♀); North Olmsted, VII-8-1942, *Syringa* sp., J. Houser (3 ad ♀). SOUTH CAROLINA: Columbia, V-21-1935, on *Juglans* sp., E. G. Seibels (2 ad ♀); St. Helena's Island, III-21-1930, on *Magnolia virginiana,* J. H. Couch (2 ad ♀). TENNESSEE: Greenbrier, VI-10-1908, *Syringa* sp., G. C. Dury (3 ad ♀). TEXAS: Houston, X-16-1917, *Ficus* sp., M. H. James, Jr. (2 ad ♀); Port Arthur, IV-12-1929, *Fraxinus Uhdei,* J. G. Sanders (4 ad ♀); San Antonio, X-8-1917, *Ficus* sp., M. H. James, Jr. (5 ad ♀); Sherman, VIII-11-1909, *Ulmus* sp., E. W. Mally (1 ad ♀). MEXICO—No locality, taken in quarantine at Brownsville, XI-12-1952, *Persea* sp., various collectors (1 ad ♀).

Hemiberlesia diffinis (Newstead)
(Fig. 2)

Aspidiotus affinis Newstead, 1893a:186 (junior homomym of *Aspidiotus affinis* Targioni Tozzetti, 1868:736).

Aspidiotus diffinis Newstead, 1893b:281 (replacement name for *Aspidioutus affinis* Newstead).

Aspidiotus (*Diaspidiotus*) *diffinis* Newstead; Cockerell, 1897:23.

Hemiberlesia diffinis (Newstead); Leonardi, 1898:119.

Aspidiotus jatrophae Townsend and Cockerell, 1898:178 (synonymized by Marlatt, 1900:425).

Aspidiotus jatrophae var. *parrotti* Newell, 1899:23 (synonymized by Marlatt, 1900: 425).

Hemiberlesia iatrophae (Townsend and Cockerell); Leonardi, 1900:339 (misspelling).

Aspidiotus diffinis parrotti (Newell); Fernald, 1903:258.

Hemiberlesia diffinis parrotti (Newell); MacGillivray, 1921:438.

Abgrallaspis diffinis (Newstead); Komosinska, 1969:60.

Borchsenius (1966) treated *Aspidiotus fabernii* Houser as a synonym of *Hemiberlesia diffinis;* we have examined type material of the former and find it to be a distinct species that is tentatively placed in *Quadraspidiotus* (**new combination**).

Type data.—We have examined the type series of *Aspidiotus diffinis* Newstead and here designate as lectotype the left specimen in the middle row which is an adult female mounted on a slide with 10 other specimens and labelled as follows: left label "No 129/13.iv, p. 119/R. Newstead"; right label "Aspidiotus/diffinis Newst./cotype ♀♀/Demerara./BM 1945, 121"; a separate label is on the back of the slide giving the position of the lectotype with the following designation "LECTOTYPE/PARALECTOTYPE." (BMNH). In addition, there are 5 slides containing 16 specimens that were part of the original series from Demerara but were mounted subsequently and were not used by Newstead for the original description (USNM). We have examined the type series of *Aspidiotus jatrophae* Townsend and Cockerell, and here designate as lectotype the right specimen which is an adult female mounted on a slide with 2 other adult females and labelled as follows: left label "7682: *Aspidiotus*/(*jatrophae* T.&C. Type)/*diffinis* Newst./On *Jatropha*/Frontera, Mex./(Twns.)/Ckll. Coll."; right label "*Aspidiotus jatrophae*/Townsend & Cockerell/ LECTOTYPE &/PARALECTOTYPE/" and provides a map of the position of the lectotype. In addition, there are 18 adult female paralectotypes and 7 second-instar exuviae paralectotypes on 2 additional slides in USNM and 2 adult females plus pieces of adults and several immatures on 1 slide in BMNH. There is a long series of specimens collected by Townsend and/or Koebele on *Jatropha* at several different localities during the same expedition to Mexico, but these have different Division of Entomology lot numbers and were not mentioned in the original description. We have examined the type series of *Aspidiotus jatrophae* var. *parrotti* Newell, and here designate as lectotype the left specimen which is an adult female mounted on a slide with 5 other adult females and labelled as fol-

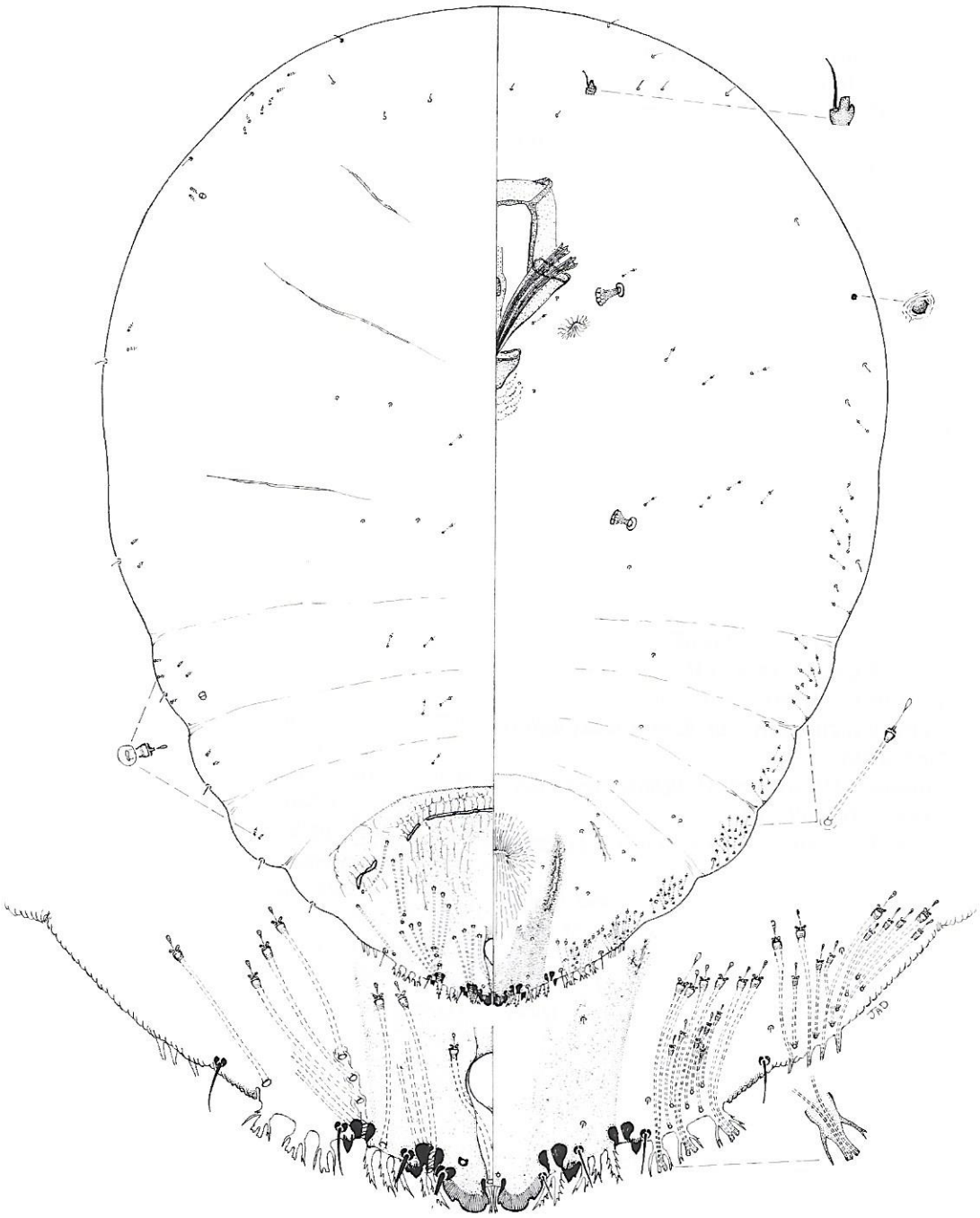

Fig. 2. Adult female *Hemiberlesia diffinis.* Mazatlan, Mexico, July 26, 1979, on *Prunus domestica,* S. Ryan.

lows: left label "*Aspidiotus diffinis/parrotti* Newell/Type/ On "Barenjeno chiquito"/ Frontera, Mex./(Townsend)/June 9, 1897/ Ckll. Coll."; right label "*Aspidiotus jatrophae/*var. *parrotti* Newell/LECTOTYPE &/PARALECTOTYPE/" and provides a map of the position of the lectotype. In addition, there are 10 adult female paralecto-

types on 4 additional slides in USNM and 4 adult females and 2 second-instar female on 1 slide in BMNH.

Slide-mounted characters.—Adult female (Fig. 2) with 3 pairs of definite lobes, fourth lobes, when present, represented by small sclerotized swelling; paraphysis formula usually 2-2-0, rarely 2-2-1, with paraphyses in space between lobe 2 and median lobe, attached to medial margin of lobe 2, medial margin of lobe 3, and in space between lobes 2 and 3. Median lobes separated by space 0.1–0.2(0.1) times width of median lobe, with or without small paraphysis attached to medial margin, without basal sclerotization or yoke, medial margin usually slightly converging apically, lateral margins strongly converging, with 1 lateral notch and 0–1(0) medial notch; second lobes sclerotized, pointed, with lateral notch, about one-third to one-quarter size of median lobes; third lobes sclerotized, pointed, without notches, equal to or slightly smaller than second lobes. Plates between median lobes and second lobe, between second lobes and third lobes, and between third lobes and fourth lobes with increasingly larger tines, sometimes with 3 or more simple plates anterior of fourth lobes, plates in first and second spaces apparently without microducts; plates in third space distinctly shaped, each with 2 or 3 large microducts, plates anterior of seta marking segment 5 with 2 or 3 microducts; plate formula 2-3-3; median lobes each with 2 slender plates between them about 0.8–1.1(1.1) times as long as median lobes. Macroducts of 1 size, on segments 5 to 7 in marginal and submarginal areas, duct between median lobes extending 1.9–3.7(2.4) times distance between posterior apex of anal opening and base of median lobes, 26–32(28) μ long, with 11–18(15) macroducts on each side of pygidium on segments 5–8, some macroduct orifices anterior of anal opening. Pygidial microducts on venter in submarginal and marginal areas of segment 5 and 6, with 5–14(10) ducts; prepygidial ducts of 2 sizes, longer size in submarginal and marginal areas of segments 1 to 3, also present submedially near spiracles, shorter size present along body margin from from segment 3 or 4 to head; on dorsum pygidial ducts absent; prepygidial microducts of 2 sizes, larger size in submedial areas of any or all of mesothorax to 4, smaller size in submarginal areas of head or prothorax to segments 2 or 3. Perivulvar pores absent. Pores absent near spiracles. Anal opening located 0.8–1.5(1.2) times length of anal opening from base of median lobes, anal opening 26–32(28) μ long. Dorsal seta laterad of median lobes 0.9–1.4(1.1) times length of median lobe. Eyes rarely absent, usually represented by small sclerotized spur or dome, on mesothorax. Antennae with 1 seta. Cicatrices usually present on prothorax and segment 1. Body pear shaped. Sometimes with sclerotization on thorax and head.

Specimens examined.—We have seen specimens from the following host genera: *Annona, Cocos, Couroupita, Bursera, Cassia, Dracaena, Drepanocarpus, Erythrina, Hevea, Hibiscus, Jatropha, Mammea, Manihot, Oncidium, Persea, Philodendron, Plumeria, Prunus, Psidium, Punica, Spondias,* and *Theobroma.*

We have examined specimens from the following countries: Brazil, Colombia, Costa Rica, Curaçao, Dominica, Ecuador, El Salvador, Guatemala, Guyana, Jamaica, Mexico, Nicaragua, Panama, and Peru.

Discussion

Hemiberlesia diffinis differs from *H. neodiffinis* by having 3 unusually large plates in the third space which each have 2 or 3 associated microducts and by having a macroduct between the median lobes. *Hemiberlesia neodiffinis* has 3 smaller plates in the third space which each have 1 associated microduct and lacks a macroduct between the median lobes.

We have studied several collections of a species similar to *Hemiberlesia neodiffinis* on *Tilia* from Ontario, Canada. It differs by usually having a macroduct between the median lobes and by having at least 2 lat-

eral notches on each median lobe. We have not described this species because we have insufficient material and have been unable to evaluate variation in critical characters. Jarvis (1911) quoted King as suggesting that "Mr. King thinks this species may prove to be a variety of A. diffinis." Lindinger (1932) agreed with King and called the Canadian population *Aspidiotus diffinis* var. King. The species also has been discussed by King (1901, 1902), Fletcher and Gibson (1908), and Gibson (1911).

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