

STUDIES OF THE COCCOIDEA

13. THE GENERA *AONIDIELLA*, *CHRYSOMPHALUS* AND *QUADRASPIDIOTUS* IN QUEENSLAND

By A. R. BRIMBLECOMBE, M.Sc., Ph.D.*

SUMMARY

The genera *Aonidiella* and *Chrysomphalus* are each represented in Queensland by four species and *Quadraspidotus* by one.

The species *A. aurantii* (Maskell), *C. ficus* Ashmead and *Q. perniciosus* (Comstock) are widely distributed and important economic pests.

Indigenous species are *A. eremocitri* McKenzie, *C. rubrullatus* (Froggatt) and *C. trifasciculatus* Brimblecombe.

INTRODUCTION

Some of the most common and economically important scale insects in Queensland occur in the genera *Aonidiella*, *Chrysomphalus* and *Quadraspidotus* (family Diaspididae). A considerable amount of data has been obtained on the distribution and hosts of the various species and this is presented according to the pattern in Part 3 of these studies and continued in Part 5 (Brimblecombe 1955, 1956).

The synonymy of some of the species is rather extensive. In this paper, synonyms listed are not exhaustive and relate essentially to those used at one time or another as names for these insects in Australia. The first record only is given for each host in each locality.

Genus *AONIDIELLA* Berlese and Leonardi

Synonymy:

1895: *Aonidiella* Berlese and Leonardi; *Rivista di Patologia Vegetale*, 4:p.77.

1897: *Aspidiotus* (*Aonidiella*) Berlese and Leonardi: Cockerell; United States Department of Agriculture, Division of Entomology, Technical Series No. 6:p.29.

1899: *Chrysomphalus* (*Aonidiella*) Berlese and Leonardi: Cockerell; *Bulletin of the Illinois State Laboratory of Natural History*, 5:p.396.

Generic type.—*Aspidiotus aurantii* Maskell.

The genus *Aonidiella* constituted an early separation from the parent genus *Aspidiotus* Bouché and was named to contain only the generic type *A. aurantii*. Later, Leonardi (1899) expanded the scope of the genus to include 11 species,

* Deputy Government Entomologist, Queensland Department of Agriculture and Stock.

some being transferred from *Aspidiotus*, others from *Chrysomphalus*. The difference between *Aonidiella* and *Chrysomphalus* was not clearly understood and in the same year Cockerell (1899) reduced the former to a subgenus of the latter. Within a few years Fernald (1903) reduced it completely to a synonym of *Chrysomphalus*, a status generally accepted for almost 20 years.

Reinstatement of *Aonidiella* as a valid genus was made by MacGillivray (1921), who removed some of the species previously included. Support for this was given by McKenzie (1937*a*, 1937*b*), who later (1938) critically revised the genus and in defining the species referable to it retained only a few of the many which at various times it had accommodated.

Two of the species, *A. aurantii* and *A. eremocitri*, were described from Australia. Whether the former is indigenous has at times been doubted but the latter is known only from this country. These and two other species, *A. inornata* McKenzie and *A. orientalis* (Newstead), occur in Queensland.

Names Used in the Genus Aonidiella.

- 1879: *aurantii* (Maskell), retained in *Aonidiella*.
 1895: *cerata* (Maskell), referred to *Monaonidiella*.
 1937: *eremocitri* McKenzie, retained in *Aonidiella*.
 1895: *fusca* (Maskell) = *Quadraspidotus perniciosus* (Comstock).
 1938: *inornata* McKenzie, retained in *Aonidiella*.
 1916: *miniatae* (Green) = *Chrysomphalus rubribullatus* (Froggatt).
 1894: *orientalis* (Newstead), retained in *Aonidiella*.
 1881: *perniciosa* (Comstock), referred to *Quadraspidotus*.

***Aonidiella aurantii* (Maskell)**

(Figures 1 and 2)

Synonymy:

- 1879: *Aspidiotus aurantii* Maskell; Transactions of the New Zealand Institute 1878, 11:p.199.
 1881: *Aspidiotus citri* Comstock; The Canadian Entomologist, 13:p.8.
 1881: *Aspidiotus coccineus* Gennadius; Annales de la Soci t  Entomologique de France, (6) 1:p.189.
 1881: *Aonidia gennadius* Targioni-Tozzetti; Annali di Agricoltura 1881 (No. 34):p.151.
 1895: *Aonidiella aurantii* (Maskell); Berlese and Leonardi; Rivista di Patologia Vegetale, 4:p.83.

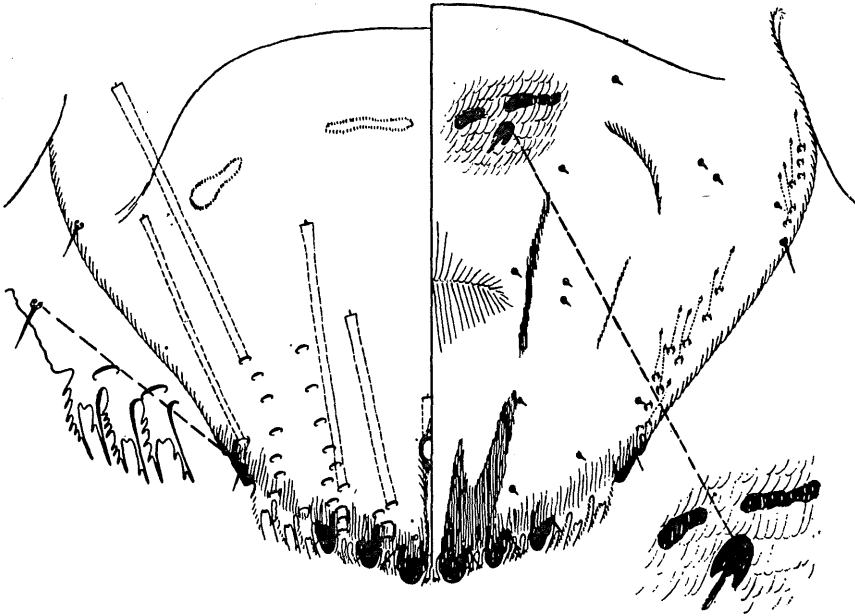


Fig. 1.—*Aonidiella aurantii*. Pygidium of adult female (after McKenzie).

- 1897: *Aspidiotus (Aonidiella) aurantii* Maskell: Cockerell; United States Department of Agriculture, Division of Entomology, Technical Series No. 6:p.29.
- 1899: *Chrysomphalus (Aonidiella) aurantii* (Maskell): Cockerell; Bulletin of the Illinois State Laboratory of Natural History, 5:p.396.
- 1902: *Aspidiotus (Chrysomphalus) aurantii* Maskell: Kuwana; Proceedings of the Californian Academy of Science, 3:p.70.
- 1903: *Chrysomphalus aurantii* (Maskell): Fernald; Massachusetts Agricultural Experiment Station, Special Bulletin No. 88:p.288.

Type localities and host.—New South Wales; Sydney, on oranges imported into New Zealand: and New Zealand; Governor's Bay, on oranges.

This insect has been cosmopolitan, mainly on citrus, for many years. In addition to Maskell's type records from Australia and New Zealand, it was in the one year 1881 described as a new species separately in Italy, France and the United States. The country of origin therefore is difficult to determine. Maskell later (1887) stated that it was European; other authors have considered its origin to be in east Asia. Few of the records in Queensland are from native plants and none are from such plants in rain-forest.

The insect is most common on citrus, which is infested throughout the State and to an extent of major importance in commercial orchards (Tryon 1889, 1894). Much attention has been given to its life history and control (Summerville 1934; Smith 1939; May 1947; Brimblecombe 1951, 1958b).

Hosts and distribution.—*Actinidia chinensis* Planch., Ormiston, Mar. 1952. *Aleurites fordii* Hemsl., Glasshouse Mts., Oct. 1936. *Asparagus racemosus* Willd., Brisbane, May 1947. *Castanospermum australe* A. Cunn. and Fraser ex Hook., Brisbane, June 1948, Yarraman, June 1948. *Cinnamomum camphorae* (L.) Neds & Eberm., Brisbane, Jan. 1948; Rockhampton, 1902 (H. Tryon).

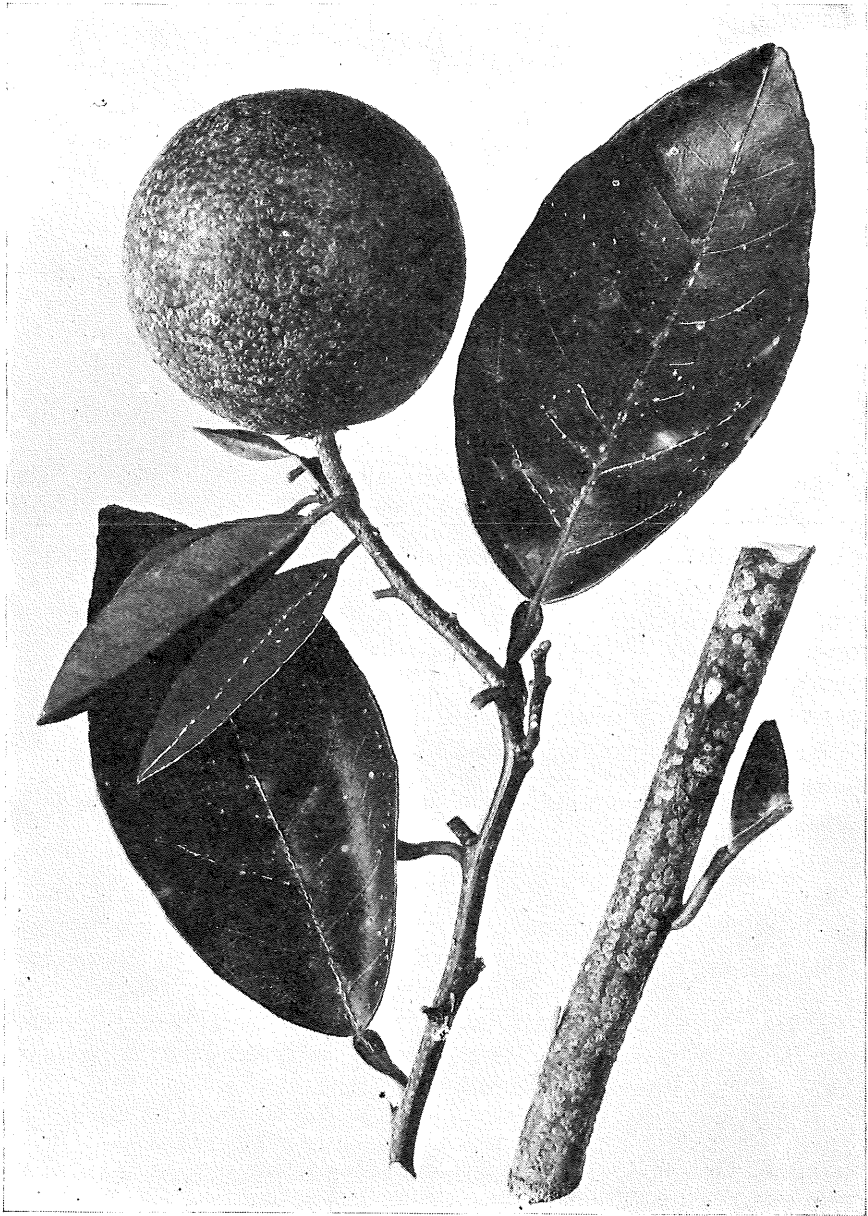


Fig. 2.—*Aonidiella aurantii*. Heavy infestation on orange fruit and twigs.

Cinnamomum oliveri F. M. Bail., Brisbane, 1915 (H. Tryon). *Citrus aurantifolia* (Christm.) Swingle, Brisbane, Feb. 1952; Howard, Mar. 1932 (W. A. T. Summerville); Kingaroy, Apr. 1952; Mooloolah, Mar. 1955 (T. Manefield). *Citrus aurantium* L., Bouldercombe, Nov. 1953 (T. Manefield); Forest Hill, Jan. 1928; Gayndah, Jan. 1952 (T. Manefield); Gunalda, June 1951 (T. Manefield); Howard, Oct. 1953 (T. Manefield); Kilkivan, Aug. 1951. *Citrus grandis* Osbeck, Brisbane, Dec. 1956; Mundubbera, September, 1953 (T. Manefield); Nambour, Nov. 1954 (T. Manefield). *Citrus limon* Burm. f., Ayr, Jan. 1956; Bell, July, 1955; Biloela, Aug. 1953 (T. Passlow); Byfield, Nov. 1953 (T. Manefield); Charters Towers, Apr. 1954 (T. Manefield); Forest Hill, Dec. 1928; Gayndah, Apr. 1916 (H. Tryon); Gatton, Mar. 1934; Howard, June 1951 (T. Manefield); Longreach, June 1955; Millmerran, Apr. 1953 (A. W. S. May); Mundubbera, Sept. 1953; Nambour, Jan. 1933 (W. A. T. Summerville); Nundah, Feb. 1900 (H. Tryon); Rockhampton, Aug. 1954 (T. Passlow); Southport, Apr. 1954; Sunnybank, July, 1916 (H. Tryon); Wowan, July 1953 (T. Passlow). *Citrus medica* L., Brisbane, 1915 (H. Tryon); Bundaberg, June 1953 (T. Manefield). *Citrus paradisi* Macf., Atherton, Oct. 1955; Charters Towers, Jan. 1956 (T. Manefield); Gayndah, Jan. 1933 (W. A. T. Summerville); Palmwoods, Jan. 1933 (W. A. T. Summerville); Southport, June 1948; Yarraman, Apr. 1952. *Citrus reticulata* Blanco, Brisbane, Nov. 1933; Byfield, Nov. 1953; Cardwell, Feb. 1956; Eidsvold, Mar. 1952; Forest Hill, Jan. 1934; Gayndah, Jan. 1933 (W. A. T. Summerville); Longreach, June 1955; Maryborough, June 1953; Nambour, Jan. 1933 (W. A. T. Summerville). *Citrus sinensis* Osbeck, Belmont, Feb. 1953; Beta, June, 1954; Biloela, Aug. 1953 (T. Passlow); Bouldercombe, Nov. 1953 (T. Manefield); Bribie Is., Nov. 1951; Brisbane, 1894-95* (H. Tryon); Bundaberg, June 1953; Buderim, Jan. 1933; Cardwell, Feb. 1902 (H. Tryon); Charters Towers, Apr. 1954; Clare, Apr. 1950 (W. A. Smith); Cooroy, 1898-99* (H. Tryon); Coulston Lakes, Sept. 1953 (T. Manefield); Forest Hill, Dec. 1934; Gatton, Jan. 1934; Gayndah, Apr. 1916, Gladstone, Jan. 1902, Gympie, 1902-03* (H. Tryon); Howard, Dec. 1932 (W. A. T. Summerville); Imbil, Jan. 1936; Longreach, June 1955; Mackay, 1898-99*, Marburg, 1895-96*, Maryborough, 1899-1900* (H. Tryon); Mitchell, Aug. 1954; Mt. Isa, Jan. 1958 (H. Lavery); Mundubbera, Jan. 1933 (W. A. T. Summerville); Nambour, 1902-03*, Ormiston, Nov. 1910 (H. Tryon); Palmwoods, Jan. 1933 (W. A. T. Summerville); Ravenshoe, Feb. 1956 (T. Manefield); Rockhampton, 1895-96* (H. Tryon); Southport, June 1935; Sunnybank, July 1916 (H. Tryon); Tewantin, Sept. 1951 (T. Manefield); Theodore, July 1930; Tiaro, 1894, Tinana, 1894, Toowoomba, 1898-99* (H. Tryon); Walloon, Apr. 1954; Westbrook, Sept. 1911 (H. Tryon); Wowan, July 1953 (T. Passlow); Yarraman, June 1948. *Citrus* spp., Alpha, Feb. 1955 (T. Passlow); Alton Downs, Jan. 1955 (T. Passlow); Anakie, 1916-17*, Aramac, Atherton, 1912-13*, Blackall Ra., 1900-01* (H. Tryon); Bollon, May 1955; Bowen, 1906-07*, Brisbane, 1897-98*, Byrnestown, 1912-13*,

* On this and subsequent pages these records are taken from the Annual Reports of Queensland Department of Agriculture and Stock for the years mentioned.

Charleville, 1910-11*, Childers, 1897-98*, Churchill, 1910-11*, Darling Downs, 1897-98*, Eidsvold, 1897-98*, Esk, 1912-13*, Grantham, 1912-13*, Gympie, 1902, Ipswich, 1906-7*, Leyburn, 1912-13*, Mackay, 1897-98*, Mitchell, 1916-17*, Nambour, 1902, North Coast, 1897-98*, Pittsworth, 1909-10* (H. Tryon); Roma, July 1961 (M. Bengston); Rosewood, 1909-10* (H. Tryon); Yamala, Aug. 1955 (T. Passlow). *Cordia dichotoma* Forst. f., Ayr, Apr. 1953 (W. A. Smith). *Eremocitrus glauca* (Lindl.) Swingle, Marmor, Oct. 1955. *Erythrina caffra* Thumb., Tugun, Jan. 1949. *Erythrina vespertilio* Benth., Brisbane, 1945. *Ficus carica* L., Brisbane, 1906-07* (H. Tryon); Cecil Plains, July 1961 (M. Bengston); Forest Hill, Jan., 1935; Mackay, 1898-99*, Mt. Larcom, Sept. 1914 (H. Tryon); Murgon, 1937; Nambour, 1912 (H. Tryon); Rockhampton, Nov. 1952; Sunnybank, Jan. 1935; Surat, Feb. 1949. *Flacourtia* sp., Brisbane 1906-7* (H. Tryon). *Fortunella margarita* (Lour.) Swingle, Howard, June 1951 (T. Manefield). *Gerbera jamesoni* Bolus, Indooroopilly, Mar. 1957. *Gladiolus* sp., Brisbane, Jan. 1954. *Hydriastele wendlandiana* (F. Muell.) Wendl. and Drude, Brisbane, Feb. 1961. *Juglans regia* L., Gatton, 1934. *Leptospermum scoparium* Forst., Brisbane, Sept. 1958. *Ligustrum* sp., Brisbane, Apr. 1954. *Malus sylvestris* Mill., Herberton, Oct. 1960 (G. W. Saunders); Isis, 1907-08* (H. Tryon); Kingaroy, May, 1937, Rockhampton, June 1961 (T. Passlow); Townsville, June 1961 (H. Lavery). *Morus alba* L., Brisbane, Dec. 1945. *Prunus amygdalus* Batsch., Pinbarren, 1897-98* (H. Tryon). *Prunus armeniaca* L., Darling Downs, 1897-98* (H. Tryon). *Prunus persica* (L.) Batsch., Gatton, July 1911 (H. Tryon); Kingaroy, May 1937; Rockhampton, 1897-98* (H. Tryon). *Ricinus communis* L., Forest Hill, Dec. 1932. *Rosa* sp., Brisbane, 1897-98*, Broadwater, 1897-98* (H. Tryon); Nambour, July 1952 (T. Manefield); Townsville, 1916-17* (H. Tryon). *Vitis vinifera* L., Biloela, Jan. 1958 (T. Passlow); Brisbane, 1895-96*, Bundaberg, 1900-01* (H. Tryon); Charleville, May, 1957; Townsville, June 1961 (H. Lavery).

***Aonidiella eremocitri* McKenzie**

(Figure 3)

1937: *Aonidiella eremocitri* McKenzie: The Pan-Pacific Entomologist, 13: p. 177.

Type locality and host.—Queensland; Marmor, on *Eremocitrus glauca*.

McKenzie (1938) pointed out that this species resembles *A. comperei* McKenzie from India but differs in having four instead of two small groups of perivulvar pores. Some of the specimens examined in the present study show only two groups of these pores but have been determined as *A. eremocitri* in having a large thoracic tubercle and were part of a small population which included specimens with four groups of perivulvar pores. Previously only the type material was known. The new records are from rain forest trees.

Hosts and distribution.—*Celastrus bilocularis* F. Muell., Yarraman, July 1947; *Owenia venosa* F. Muell., Yarraman, May, 1947.

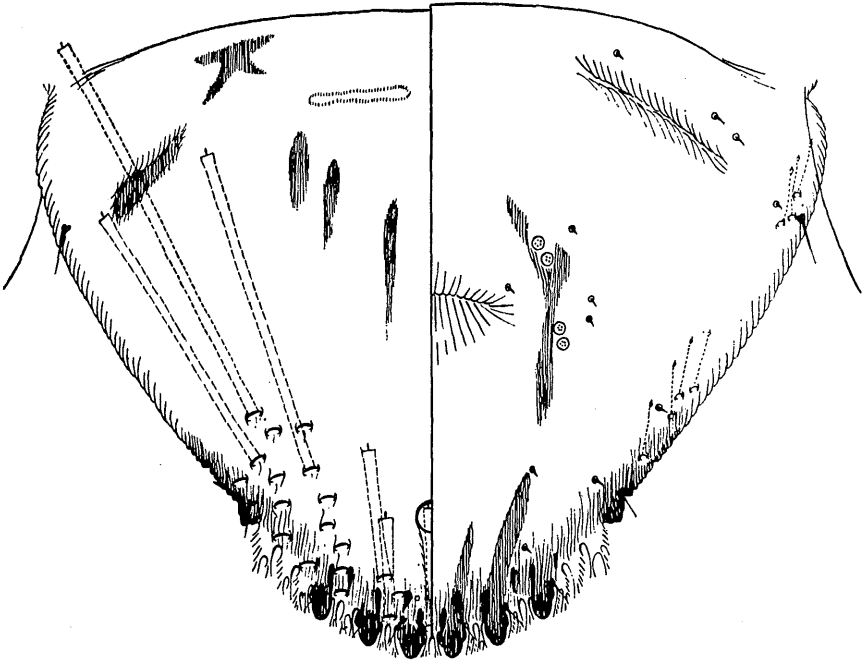


Fig. 3.—*Aonidiella eremocitri*. Pygidium of adult female (after McKenzie).

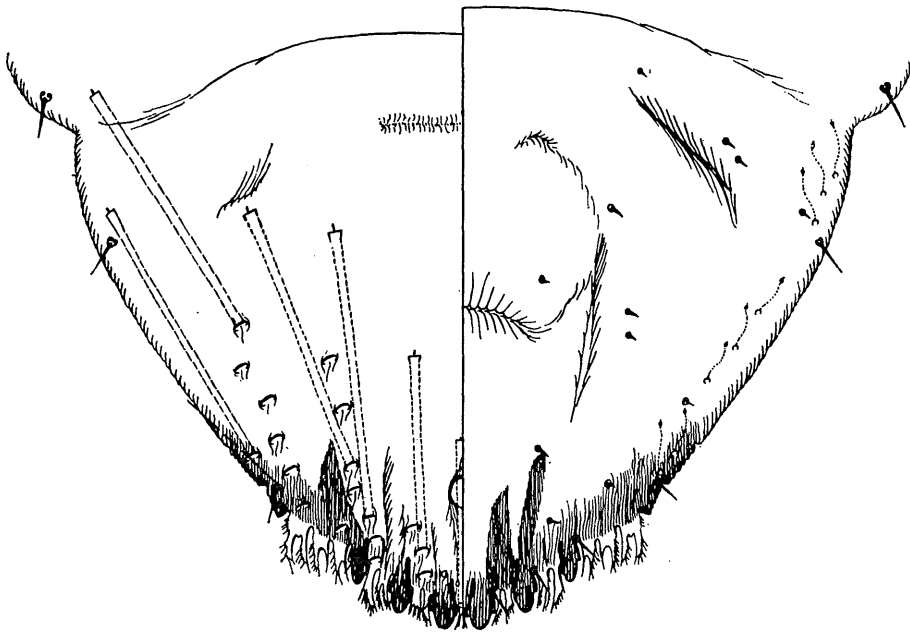


Fig. 4.—*Aonidiella inornata*. Pygidium of adult female (after McKenzie).

***Aonidiella inornata* McKenzie**

(Figure 4)

1938: *Aonidiella inornata* McKenzie: Microentomology, 3:p.10.*Type locality and host.*—Philippine Is.; Los Banos, on *Astronia* sp.

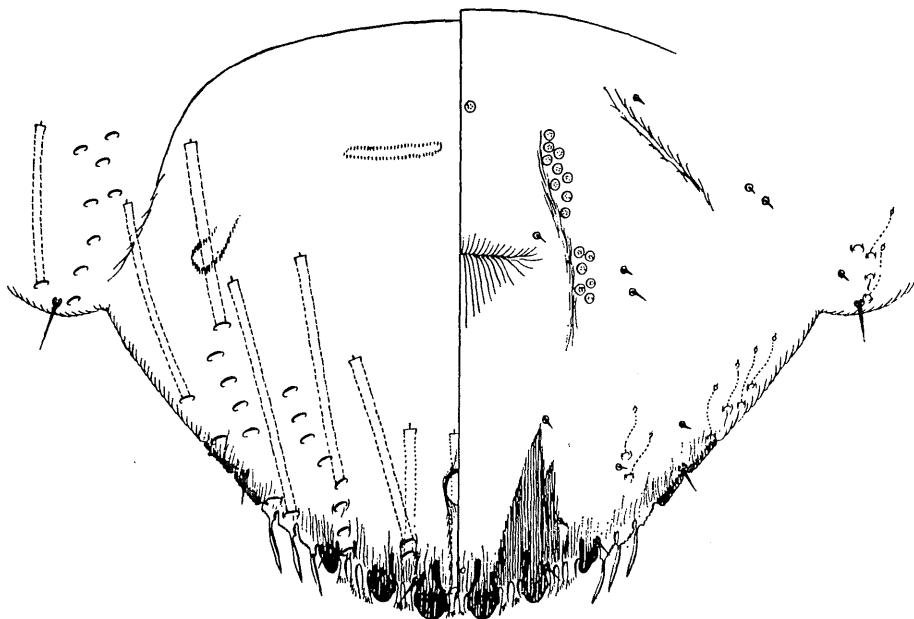
This species is known also from Hong Kong and Hawaii. Its presence in a rain-forest area well inland in Queensland indicates establishment of long standing in this country.

Host and locality.—*Fragraea cambageana* Domin, Julatten, Sept. 1953.***Aonidiella orientalis* (Newstead)**

(Figures 5 and 6)

*Synonymy:*1894: *Aspidiotus orientalis* Newstead; Indian Museum Notes 3:p.26.1921: *Furcaspis orientalis* (Newstead): MacGillivray; The Coccidae, p. 408.1938: *Aonidiella orientalis* (Newstead): McKenzie; Microentomology, 3:p.12.*Type locality.*—India; Madras (host not recorded).

This species is known from a variety of hosts in most tropical countries. Its occurrence in Queensland has recently been reported (Brimblecombe 1961).

Host and localities.—*Carica papaya* L., Thursday Is., May 1954; Mt. Isa, July 1961.Fig. 5.—*Aonidiella orientalis*. Pygidium of adult female (after McKenzie).

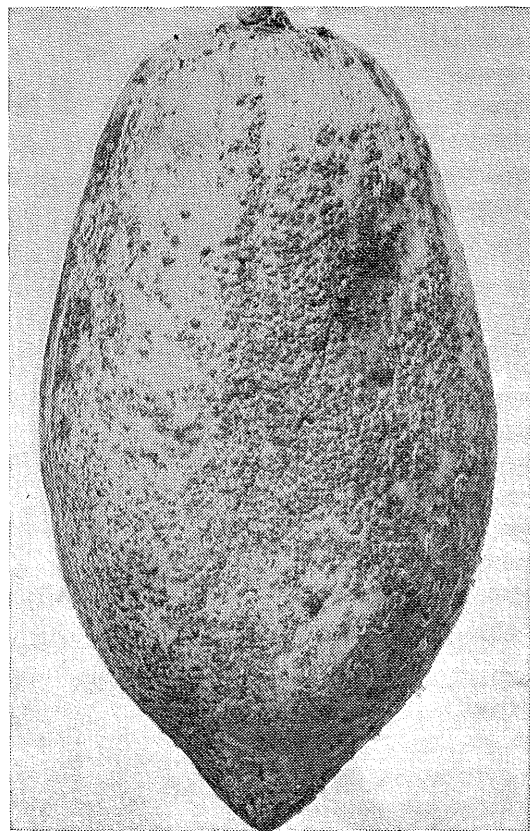


Fig. 6.—*Aonidiella orientalis*. Heavy infestation of papaw fruit.

Genus **CHRYSOMPHALUS** Ashmead

Synonymy:

1880: *Chrysomphalus* Ashmead; The American Entomologist, 3:p.268.

1897: *Aspidiotus* (*Chrysomphalus*) Ashmead: Cockerell; United States Department of Agriculture, Division of Entomology, Technical Series No. 6, p.12.

Generic type.—*Chrysomphalus ficus* Ashmead.

Most authorities regarded this as a valid genus but others, following the lead of Cockerell (1897), for many years regarded it merely as a subgenus of *Aspidiotus*. Affinities, however, are closer to *Aonidiella*. MacGillivray (1921) reaffirmed its validity. This was accepted by Ferris (1938) and a complete revision by McKenzie (1939) clearly defined its limits.

Most of the species of *Chrysomphalus* have been described from tropical and subtropical countries. McKenzie (1939) strongly believed Oriental and Australasian regions to be possible origins of the genus and suggested that

Australia and Indo-Malaya may provide more new species. *C. fodiens* (Maskell) and *C. variabilis* McKenzie were previously known to be native to Australia and the recent description of *C. trifasciculatus* Brimblecombe and the placing of *Aspidiotus rubribullata* Froggatt in this genus (Brimblecombe 1958a) add support to McKenzie's view. *C. ficus* Ashmead has previously been recorded here. *C. dictyospermi* (Morgan) is now recorded and *C. bifasciculatus* Ferris has been determined from material collected in Canberra, making a total of seven species in this country. Two introduced and two native species occur in Queensland.

Names used in the Genus Chrysomphalus

- 1879: *aurantii* (Maskell), referred to *Aonidiella*.
 1938: *bifasciculatus* Ferris, retained in *Chrysomphalus*.
 1889: *dictyospermi* (Morgan), retained in *Chrysomphalus*.
 1880: *ficus* Ashmead, retained in *Chrysomphalus*.
 1891: *fodiens* (Maskell), retained in *Chrysomphalus*.
 1894: *orientalis* (Newstead), referred to *Aonidiella*.
 1890: *rossi* (Maskell), referred to *Lindingaspis*.
 1914: *rubribullatus* (Froggatt), retained in *Chrysomphalus*.
 1959: *trifasciculatus* Brimblecombe, retained in *Chrysomphalus*.
 1899: *rossi* var. *victoriae* Cockerell = *Lindingaspis victoriae* (Cockerell).

***Chrysomphalus dictyospermi* (Morgan)**

(Figures 7 and 8)

Synonymy:

- 1889: *Aspidiotus dictyospermi* Morgan; The Entomologist's Monthly Magazine, 25:p.352.
 1897: *Aspidiotus (Chrysomphalus) dictyospermi* Morgan: Cockerell; United States Department of Agriculture, Division of Entomology, Technical Series, No. 6, p.23.
 1897: *Chrysomphalus dictyospermi* (Morgan): Leonardi; Rivista di Patologia Vegetale, 5:p.296.

Type locality and host.—British Guiana; Demarara, on *Dictyospermum album*.

This species is now known from most tropical and subtropical countries on a variety of hosts although mainly on palms. In Queensland it occurs throughout the eastern coastal belt on both introduced and native hosts. Commonest occurrences are on avocados and mangoes but as yet not as an economic pest.

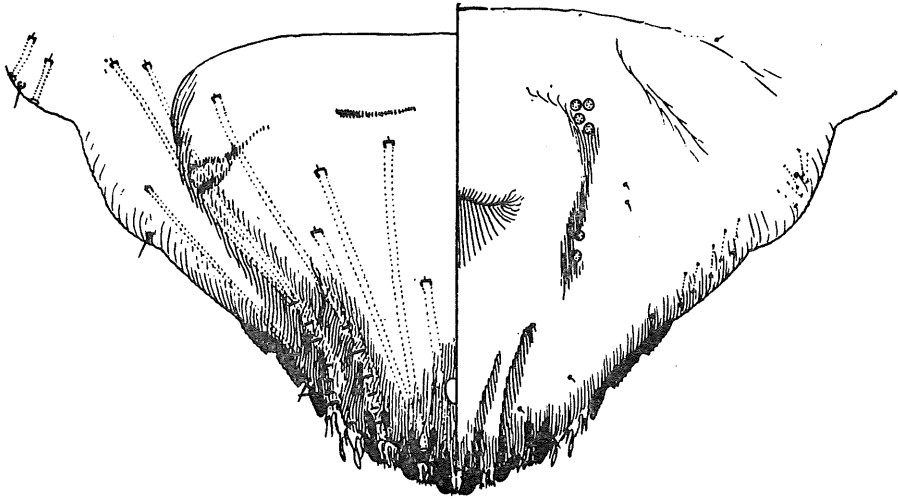


Fig. 7.—*Chrysomphalus dictyospermi*. Pygidium of adult female (after Ferris).

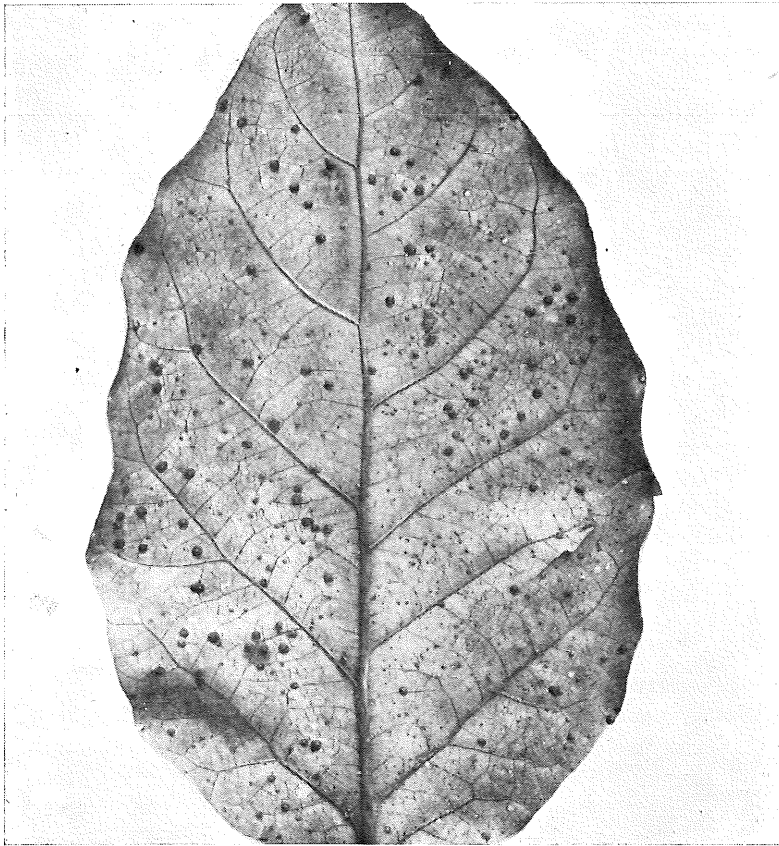


Fig. 8.—*Chrysomphalus dictyospermi*. Infestation on avocado leaf.

Hosts and distribution.—*Agonis flexuosa* (Willd.) Schau., Brisbane, June 1956. *Aloe ciliaris* Haw., Brisbane, July, 1958. *Camellia japonica* L., Brisbane, Sept. 1952; Northgate, Feb. 1952. *Calophyllum inophyllum* L., Cardwell, Sept. 1958. *Dendrobium bigibbum* Lindl., Brisbane, Sept. 1952. *Elaeodendron* sp., Brisbane, June 1956. *Endiandra palmerstoni* (F. M. Bail.) White and Francis, Gadgarra, Apr. 1941. *Mangifera indica* L., Ayr, June 1951 (W. A. Smith); Brisbane, Nov. 1957; Finch Hatton, Sept. 1958; Sunnybank, Aug. 1949; Wide Bay, Apr. 1912 (H. Tryon). *Persea americana* Mill., Bundaberg, Jan. 1950; Kenmore, Oct. 1961 (R. P. Kleinschmidt); Ormiston, June 1958; Palmwoods, Oct. 1955 (W. A. Smith); Sunnybank, July 1955. *Phoenix* sp., Surfers Paradise, Feb. 1957. *Phormium tenax* Forst., Petrie, Jan. 1953. *Pyrus communis* L., Pialba, Apr. 1912 (H. Tryon). *Randia fitzalani* (F. Muell.) F. Muell. ex Benth., Giru, July 1951 (W. A. Smith). *Strelitzia reginae* Banks, Kenmore, Oct. 1961 (R. P. Kleinschmidt); Nambour, June 1951.

Chrysomphalus ficus Ashmead

(Figures 9 and 10)

Synonymy:

- 1880: *Chrysomphalus ficus* Ashmead; The American Entomologist, 3:p.267.
 1881: *Aspidiotus ficus* (Ashmead): Comstock; The Canadian Entomologist, 13:p.8.
 1895: *Aspidiotus (Chrysomphalus) ficus* (Ashmead): Berlese; Rivista di Patologia Vegetale, 4:p.38.
 1899: *Chrysomphalus aonidum* (L.): Cockerell; Proceedings of the Academy of Natural Sciences of Philadelphia, p. 273.

Type locality and host.—Florida; Orlando, on orange.

This species is known from most countries on a wide variety of hosts and often is of economic importance, especially on citrus. Records in Queensland are mostly from the eastern coastal belt but it is known to occur in some of the dry inland areas. It is a common insect on citrus, particularly the orange, and is of importance in commercial orchards. Most of the hosts are introduced species growing under cultivated conditions.

Hosts and distribution.—*Acacia complanata* A. Cunn. ex Benth., Brisbane, Mar. 1903, Paddington, Feb. 1900 (H. Tryon). *Agonis flexuosa* (Willd.) Schau., Brisbane, June 1956. *Annona squamosa* L., Sunnybank, Feb. 1935. *Araucaria bidwillii* Hook., Brisbane, Sept. 1916 (H. Tryon). *Arecastrum romanzoffianum* (Cham.) Becc., Brisbane, July 1914 (H. Tryon). *Austromyrtus hillii* (Benth.) Burrett, Brisbane 1900 (H. Tryon). *Callistemon viminalis* (Soland. ex Gaertn.) G. Don. ex Loud., Brisbane, Nov. 1940. *Castanospermum australe* A. Cunn. and Fraser ex Hook., Brisbane, Dec. 1901 (H. Tryon). *Camellia japonica* L., Brisbane, Mar. 1948; Kenmore, July 1956 (R. P. Kleinschmidt). *Canna indica* L., Brisbane, 1914 (H. Tryon). *Ceratonia siliqua* L., Brisbane, 1904-05*

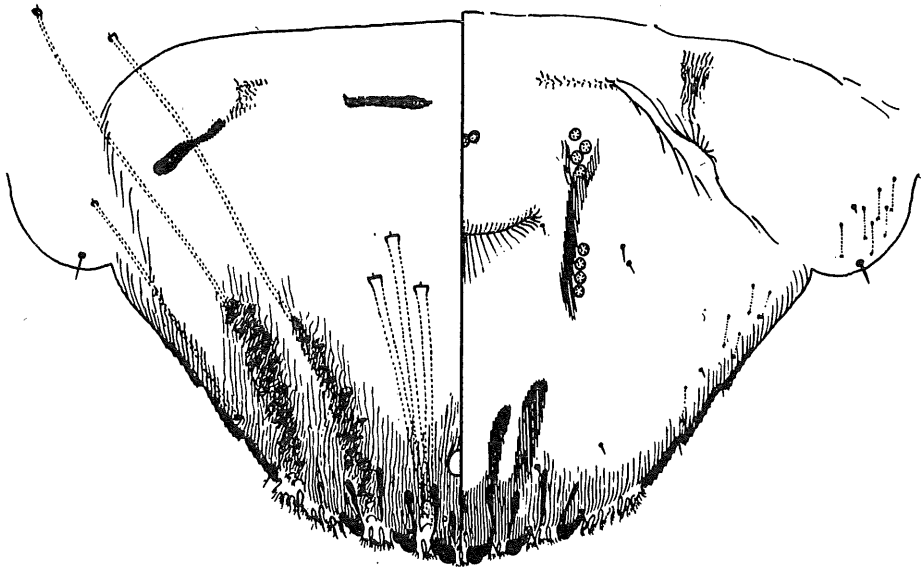


Fig. 9.—*Chrysomphalus ficus*. Pygidium of adult female (after Ferris).



Fig. 10.—*Chrysomphalus ficus*. Heavy infestation of orange fruit.

(H. Tryon). *Ceratopetalum gummiferum* Sm., Brisbane, Dec. 1953. *Cinnamomum camphorae* (L.) Neds. and Eberm., Brisbane Aug. 1897; Rockhampton, 1902-03* (H. Tryon). *Citrus limon* Burm. f., Biloela, Aug. 1953 (T. Passlow); Forest Hill, Jan. 1930; Nambour, Jan. 1933; Palmwoods, Feb. 1933 (W. A. T. Summerville); Wowan, July 1953 (T. Passlow). *Citrus paradisi* Macf., Nambour, Mar. 1933. *Citrus reticulata* Blanco, Buderim, Feb. 1933 (W. A. T. Summerville); Cooroy, Jan. 1933; Forest Hill, Jan. 1930; Grantham, Mar. 1935; Nambour, Feb. 1931 (W. A. T. Summerville); Rockhampton, Aug. 1954 (T. Passlow). *Citrus sinensis* Osbeck, Biloela, Aug. 1953 (T. Passlow); Brisbane 1898-99* (H. Tryon); Cardwell, Feb. 1936; Charters Towers, Sept. 1956; Cooroy, Feb. 1933 (W. A. T. Summerville); Forest Hill, Jan. 1930; Gayndah, Jan. 1933 (W. A. T. Summerville); Grantham, Mar. 1935; Koah, 1960 (J. H. Simmonds); Mackay, 1908-09*; Maryborough, 1902-03* (H. Tryon); Nambour, Jan. 1933 (W. A. T. Summerville); Nundah, Feb. 1900 (H. Tryon); Oxley, 1902-03*; Rockhampton, 1895-96* (H. Tryon); Wowan, July 1953 (T. Passlow). *Citrus* spp., Brisbane, 1897-98*; Buderim, Oct. 1918 (H. Tryon); Emerald, Jan. 1957; Mackay, 1897-98*; Maryborough, 1899-1900*; Oxley, 1902-03* (H. Tryon). *Cosmos bipinnatus* Cav., Brisbane, Mar. 1914 (H. Tryon). *Cymbidium* sp., Brisbane, Jan. 1950. *Dendrobium kingianum* Bidw., Brisbane, Apr. 1949. *Dendrobium moschatum* Sw., Brisbane, Apr. 1949. *Dendrobium* sp., Brisbane, 1898-99* (H. Tryon). *Dracaena draco* L., Brisbane, Sept. 1951. *Elaeodendron* sp., Cairns, June 1955 (G. W. Saunders). *Eugenia smithii* Poir., Brisbane, Jan. 1947. *Ficus macrophylla* Desf., Brisbane, Oct. 1899 (H. Tryon); Redland Bay, Sept. 1941. *Hedera helix* L., Brisbane, Oct. 1905 (H. Tryon). *Hibiscus rosa-sinensis* L., Brisbane, 1945. *Hydriastele wendlandiana* (F. Muell.) Wendl. and Drude, Brisbane, Dec. 1953. *Livistona australis* (R. Br.) Mart., Brisbane, Aug. 1956. *Mangifera indica* L., Brisbane, May, 1948; Laidley, May, 1948 (H. Jarvis). *Nerium oleander* L., Brisbane, Mar. 1949. *Olea europaea* L., Brisbane, May 1916; Broadwater 1906-07* (H. Tryon); Koah, Apr. 1961 (G. W. Saunders). *Pandanus* sp., Brisbane, Sept. 1951. *Persea americana* Mill., Beerwah, May 1958; Gatton, Aug. 1951; Rockhampton, Apr. 1940. *Phoenix* sp., Brisbane, Oct. 1899 (H. Tryon). *Rosa* sp., Townsville, 1916-17* (H. Tryon). *Severina buxifolia* Ten., Dalby, Dec. 1900 (H. Tryon). *Strelitzia reginae* Banks, Brisbane, Apr. 1953. *Thea sinensis* L., South Johnstone, Oct. 1953 (W. A. Smith). *Vitis vinifera* L., Ipswich, Mar. 1916 (H. Tryon).

***Chrysomphalus rubribullatus* (Froggatt)**

(Figure 11)

Synonymy:

- 1897: *Aspidiotus perniciosus* var. *eucalypti* Fuller; Journal of the Bureau of Agriculture, Western Australia, 4:p.1344.
- 1899: *Aspidiotus* (*Diaspidiotus*) *perniciosus* var. *eucalypti* Fuller; Cockerell; Bulletin of the Illinois State Laboratory of Natural History, 5:p.396.

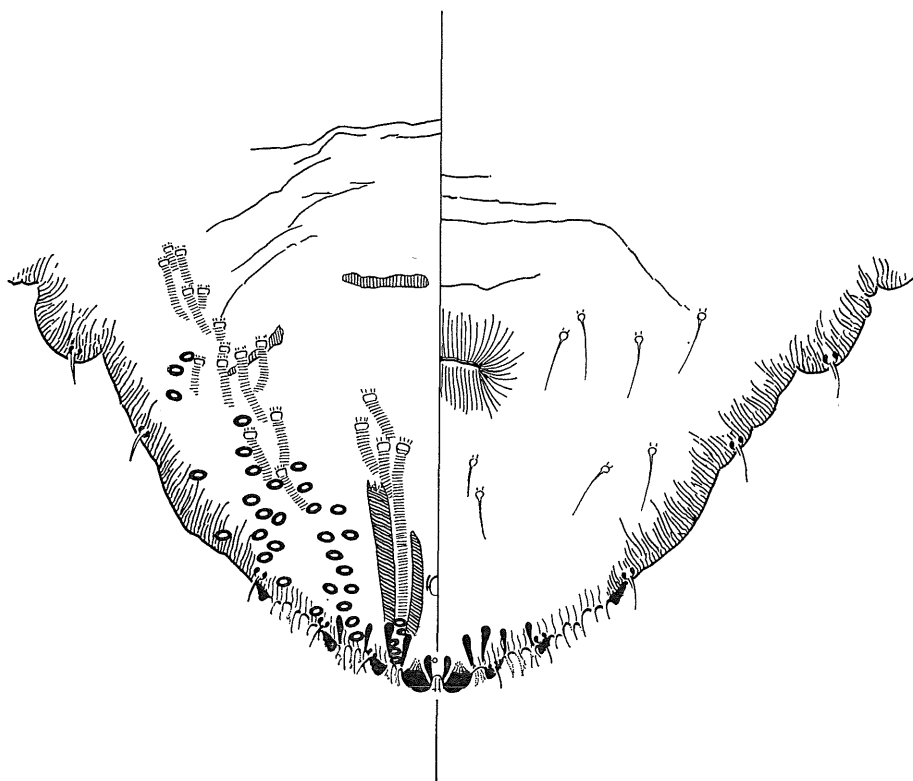


Fig. 11.—*Chrysomphalus rubribullatus*. Pygidium of adult female.

- 1914: *Aspidiotus (Aspidiella) rubribullata* Froggatt; Agricultural Gazette of New South Wales, 25:p.317.
- 1916: *Aspidiotus (Aonidiella) miniatae* Green; Bulletin of Entomological Research, 7:p.53.
- 1921: *Neosignoretia miniatae* (Green): MacGillivray; The Coccidae, p.424.
- 1941: *Diaspidiotus eucalypti* (Fuller): Ferris; Microentomology, 6:p.43.
- 1941: *Quadraspidotus rubribullatus* (Froggatt); Ferris; Microentomology, 6:p.48.
- 1958: *Chrysomphalus rubribullatus* (Froggatt): Brimblecombe; Queensland Journal of Agricultural Science, 15:p.69.

Type localities and hosts.—Western Australia; near Perth, on *Eucalyptus* sp. New South Wales; Trangie, on *Eucalyptus* sp.

A discussion on the synonymy has been given previously (Brimblecombe 1958a). The descriptions by Fuller, Froggatt and Green involve three widely separated localities, namely Perth (Western Australia), Trangie (New South Wales) and Darwin (Northern Territory). This species is also known to occur in Victoria and Queensland and therefore it may be regarded as distributed

throughout Australia. It was at first considered to have affinities with *Quadraspidotus perniciosus* (Comstock) and at times the latter species as misidentification has been recorded on eucalypts. The insect is confined to eucalypts as hosts. Infestations may be heavy but not of economic importance.

Hosts and distribution.—*Eucalyptus camaldulensis* Dehn., Thangool, July 1949. *Eucalyptus crebra* F. Muell., Barakula, Oct. 1938; Warwick, Oct. 1937. *Eucalyptus melanophloia* F. Muell., Rosewood, Mar. 1900 (H. Tryon). *Eucalyptus* sp., Inglewood, Oct. 1954; Pikedale, Oct. 1954.

Chrysomphalus trifasciculatus Brimblecombe

(Figure 12)

1959: *Chrysomphalus trifasciculatus* Brimblecombe; Queensland Journal of Agricultural Science, 16:p.123.

Type locality and host.—South Queensland, on *Eucalyptus* sp.

Only the type material has been recorded in Queensland. The insects were clustered on the bark of a young tree. Other records are from eucalypts in New South Wales.

Genus **QUADRASPIDIOTUS** MacGillivray

Synonymy:

1921: *Quadraspidotus* MacGillivray; The Coccidae, p. 388.

1921: *Comstockaspis* MacGillivray; The Coccidae, p. 391.

Generic type.—*Aspidiotus ostreaeformis* Curtis.

The synonymy of this genus was discussed by Ferris (1938) and McKenzie (1943). Most of the valid species were described from Europe and America; others from the Orient have been assigned to it in recent years. Only the generic type occurs in Queensland.

Names used in the Genus Quadraspidotus

1881: *perniciosus* (Comstock), retained in *Quadraspidotus*.

1914: *rubribullatus* (Froggatt), referred to *Chrysomphalus*.

Quadraspidotus perniciosus (Comstock)

(Figures 13, 14 and 15).

Synonymy:

1881: *Aspidiotus perniciosus* Comstock: Report of the United States Department of Agriculture 1880, p.304.

1895: *Aonidia fusca* Maskell: Transactions of the New Zealand Institute 1894, 27:p.43.

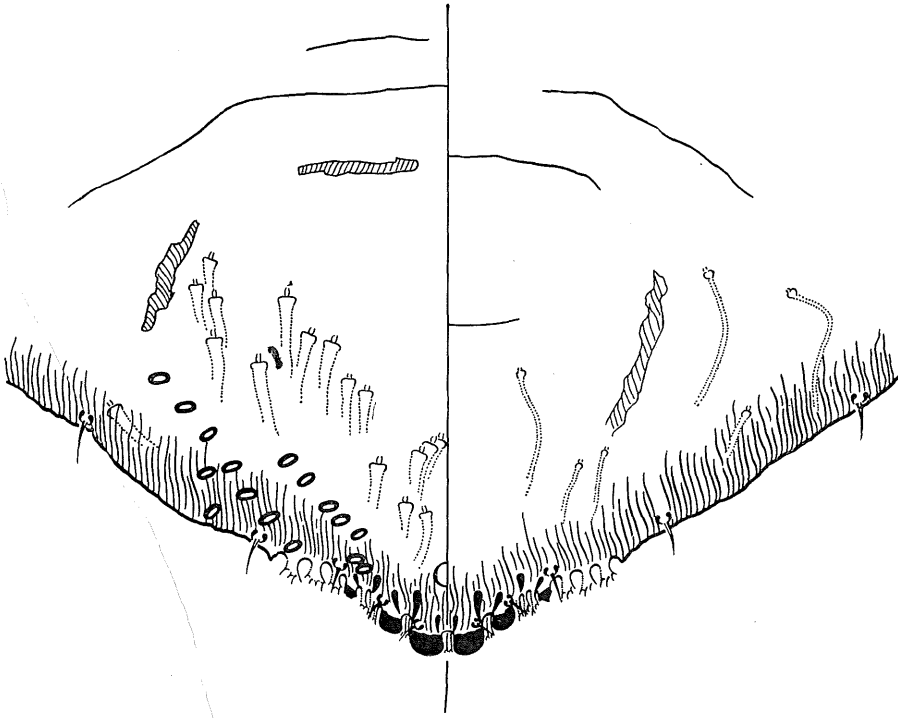


Fig. 12.—*Chrysomphalus trifasciculatus*. Pygidium of adult female.



Fig. 13.—*Quadraspidiotus perniciosus*. Pygidium of adult female (after Ferris)

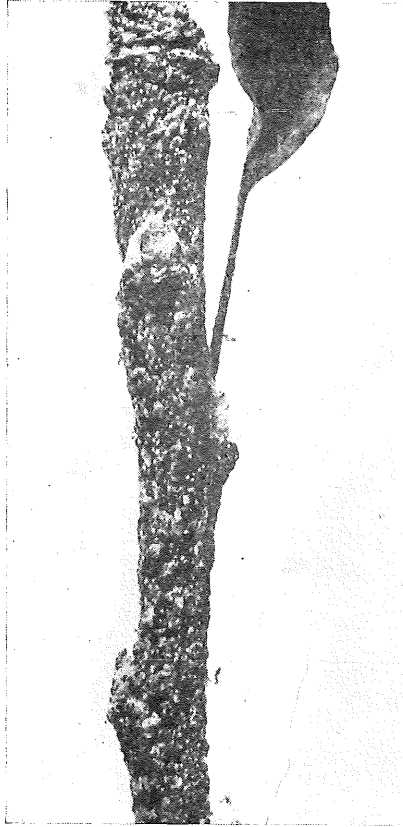


Fig. 14.—*Quadraspidiotus perniciosus*.
Infestation on apple twig.

- 1896: *Aspidites perniciosus* (Comstock): Berlese and Leonardi; Rivista di Patologia Vegetale, 4:p.349.
- 1897: *Aspidiotus (Diaspidiotus) perniciosus* Comstock: Cockerell; United States Department of Agriculture, Division of Entomology, Technical Series No. 6:p.14.
- 1898: *Aonidiella perniciososa* (Comstock): Leonardi; Rivista di Patologia Vegetale, 6:p.330.
- 1899: *Aonidiella fusca* (Maskell): Leonardi; Rivista di Patologia Vegetale, 7:p.187.
- 1921 *Comstockaspis perniciososa* (Comstock): MacGillivray; The Coccidae, p.391.
- 1941: *Quadraspidiotus perniciosus* (Comstock): Ferris; Microentomology, 6:p.46.

Type locality and hosts.—California; Santa Clara County, on apple, pear, plum and other trees.

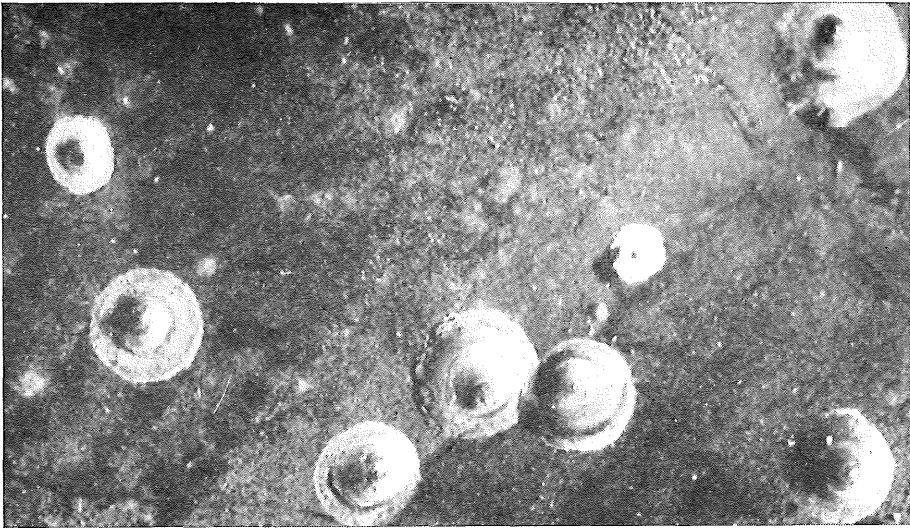


Fig. 15.—*Quadraspidiotus perniciosus*. Infestation on plum fruit.

This insect has spread to most countries of the world and is a troublesome pest in deciduous fruit orchards. Pest status and general distribution in Queensland have previously been discussed (Jarvis 1926; Bengston 1961; Brimblecombe 1962).

Hosts and distribution.—*Carica papaya* L., Aspley, May 1939. *Cydonia oblonga* Mill., Allora, 1906-07* (H. Tryon). *Eriobotrya japonica* (Thunb.) Lindl., Palmwoods, 1918-19* (H. Tryon). *Juglans regia* L., Warwick, Jan. 1947. *Malus sylvestris* Mill., Ayr, June 1961 (J. J. Davis); Brisbane, 1900-01*, Crows Nest, 1898-99*, Darling Downs, 1907-08*; Eukey, Mar. 1961 (M. Bengston); Jimboomba, 1900-01*, Kalunga, June 1961 (G. W. Saunders); Killarney, 1897-1900* (H. Tryon); Kingaroy, May 1937 (W. A. Smith); Monto, Sept. 1961 (W. A. Smith); Rockhampton, June 1961 (T. Passlow); Stanthorpe, 1895-96*, Toowoomba, 1900-01*, Warwick, 1898-99* (H. Tryon). *Prunus amygdalus* Batsch., Rockhampton, 1895-96* (H. Tryon). *Prunus armeniaca* L., Goondiwindi, July 1961 (M. Bengston); Stanthorpe, Oct. 1949; Toowoomba, 1900-01* (H. Tryon); Warwick, July 1961 (M. Bengston). *Prunus avium* L., Stanthorpe, Sept. 1911 (H. Tryon). *Prunus domestica* L., Brisbane, 1902-03*, Cooroy, 1898-99*, Crows Nest, 1915-16*, Dalby, July 1961 (M. Bengston); Darling Downs, 1897-98* (H. Tryon); Kaban, June 1961 (G. W. Saunders); Kingaroy, May 1937 (W. A. Smith); Mt. Lofty, July 1930; Mulgeldie, June 1931; Nanango, June 1937; Ravenshoe, May 1952 (G. W. Saunders); Stanthorpe, 1900-01*, Thorndale, July 1961 (M. Bengston); Tumavil, 1915-16*, Warwick, 1900-01*, Woolooga, Apr. 1915 (H. Tryon). *Prunus persica* (L.) Batsch., Allora, 1910-11* (H. Tryon); Brisbane, June 1931; Darling Downs, 1897-98* (H. Tryon); Forest Hill, May 1947; Gigoonga, Sept. 1929; Jimboomba, 1900-01*, North Coast, 1897-98*, Raglan, 1902-03*, Stanthorpe, 1895-96*, Toowoomba,

1900-01* (H. Tryon). *Prunus persica* (L.) Batsch. var. *nectarina* (Ait.) Maxim., Applethorpe, July 1961 (M. Bengston); Ayr, Oct. 1961 (J. J. Davis); Ballandean, June 1961 (M. Bengston); Dalby, July 1961 (M. Bengston); Goomeri, July 1958; Kaban, June 1961 (G. W. Saunders). *Pyrus communis* L., Ballandean, Feb. 1927; Brisbane, 1902-03*, Darling Downs, 1897-98* (H. Tryon); Eidsvold, Oct. 1957; Roma, June 1961 (M. Bengston); Toowoomba, 1900-01*, Warwick, 1898-99*, Westbrook, 1910-11* (H. Tryon). *Rosa* sp., Brisbane, Mar. 1935. *Vitis vinifera* L., Brisbane, Dec. 1915 (H. Tryon).

ACKNOWLEDGEMENT

Officers of the Botany Section of this Department identified many of the host species.

REFERENCES

- BENGSTON, M. (1961).—San José scale on deciduous fruits. *Qd Agric. J.* 87:706-7.
- BRIMBLECOMBE, A. R. (1951).—Control of red scale on figs. *Qd Agric. J.* 73:283-5.
- BRIMBLECOMBE, A. R. (1955).—Studies of the Coccoidea. 3. The genera *Chentraspis*, *Clavaspis*, *Lindingaspis* and *Morganella* in Queensland. *Qd J. Agric. Sci.* 12:39-56.
- BRIMBLECOMBE, A. R. (1956).—Studies of the Coccoidea. 5. The genus *Ceroplastes* in Queensland. *Qd J. Agric. Sci.* 13:159-67.
- BRIMBLECOMBE, A. R. (1958a).—Studies of the Coccoidea. 7. New designations of some Australian Diaspididae. *Qd J. Agric. Sci.* 15:59-94.
- BRIMBLECOMBE, A. R. (1958b).—Control trials against red scale on figs. *Qd J. Agric. Sci.* 15:215-39.
- BRIMBLECOMBE, A. R. (1961).—Scale insects on papaws. *Qd Agric. J.* 86:163-4.
- BRIMBLECOMBE, A. R. (1962).—Studies of the Coccoidea. 12. Species occurring on deciduous fruit and nut trees in Queensland. *Qd J. Agric. Sci.* 19:219-29.
- COCKERELL, T. D. A. (1897).—The San José scale and its nearest allies. Tech. Ser. U.S. Div. Ent. No. 6.
- COCKERELL, T. D. A. (1899).—First supplement to the check list of the Coccidae. *Bull. Ill. Lab. Nat. Hist.* 5:389-98.
- FERNALD, M. E. (1903).—A catalogue of the Coccidae of the world. Spec. Bull. Mass. Agric. Exp. Sta. No. 88.
- FERRIS, F. G. (1938).—“Atlas of the Scale insects of North America. Series 2.” (Stanford University Press: Stanford.)
- JARVIS, H. (1926).—The San José scale. *Qd Agric. J.* 27:513-7.
- LEONARDI, G. (1899).—Saggio di Sistematica Degli *Aspidiotus*. *Riv. Pat. Veg., Padova* 7:173-225.
- MACGILLIVRAY, A. D. (1921).—“The Coccidae.” (Scarab Press: Urbana, Ill.)
- MASKELL, W. M. (1887).—“An Account of the Insects Noxious to Agriculture and Plants in New Zealand. The Scale Insects (Coccidae).” (Government Printer: Wellington.)

- MAY, A. W. S. (1947).—Red scale control. *Qd Agric. J.* 65:311-14.
- MCKENZIE, H. L. (1937a).—Morphological differences separating Californian red scale, yellow scale and related species (Homoptera, Diaspididae). *Univ. Calif. Publ. Ent.* 6:323-36.
- MCKENZIE, H. L. (1937b).—Generic characteristics of *Aonidiella* Berlese and Leonardi, and description of new species from Australia (Homoptera, Diaspididae). *Pan-Pacif. Ent.* 13:176-80.
- MCKENZIE, H. L. (1938).—The genus *Aonidiella* (Homoptera, Coccoidea, Diaspididae). *Microentomology* 3:1-36.
- MCKENZIE, H. L. (1939).—The genus *Chrysomphalus* and supplementary notes on the genus *Aonidiella* (Homoptera, Coccoidea, Diaspididae). *Microentomology* 4:51-77.
- MCKENZIE, H. L. (1943).—The genus *Targionia* and some of its allies (Homoptera: Coccoidea: Diaspididae). *Microentomology* 8:82-111.
- SMITH, J. H. (1939).—Red scale on citrus. *Qd Agric. J.* 52:523-8.
- SUMMERVILLE, W. A. T. (1934).—Queensland citrus scale insects. *Qd Agric. J.* 41:450-86, 568-91; 42:4-33, 186-207.
- TRYON, H. (1889).—"Enquiry into Diseases Affecting the Fruit Trees and Other Economic Plants in the Toowoomba District." (Government Printer: Brisbane.)
- TRYON, H. (1894).—The diseases affecting the orange orchards of Wide Bay and the insect pests prevalent therein. *Bull. Qd Dep. Agric.* No. 4, 2nd ser.

(Received for publication June 5, 1962)