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STUDIES ON SOME INDIAN ALEYRODIDAE*

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INTRODUCTION

Aleyrodids or whiteflies are small, inconspicuous phytophagous insects often overlooked inspite of their abundance. This is evident from lack of substantial work on this group in this country for the past quarter of a century or more. Several species are known to be economically important and particular mention may be made of species such as the greenhouse whitefly *Trialeurodes vaporariorum* (Westwood), the sugarcane whiteflies *Neomaskellia bergii* (Signoret) and *Aleurolobus barodensis* (Maskell), the jasmine aleyrodid *Dialeurodes kirkaldyi* (Kotinsky), the citrus whiteflies *Aleurocanthus woglumi* Ashby, *Dialeurolonga elongate* (Dozier) and *Dialeurodes citri* Ashmead and the cotton whitefly *Bemisia tabaci* (Gennadius). The last named species has also been known to be the vector of a number of virus diseases of crop plants. The aleyrodids inhabit the leaves of plants, generally the undersurface, and a few species are found on petioles and stem. They are typically pests of angiosperms, most species infesting dicotyledonous plants; a few have been reported to infest ferns. Aleyrodids are mostly restricted to the tropics and subtropics though they have also been reported to occur in the cooler regions of the world.

The adult aleyrodids are small forms, with 7-segmented antennae, two ocelli, a pair of compound eyes and both sexes with two equal pairs of opaque, whitish, clouded or mottled or banded wings; the rostrum is 3-segmented and tarsi 2-segmented. Four larval instars are characteristic, the last, the 'pupal instar', being of considerable value in the determination of species in view of the possession of many striking characteristics in the 'pupal case' or the last larval exuvium.

The economic importance of this group of insects has been well realised in other countries particularly in North America and Europe and much headway has been made on the studies of this group both on systematics and bionomics. There are many species of aleyrodids in India causing substantial damage to cultivated crops but, however, very little work has been done on this group as a whole. The high economic status of these insects and lack of sufficient information of

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this group necessitates taking up intensive studies on these interesting insects, with particular reference to taxonomy, and the present study is a further contribution to the knowledge of Indian Aleyrodidae.

Review of Literature

Though Cestone was the first to notice an aleyrodid in the 17th century, it was left to Reaumur (1734) to describe it and place it among the moths, and for which Linnaeus (1758) gave the name *Phalaena* (*Tinea*) *proletella*. Later it was placed under Hemiptera by Latreille in 1796, who christened it as *Aleyrodes* referred to as *Aleurodes* by Burmeister (1835). It was only in the year 1840 the family Aleyrodidae was established by Westwood and the first world monograph on the family was published by Signoret (1868) which included twentythree species, and a further addition of fortythree species was made by Maskell (1895) making the total sixtysix.

Reviewing the essential world literature pertaining to aleyrodids it may be found that the North American species were listed by Quaintance (1900), Cockerell (1902) and Bemis (1904). Kirkaldy (1907) published a systematic and bibliographic catalogue of the species of the world and in 1909 Quaintance listed 141 species. A comprehensive revision of the family was made by Quaintance and Baker (1913, 1914 and 1917) and these contributions formed the basis for modern classification of the family. Hempel (1922 and 1923) and Bondar (1923) erected several genera from South America. Since then a number of workers contributed to the study of the Nearctic species of aleyrodids and mention may be made of the papers of Dozier (1927) on aleyrodids of Porto Rico, and of Baker (1937), Sampson (1944 and 1945), Sampson and Drews (1940, 1941 and 1944), Russell (1947 and 1948), and Drews and Sampson (1956 and 1958) on North American species, and of Russell (1943) on West Indies species.

The Japanese aleyrodids were studied by Kuwana (1911 and 1927) and Takahashi (1934b, 1935b & c, 1938a, 1946, 1949a, 1952c, 1954, 1955b, 1957, 1960 and 1963). Dozier (1928) and Dumbleton (1961a) reported on aleyrodids of South Pacific. The aleyrodids of New Caledonia were investigated by Cohic (1959a, b and c) and Dumbleton (1956b and 1961a) and those of Formosa, Island of ReUnion, Micronesia and Mauritius by Takahashi (1932, 1933, 1934a, 1935a, 1936, 1938b, 1939 and 1956). The aleyrodids of Australia and New Zealand were published by Takahashi (1937 and 1950) and Dumbleton (1956a and 1957).

The aleyrodids of Palaearctic region were studied by a number of workers and the contributions of Silvestri (1914 and 1915) on Italian species, of Goux (1949) on French species, of Gomez-Menor (1943, 1945 and 1954) on Spanish aleyrodids, of Ossiannilsson (1944 and 1955) on Swedish species, of Takahashi (1949b) on aleyrodids of Riouw Islands, of Chou (1949) on Chinese aleyrodids, of Danzig (1964) on Russian species, of Zahradnik (1956, 1957, 1961 and 1963) on Czekoslovakian aleyrodids, of Dobreanu and Manolache (1956) on Rumanian aleyrodids and of Klimaszewski and Szelegiewicz (1962) on aleyrodids of Poland form some important publications. Though the British whiteflies were investigated by Harrison (1920) and Trehan (1938 and 1940),

a revision of them was recently done by Mound (1962a, 1966 and 1967).

In the study of Ethiopian aleyrodid fauna, though Newstead (1911 and 1921), Dozier (1934), Corbett (1935), Gomez-Menor (1954) and Russell (1960 and 1962) made some contributions to the study of African species, it was Mound (1961 and 1965a) and Cohic (1966 a and b) who made some substantial contribution adding eight new genera and a number of new species. The aleyrodids of Canary Islands were studied by Gomez-Menor (1954). The Egyptian species were dealt with by Priesner and Hosny (1932 and 1934a and b). Takahashi (1951a, 1952b, 1955a, 1961 and 1962) and Takahashi and Mamet (1952) described a large number of new species and erected ten new genera from Madagascar.

In the Oriental region the study of aleyrodids first received attention in India and the Indian species were studied by Maskell (1895), Buckton (1903), Peal (1903), Quaintance and Baker (1917), Misra (1923), Dozier (1928), Corbett (1935 and 1939), Singh (1931, 1938, 1940 and 1944), Takahashi (1950) and Rao (1958). Singh (1932, 1933, 1938 and 1944) reported on aleyrodids of Burma. The Ceylonese and Malayan species of aleyrodids were published by Corbett (1926, 1927 and 1935) and Takahashi (1951b and 1952a). Takahashi (1942a and b, 1943 and 1950) contributed to the study of aleyrodids of Thailand, French Indo-China and Borneo.

The biology, ecology and control of a few economically important species have been investigated by several workers. Morrill (1903) first observed parthenogenesis and later in collaboration with Back (1911) reported that unfertilised eggs gave rise to males. In *Trialeurodes vaporariorum* (Westwood) unusual parthenogenetic behaviour was noticed in that the American race gave rise to males when reproduced parthenogenetically and the English race to females (Morrill 1903; Hargreaves 1915; Williams 1917; Stoll and Schull, 1919; Schrader, 1920 and 1926, and Thomsen, 1925 and 1927). The seasonal colour variations in the British whitefly *Aleyrodes fragariae* Walker(=*A. lonicerae* Walker) were studied by Trehan (1939). The contributions on the bionomics, ecology and control of the Greenhouse whitefly *Trialeurodes vaporariorum* (Westwood) (Morrill 1903, Hargreaves 1915 and Lloyd 1922), the British cabbage whitefly *Aleyrodes proletella* (Linnaeus)=*A. brassicae* Walker) (Butler 1938a and b and Elkhidir 1967) and the cotton whitefly, *Bemisia tabaci* (Gennadius) on tobacco in Israel (Avidov 1956) are important. Mound (1962b) studied olfaction and colour sensitivity in *Bemisia tabaci* (Gennadius). Mound (1965b) working on the effect of *Bemisia tabaci* (Gennadius) on cotton in the Sudan Gezira reported serious reduction in cotton yield and lowering of the seed weight and the lint weight per boll. In the recent years the importance of host-correlated variations in aleyrodids was brought out by Russell (1948) and Mound (1963). In the field of biological control of pests, biological control of the citrus black fly *Aleurocanthus woglumi* Ashby by the introduction of its natural enemies received greater attention (Woglum 1913, Gowdey and Ashby 1921, Edwards 1932, Smith *et al.* 1964, Bennett and Whervin 1965 and Whervin 1968).

The role of the whitefly *Bemisia tabaci* (Gennadius) as an important vector of virus diseases of crops in the field of economic entomology

needs no emphasis. 'Leaf crinkle' or 'leaf curl' of cotton in Nigeria and Sudan 'Cassava mosaic' in Africa are known to be transmitted by the whitefly (Golding 1930 and 1936, Kirkpatrick 1930 and 1931).

While reviewing in particular the taxonomic work done so far in India, it may be seen that Maskell (1895) was the first to study Indian aleyrodids who described five new species. Peal (1903) added seven new species and Buckton (1903) one more new species. Quaintance and Baker (1917) described a number of new species from the material collected by R. S. Woglum from the Orient in 1910 and this is the second occasion on which Indian material was handled. Misra (1923) added a new species from castor, and Dozier (1928) added one more new species *Dialeurodes* (*Dialeurolonga*) *elongata*. It was Singh (1931) who made a somewhat detailed study of the family in India recording 44 species of which 25 were new. Subsequently, Corbett (1935 and 1939) added three new species and Singh (1938, 1940 and 1944) included five more species to his original list. Takahashi (1950) added one new species in the genus *Tetraleurodes*. Though Singh's paper (1931) formed a significant contribution to the study of Indian aleyrodids, he dealt with only three species from southern parts of India. His few subsequent papers were also on species from north India. Though Ayyar in 1923 made mention of eight species (without giving their scientific names) as occurring in South India only in 1940 he furnished some notes on aleyrodids of sugarcane, citrus, jasmine, Eugenia, castor, and pomegranate. Usman and Puttarudraiah (1955) listed eight species from Mysore State and Rao (1958) twentytwo species from Hyderabad (Andhra Pradesh). It may be inferred from the above that a large gap exists in our knowledge of aleyrodid fauna of India.

Analysing the work done on different aspects of the group in this country, it must be said that studies on morphology, biology, population dynamics, ecology, control and economic importance have received fairly appreciable attention. Roonwal (1936) detailed sexual dimorphism and post-embryonic growth in *Dialeurodes dissimilis* Quaintance and Baker. Rakshpal (1940a and b, and 1941) reported on the morphology and mode of working of genitalia, mechanism of respiration, and post-embryonic development of male genitalia and respiratory system. Singh (1936, 1943, 1948 and 1955) reported on antennae, external genitalia and vasiform orifice of adult aleyrodids and vasiform orifice of larval aleyrodid. The morphology of the adults of *Aleurolobus barodensis* (Maskell) and *Trialeurodes rara* (Singh) were studied by Mahmood (1955) and Kurian (1962) respectively. Singh (1931), while working on Indian aleyrodids, added brief notes on the biology of a number of species. Husain (1930), Husain and Trehan (1933, 1940 and 1942), and Husain *et al.* (1936) made detailed studies of *Bemisia tabaci* (Gennadius) on cotton, and Pruthi and Samuel (1942), and Samuel (1950) on the study of biology and natural enemies of the insect on tobacco. The life-cycle of citrus aleyrodids and their control in the Punjab were reported by Husain and Khan (1945). Investigations were also carried out from time to time on various aspects of the two aleyrodid pests of sugarcane *Neomaskellia bergii* (Signoret) and *Aleurolobus barodensis* (Maskell) by a number of workers (Misra 1921, Mathur 1941, Gupta 1938, 1939 and 1953; Prasad, 1954, Mahmood, 1955, Basheer, 1956, Khan and Krishnamurthy Rao, 1956, Giridhari Lal, 1958, Leela

David *et al.* 1962, and Agarwal and Siddiqui 1964. Khanna *et al.* (1948) and Gupta and Avasthy (1955) reported on sampling the incidence of whitefly on sugarcane. A loss of 30-40 per cent in sucrose and 20-25 per cent in total solids due to whitefly attack in sugarcane and 1.21, 2.71 and 2.81 unit loss of sugar recovery in light, medium and heavy attacks, respectively, have been estimated by various workers (Agarwal and Siddiqui 1964). David (1961, 1963) investigated the effects of weather factors on the occurrence of the aleyrodids *Aleurocanthus spiniferus* Quaintance on rose and *Siphoninus phillyreae* Haliday on pomegranate and also the host-predator relationship in the latter. The biology and control of the castor whitefly *Trialeurodes rara* Singh were also studied by Kurian (1962), David and Radha (1964), Radha (1971) and Sundara Babu (1971). In India 'leaf crinkle' or 'leaf curl' of cotton, 'leaf curl' of tobacco, tomato and *Zinnia elegans*, 'yellow vein mosaic' of *Abelmoschus esculentus* (lady's finger), pumpkin and *Althaea rosea* (hollyhock), Dolichos yellow mosaic, double bean yellow mosaic, leaf curl and enation mosaic of *Hibiscus rosasinensis*, papaya leaf curl, potato necrosis and sunnhemp phyllody are known to be transmitted by the well known whitefly vector *Bemisia tabaci* (Gennadius) (Mathur, 1933; Uppal *et al.* 1940; Pruthi and Samuel 1937, 1939, 1941 and 1942; Cooper and Varma 1948 and 1950; Cooper 1950 and John 1957).

A perusal of the above review of literature reveals the neglect in the taxonomic studies of this important group of insects in this country, particularly in South India.

CLASSIFICATION OF ALEYRODIDAE

(Keys to subfamilies and tribes)

Phalaena (*Tinea*) *proletella* described by Linnaeus in 1758 and placed by him among moths formed the first valid species of the family. Its hemipterous nature was recognised in 1796 by Latreille who erected the genus *Aleyrodes*. However, only in 1810 *proletella* was made the type of the genus *Aleyrodes*. The family name Aleyrodidae was established by Westwood in 1840. In 1909 Enderlein recognised two subfamilies Udamoselinae and Aleyrodinae and one more new subfamily Uraleyrodinae was erected by Sampson and Drews (1941).

Although aleyrodids were known since 1758 it was only in 1943 tribes under this family were recognised by Sampson for the first time who proposed five tribes and named them as Neomaskellini, Aleurochitonini, Siphonini, Dialeurodini and Aleyrodini. A sixth tribal division was proposed by Russell (1947) and two more new tribes, Aleurocanthini and Aleurolobini were recognised by Takahashi (1954).

At present the classification of the major groupings higher than tribes and genera are based primarily on wing venation and secondarily on characters of pupal case. The tribes and genera are now principally recognised from pupal cases (Sampson, 1943). Russell (1947) pointed out that "accurate definition of tribes in the Aleyrodidae is a perplexing problem, owing to the paucity of morphological characteristics indicative of tribal limits" and scrarcity of positively associated stages as majority of species are known only by pupal cases.

The contributions of Quaintance and Baker (1913, 1914 and 1917) formed the basis for modern classification of the family. Sampson (1943) attempted a new generic classification based on a reshuffling of characters of pupal cases and proposed new tribal divisions too. In 1947 he proposed additions and corrections to his earlier work. Russell (1947 and 1948) brought out the taxonomic importance of the structural details of the ventral surface of pupal case and also the possibility of recognising the male case by the presence of the bifid sac or male organ. Sampson and Drews (1956) published an upto date key to genera of the subfamily Aleyrodinae which served as an excellent basis for determination of seventyfive genera known at that time. Since then 24 new genera have been added to the list making the total genera 99 known till date. A brief account of the system of classification of Aleyrodidae upto tribes is detailed hereunder.

Superfamily: ALEYRODOIDEA Handlirsch, 1903
Family : ALEYRODIDAE Westwood, 1840
Subfamily: 1. URALEYRODINAE Sampson and Drews, 1941
Subfamily: 2. UDAMOSELINAE Enderlein, 1909
Subfamily: 3. ALEYRODINAE Enderlein, 1909.

Tribes of subfamily Aleyrodinae:

1. Neomaskellini Sampson, 1943
2. Aleurochitonini Sampson, 1943
3. Siphonini Sampson, 1943
4. Dialeurodini Sampson, 1943
5. Aleyrodini Sampson, 1943
6. Trialeurodini Russell, 1947
7. Aleurocanthini Takahashi, 1954
8. Aleurolobini Takahashi, 1954.

Key to Subfamilies of the family **Aleyrodidae**

(Sampson, 1943, *Ent. Amer.* (N.S.), 23(3): 183)

a. PUPAL CASES

1. Vasiform orifice invisible, hidden by caudal horn... ..... *Uraleyrodinae*
   Vasiform orifice visible. .2
2. Case with compound or agglomerate pores; if with simple pores, case thin and flat, operculum transversely rectangular, lingula conical and included; tracheal folds rarely present; margin smooth or with one row of teeth. .. *Udamoselinae*
   Case without compound or agglomerate pores; tracheal folds often present; margin often with two rows of teeth. *Aleyrodinae*

b. ADULTS

1. Paronychium spine-like; forewing may have costal, subcostal, radial, cubital, medial, and anal veins. ... *Udamoselinae*
   Paronychium blade-like; forewing may have radial, and cubital veins. .. . *Aleyrodinae*

Key to Tribes of the subfamily **Aleyrodinae**

1. Vasiform orifice transversely elliptical, wider than long; lingula extremely short, hardly longer than wide. . ... *.Neomaskellini*
   Vasiform orifice not transversely elliptical, at least as long as wide. .2
2. Dorsum completely covered with simple pores. .. .. .. *.Aleurochitonini*
   Dorsum with relatively few simple pores. ..3
3. Dorsum with elongate, siphon-like wax tubes. ... ... *.Siphonini*
   Dorsum without siphon-like wax tubes. .4
4. Tracheal pores or clefts usually present; if absent vasiform orifice definitely notched at hind end and caudal furrow distinctly defined, or lateral ridges (rhachis) developed on the abdomen and dorsum with many short spine-like setae, many of which are capitate. Lingula usually small, wanting long setae. Tracheal combs and eye spots lacking. .... *.Dialeurodini*

   Tracheal pores or clefts absent, tracheal combs sometimes developed; vasiform orifice not notched at the hind end. Lingula sometimes large, exposed and with a pair of long setae. Eye spots present in some species. .. .5
5. Submargin with a row of disc pores and porettes with variously associated conspicuous papillae. *Trialeurodini*

   Submargin without a row of disc pores and porettes. 6
6. Seventh abdominal segment nearly as long as or a little shorter than the sixth; vasiform orifice rounded, not elongate, sometimes elevated; lingula concealed; caudal furrow absent. .. ... *.Aleurocanthini*

   Seventh abdominal segment much shortened at the median area in many genera; vasiform orifice subcordate, triangular or truncated at the hind end, elongated in some species; lingula exposed, knobbed; caudal furrow sometimes developed.. .7
7. Knobbed part of lingula elongate, much longer than wide. . ... .. *Aleurolobini*

   Knobbed part of lingula globular, not distinctly longer than wide.... ... *.Aleyrodini*

STUDIES ON SOME INDIAN ALEYRODIDS

There has been a considerable neglect in the taxonomic studies on this group and the available information on the occurrence of species is thoroughly inadequate. This study, therefore, aims at providing a means of recognising the genera and species on the basis of examination of pupal cases and involves:

(*a*) Description of new genera and species from this country.
(*b*) Revision and redescription of poorly known species.
(*c*) Recording of species new to this geographical region.

(*d*) Aleyrodid—aleyrodid, and aleyrodid—other insects association on the same host plant.
(*e*) Host correlated variations in a few species of aleyrodids studied.

In the present work sixty species in twentyfour genera are discussed, of which thirty are new to science. Further, one new genus has been erected in addition to three new combinations suggested and six known genera recorded for the first time in this country. A few already known Indian species have been assigned to three genera hitherto not recorded from India. Four species known outside the country have been reported for the first time to occur in India. In addition, seven species so far known to occur only in northern part of the country have also been observed to be prevalent in South India. The various species studied are listed below.

List of Species of Aleyrodids Studied

I. Genus *Acaudaleyrodes* Takahashi
1. *A. rhachipora* (Singh)

II. Genus *Aleurocanthus* Quaintance and Baker
2. *A. davidi* sp. n.
3. *A. loyolae* sp. n.
4. *A. mangiferae* Quaintance and Baker
5. *A. marudamalaiensis* sp. n.
6. *A. rugosa* Singh
7. *A. seshadrii* sp. n.
8. *A. spiniferus* Quaintance
9. *A. splendens* sp. n.
10. *A. valparaiensis* sp. n.
11. *A. woglumi* Ashby

III. Genus *Aleurocybotus* Quaintance and Baker
12. *A. indicus* sp. n.

IV Genus *Aleurolobus* Quaintance and Baker
13. *A. barodensis* (Maskell)
14. *A. confusus* sp. n.
15. *A. marlatti* (Quaintance)
16. *A. moundi* sp. n.

V Genus *Aleuromarginatus* Corbett
17. *A. kallarensis* sp. n.
18. *A. tephrosiae* sp. n.

VI. Genus *Aleuroplatus* Quaintance and Baker
19. *A. alcocki* (Peal)
20. *A. mysorensis* sp. n.

VII. Genus *Aleurotrachelus* Quaintance and Baker
21. *A. caerulescens* Singh
22. *A. coimbatorensis* sp. n.
23. *A. multipapillus* Singh

VIII. Genus *Aleurotuberculatus* Takahashi
24. *A. cardamomi* sp. n.
25. *A. psidii* (Singh)
26. *A. russellae* sp. n.
27. *A. takahashii* sp. n.

IX. Genus *Asterobemisia* Tehan
28. *A. moringae* sp. n.

X. Genus *Asterochiton* Maskell
29. *A. cordiae* sp. n.

XI. Genus *Bemisia* Quaintance and Baker
30. *B. haneocki* Corbett
31. *B. jasminum* sp. n.
32. *B. tabaci* (Gennadius)

XII. Genus *Dialeurodes* Cockerell
33. *D. armatus* sp. n.
34. *D. bassiae* sp. n.
35. *D. cardamomi* sp. n.
36. *D. dissimilis* Quaintance and Baker
37. *D. distinctus* sp. n.
38. *D. eugeniae* (Maskell)
39. *D. indicus* sp. n.
40. *D. ixorae* Singh
41. *D. kirkaldyi* (Kotinsky)

XIII. Genus *Dialeurolonga* Dozier
42. *D. elongata* (Dozier)
43. *D. fici* sp. n.

XIV. Genus *Dialeuropora* Quaintance and Baker
44. *D. decempuncta* Quaintance and Baker
45. *D. pterolobiae* sp. n.

XV Genus *Indoaleyrodes* g. n.
46. *I. pustulatus* g. et sp. n.

XVI. Genus *Lipaleyrodes* Takahashi
47. *L. crossandrae* sp. n.
48. *L. euphorbiae* sp. n.

XVII. Genus *Neomaskellia* Quaintance and Baker
49. *N. bergii* (Signoret)

XVIII. Genus *Neopealius* Takahashi
50. *N. nilgiriensis* sp. n.

XIX. Genus *Pealius* Quaintance and Baker
51. *P. indicus* sp. n.
52. *P. schimae* Takahashi
53. *P. spina* (Singh) comb. n.

XX. Genus *Rhachisphora* Quaintance and Baker
54. *R. trilobitoides* (Quaintance and Baker)

XXI. Genus *Siphoninus* Silvestri
55. *S. phillyreae* (Haliday)

XXII. Genus *Taiwanaleyrodes* Takahashi
56. *T. indicus* (Singh) comb. n.

XXIII. Genus *Trialeurodes* Cockerell
57. *T. rara* Singh
58. *T. ricini* (Misra)
59. *T. vaporariorum* (Westwood)

XXIV Genus *Zaphanera* Corbett
60. *Z. publicus* (Singh) comb. n.

Materials and Methods

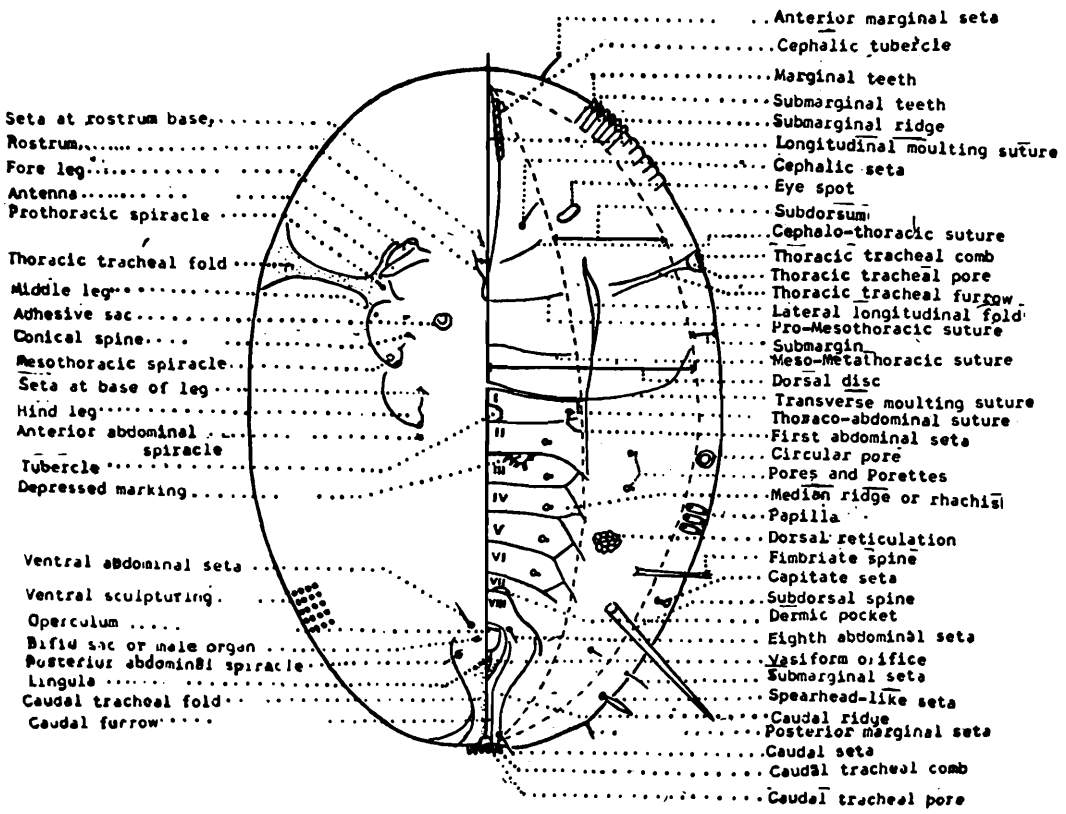
The material for the present study was collected from leaves bearing pupal cases mainly from different parts of three States viz., Tamil Nadu, Kerala and Karnataka in South India.

In the preparation of permanent mounts for critical studies, the pupal cases, from which adults have emerged, were carefully removed from the leaf surface with a very fine needle. Dry specimens were moistened prior to removal. The specimens were treated with 10 percent sodium hydroxide solution and heated gently for 10-15 minutes, depending on age and size of specimen. In the case of black specimens they were allowed to remain in 10 percent sodium hydroxide solution for 12 to 36 hours till they got decolourised to the desired extent. In a few cases specimens, which were very dark, required to be bleached in hydrogen peroxide. The specimens were then transferred to glacial acetic acid to neutralise the action of sodium hydroxide and also to remove wax. When necessary the specimens were cleared by gently pressing them with a fine needle bent slightly at its tip. The colourless specimens were stained with acid fuchsin and again transferred to glacial acetic acid for dehydration and removal of excess stain. Decolourised specimens were generally not stained. They were then cleared in carbo-xylol (a mixture of carbolic acid and Xylol at 1: 3) for 10-15 minutes, then taken to clove oil and after about 5 minutes mounted in Canada balsam. All the specimens were generally mounted keeping the dorsal side above, while a few with the ventral side above. Measurements were made with an ocular micrometer and drawings with the aid of a camera lucida.

Taxonomic Characters of Aleyrodids

The most important characteristic features that are taken into consideration in the taxonomy of aleyrodid are: presence or absence of thoracic and/or caudal tracheal folds, pores or combs; nature of combs; whether dorsal disc separated from submargin by a suture-like line or fold; shape of vasiform orifice and operculum, elevated or not; whether lingula knobbed, spatulate or otherwise, setose or not, exposed or concealed, included or extruded; whether seventh abdominal segment shorter than sixth; presence or absence of papillae, pores and porettes

on submargin and dorsal disc. The other characters of value are: marginal, submarginal and dorsal setae or spines; ventral abdominal setae; antennae and visibility of spiracles; presence or absence of setae or conical spines at base of legs and rostrum. In view of the availability



Text-fig. 1. Structural features of a generalised Aleyrodid pupal case.

of several striking characters relating to the pupal cases, which serve for determination of genera and species, it would appear unnecessary to mention in detail the essential structural features of an aleyrodid pupal case in general. The accompanying diagram (Text–fig. 1) giving the structural features of a generalised aleyrodid appears self-explanatory.

Key to genera of the **Aleyrodinae** *af India*

1.	Vasiform orifice transversely elliptical, elevated, lingula extremely short, submargin with a row of long setae; dorsum without papillae or pores.	.*Neomaskellia* Quaintance and Baker, 1913
	Vasiform orifice not transversely elliptical, dorsum with relatively few simple pores.	.2
2.	Dorsum with elongate siphon-like wax tubes.	.*Siphoninus* Silvestri, 1915
	Dorsum without siphon-like wax tubes.	.3
3.	Possessing at least one of the following characters: Thoracic tracheal folds, combs or pores; caudal tracheal folds, combs or pores.	.4
	Not possessing any of the above characters.	.. .21
4.	Possessing only caudal fold or pore.	.5
	Possessing thoracic and caudal tracheal folds, pores or combs. ..	.8

5. Submarginal area separated from dorsal disc by a line and with wax plates in clusters arranged in a row. .*Lipaleyrodes* Takahashi, 1962

   Submarginal area not separated from dorsal disc; wax plates in clusters not present. 9

6. Dorsum with two pairs of long 2-segmented setae on cephalic and first abdominal regions.. ... .. . *Taiwanaleyrodes* Takahashi, 1932

   Dorsum without 2-segmented setae. 7

7. Dorsum with circular raised papillae-like pores and submargin with a row of spines. .*Singhiella* Sampson, 1943

   Dorsum with round patches of suture-like markings. .*Aleuroclava* Singh, 1931

8. Possessing thoracic and caudal folds and/or pores 9

   Possessing thoracic and caudal folds and/or combs of teeth. .15

9. Submargin with a ring of large circular pores. *Dialeuropora* Quaintanee and Baker 1917

   Submargin without a ring of large circular pores .10

10. Dorsum with furrows and reticulations; submargin with a series of spines and a row of pores. *Rhachisphora* Quaintance and Baker, 1917

    Dorsum lacking furrows and reticulations .11

11. Seventh abdominal segment not shorter than sixth. ... .12

    Seventh abdominal segment shorter than sixth; lingula exposed and included; vasiform orifice not surrounded by a trilo bed figure. .13

12. Dorsum with fine granules and tubercles and a row of papilla-like structures... .*Aleurotuberculatus* Takahashi, 1932

    Submargin without a series of papillae; vasiform orifice usually small, lingula lingula usually concealed .*Dialeurodes* Cockerell, 1902

13. Vasiform orifice subcordate, usually large; lingula knobbed; submargin with a series of pores or papillae.. .. .*Dialeurolonga* Dozier, 1928

    Vasiform orifice subtriangular or elongately triangular in shape.. 14

14. Vasiform orifice elongately triangular, operculum subcordate to transversely elliptical; lingula spatulate with a pair of terminal setae. .*Bemisia* Quaintance and Baker, 1914

    Vasiform orifice subtriangular but rounded apically; floor with subparallel transverse ridges; operculum semicircular; lingula with lateral knob at base on each side without terminal paired setae. .*Indoaleyrodes* n.g.

15. Submargin separated from dorsal disc by a suture-like line or fold... .. .. .16

    Submargin not separated from dorsal disc.. .. 17

16. Vasiform orifice surrounded by a trilobed figure; lingula hidden.....*Aleurolobus* Quaintance and Baker, 1914

    Vasiform orifice not surrounded by a trilobed figure; lingula exposed, included.. ..... .*Asterochiton* Maskell, 1878

17. Vasiform orifice situated in a ribbed pyriform pit; submargin with a series of setae; lingula knobbed and exposed... .. .*Pealius* Quaintance and Baker, 1914

Vasiform orifice not situated in a ribbed pyriform pit; sub margin without a series of setae.. 18

18. Lingula hidden by rounded operculum.....*Aleuroplatus* Quaintance and Baker, 1914

Lingula exposed and included.. 19

19. Submargin with a row of large papilla-like pores.. .....*Trialeurodes* Cockerell, 1902

Submargin lacking row of papillae like pores.. ..... .20

20. Vasi-form orifice elongately triangular; operculum semi circular; lingula spatulate with a terminal pair of setae.. .*Asterobemisia* Trehan, 1940

Vasiform orifice triangular with caudal end rounded; lingula knobbed bearing a pair of terminal setae.. . .*Neopealius* Takahashi, 1954.

21. Margin with two rows of teeth. .. .. .22

Margin smooth or with one row of teeth. .23

22. Dorsum with a prominent central ridge; vasiform orifice not elevated.....*Aleurotrachelus* Quaintance and Baker, 1914

Dorsum with small circular pores; vasiform orifice elevated. .....*Zaphanera* Corbett, 1926

23. Submarginal area separated from dorsal disc by a line; vasiform orifice elevated; lingula hidden. .... *Tetraleurodes* Cockerell, 1902

Submarginal area not separated from dorsal disc; vasiform orifice may or may not be elevated; lingula hidden orexposed. .. .. .24

24. Operculum extremely short; vasiform orifice elevated and elongately elliptical. .*Acaudaleyrodes* Takahashi, 1951

Operculum not extremely short; vasiform orifice elevated or not elevated and variably shaped. 25

25. Vasiform orifice elevated, small, rounded or subcordate; lingula hidden; dorsum with many prominent spines. .....*Aleurocanthus* Quaintance and Baker, 1914.

Vasiform orifice not elevated; vasiform subcordate or cordate; dorsum without many prominent spines. .. .26

26. Margin irregularly toothed; vasiform orifice subcordate; operculum roundly trapezoi dal; lingula knobbed, setose and exposed ..... .*Aleyrodes* Latreille, 1795

Margin regularly toothed; operculum subcordate or trapezoidal. ..... .27

27. Operculum subcordate; lingula knobbed, exposed and usuall excluded.: .....*Aleurotulus* Quaintance and Baker, 1914

Operculum otherwise shaped; lingula exposed but included. 28

28. Vasiform orifice cordate; operculum roundly trapezoidal; dorsal setae small, in conspicuous... . .. .*Aleuromarginatus* Corbett, 1935

Vaisform orifice subcordate; operculum trapezoidal; median abdominal area with a series of pit-like structures. .....*Aleurocybotus* Quaintance and Bakre, 1914

Systematic Account

I. Genus **Acaudaleyrodes** Takahashi, 1951

Type species.—*Acaudaleyrodes pauliani* Takahashi, 1951. *Mem. Inst. scient. Madagascar*, **6A**: 382.

The striking features of this genus are: absence of thoracic and caudal tracheal folds, combs and pores; dorsum with a pair of longitudinal folds without papillae; vasiform orifice elongately elliptic with extremely short transversely rectangular operculum; lingula slightly exposed and truncate apically.

1. **Acaudaleyrodes rhachipora** (Singh, 1931)

(Text-fig. 2)

1931. *Aleurotrachelus rachioora* Singh, 1931, *Mem. Dept. Agric. India, Ent. Ser.* **12**(**1**): 57.
1962. *Acaudaleyrodes rachipora* (Singh) Russell, Comb. n., *Bull. Brooklyn Ent. Soc.* **57**: 63-65.
1965. *Acaudaleyrodes rhachipora* (Singh) Mound, *Bull. Br. Mus. nat. Hist., Ent*, **17**(**3**): 113-160.

The following additional descriptive notes are added to the original description of the species by Singh.

Pupal case black or brown with white waxy fringe; 0.71-0.81 mm long and 0.50-0.60 mm wide. Marginal teeth 10 in 0.1 mm. Cephalic setae minute, 8-11* long; cephalic tubercles well developed. Transverse moulting suture anterior to thoraco-abdominal suture curves deeply to posterior and then recurves to anterior. Variation noticeable in the shape of median rhachis and in the median tubercles on abdominal segments 1 to 6; median tubercles in 1-3 rows. Vasiform orifice 43-50 long and 33-36 wide. Operculum 8 long and 18 wide. Lingula setose and slightly expanded at apex. Eighth abdominal setae 22 long; caudal setae 26-66 long. Ventral abdominal setae 14 long, 25-28 apart. A small conical seta 5 long at base of each leg.

Hosts.—*Bauhinia* sp., *Cassia fistula, Dalbergia sissoo, Euphorbia pilulifera* (Singh, 1931), *Cassia auriculata, Tamarindus indicus* (Rao, 1958), *Abrus precatorius, Delonix elata, Inga dulce* and *Prosopis juliflora* (new host records).

Distribution.—Bihar, Baroda (Singh 1931), Hyderabad (Andhra Pradesh) (Rao, 1958), Tamil Nadu and Karnataka States (new distribution records).

Materials examined.—42 pupal cases on *Prosopis juliflora*, Coimbatore, 9-3-1967, B. V David; 2 pupal cases, on *Inga dulce*, Coimbatore, 11-4-1967 (B. V David); 62 pupal cases, on *Delonix elata*, Coimbatore, June 1968, B. V. David; 12 pupal cases, on *Cassia auriculata*, Kunigal (Karnataka State), 28-3-1969, B. V David; 26 pupal cases, on *Tamarindus indicus*, Thanjavur, 1-6-1969, B. V David; and 14 pupal cases, on *Abrus precatorius*, Vellore, 25-8-1971, B. V David.

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* All measurements in microns unless otherwise specified.

The specimens from *Prosopis juliflora* were examined by Cohic in 1968 who remarked as follows: "In my opinion there is only one species, the yellow one are immature, they are flat, the rachis is not developed. The same thing occurs in Africa with *Acaudaleyrodes africana*. I cannot find any differences between your *Acaudaleyrodes* and *Acaudaleyrodes citri* which is common in Africa, and probably this one is the same as *A. rachipora* (Singh) but I had never seen type material of this species. Your specimens has the lingula expanded apically as in *A. citri*" Similarly, Mound (1965) reported that material from India and Pakistan in the British Museum collection cannot be distinguished from *A. citri*, and *A. rhachipora* should be easily recognized as its lingula is not expanded apically as per Singh's original description. Specimens collected from *Tamarindus indicus* were determined by Russell as *A. rhachipora*.

A detailed examination of pupal cases from the different hosts mentioned did not show any difference among them. The lingula was visible only in a few cases and was found to be setaceous and slightly expanded at tip. Singh in his description has remarked that the lingula is 'cylindric setose' In the figure also he has not clearly indicated the details. It is quite likely that he might have encountered similar difficulties in getting a perfect mount showing appreciably the lingula. The type of this species was not available to the writer for arriving at definite conclusions. In view of the above, the present series of specimens examined are retained under *Acaudaleyrodes rhachipora* (Singh). It is likely that *A. citri* may prove to be a synonym of *A. rhachipora*.

II. Genus **Aleurocanthus** Quaintance and Baker, 1914

Type species.—*Aleyrodes spiniferus* Quaintance, 1903, *Canad. Ent.* **35**: 61-64.

The species included in this genus are characterised by the pupal cases possessing many prominent spines on the dorsum and the elevated vasiform orifice. The operculum is rounded or subcordate and the lingula hidden.

2. **Aleurocanthus davidi** sp. n.

(Text-fig. 4)

Pupal case.—Transparent, oval, slightly narrowed anteriorly; 0.88-1.00 mm long and 0.63-0.78 mm wide.

Margin.—Margin with a row of rounded teeth, 12 teeth in 0.1 mm. Thoracic and caudal tracheal pores or combs absent. Anterior marginal setae 11 long; posterior marginal setae 36 long.

Dorsal surface.—Dorsum with three pairs of thin setae—a pair of cephalic setae, 39 long; a pair of setae on the eighth abdominal segment cephalic setae, 39 long; a pair of setae on the eighth abdominal segment laterad of base of vasiform orifice, 92 long; and a pair of submarginal caudal setae, 116 long. Dorsal surface with a series of spines—nine pairs on cephalothorax and thirteen pairs on abdomen (six pairs medially on abdominal segments 1 to 6); 23-168 long. The transverse moulting suture reaches the margin.

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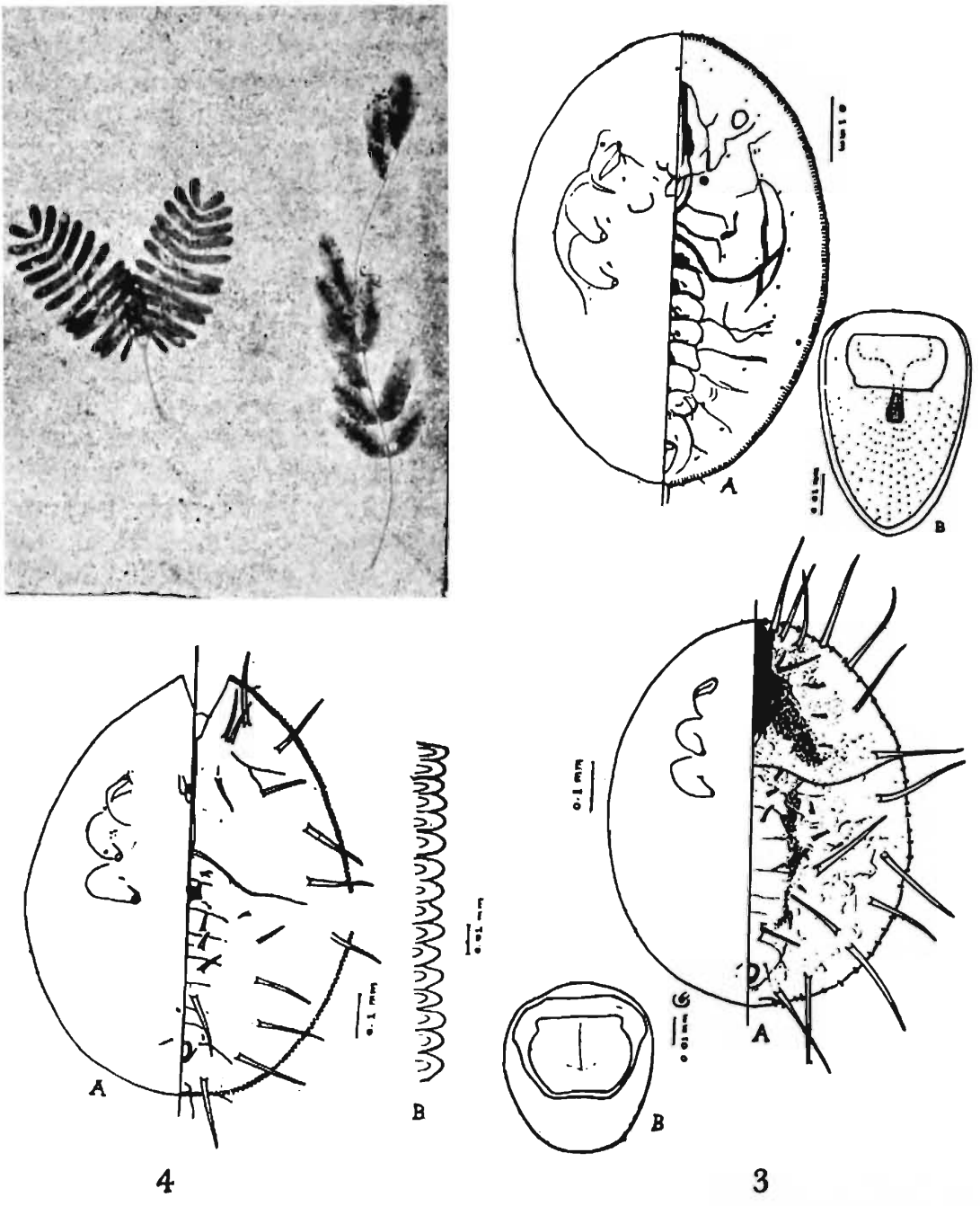

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Text-figs. 2-4. (2) (left to right) Infestation of *Acaudaleyrodes rachipora* on *Prosopis juliflora* and *Abrus Precatorius;* A. Pupal case, B. Vasiform Orifice, (4) *Aleurocanthus davidi*, sp. n A. Pupal case, B. Margin of pupal case; (3) *Aleurocanthus loyolae*, sp. n. A. Pupal case, B. Vasiform orifice.

Vasiform orifice elevated, longer than wide, 61 × 36. Operculum slightly longer than wide, 30 × 25. Lingula hidden.

Ventral surface.—Ventral abdominal setae 17 long, 47 apart. All the four pairs of spiracles visible. Antennae not extending beyond the base of fore legs; mesothoracic legs at base with four small conical spines.

Host.—Ipomoea sp.

Holotype.—One case on slide, on *Ipomoea* sp., Coimbatore, 3-5-1957, S. K. David.

Paratypes.—Fourteen cases on slides bearing the same details. Nine pupal cases on slides, on *Ipomoea* sp., 12-6-1957, S. K. David. [Paratypes deposited in the collections of the Zoological Survey of India, Calcutta, British Museum (Natural History), London and Department of Entomology, U.S.D.A., Washington.

This species closely resemble *Aleurocanthus strychnosicola* Cohic, but differs in having only eight submarginal spines and in not possessing short submarginal spines and ventral sub-marginal sculpturing.

This species is named after Dr. S. K. David, Aphidologist, who collected this species.

3. **Aleurocanthus loyolae** sp. n.

(Text-fig. 3)

Pupal case.—Jet black with a fringe of white wax; exuviae of previous instars found sticking to spines on dorsum; globules of exudation sticking to distal end of spines. Oval in shape with the dorsum elevated medially; 0.90-0.93 mm long and 0.68-0.70 mm wide. Found in groups on the undersurface of leaves.

Margin.—Margin with a single row of pointed teeth, 12-13 teeth in 0.1 mm. Thoracic and caudal tracheal pores or combs absent. Paired anterior and posterior marginal setae 22 long.

Dorsal surface.—Cleared case brown, with darker shades on cephalothorax and submedially on rhachis. Dorsum with three pairs of setae—cephalic setae, 55 long; setae on the eighth abdominal segment laterad of base of vasiform orifice, 83 long; caudal setae 83-146 long. Thirteen pairs of long submarginal spines—seven pairs on cephalo-thorax and six pairs on abdomen seen. A pair of moderately long spines just below the cephalic setae; three pairs of smaller spines on the subdorsal region of cephalo-thorax; rhachis with three pairs of short spines on abdominal segments 1 to 3 and a pair of slightly longer spines on segment 7; five pairs of smaller spines and two pairs of longer spines laterad of rhachis; length of various spines ranging from 40-211. In addition a row of minute knobbed setae present in the submarginal area. Transverse moulting suture runs to the posterior for a short distance and bends to the anterior reaching the margin.

Vasiform orifice elevated, subcordate, 52 × 44. Operculum somewhat broadly rectangular. Lingula concealed.

Ventral surface.—Ventral abdominal setae 41 long, 33 apart. Antenna not extending beyond base of fore leg. All the spiracles visible. A minute seta at base of each of meso- and meta-thoracic legs. A pair of minute setae at base of rostrum evident.

Host.—*Streblus asper* and an unidentified shrub.

Holotype.—One pupal case on a slide, on *Streblus* sp., Burliar (Nilgiris), 13-8-71, B. V David.

Paratypes.—Twentyseven pupal cases on slides on *Streblus* sp., Burliar, 13-8-71, B. V David; seventeen pupal cases on slides, on unidentified shrub, Madras (Loyola College), 28-7-71, B. V David; eight pupal cases on slide, on *Streblus asper*, Madras, 14-2-1971 and numerous specimens on dry leaves in collection. [Paratypes deposited in the collections of the Zoological Survey of India, Calcutta and the British Museum (Natural History), London].

This species comes close to *Aleurocanthus spiniferus* (Quaintance) but differs in in having distinct brown patches on dorsum, in the arrangement and length of dorsal spines and in the structural details of vasiform orifice.

4. **Aleurocanthus mangiferae** Quaintance and Baker

1917. *Aleurocanthus mangiferae* Quaintance and Baker, *Proc.U.S. natn. Mus.*, **51**:345.
1931. *A. mangiferae* Quaintance and Baker, Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 69.

This is a well known species found infesting mango leaves throughout the plains of India. The description provided by Quaintance and Baker, and Singh are adequate.

Host.—Mangifera indica (Mango).

Material examined.—Sixteen pupal cases mounted on slides, on mango leaves, Neyveli, 23-1-1967, B. V David; numerous pupal cases on dry leaves in the collections of the writer.

Pupal cases on dry leaves of Mango, Cuddalore, 23-1-1967, B. V David.

5. **Aleurocanthus marudamalaiensis** sp. n.

(Text-fig. 5)

Pupal case.—Black with a fringe of wax and with exuviae of previous instars sticking to spines on dorsum; globules of exudation found sticking to distal end of spines. Oval in shape; 0.95-0.96 mm long and 0.71-0.75 mm wide. Found on the undersurface of leaves singly and very much scattered.

Margin.—Margin with rounded teeth, 11 teeth in 0.1 mm. Paired anterior and posterior marginal setae 22 long. Thoracic and caudal tracheal pores or combs wanting.

Dorsal surface.—Dorsum with prominent spines. Eleven pairs of spines on cephalo-thorax and sixteen pairs on abdomen (six pairs on submargin, three pairs on subdorsum and seven pairs on abdominal segments 1-7). Length of spines 16 to 138 long. A pair of thin setae, 55 long laterad at base of vasiform orifice and a pair of caudal setae, 89 long evident. Transverse moulting suture reaches margin. Thoracic and caudal tracheal furrows wanting.

Vasiform orifice elevated, subcircular, 55 long and 47 wide, lateral walls and caudal end ridged; operculum wider than long (36×30) nearly filling the orifice and concealing the lingula.

Ventral surface.—Ventral abdominal setae 29-39 long, 36-43 apart. Adhesive sac visible. No setae at base of legs and rostrum.

Host.—Ficus bengalensis (Banyan tree).

Holotype.—One pupal case on slide, on *Ficus bengalensis*, Coimbatore, 22-10-1966, B. V David.

Paratypes.—Seven cases on slides, on *Ficus bengalensis*, Coimbatore, 22-10-1966, B. V David; two pupal cases on slide, on *Ficus bengalensis*, Coimbatore, 10-4-1967, B. V David.

This species appears to resemble *Aleurocanthus multispinosus* Dumbleton, but differs considerably in the length and arrangement of spines on rhachis, in the number of spines on cephalo-thorax and in the structural details of vasiform orifice.

6. **Aleurocanthus rugosa** Singh

(Text-fig. 6)

1931. *Aleurocanthus rugosa* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 71.

The following additional description is provided.

Pupal case.—Length 0.896-0.913 mm, width 0.664-0.681 mm.

Margin.—Anterior marginal setae 17 long; posterior marginal setae 20 long.

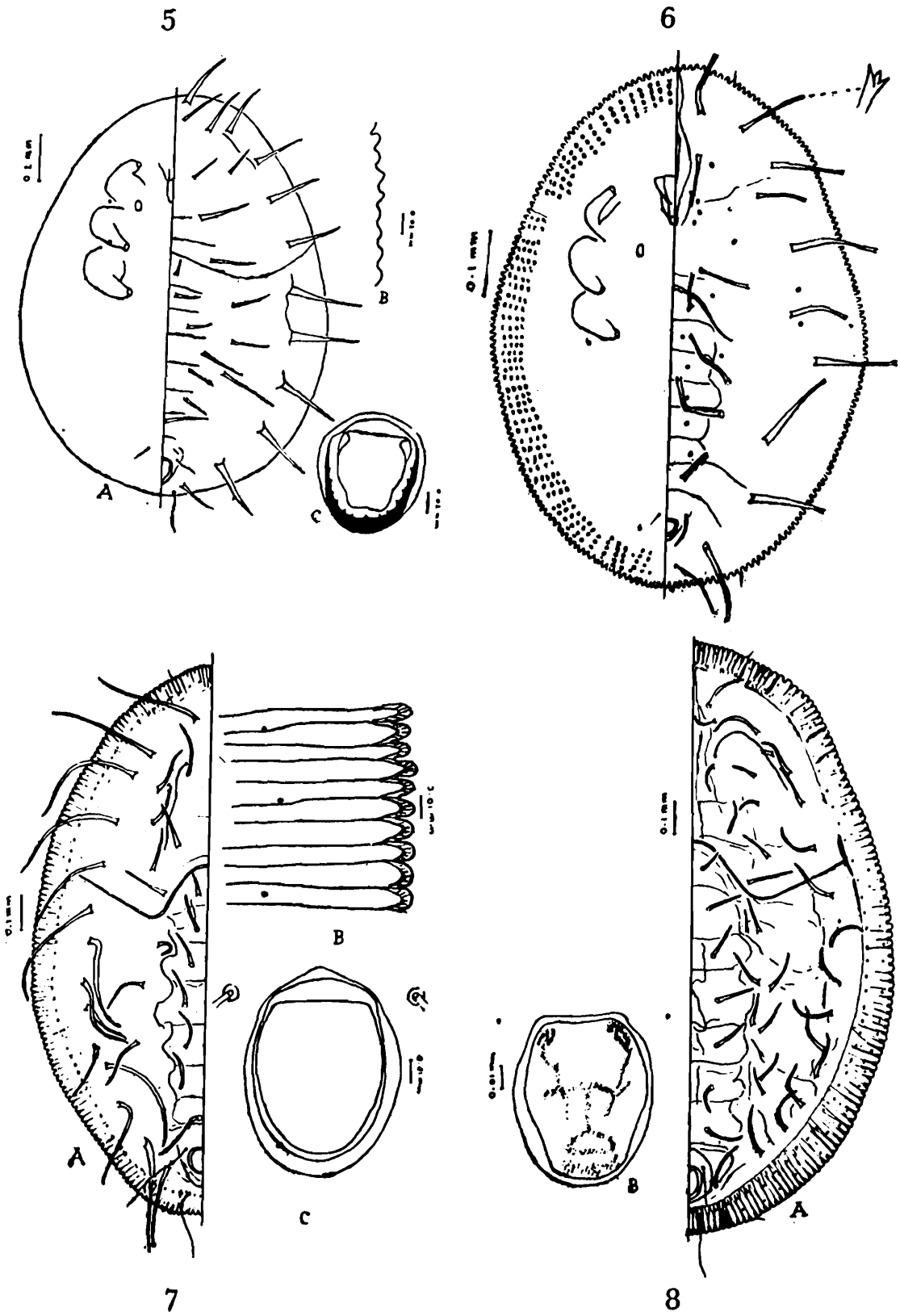
Dorsal surface.—Length of spines on dorsum 63 to 135. Cephalic setae 50 long; eighth abdominal setae 59 long. Vasiform orifice length 36-40, width 50; operculum length 23-26, width 23-26, caudal setae 132 long.

Ventral surface.—Ventral abdominal setae 20 long, 40 apart. Anterior and posterior abdominal spiracles distinct. Antennae not extending beyond fore leg. Submargin with about four or five rows of rectangular markings, absent only at tracheal fold area. No setae at base of legs and rostrum.

Host.—Syzigium jambolanum, Piper betel, Psidium quajava, Michelia chamoaca (Singh, 1931) and *Anona* sp., *Polyalthia longifolia* and *Polyalthia pendula* (new host records).

Distribution.—Pusa (Bihar) (Singh, 1931); Coimbatore and Madras (Tamil Nadu) (new distribution record).

Material examined.—Two pupal cases on slides, on *Polyalthia pendula*, Coimbatore, 16-11-1966, B. V David; eleven pupal cases mounted, on an unidentified shrub, Madras, 9-7-1971, B. V David; twentyfive pupal cases mounted, on *Anona* sp., Madras, 3-8-1971, B. V David; five pupal cases mounted, on *Polyalthia longifolia*, Madras, 13-9-1971, B. V David.



Text-figs. 5-8. (5) *Aleurocanthus marudamalaiensis*, sp. n. A. Pupal case, B. Margin, C. Vasiform Orifice, (6) *Aleurocanthus rugosa* Pupal case; (7) *Aleurocanthus seshadrii* sp. n. A. Pupal case, B. Margin, C. Vasiform orifice; (8) *Aleurocanthus splendens* sp. n. A. Pupal case, B. Vasiform orifice.

7. **Aleurocanthus seshadrii** sp. n.

(Text-fig. 7)

Pupal case.—Jet black with marginal fringe of wax; Elliptic 1.56-1.59 mm long, 0.99-1.00 mm. wide. Found scattered on the under-surface of leaves.

Margin.—Margin with a row of rounded teeth, 10-11 in 0.1 mm. Anterior and posterior marginal setae 36-50 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—The paired thin cephalic setae about 99 long; the eighth abdominal setae thin, laterad of base of vasiform orifice, 122 long; a pair of long caudal setae, sub-marginal in position, 165 long. The transverse moulting suture runs posteriorly to the level of the suture between the abdominal segments 1 and 2 and then bends sharply to anterior, extending upto submargin. Dorsum with eleven pairs of spines on cephalo-thorax, seven pairs submedially on abdominal segments 1 to 7, three pairs laterad of indistinct rhachis and nine pairs on subdorsum; 130-356 long. Submargin distinct with ridges running mesad of marginal teeth; each tooth with a pore at base; minute pores scattered on submarginal area.

Vasiform orifice elevated, oval, longer than wide (86 × 66). Operculum similarly shaped (69 × 59), filling the orifice and concealing the lingula.

Ventral surface.—Ventral abdominal setae 40 long, 66 apart. Setae at base of legs wanting.

Host.—Bamboo.

Holotype.—One pupal case on a slide, on bamboo, Mallisery Estate near Kongode (Kerala State), 27-9-1968, B. V David.

Paratypes.—Two cases on a slide bearing the same details in the collection of the British Museum (Natural History), London. One case on a slide in the collection of the author.

This species is quite distinct from *Aleurocanthus bambusae* (Peal), differing very much in the arrangement of spines, size, course of transverse moulting suture on pupal case, etc.

This species is named after Dr. A. B. Seshadri, the then Professor of Entomology, Agricultural College and Research Institute, Coimbatore, now Head of the Division of Nematology, Indian Agricultural Research Institute, New Delhi, under whom the study of aleyrodids was initiated by the senior author.

8. **Aleurocanthus spiniferus** (Quaintance)

(Plate I)

1903. *Aleurodes spinifera* Quaintance, *Canad. Ent.* **35**: 63.
1914. *Aleurocanthus spiniferus* (Quaintance), Quaintance and Baker, *U.S. Dept. Agric., Bur. Ent., Techn. Ser.*, **27**(2): 102.
1931. *Aleurocanthus rosae* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**: 70.

This is a widespread species in India. It is occasionally serious on rose.

Hosts.—Citrus (Usman and Puttarudraiah 1955), Rose (*Rosa* sp.) (Singh 1931) and *Vitis vinifera* (grapevine) (new host record).

Material examined.—Five pupal cases mounted, on Rose, Coimbatore, 14-4-1967, B. V David; three pupal cases mounted, on *Vitis vinifera*, Coimbatore, 5-8-1967, B. V David; numerous pupal cases on dry leaf of *Vitis vinifera*, Coimbatore, 18-9-1971, M. Mohanasundaram.

9. **Aleurocanthus splendens** sp. n.

(Text-fig. 8)

Pupal case.—Jet black with dense white fleecy waxy filaments covering the dorsum to which the exuviae of previous instars stick. Shape elliptical, broadest caudad. Length 1.33-1.78 mm, width 0.83-1.21 mm. Found on the undersurface of leaf.

Margin.—Margin with a row of broad teeth each tooth with a pore at base; 7 teeth in 0.1 mm, broad at base and rounded at tip. Paired anterior and posterior marginal setae 26-33 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—A pair of thin cephalic setae, about 297 long; a pair of thin setae on the eighth abdominal segment latered of base of vasiform orifice, 55 long; and a pair of submarginal thin long caudal setae, 201 long. Dorsum with thirtyeight pairs of spines distributed as follows: 13 pairs on cephalothorax; 7 pairs submedially on abdominal segments 1-7, 8 pairs in four groups on either side laterad of rhachis and 10 pairs in a line on subdorsum. Transverse moulting suture runs posteriorly and turns sharply to anterior at the level of suture between abdominal segments 1 and 2, reaching the submargin. Submargin with broad ridges running mesad of marginal teeth and with minute pores scattered on submarginal area.

Vasiform orifice elevated oval, longer than wide (89 × 69). Operculum similarly shaped (83 × 66) covering the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 17 long, 55 apart. No setae at base of legs.

Host.—Phoenix humilis.

Holotype.—One pupal case on slide, on *Phoenix humilis*, 24-4-1969, Perammur (Tiruchirapalli district, Tamil Nadu), B. V David.

Paratypes.—One pupal case on slide in the collection of the Zoological Survey of India, Calcutta; one pupal case on slide in the collection of the British Museum (Nat. History), London; seven pupal cases on slide bearing the same details. Pupal cases on dry leaves in the collections of the writer.

This species closely resembles *Aleurocanthus bambusae* (Peal) from which it differs in size, in the number of marginal teeth in 0.1 mm length and in having distinctly four pairs of spines on either side of rhachis.

10. **Aleurocanthus valparaiensis** sp. n.

(Text-fig. 9)

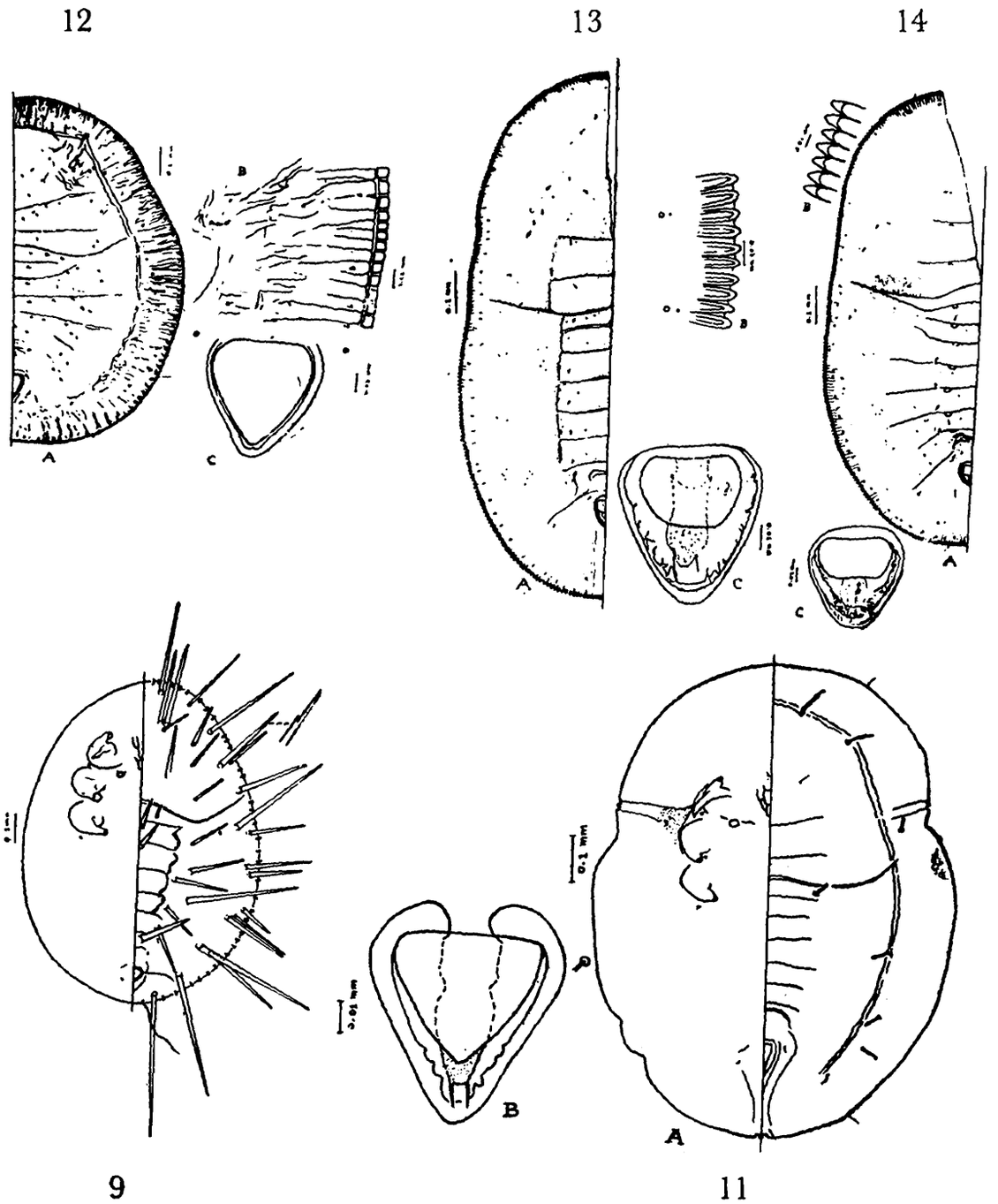
Pupal case.—Jet black with fringes of wax; oval 1.11-1.15 mm long and 0.83-0.85 mm wide. Found on the undersurface of leaves in colonies.

Margin.—Margin with a row of pointed teeth, 10 in 0.1 mm. Anterior and posterior marginal setae 13-16 long. Thoracic and caudal tracheal pores or combs wanting.

Dorsal surface.—A pair of thin setae laterad of vasiform orifice 99 long and a pair of submarginal thin long caudal setae 231 long. Dorsal surface with long pale spines varying in length from 55-400. Thirteen pairs of spines on cephalothorax and twentyone pairs on abdominal segments distributed as illustrated. Submargin with a row of small stout knobbed setae.

Vasiform orifice elevated, subcircular (55 × 55). Operculum similarly shaped filling the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 28 long, 25 apart. Antenna normal, does not extend beyond fore leg. All the four pairs



Text-figs. 9, 11-14. (9) Pupal case of *Aleurocanthus valparaiensis* (11) *Aleurolobus confusus*, sp. n. A. pupal case, B. Vasiform Orifice; (12) *Aleurolobus moundi* sp. n. A. Pupal case, B. Margin C. vasiform orifice, (13) *Aleuromarginatus kallerensis*, sp. n. A. Pupal case, B. Margin, C. Vasiform orifice; (14) *Aleuromarginatus tephrosiae* A. Pupal case, B. Margin, C. vasiform orifice.

of spiracles and adhesive sac visible. A minute seta at base of each of meso- and metathoracic legs evident. Setae at base of rostrum lacking.

Host.—Piper nigrum.

Holotype.—One pupal case on slide, on *Piper nigrum* (pepper), Valparai (6,000 feet), 16-4-1967, B. V David.

Paratypes.—Thirtyeight pupal cases on slides bearing the same details. Pupal cases on leaves in the collections of the writer. Material is also in the collections of the British Museum (Natural History), London and of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington. Nine pupal cases on a slide, on wild *Piper* sp., Burliar, 13-8-1971, B. V David.

This species in general appearance resembles *Aleurocanthus citriperdus* Quaintance and Baker but differs in the number and arrangement of dorsal spines.

11. **Aleurocanthus woglumi** Ashby

(Plate I)

1917. *Aleurocanthus woglumi* (Ashby). Quaintance and Baker, *Proc. U.S. natn. Mus.* **51:** 336, 355.

This is commonly known as the Citrus Blackfly and is a well-known serious pest of citrus in many parts of the world. In India this is widely distributed found infesting citrus in serious proportions.

Hosts.—Orange (*Citrus* sp.) (Husain and Khan, 1945); sapota (*Achras zapota*) (Rao and Rao, 1962); Pommello (*Citrus* sp.), *Morinda tinctoria* and *Murraya koenigii* (new host records).

Material examined.—On Pommello, Coimbatore, 11-7-1966, B. V David; Fourteen pupal cases mounted, on orange, Yercaud, 20-1-1967, B. V David; on *Morinda tinctoria*, Coimbatore, 9-3-1967, B. V David and five pupal cases mounted, on *Murraya koenigii*, Coimbatore, 15-8-1969, B. V David.

Key to Indian Species of **Aleurocanthus**

1. Pupal case not jet black in colour. .2
   Pupal case jet black in colour. .4
2. Dorsal spines fimbriate, 19 pairs of spines and 6 pairs of papillae evident on dorsal surface. .. .. *rugosa* Singh
   Dorsal spines non-fimbriate, papillae absent. 3
3. 22 pairs of spines evident on dorsal surface; lingula hidden. ...*davidi* sp. n.
   18 pairs of spines evident on dorsal surface; lingula tip seen. .*simolex* Singh*
4. Submargin with about 55 pairs of spines; operculum with markings..*longispinus* Quaintance and Baker*

   Submargin without or with less number of spines; operculum without markings. .5
5. Submarginal area with linear ridges. .. .. .116
   Submarginal area without linear ridges. .. 8

* Species known in India that are not studied here.

6. Dorsum with 30 pairs of spines (11 pairs on cephalo-thorax and 19 pairs on abdomen). .. ...*seshadrii* sp. n.

Dorsum with 38 pairs of spines. . 7

7. Pupal case 1.44 mm × 0.96 mm; 4 pairs of spines in a row on either side of rhachis .*splendens* sp. n.

Pupal case 2.1 mm × 1.4 mm; arrangement of spines on either side of rhachis differs considerably. . .*bambusae* (Peal)*

8. Possessing 29 pairs of spines on dorsal surface. 9
Not possessing 29 pairs of spines on dorsal surface. 12

9. Dorsum with brown patches on cephalothorax and abdomen; 11 pairs of spines on cephalo-thorax. *loyolae* sp. n.

Dorsum lacking shades of brown patch; 13 pairs of spines on cephalo-thorax. 10

10. An irregular row of capitate setae just above the submarginal row of spines. . .. .*spiniferus* (Quaintance)

A regular row of capitate setae evident. : 11

11. Vasiform orifice subcordate. .*husaini* Corbett*

Vasiform orifice circular. .. .*woglumi* Ashby

12. Marginal teeth knobbed; 37 pairs of spines on dorsal surface. .*mangiferae* .. .Quaintance and Baker

Marginal teeth not knobbed; possessing 27, 33 or 34 pairs of spines on dorsal surface. 13

13. Dorsal surface with 27 pairs of spines margin with rounded teeth..*marudamalaiensis* sp. n.

Dorsal surface with 33 or 34 pairs of spines; margin with pointed teeth.. 14

14. Possessing 18 pairs of spines on submargin and 15 pairs on dorsal disc; marginal teeth 14 in 0.1 mm. .. ..*citriperdus* Quaintance and Baker*
Possessing 16 pairs of spines on submargin and 18 pairs on dorsal disc; marginal teeth 11 in 0.1 mm.. .. .*valparaiensis* sp. n.

III. Genus **Aleurocybotus** Quaintance and Baker

Type species.—*Aleurodes graminicolus* Quaintance, 1899, *Can. Ent.***31:** 89.

Pupal case narrowly elongate with toothed margin; submargin not separated from dorsal disc; median area of abdomen with pit-like structures; tracheal folds not discernible; vasiform orifice subcordate, operculum trapezoidal, lingula exposed and usually included, but apex sometimes exserted.

12. **Aleurocybotus indicus** sp. n.

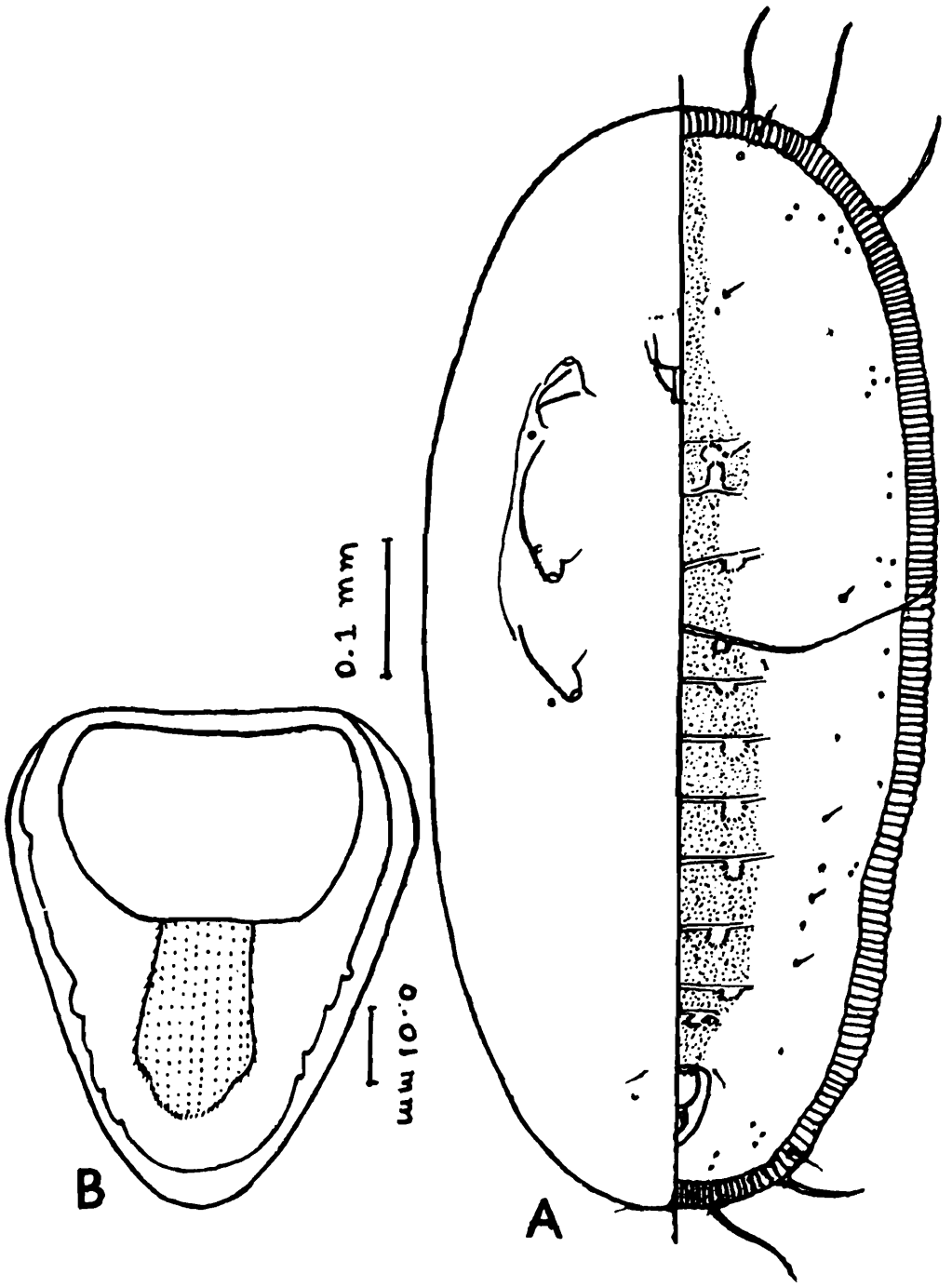
(Text-fig. 10)

Pupal case.—White with the median area from cephalic region to vasiform orifice light brownish; wax tubes poorly developed and a short rim of waxy secretion raises the case from leaf surface. Elongate and narrow, 0.88-0.92 mm long and 0.40-0.41 mm wide. Found infesting both surfaces of leaf blades and leaf sheath of grass.

Margin.—Margin crenulate, with 10-11 rounded irregular crenulations in 0.1 mm, deflexed under case when mounted. Usual anterior and posterior marginal setae minute, 13 long, Ventral in position.

Dorsal surface.—The usual dorsal setae minute—the cephalic setae 6 long, the first abdominal setae 8 long and the setae laterad of vasiform orifice 8 long. The transverse moulting suture bends to anterior reaching the margin. Pit-like structures evident medially on the thoracic

and abdominal segments. Tracheal furrows absent. Minute pores found scattered on dorsum. Submargin with three pairs of long setae anteriorly, 83-99 long, two pairs of setae posteriorly 86-106 long; in addition a pair of minute setae present on each of metathorax and abdominal segments 1, 4, 5 and 6. A series of pores and porettes in a line in the submargin.



Text-fig. 10. *Aleurocybotus indicus* sp. n. A pupal case, B. vasiform orifice.

Vasiform orifice subcordate, 59 long and 50 wide; lateral walls slightly ridged. Operculum trapezoidal, wider than long (36×26). lingula setose, exposed, included.

Ventral surface.—Ventral abdominal setae 8-11 long, 50 apart. All the four pairs of spiracles visible. Antenna not extending beyond fore leg. Setae at base of legs and rostrum, and tracheal folds absent.

Hosts.—*Chloris barbata* and *Dactyloctenium aegyptiacum.*

Holotype.—Pupal case on slide, on *Chloris barbata*, Coimbatore, 20.5.1966, B. V David.

Paratypes.—Five pupal cases mounted, on *Chloris barbata*, Coimbatore, 20-5-1966, B. V David; two pupal cases on slide, on *Chloris barbata*, Coimbatore, 23-2-1967, B. V David; 3 cases on slide, on *Dactyloctenium aegyptiacum*, Madras, 18-9-1971, B. V David. Pupal cases on leaves of *Chloris barbata*, Coimbatore, 15-3-1969, B. V David in the collections of the senior author, and also of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington and the British Museum. (Natural History), London.

This species is quite distinct from the other two known species, viz., *A. graminicolus* (Quaintance) and *A. setiferus* Quaintance and Baker in possessing five pairs of longer submarginal setae.

This genus is being reported from India for the first time.

IV Genus **Aleurolobus** Quaintance and Baker

Type species.—*Aleurolobus marlatti* (Quaintance), 1903, *Can. Ent.*, **34**: 61.

Pupal case usually dark brown to blackish; margin toothed, with moderately developed wax tubes; submarginal area separated from dorsal disc by suture-like lines; minute pores present on dorsum; tracheal folds in most cases obscure or wanting but in some evident, terminating on margin in few specialised teeth, vasiform orifice sub cordate, operculum similarly shaped almost filling the orifice and obscuring the lingula. A trilobed figure surrounding the orifice quite characteristic.

13. **Aleurolobus barodensis** (Maskell)

(Plate I, part)

1896. *Aleurodes barodensis* Maskell, *Trans. N. Zealand Inst.*, **28** : 424.
1902. *Aleyrodes barodensis* Cockerell, *Proc. Acad. nat. Sci. Phila.* 281.
1897. *Aleurodes longicornis* Zehntner, *Archief Java Suikerind*, **5** : 381.
1917. *Aleurolobus barodensis* (Maskell), Quaintance and Baker, *Proc. U.S. natn. Mus.* **51** : 359.

This is a well known pest of sugarcane in many parts of the world and in India it has a very wide distribution, and the description of the species by Quaintance and Baker (1917) appears to be complete.

Hosts.—*Saccharum officinarum* (sugarcane) (Singh, 1931); *Erianthus arundinaceum* and *E. ciliaris* (Rao, 1958).

Distribution.—Throughout India.

Material examined.—Twentythree pupal cases, on sugarcane, Cuddalore, 23-1-1967. B. V David. Numerous pupal cases on leaves in collections—on sugarcane, Cuddalore, 12-9-1967, G. Varadarajan; on sugarcane, Kayarambedu (Madras), 5-1-1971, B. V David.

14. **Aleurolobus confusus** sp. n.

(Text-fig. 11)

Pupal case.—White with sparse marginal waxy secretion, oval in shape. Female case: Length 1.04-1.10 mm long and 0.78-0.85 mm wide; Male case: 0.83-0.85 mm long and 0.59-0.61 mm wide. Found on the undersurface of leaflets.

Margin.—Finely crenulate. Paired anterior and posterior marginal setae, 16 and 33 long, respectively. Thoracic and caudal tracheal ends each with a tooth-like projection. Margin variously indented depending upon development between or along the sides of hairs on the undersurface of leaflets.

Dorsal surface.—Three pairs of usual dorsal setae evident—a pair on cephalic region 41 long, a pair of blunt setae 25-39 long on first abdominal segment, and a pair of pointed setae on eighth abdominal segment, minute, 8 long, laterad of base of vasiform orifice. A pair of caudal submarginal setae, 76 long, submargin separated from dorsal disc by a distinct fold; transverse moulting suture, bending slightly to anterior, extending upto the fold. Abdominal segments distinct, seventh segment medially shortened. Seven pairs of blunt setae along the submarginal fold, two pairs on cephalic region, a single pair on thoracic region and four pairs on the abdomen, 36-76 long. Thoracic and caudal tracheal folds evident.

Vasiform orifice subcordate, surrounded by a trilobed figure, 79 long, 63 wide lateral walls of orifice slightly ridged. Operculum similarly shaped, length 43 and width 50. Lingula setose, club-shaped, exposed and included, bearing subapically a pair of setae.

Ventral surface.—Ventral abdominal setae 27-30 long, 50-56 apart. Antenna in male reaching middle of mesothoracic leg and in female extending to the base of mesothoracic leg. All the four pairs of spiracles visible. Thoracic tracheal folds distinct, with half the length towards its base dotted. Caudal tracheal folds evident but not dotted. Setae at base of legs absent. A pair of minute setae at base of rostrum visible.

Host.—Murraya koenigii.

Holotype.—One pupal case on slide, on *Murraya koenigii*, Madras, 25-7-1971, B. V David.

Paratypes.—Six pupal cases on slides bearing the same data. Pupal cases on leaves in the collections of the senior author and in the collections of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington D. C., the British Museum (Natural History), London, and the Zoological Survey of India, Calcutta.

This species resembles *Aleurolobus simulus* (Peal) but differs from it in size and in possessing a tooth-like projection at thoracic and caudal tracheal ends.

15. **Aleurolobus marlatti** (Quaintance)

1903. *Aleurodes marlatti* Quaintance, *Can. Ent.*, **34** : 61.
1917. *Aleurolobus marlatti* (Quaintance), Quaintance and Baker, *Proc. U. S. natn. Mus.*, **51** : 361.

The description of the species by Quaintance and Baker appears to be complete.

Host.—Acid lime (*Citrus* sp.) (Husain and Khan, 1945) and *Murraya koenigii* (new host record).

Material examined.—Two cases mounted, on *Murraya koenigii*, Coimbatore, 17-3-1967, B. V David; two cases mounted, on *Citrus* sp. (acid lime), Madras, 25-7-1971, B. V David.

Numerous pupal cases on dry leaves of *Murraya koenigii* and acid lime in the collections of the senior author.

16. **Aleurolobus moundi** sp. n.

(Plate I, & Text-fig. 12)

Pupal case.—Black with a marginal fringe of wax and white powdery meal on dorsum; oval, 1.59-1.68 mm long and 1.36-1.40 mm wide.

Margin.—Crenulate; 7-8 crenulations in 0.1 mm. Paired anterior and posterior marginal setae 20-26 long. Thoracic tracheal pore areas not differentiated from margin; caudal tracheal pore not indicated.

Dorsal surface.—Dorsum separated from submargin by a distinct suture-like line. The usual dorsal setae are small—a pair of cephalic setae 11 long, a pair of first abdominal setae 11 long and a pair of setae laterad of base of vasiform orifice, 17 long. A paif of submarginal minute caudal setae on either side of caudal furrow. Transverse moulting suture reaches the submarginal fold. Abdominal segments with distinct sutures; second abdominal suture bends sharply to anterior and meets the first suture; eighth abdominal segment not distinctly trilobed, being typical of the genus. Seventh abdominal segment short, one-third of sixth segment; eighth almost twice the length of sixth. Paired submedian depressions evident on each abdominal segment. Sublaterally four pairs of minute setal evident on abdominal segments 3 to 6. Eye spots prominent. Submargin broad, one-quarter of overall width and with about ten pairs of minute setae, four pairs on cephalothorax and six pairs on abdomen. Marginal teeth broadly rounded, with suture-like markings extending mesad across the submargin. Submargin with a series of about 70 pores and porettes on each side. Both the submarginal area and dorsal disc are sparsely covered with pores and porettes.

Vasiform orifice subcordate with transverse posterior margin; operculum thin, pointed posteriorly, filling the orifice and obscuring the lingula. Caudal furrow rather narrow, 195 long.

Ventral surface.—All the four pairs of spiracles visible. Antenna extending upto prothoracic spiracle. Adhesive sac visible. Setae at base of legs and rostrum wanting.

Holotype.—One pupal case mounted, on *Bassia* sp., Madras, 21-7-1971, B. V David.

Paratypes.—Seven pupal cases on slides bearing the same details. [Paratypes deposited in the collection of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

Numerous pupal cases on dry leaves of *Bassia latifolia*, Coimbatore, 7-11-1966, B. V David; on *Bassia longifolia*, Kovilpatti, 31-1-1967, B. V David.

This species resembles *Aleurolobus taonabae* Q. & B. but differs from it in being bigger in size and in other details.

This distinct species is named after Mr. L. A. Mound of the British Museum (Natural History), Commonwealth Institute of Entomology, London.

Key to Indian Species of **Aleurolobus**

1. Pupal case white; submarginal area with prominent setae. *confusus* sp. n.
   Pupal case black; submarginal area without prominent setae. 2
2. Thoracic tracheal folds terminate in three rounded teeth. 3
   Thoracic tracheal folds not discernible. 4
3. Pupal case 1.35×1.1 mm; margin with a short fringe of wax and whiter tufts of wax from pores of tracheal folds; a pear-shaped wax figure on dorsum of abdomen, from which run lines of wax along sutures to submarginal rim. *marlatti* (Quaintance)
   Pupal case 1.29×1.01 mm; margin with a broad filamentous colourless fringe of wax and white waxy powder; submarginal fold indicated by waxy powder; cephalo-thorax and abdomen again defined in wax; six radial lines of wax in abdomen extend upto submarginal fold. *.bidentatus* Singh*
4. Pupal case very elongate elliptical; 2.25×1.15 mm dense black; margin with a fringe of long snowy white wax rods; dorsum sometimes dusted with white powdery meal. .. *.barodensis* (Maskell)
   Pupal case oval; 1.64×1.40 mm; marginal fringe of wax and white powdery meal on dorsum evident. *.moundi* sp. n.

V. Genus **Aleuromarginatus** Corbett, 1935.

Type species.—*Aleuromarginatus tephrosiae* Corbett, 1935, *Ann. Mag. nat, Hist.*, **16** (10): 246

The species included in this genus are characterised by the following: Pupal case with a row of teeth with large marginal pores; submarginal area not separated from dorsal disc; thoracic and caudal pores or combs absent though caudal fold may merely be indicated. Vasiform orifice cordate; operculum roundly trapezoidal filling about half the orifice; lingula knobbed, exposed, included.

17. **Aleuromarginatus kallarensis** sp. n.

(Text-fig. 13)

Pupal case.—Light brown with a marginal fringe of wax and deeper brown shades mid-dorsally; elliptic but slightly constricted at thorax and slightly emarginate posteriorly; 1.33-1.46 mm long and 0.75-0.85 mm wide. Found on both surfaces of leaf.

Margin.—Margin strongly toothed with a pore at base of each tooth; 13-14 teeth in 0.1 mm. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—Dorsum with deep brown shades medially along longitudinal moulting suture and on rhachis, along thoracic sutures

and laterad of rhachis. Dorsum sculptured with dotted markings. Dorsal setae 21 pairs, minute, blunt and apparently hooked, 11 pairs on cephalo-thorax, about 17 long; five pairs submedially on abdominal segments 1,3-6, about 11 long; a pair laterad of base of vasiform orifice, 14 long; a pair subdorsally at a level of second abdominal segment; two pairs subdorsally caudal of vasiform orifice and a pair submarginally on either side of caudal furrow. Transverse moulting suture reaches submargin; rhachis discernible. Dorsal disc sparsely scattered with pores and porettes. A series of submarginal pores and porettes, about 44 pairs, very characteristic. Thoracic tracheal furrows absent; caudal tracheal furrow slightly indicated. Abdominal segment seven shorter; pockets distinct.

Vasiform orifice cordate, longer than wide (69 × 56), lateral walls ridged; operculum broadly trapezoidal filling half the orifice (43 × 30); lingula setose, knobbed, bearing subapically a pair of setae, exposed, included.

Ventral surface.—Ventral abdominal setae 19-25 long, 59 apart. Antenna slender, long, extending slightly beyond the prothoracic spiracle but not reaching base of mesothoracic leg. All the four pairs of spiracles visible. A minute seta at base of each of meso-and metathoracic legs evident. Marginal setae arise ventrally.

Hosts.—*Pongamia glabra* and *Pterolobium indicum.*

Holotype.—One pupal case mounted, on *Pterolobium indicum*, Kallar (Nilgiris), 4-9-1966, B. V David.

Paratypes.—Twelve pupal cases mounted bearing the same details; numerous pupal cases on leaves in the collections of the senior author, Sixteen pupal cases mounted, on *Pongamia glabra*, Coimbatore, 31-10-1966, B. V David; numerous cases on dry leaves in collection. Thirty pupal cases mounted, on an unidentified Papilionaceous shrub, Tambaram (Madras), 4-1-1970, B. V David; numerous pupal cases on leaves in collection. [Paratypes deposited in the collection of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

This species is quite distinct rom *Aleuromarginatus tephrosiae* Corbett in having a rhachis and a submarginal series of pores and porettes and in the structural details of marginal teeth and vasiform orifice.

18. **Aleuromarginatus tephrosiae** Corbett, 1935

(Text-fig. 14)

1935. *Aleuromarginatus tephrosiae* Corbett, 1935, *Ann. Mag. nat. Hist.*, **16**(10): 247.
1940. *Aleuromarginatus indica* Singh, *Rec. Indian Mus.*, **42**: 453-456, *Syn. n.*

The following additional description is provided to the original description of the species by Corbett.

Pupal case.—Length 1.26-1.30 mm. Width 0.78-0.85 mm. Found on both upper and lower surface of leaflets of *Tephrosia* causing pits on them.

Margin.—Margin strongly toothed with a pore at the base of each tooth. The large marginal pores have been erroneously referred to as a second row of teeth by Corbett.

Dorsal surface.—Dorsal setae 21 pairs—11 pairs on cephalo-thorax about 14 long; 10 pairs on abdominal region, 11-14 long (five pairs submedially on abdominal segments 1, 3-6; a pair laterad of base of base of vasiform orifice, 20 long; a pair subdorsally at a level of second abdominal segment, two pairs sublaterally caudal of vasiform orifice and a pair submarginally on either side of caudal furrow. Transverse moulting suture almost reaches the margin. Abdominal rhachis absent.

Vasiform orifice cordate, 73×66; operculum wider than long (50×28); lingula setose and blunt bearing terminally a pair of small setae, exposed, included.

Ventral surface.—Ventral abdominal setae 36 long, 83 apart. Marginal setae arise ventrally on small tubercles. All the four pairs of spiracles visible. Antenna slender, long, extending slightly beyond base of fore leg. A minuteseta at base of each of meso-and metathoracic legs evident.

Host.—*Tephrosia purpurea* (Rao, 1958).

Distribution.—Hyderabad (Andhra Pradesh) (Rao, 1958); Badnera (Maharashtra), Marudamalai (Coimbatore), Sawyerpuram, Neyveli, Madras (Tamil Nadu) (new distribution records).

Material examined.—Three pupal cases mounted, on *Tephrosia purpurea*, Marudamalai, 22-10-1966, B. V David; three pupal cases mounted, on *Tephrosia purpurea*, Madras, 15.9.1971, B. V David. Numerous pupal cases on leaves of *Tephrosia purpurea*, Sawyerpuram, 29.7.1969, B. V David.

Mound (1965) has remarked that 'the characters given by Singh (1940) in his descritpion of *A. indica* do not separate this species from the type-species' An examination of the type of *A. indicus* Singh available with the Zoological Survey of India, Calcutta, confirmed that the species is a synonym of *A. tephrosiae* Corbett.

Key to Indian Speies of **Aleuromarginatus**

1. Rhachis discernible; a series of submarginal pores and porettes evident.. *kallarensis* sp. n.

   Rhachis not discernible, a series of submarginal pores only evident. .. .. .. *tephrosiae* Corbett

VI. Genus **Aleuroplatus** Quaintance and Baker, 1917

Type species.—*Aleurodes guercusaguaticae* Quaintance, 1900, *Bull. U.S. Bur. Ent.*, **8**: 1-43

Though this genus is not well defined at present, the species included in it are characterised by the absence of submarginal wax glands and first abdominal setae, margin with a single row of teeth, thoracic tracheal folds ending in a comb of teeth, and vasiform orifice being

transversely elliptical, rounded or roundly quadrangular, operculum filling one-third of orifice and obscuring the lingula.

19. **Aleuroplatus alcocki** (Peal, 1903)

(Text-fig. 15)

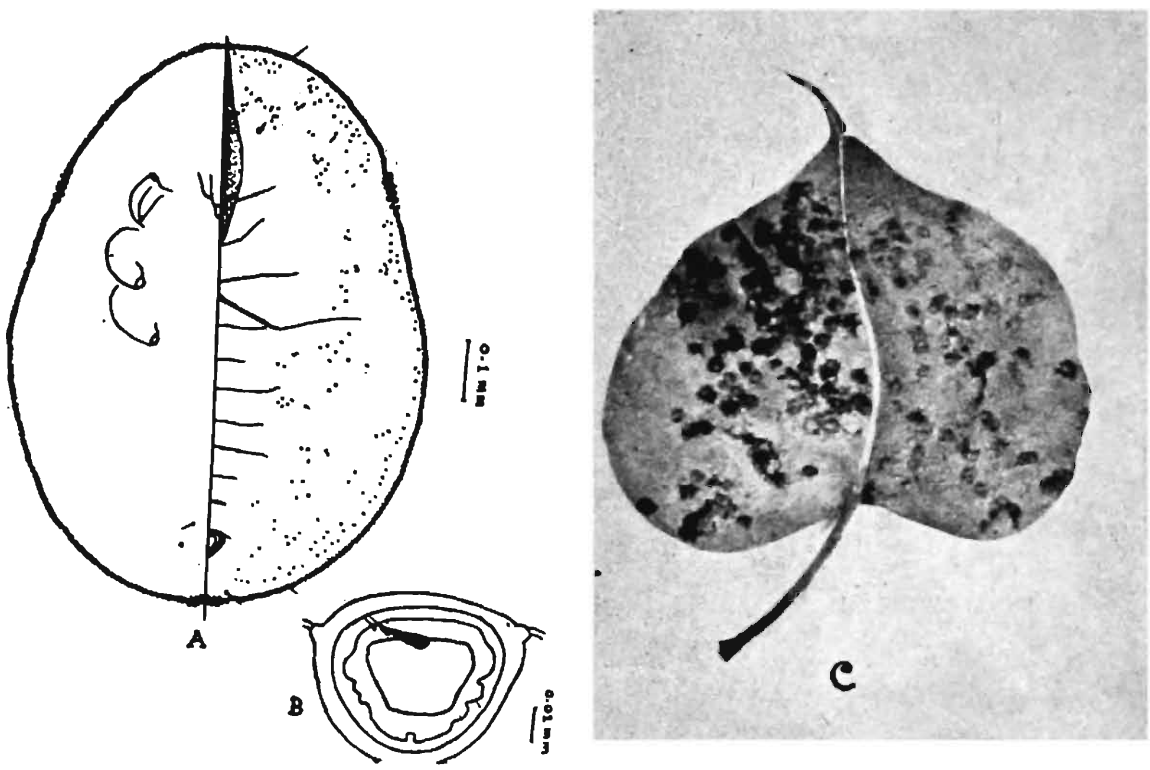
1903. *Aleurodes alcocki* Peal, *J. Asiat. Soc. Bengal*, **72**(2): 61-98.
1931. *Aleuroplatus alcocki* (Peal), Singh, *Mem. Dept. Agric., India, Ent. Ser.* **12**(1): 19.

The following additional notes are provided.

Pupal case.—Length 0.80-0.95 mm. Width 0.58-0.72 mm.

Margin.—Margin distinctly toothed with about 19 teeth in 0.1 mm. Paired anterior and posterior marginal setae about 19 long. Thoracic tracheal combs ending in 6-8 teeth, distinct from marginal teeth; caudal tracheal comb distinct with 7-8 teeth.

Dorsal surface.—Cephalic setae minute; setae on first abdominal segment wanting; setae on eighth abdominal segment on a tubercle laterad of vasiform orifice, 17-19 long. Caudal setae 33 long. Vasiform orifice 41 long, 52 wide; operculum 22 long, 25 wide; lingula concealed.



Text-fig. 15. *Aleuroplatus alcocki*, A. Pupal case, B. Vasiform orifice, C. pupal cases on the undersurface of *Ficus religiosa* leaf.

Ventral surface.—Ventral abdominal setae 25 long, 39 apart, placed cephalad of vasiform orifice. A small seta at the base of each of meso- and metathoracic legs. Antenna not extending beyond the base of fore leg. A pair of minute setae at the base of rostrum evident. All the four pairs of spiracles visible.

Hosts.—*Ficus bengalensis* (Peal, 1903), *Ficus religiosa* (Singh, 1931), *Polyalthia longifolia* and *P. pendula* (new host record).

Distribution.—Calcutta (Peal, 1903); Pusa (Bihar) (Singh, 1931); Coimbatore and Madras (Tamil Nadu) (new distribution records).

Material examined.—Twelve pupal cases mounted, on *Polyalthia longifolia*, Coimbatore, 11-11-1966, B. V David; one pupal case mounted, on *Polyalthia pendula*, Coimbatore, 5-4-1967, B. V David; fortyfour pupal cases mounted, on *Ficus religiosa*, Madras, 31-7-1971, B. V David.

20. **Aleuroplatus mysorensis** sp. n.

(Text-fig. 16)

Pupal case.—Black, embedded in a transparent resinous substance; subelliptic; 0.78-1.08 mm long, 0.53-0.78 mm wide. Found on both surfaces of leaf.

Margin.—Marginal row of rounded teeth with a pore at base; 18-19 teeth in 0.1 mm. Paired anterior and posterior marginal setae minute. Thoracic and caudal tracheal combs ending in a tooth; tooth narrower at base and wider at rounded apex; indented at caudal tracheal comb area.

Dorsal surface.—Cleared pupal case brown. A pair of cephalic setae and a pair of eighth abdominal setae laterad of base of vasiform orifice minute; setae on first abdominal segment wanting. Transverse moulting suture runs posteriorly to the level of first abdominal suture and then bends sharply to anterior extending upto submargin. Abdominal segments 1-7 with submedian depressions. Eye spot faintly indicated. Minute pores and porettes found scattered on dorsal disc. Minute setae are found scattered on subdorsum and submarginal area. Submargin with many short sutural lines running mesad from margin.

Vasiform orifice rounded with a thickly chitinised rim bearing laterad of the base of orifice a pair of minute setae. Vasiform orifice surrounded by broken dark spots laterad and caudad arranged in circles. Operculum subcircular filling the orifice and obscuring the lingula.

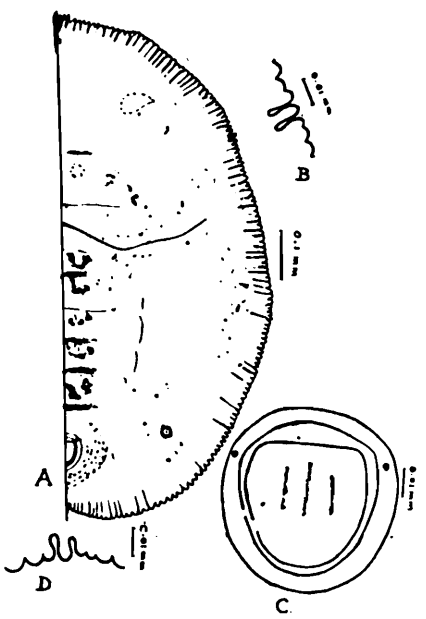
Ventral surface.—Antenna short not extending beyond the base of foreleg; all the four pairs of spiracles visible.

Holotype.—One pupal case mounted, on an unidentified tree, Babboor village (Karnataka State), 15-9-1969, B. V David.

Paratypes.—Ten pupal cases mounted bearing the same details. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.]

This species in general appearance resembles *Aleuroplatus incisus* Quaintance and Baker in the tracheal folds armed with an elongate tooth, but differs in the tooth being not situated in a distinct sinus, in not possessing a long caudo-lateral setae and in the shape of operculum.

16



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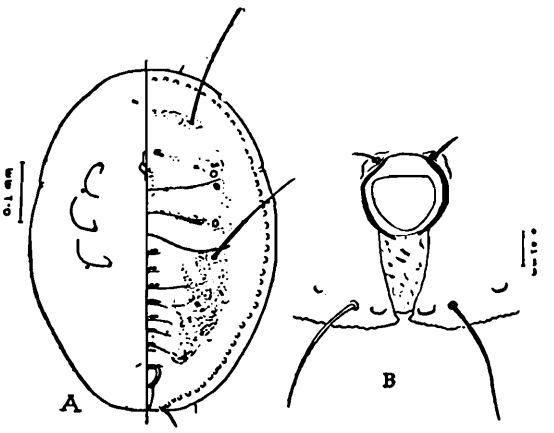

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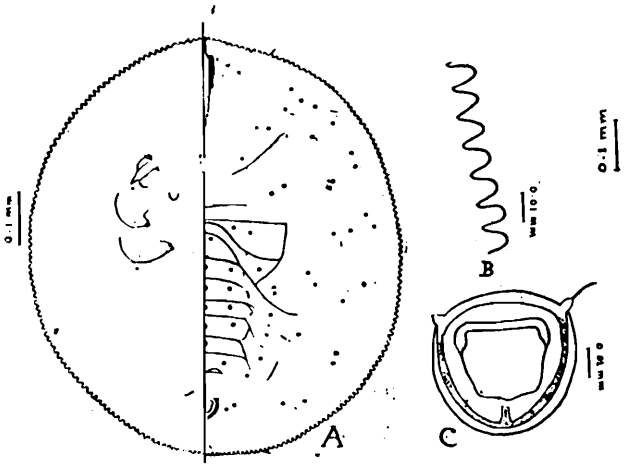

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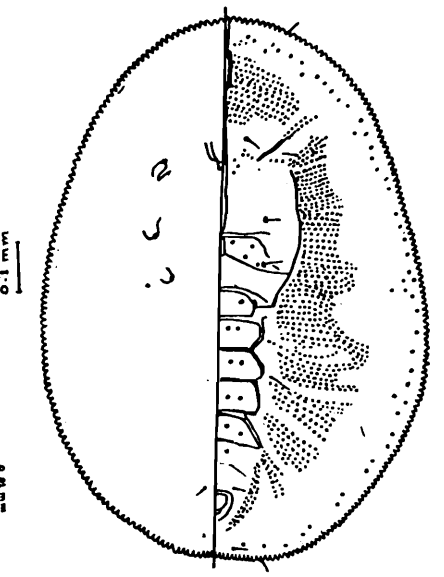


Text-figs. 16, 17, 19, 20. (16) *Aleuroplatus mysorensis* sp. n. A. pupal case, B. Thoracic tracheal pore, C. Vasiform oifice; (17) *Aleurotrachelus caerulescens*, A. Pupal case, B. Margin, C. Vasiform orifice; (19) Pupal case of *Aleurotrachelus multipapillus;* (20) *Aleurotuberculatus cardomomi* sp. n. A. Pupal case, B. Vasiform orifice and caudal tracheal pore.

Key to Indian Species of **Aleuroplatus**

1. Pupal case black, embedded in a transparent resinous substance. .. . 2
   Pupal case brown, embedded in a transparent resinous substance; thoracic and caudal tracheal combs provided with 4-9 teeth. .*alcocki* (Peal)
2. Eye spots absent; thoracic and caudal tracheal combs with about seven long widely separated teeth with minute serrations along their lateral margin...*pectenserratus* Singh*

   Eye spots indicated; thoracic and tracheal combs with a distinct tooth.. .. . .*mysorensis* sp. n.

VII. Genus **Aleurotrachelus** Quaintance and Baker, 1914

Type species.—Aleurodes tracheifer Quaintance, 1900, *U. S. Dept. Agr. Div. Ent. Bull. Tech. Ser.*, **8** : 1-64.

The important characteristic features of this genus are as follows: Margin of pupal case with two rows of teeth; dorsal disc not separated from submargin; a prominent central ridge on dorsum terminating cephalad in a more or less arrow-shaped figure. Vasiform orifice cordate; operculum subcordate nearly filling orifice; lingula usually hidden, when visible, slightly expanded at tip.

21. **Aleurotrachelus caerulescens** Singh

(Text-fig. 17)

1931. *Aleurotrachelus caerulescens* Singh, *Mem. Dept. Agric. India, Ent. Ser.*, **12**(1): 59.

The following notes are provided to Singh's original description of the species.

Pupal case.—0.85-0.86 mm long, 0.68-0.69 mm wide.

Margin.—Thoracic and caudal tracheal pores or combs wanting. Margin with a double row of teeth, rounded, about 15 teeth in 0.1 mm. Paired anterior and posterior marginal setae, about 17 long.

Dorsal surface.—The anterior part of mid-dorsal suture tuberculate. A pair of cephalic setae, 5-8 long; a pair of setae on the eighth abdominal segment cephalad of the orifice on tubercles, 8 long and a pair of caudal setae, 8 long. Papillae-like pores medially on abdominal segments 1-6; submedially on segments 2-5; pores also found scattered on subdorsum and along submargin.

Ventral surface.—Ventral abdominal setae 19 long, 39 apart. All the four pairs of spiracles discernible. Antenna extending to prothoracic spiracle; a minute seta at base of meso- and metathoracic légs.

Hosts.—*Artocarpus heterophyllus* (=*A. integrifolia*) (Singh, 1931) and *Rosa* sp. (Rao, 1958).

Distribution.—Pusa, Bihar (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958) and Madurai, Coimbatore and Madras (Tamil Nadu) (new distribution record).

Material examined.—Seven pupal cases mounted, on rose (*Rosa* sp.), Coimbatore, 11-11-1966, B. V David; six pupal cases mounted, on rose, Madurai, 5-2-1969, B. V David. Numerous pupal cases on dry leaves in collection.

22. **Aleurotrachelus coimbatorensis** sp. n.

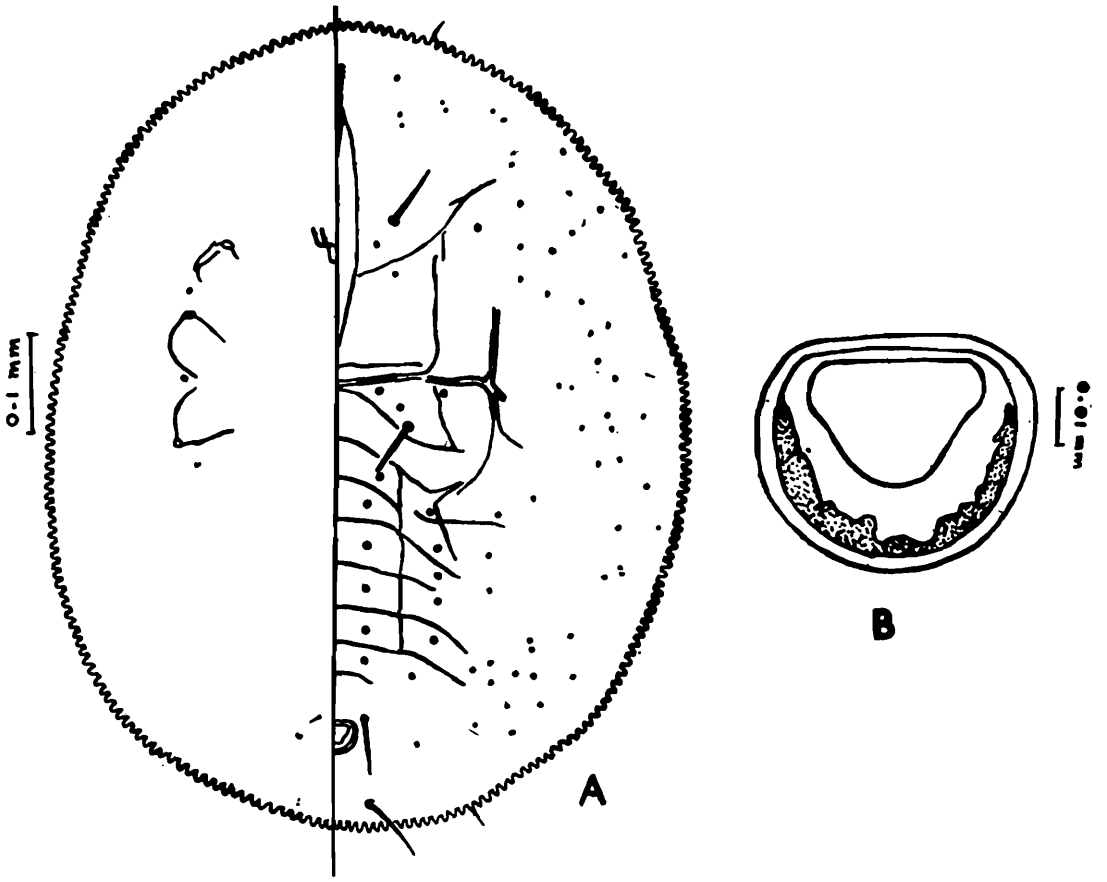
(Text-fig. 18)

Pupal case.—Oval; 0.91-0.95 mm long, 0.71-0.78 mm wide.

Margin.—Margin with a double row of teeth, rounded, about 20 teeth in 0.1 mm. Paired anterior and posterior marginal setae,

16-19 long. A pair of submarginal caudal setae, 61 long. Thoracic and caudal tracheal pores or combs or folds not indicated.

Dorsal surface.—Three pairs of dorsal setae evident—the cephalic setae 61 long, a pair submedially on metathorax, 52 long and the eighth abdominal setae laterad of vasiform orifice, 52 long. The anterior part of mid-dorsal suture with tuberculate markings. Cephalothorax with a longitudinal ridge on each side and the median abdominal rhachis with lateral folds characteristic. Minute papillae-like pores are found scattered on the dorsal disc and a few on submargin.



Text-fig. 18. *Aleurotrachelus coimbatorensis* sp. n. A. Pupal case, B. Vasiform orifice.

Vasiform orifice subcircular with a sclerotized rim, the lateral sides ridged, floor of orifice with minute tubercles; 33 long and 39 wide. Operculum wider than long with the caudal end narrow and rounded; length 17 and width 22. Lingula hidden.

Ventral surface.—Ventral abdominal setae 22 long, 36 apart. Pro- and mesothoracic spiracles and anterior and posterior abdominal spiracles evident. Antenna not extending beyond fore leg. Setae at base of legs and rostrum wanting.

Host.—*Jasminum auriculatum.*

Holotype.—One pupal cases on slide, Coimbatore, *Jasminum auriculatum*, 21-3-1957, S. K. David.

Paratypes.—Seventeen pupal cases mounted bearing the same details. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.)]

This species closely resembles *Aleurotrachelus caerulescens* Singh, but differs in having a pair of dorsal setae submedially on metathorax and in the distribution of papillae-like pores on dorsum.

23. **Aleurotrachelus multipapillus** Singh, 1932

(Text-fig. 19)

1932. *Aleurotrachelus multipapillus* Singh, *Rec. Indian Mus.*, **34**: 81-88.

Pupal case.—Light translucent yellow without any fluff, oval, female case 1.34 mm long and 0.91 mm wide, male case 0.98 mm long and 0.63 mm wide. Found on the undersurface of leaves.

Margin.—Toothed with closely set rounded teeth, about 12-13 in 0.1 mm. Paired anterior marginal setae 16 long, posterior marginal setae 21 long. Caudal setae submarginal, 16 long. Thoracic and caudal tracheal pores and folds not indicated.

Dorsal surface.—Four pairs of dorsal setae evident—the first pair being longest, 60 long, disposed laterad of mouth parts; a pair of small setae of 18 long on each of meso- and metathorax; a pair of setae at base of vasiform orifice, 31 long. The anterior part of mid-dorsal suture tuberculate. A median rhachis with folds characteristic of the genus evident. Minute papillae on subdorsum and cephalic region distributed in a definite characteristic pattern as illustrated. One or two minute pores medially on rhachis and two or three pores on thoracic region seen. Submargin with a row of minute pores numbering about 39 on one side.

Vasiform orifice almost subcordate with a sclerotized rim, 73 long, 60 wide; caudal membrane and edge tuberculate. Operculum more or less similarly shaped filling two-third of orifice. Swollen and setose part of lingula exposed; tip with two fine setae.

Ventral surface.—Ventral abdominal setae 31 long, 62 apart. A seta, 3 long, at base of metathoracic legs.

Host plant.—Bamboo.

Material examined.—Four female pupal cases and one male pupal case, on bamboo, Mallisery Estate near Kongode (Kerala State), 27-9-1968, B. V. David.

This species was first described by Singh from specimens collected from *Bambusa nana* in Syriam (Burma). This is a new addition to Indian Aleyrodidae.

Key to the Indian Species of **Aleurotrachelus**

1. A pair of small dorsal setae on each of meso- and metathorax submedially present. .. ..*multipapillus* Singh
   Dorsal setae on mesothorax wanting but on metathorax may be present or absent. 2
2. A pair of setae submedially on metathorax evident. .*coimbatorensis* sp. n.
   Dorsal setae on metathorax absent. .*caerulescens* Singh

VIII. Genus **Aleurotuberculatus** Takahashi, 1932

Type species.—*Aleurotuberculatus gordoniae* Takahashi, 1932, *Rep. Dept. Agric.*, Formosa, **59** : 20.

The species included in this genus are characterised by the pupal case with crenulate margin, a row of submarginal papillae, fine granules or papillae on dorsum, faintly discernible thoracic tracheal folds, distinct or indistinct thoracic tracheal pores and distinct caudal tracheal fold and pore. Vasiform orifice subcordate, notched at posterior margin.

24. **Aleurotuberculatus cardamomi** sp. n.

(Text-fig. 20)

Pupal case.—White without any marginal wax; elliptic; 0.78 mm long, 0.55 mm wide. Found on the under surface of leaves at 1-3 cases per leaf.

Margin.—Smoothly crenulate, 38-40 crenulations in 0.1 mm, rounded. Paired anterior and posterior marginal setae 5 long; Tracheal pore regions distinct and notched internally.

Dorsal surface.—Four pairs of setae evident—cephalic setae 189 long, first abdominal setae 208 long, setae on eighth abdominal segment laterad of base of vasiform orifice minute, 5 long and caudal setae submarginal 66 long. Dorsum with numerous minute tubercles and a row of minute tubercles on each of the first seven abdominal segments. Abdominal segment seven is not shortened medially. Submargin with about forty three pairs of broad papillae of variable sizes (10-13 × 8-13) and distinctly isolated from each other. Transverse suture not reaching margin, ends posterior to its mid-point. Subdorsal region without papillae. Vasiform orifice as long as wide (39 × 39), surrounded except on posterior end by a sclerotized ring. Posterior border of orifice transverse, notched internally. Operculum about 29 wide and occupies about two-thirds of orifice; lingula concealed with expanded round tip. Caudal furrow and folds distinct, 44 long and 26 wide at anterior, tapering to 13 at posterior.

Ventral surface.—Smooth, Ventral abdominal setae at base of vasiform orifice, 11 long, 30 apart. Setae at base of legs absent. Anterior thoracic and anterior and posterior abdominal spiracles clearly visible.

Host plant.—*Eletteria cardamomum* (Cardamom).

Holotype.—One pupal case mounted, on cardamom, Valparai (6000 feet), 16-4-1967, B. V David.

Paratypes.—Two pupal cases mounted bearing the same details. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

Related to *Aleurotuberculatus lithocarpi* Takahashi, but differs in the presence of shallow emarginated tracheal pores, in the distribution of

tubercles on dorsum, and in the number and arrangement of submarginal papillae. Also resembles *A. melastomae* Takahashi but differs considerably in the presence of a row of submarginal large papillae.

25. **Aleurotuberculatus psidii** (Singh), 1931

(Text-fig. 21)

1931. *Aleurotrachelus psidii* Singh, *Mem. Dept. Agric. India, Ent. Ser.*, **12**(1): 61-62.
1958. *Aleurotuberculatus psidii* (Singh), Rao, *Proc. 10th. int. Congr. Ent.* (1956) **1**: 331.

Pupal case.—Pale white with little waxy secretion, suboval, broader cephalad, being widest at junction of thorax and abdomen, narrowing caudad. Vasiform orifice appears brownish. Length 0.75 mm, width 0.43 mm. Found scattered singly on the under surface of leaves.

Margin.—Finely crenulate and with paired anterior and posterior marginal setae, 13 long. Tracheal pores smooth, shallow emarginations; posterior pore set in a deep cleft. Margin reflexed and visible intad of the arched line on subdorsum.

Dorsal surface.—Paired setae evident—cephalic setae 65 long, first abdominal setae 75 long, small setae cephalad of vasiform orifice 18 long and submarginal caudal setae on tubercles 44 long. The dorsal granulations are crescent and arrow-head shaped. A median abdominal ridge of 8-9 with brown pigmented tubercles with suture-like markings. Similar tubercles on cephalothorax form an anchor-shaped figure. Colourless tubercles evident at 2, 1 and 2 on the pro-, meso- and meta- thoracic legs respectively. Small contiguous arches incompletely separates the submargin from the dorsal disc.

Vasiform orifice sub-circular, rim chitinised, emarginate at posterior, 44 long and 42 wide. Operculum similarly shaped, entirely covering the orifice and concealing the lingula. Caudal furrow 55 long, terminates in a semicircular pore.

Ventral surface.—Ventral abdominal setae 8, 34 apart. Anterior and posterior abdominal spiracles visible distinctly. No setae at base of legs.

Host plant.—*Psidium guajava* (Guava).

Distribution.—Pusa (Bihar) (Singh, 1931); Himayatnagar, Begumpet (Andhra Pradesh) (Rao, 1958); throughout Tamil Nadu (new distribution record).

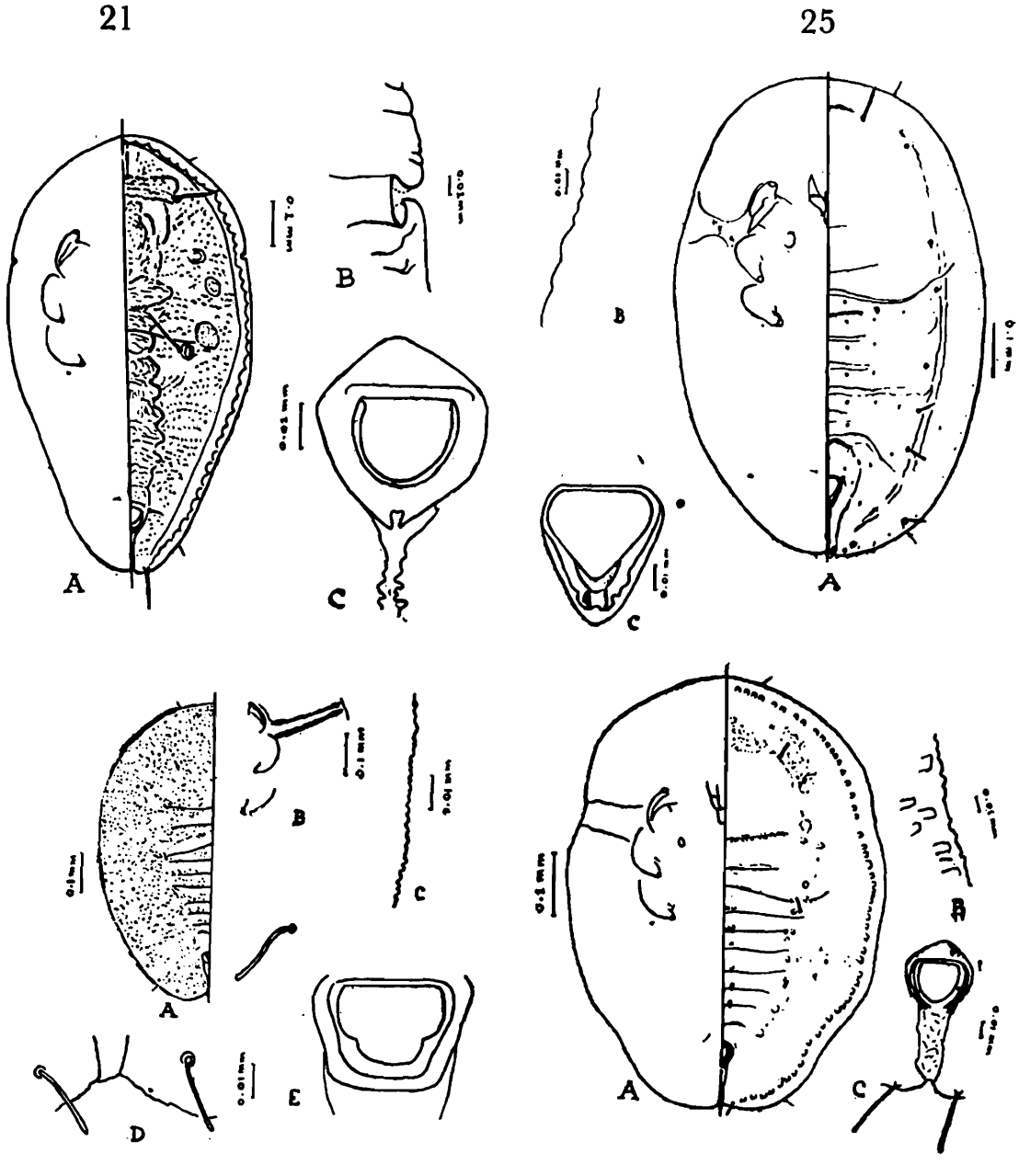
Material examined.—11 mounted specimens, on *Psidium guajava* (Guava), Coimbatore, 9-3-1967, B. V. David.

26. **Aleurotuberculatus russellae** sp. n.

(Text-fig. 22)

Pupal case.—White, with no secretion evident, elliptic, 1.01 to 1.06 mm long and 0.76 to 0.81 mm wide. Found on the undersurface of leaflets.

Margin.—Finally crenulate, 25 crenulations in 0.1 mm; anterior marginal setae pointed, 18 long; posterior marginal setae pointed, 13 long. Thoracic pores, combs or teeth not indicated; caudal margin with a deep cleft or indented.



Text-figs. 21-23, 25,(21) *Aleurotuberculatus psidii* A. Pupal case, B. Throacic tracheal pore, C. Vasiform orifice; (22) *Aleurotuberculatus russellae* sp. n. A. Pupal case dorsal surface, B. Ventral surface of thoracie, C. margin, D. Caudal tracheal pore, E. Vasiform orifice; (23) *Aleurotuberculatus takahashii* sp. n. A. Pupal case, B. Thoracie pore, C. Vasiform orifice caudal tracheal pore, (25) *Asterochiton cordiae* sp. n., A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice.

Dorsal surface.—Dorsal surface completely granulated and with four pairs of capitate setae—cephalic setae 16 long, first abdominal setae 16 long, eighth abdominal setae cephalad of vasiform orifice 13 long and submarginal caudal setae 16 long. Thoracic transverse suture not reaching the margin, abdominal segments distinct, pockets well indicated, not contiguous. A row of minute pores on submargin and on sub-dorsum evident.

Vasiform orifice is quite characteristic appearing more or less rectangular, length 34 and width 47. Operculum wider than long (31 ×26) towards caudal end, constricted at half its length and somewhat rounded; nearly fills the orifice concealing the lingula. Caudal furrow distinct and ends in a deep cleft in the caudal margin; pore, teeth or comb absent. Length 96, width (42) at caudal end of orifice and narrow (8) at caudal margin.

Ventral surface.—Smooth with a pair of ventral abdominal pointed setae 13 long, 42 apart. Thoracic tracheal folds slightly discernible; caudal fold tuberculate throughout its length. Setae at base of legs absent. Anterior and posterior abdominal spiracles evident.

Host plant.—An unidentified tree.

Holotype.—One mounted specimen, on an unidentified tree, Valparai (6000 ft), 16-4-1967, B. V David.

Paratypes.—Eight pupal cases mounted, bearing the same details. Deposited in the collections of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington, the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.

This species is very distinct and unique in having capitate setae, in the granulation of dorsal surface and in the shape of the operculum. It resembles *Aleurotuberculatus latus* Takahashi in the possession of capitate setae.

This species is named after Dr. Louise M. Russell of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington D. C.

27. **Aleurotuberculatus takahashii** sp. n.

(Text-fig. 23)

Pupal case.—White without any waxy secretion, vasiform orifice light brown; suboval, broader cephalad, being widest at junction of thorax and abdomen, narrowing caudad, indented posteriorly. Female case length 0.78 mm, width 0.56 mm. male case length 0.63 mm, width 0.43 mm. Found on the undersurface of leaves.

Margin.—Finely crenulate, about 26 crenulations in 0.1 mm; margin at thoracic pore area straight without any crenulations. Paired anterior and posterior marginal setae, 13-21 long.

Dorsal surface.—Four pairs of setae—cephalic capitate setae 39 long, first abdominal capitate setae 18 long, pointed setae on eighth abdominal segment laterad of base of vasiform orifice minute, and submarginal caudal setae 26 long on small tubercles. Transverse moulting suture bends to anterior extending to submargin. Dorsum with tubercles and numerous granules. Tubercles evident on median part of first six abdominal segments and larger tubercles on sublateral part of abdomen and cephalo-thorax. A row of papillae numbering about 50 on

submargin. Thoracic tracheal furrows not evident but caudal furrow wider at base and narrower at caudal end.

Vasiform orifice as long as wide, lateral margins sclerotized, widely notched on hind margin. Operculum sub-circular, transverse cephalad, covering most of orifice and concealing the lingula.

Ventral surface.—Ventral abdominal setae 13 long, 36 apart. Anterior and posterior abdominal spiracles seen. Thoracic tracheal folds broad and indicated faintly. Caudal tracheal fold with irregular markings. A minute seta at base of each leg present.

Host.—Cordia myxa.

Holotype.—One pupal case mounted, on *Cordia myxa*, Madras, 19-7-1971, B. V David.

Paratypes.—Eight pupal cases mounted, bearing the same details. Pupal cases on dry leaves in collection. [Deposited in the collection of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.]

This species resembles *Aleurotuberculatus lithocarpi* Takahashi, but differs in the capitate nature of anterior two pairs of dorsal setae and caudal setae and in the number of submarginal papillae.

This species is named after late Dr. R. Takahashi.

Key to Indian Species of **Aleurotuberculatus**

1. Pupal case jet black; submargin with radial striations. *.murrayae* (Singh)
   Pupal case white; submargin without radial striations. 2
2. Submargin with a row of papillae. .. 3
   Submargin without a row of papillae. . 4
3. Thoracic tracheal pore distinct and notched; cephalic and first abdominal setae long and pointed.. . ... *.cardamomi* sp. n.
   Thoracic tracheal pore area straight without any crenulations; cephalic and first abdominal setae short and capitate.... *.takahashii* sp. n.
4. Thoracic tracheal pore indicated by shallow emarginations.. 5
   Thoracic tracheal pore area not indicated, but tracheal fold evident; dorsal setae capitate. *.russellae* sp. n.
5. Dorsum granulated; basal abdominal setae present.. 6
   Dorsum with a marked tassellation all over; first abdominal setae absent *minutus* (Singh)
6. Dorsum with crescent and arrowhead shaped granulations; cephalothorax with distinct anchor-shaped tubercles; abdominal segments medially pigmented and tuberculate. *.psidii* (Singh)

   Dorsum with sparse granules sublaterally; cephalo-thorax with 2 pairs of rounded tubercles; on abdominal segments 1 and 2 and rarely on 3 medially a tubercle evident. *.hexcantha* (Singh)

IX. Genus **Asterobemisia** Trehan 1940.

Type species.—Aleyrodes avellanae Signoret, 1868 after Zahradnik, 1961, *Sb. ent. Odd. n'ar. Mus. Praze*, **34**(593): 433-438.

Pupal case elliptic, with margin finely crenulated; thoracic tracheal folds and combs indicated; caudal fold and comb present; seventh abdominal segment shorter than sixth and eighth; vasiform orifice elongately

triangular; operculum semicircular; lingula stout, spatulate with a pair of long setae at tip, exposed and included.

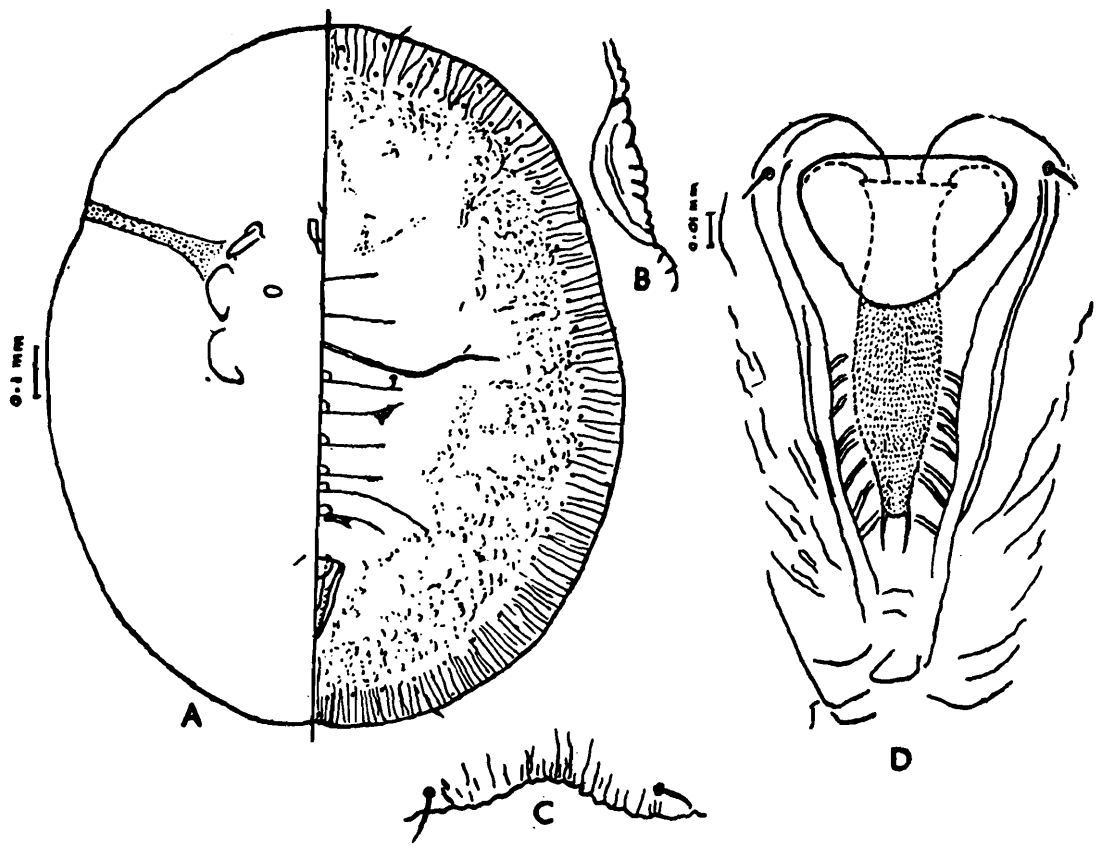
28. **Asterobemisia moringae** sp. n.

(Text-fig. 24)

Pupal case.—White without any waxy secretion, broadly oval, 1.46 mm long and 1.16 mm wide. Found on the lower surface of leaflets.

Margin.—Margin irregularly crenulate slightly emarginate at thoracic and caudal tracheal pore areas; tracheal comb slightly sclerotized and distinct than the marginal teeth. Paired anterior and posterior marginal setae, 16 and 31 long respectively.

Dorsal surface.—Four pairs of setae on dorsal surface evident—cephalic setae 17 long, first abdominal setae 21 long, eighth abdominal setae laterad of based of vasiform orifice 13 long and caudal setae 16 long. Transverse moulting suture bends to anterior extending to submargin. Abdominal segments fairly distinct, segment seven very short at the median part. Submargin with long furrows running mesad from margin. Dorsum and lateral part of abdominal segments granulated. A distinct rounded tubercle present on the median part of each of the first six abdominal segments. Eight pairs of minute setae at five pairs on the submargin of cephalic region and three pairs on the subdorsum of thoracic region and six pairs of minute setae on the subdorsum of abdomen evident; 13-21 long. Minute submarginal pores evident



Text-fig. 24. *Asterobemisia moringae* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Caudal tracheal pore, D. Vasiform orifice.

in a row. Thoracic tracheal furrows indistinct; caudal tracheal furrow slender, a little longer than orifice, 208 long from caudal margin to apex of vasiform orifice

Vasiform orifice elongate, triangular and pointed apically; 165 long, 99 wide at base; slightly sinuated at the lateral margin with about eight lateral ridges Operculum wider than long, 66×46, occupies one-third orifice. Lingula spatulate, stout, pointed at apex, with a pair of long setae, length 153, width at middle 26 and 8 at apex; exposed and included.

Ventral surface.—Ventral abdominal setae 47 long, 76 apart, located ventral to the lateral aspect of base of operculum. Thoracic tracheal fold long, narrow and faintly indiated with minute dots. Anterior and posterior abdominal spiracles distinctly visible. A pair of small setae (11 long) at base of rostrum seen. Setae at base of legs wanting.

Host.—Moringa oleifera.

Holotype.—One pupal case on slide, on *Moringa oleifera*, Coimbatore, 17-4-1967, B. V David.

Paratype.—Two pupal cases on a slide bearing the same details deposited in the collection of the British Museum (Natural History), London.

Key to Indian Species of **Asterobemisia**

1. Case broadly oval; six rounded tubercles on each of first six abdominal segments medially; minute setae 8 pairs on cephalo-thorax and 6 pairs sublaterally on abdomen in addition to usual 3 pairs of dorsal setae.. .. ... *.moringae* sp. n.
   Case elliptic; dorsum with 5 pairs of setae, 1 pair on thorax and 4 pairs sublaterally on abdomen in addition to usual 3 pairs of dorsal setae. *.leakii* (Peal)*

X. Genus **Asterochiton** Maskell 1878

Typespecies.—Asterochiton aureus Maskell, 1878, *Trans. New Zealand Inst.*, **11**: 214.

Dumbleton (1957) amended the generic description as follows: Pupal case medium sized, subelliptical to subcircular; margin with a row of teeth, dorsal disc may be separated from submargin; thoracic tracheal folds and combs and caudal tracheal comb present, caudal fold indicated; vasiform orifice subcordate, operculum transversely semicircular, subcordate or subtrapezoidal filling about half the orifice; lingula exposed and included.

29. **Asterochiton cordiae** sp. n.

(Text-fig. 25)

Pupal case.—White, with about sixty transparent waxy filaments radiating from margin and some wax middorsally on cephalo-thorax and abdomen and on subdorsum; vasiform orifice brown. Female pupal case 0.98 mm long, 0.63 mm wide; male pupal case 0.86 mm

long and 0.52 mm wide; found on the lower surface of leaves along veins and midrib, rare.

Margin.—Crenulate; crenulations shortened at tracheal pore areas, slightly indented at caudal end. Paired anterior and posterior marginal setae 22-33 long.

Dorsal surface.—Usual paired setae on dorsal surface evident—cephalic setae (broken), first abdominal setae (broken), eighth abdominal setae laterad of base of orifice 14-22 long and submarginal caudal setae 36 long. In addition a row of thick long pointed setae on subdorsum at three pairs on cephalo-thorax and four pairs on abdominal segments 1, 4, 5 and 6, and two pairs submarginal towards caudal end evident, length varies from 25-55. Dorsal disc separated from submargin by a faint fold. Transverse moulting suture bends to anterior extending to submargin. Abdominal segments distinct, seventh being medially shortened than the sixth. Pockets well developed and contiguous. Minute pores and porettes submedially a pair on each of the abdominal segments and scattered on dorsum. Submargin with a row of about 40 pairs of minute setae. Thoracic and caudal tracheal furrows indicated.

Vasiform orifice subcordate with caudal end pointed, 53-63 long, 46-53 wide. Operculum similarly shaped (33-40 long, 40-46 wide) filling half the orifice. Lingula with a pair of terminal setae, exposed, included.

Ventral surface.—Ventral abdominal setae 25 long, 39 apart. Thoracic tracheal folds distinct, half the length dotted from base of legs. Antenna of female 69 long extending to base of mesothoracic leg; in male 138 long extending to middle of mesothoracic leg. All the four pairs of spiracles and adhesive sac visible. A minute seta at base of each of meso- and metathoracic legs, a pair of minute setae at base of rostrum seen.

Host.—Cordia myxa.

Holotype.—One pupal case mounted, on *Cordia myxa* Madras, 19-7-1971, B. V David.

Paratypes.—Mounted specimens in the collections of the Systematic Entomology Laboratory, United States Department of Agriculture, Washington and the British Museum (Natural History), London.

This species in general appearance resembles *Asterochiton simplex* (Maskell), but differs considerably in the number and arrangement of long thick setae on dorsal surface, in the presence of submarginal minute setae and pores and porettes on dorsal disc and in lingula possessing a pair of terminal setae.

XI. Genus **Bemisia** Quaintance and Baker, 1914

Type species.—Aleyrodes inconspicua Quaintance, 1900, *U.S. Dept. Agr. Div. Ent. Bull.* **8,** Tech. ser : 1-64.

This genus is characteristic in including species having an elongate triangular vasiform orifice, usually with an exposed triangular lingula tip. A series of subdorsal setae are present which may be often overlooked when small, but are occasionally long and stout.

30. **Bemisia hancocki** Corbett

(Text-fig. 26)

1936. *Bemisia hancocki* Corbett, *Proc. R. ent. Soc. London* (B), **5**: 18-22.
1965. *Bemisia hancocki* Corbett, Mound, *Bull. Br. Mus. nat. Hist. Ent.*, **17**(3): 140-142.

Pupal case.—White without any waxy secretion, elliptic with hind end slightly indented, 0.95-1.00 mm long and 0.66 mm wide. Found on both surfaces of leaflets of host plant.

Margin.—Margin finely crenulate, slightly emarginate at thoracic and caudal tracheal pore areas which are not discernible in some specimens. The teeth in the tracheal comb are slightly sclerotized and distinct than the other marginal teeth. Paired anterior and posterior marginal setae, 13-16 long.

Dorsal surface.—Paired setae on dorsal surface as follows: Cephalic setae 26 long, first abdominal setae 13 long, eighth abdominal setae 11 long situated laterad of base of vasiform orifice and caudal setae 16 long. Transverse moulting suture short. Abdominal segments fairly distinct, segment seven very short at the median part. Submargin with furrows running mesad from margin. Dorsum with numerous granules and lateral part of abdominal segments also granulated. Distinct rounded tubercles larger than dorsal granules numbering about six pairs present laterad of abdominal segments and medially one on each of the first six abdominal segments. About eight pairs of rounded tubercles seen on the cephalo-thorax. Subdorsum with three pairs of minute setae on cephalo-thorax and five pairs of minute setae in a row on each side of posterior part of abdomen; 13-21 long. Thoracic tracheal furrows not indicated; caudal furrow slender and as long as orifice, 74-77 long. Pockets well developed and not contiguous.

Vasiform orifice elongated, triangular and pointed caudad; slightly sinuated at the lateral margin with five lateral ridges. Length 122, width 91 at base and 21 at apex. Operculum sub-circular, wider than long, 65×43, narrowed and rounded apically; occupies one third orifice. Lingula stout, 104 long, spetulate, pointed apically (28 wide at middle and 5 at apex) with a pair of long setae, exposed and included.

Ventral surface.—Ventral abdominal setae 26 long, 60 apart; situated ventrally just anterior to the caudal end of operculum. Thoracic tracheal fold long and faintly indicated with minute dots. A pair of minute setae present at base of rostrum. Anterior and posterior abdominal spiracles evident. Setae at base of legs absent.

Host plant.—*Tephrosia purpurea.*

Material examined.—Eleven pupal cases mounted, on *Tephrosia purpurea*, Badnera (Maharashtra), 30-8-1969, B. V David. Two pupal cases, on *Tephrosia purpurea*, Madras, 15-9-1971, B. V David.

This species known so far from Western Africa and is reported for the first time from India.

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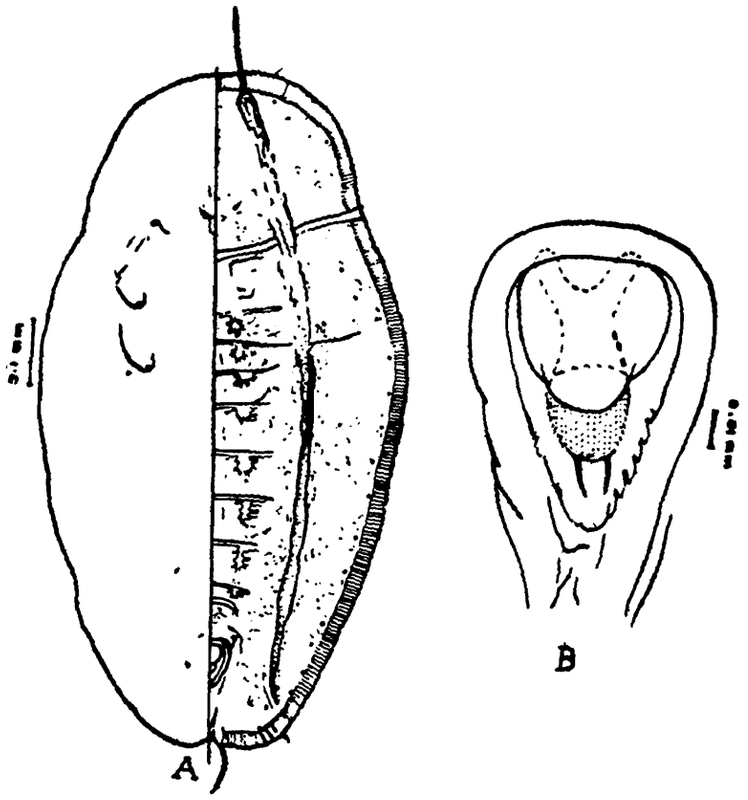
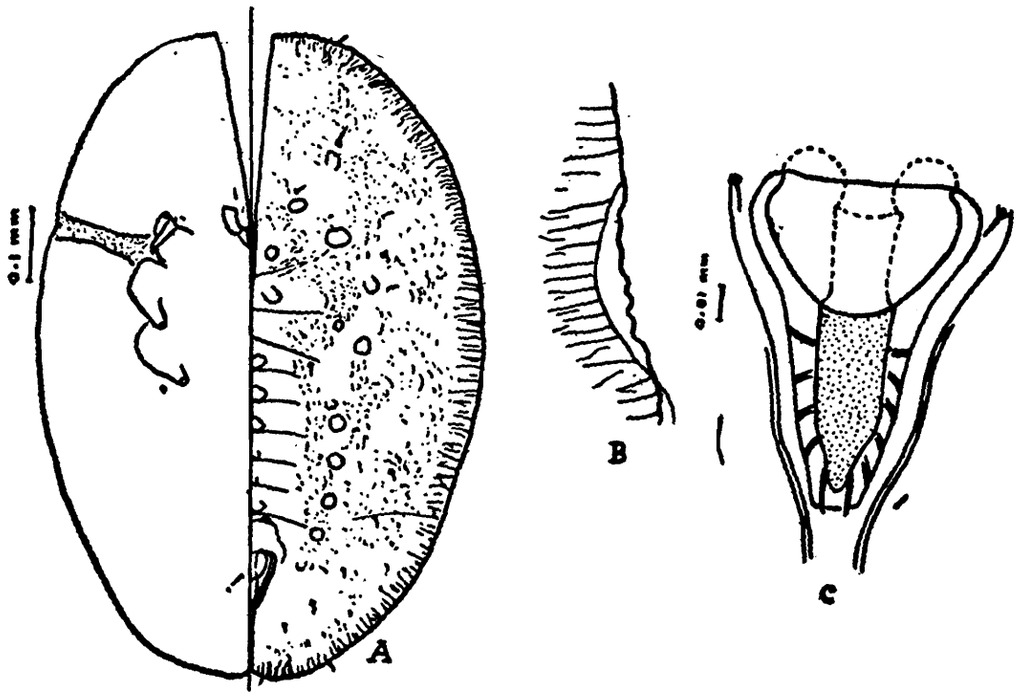




26

Text-figs. 26-27. (26) *Bemisia hancocki* A pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, (27) *Bemisia jasminum* sp. n. A. Pupal case, B. Vasiform orifice.

31. **Bemisia jasminum** sp. n.

(Text-fig. 27)

Pupal case.—White, flat, elongate oval, operculum brownish, slightly narrowed across thoracic folds, widest about mid-length, idented caudally. Waxy secretion scanty but case elevated slightly due to a narrow palisade all round the margin. Length 1.10 mm, width 0.56 mm. Found along midrib and veins on the lower surface of leaves.

Margin.—Crenulate; paired anterior and posterior marginal setae 14 long and caudal setae arising on tubercles at the end of caudal ridges, 83 long. Thoracic tracheal pore ending slightly emarginate and distinct.

Dorsal surface.—Dorsal setae minute—a pair of cephalic setae 8 long, a pair of first abdominal setae 5 long and a pair of eighth abdominal setae lataerad of base of vasiform orifice 5 long. A narrow raised tuberculate line defines the dorsal area running from cephalic region to a point level with the posterior end of vasiform orifice; length about 0.80 mm. A pair of long setae of 112 long arising at the chephalic terminal end of tuberculate line. The dorsal area between the tuberculate lines slightly concave in the cephalic region continuing upto mesothoracic suture and in the abdominal region. The subdorsal area with minute rounded sculpturing and similar sculpturing in between the tuberculate line and the lateral part of abdominal segments. Transverse moulting suture slightly bends to anterior but does not reach margin. A tuberculate or toothed line anteriorly on mesothorax. A pair of paramedian lobed depressed markings on metathorax and the abdominal segments 1 to 7; seventh abdominal segment shorter than sixth. Submargin radially striate and internally bound by a faint submarginal line; along this line a row of about 18 pairs of minute pores evident. Pockets well developed and contiguous.

Vasiform orifice triangular; 83 long, 60 wide with slight folds laterally. Operculum subcordate covering about half the length of orifice. Lingula setose, exposed, included, club-shaped, bears a pair of setae subapically. Two demarcated lines enclosing the orifice laterally continue to the caudal end forming tuberculate ridges enclosing a grooved area in between and bearing terminally the caudal setae; length of caudal ridge 76. The anal furrow is contained by the ridges.

Ventral surface.—Ventral abdominal setae 20 long, 36 apart. A pair of minute setae present at base of rostrum. Setae at base of legs absent. Anterior and posterior abdominal spiracles evident.

Host.—Jasmine (*Jasminum* sp.)

Holotybe.—One case on a slide, Neyveli (Tamilnadu), on Jasmine, 22-1-67, B. V David.

Paratybes.—Two mounted slides bearing the same details deposited in the collections of the Entomology Research Division, U.S.D.A., Washington and the British Museum (Natural History), London. Four pupal cases on slides in the collections of the senior author.

This species resembles *Bemisia helvi* (Dumbleton) but differs considerably in size, usual dorsal setae being minute, lateral tuberculate line reaching a point just to the level of caudal end of vasiform orifice, depressed markings on abdominal segments 1-7 and in the lingula being club-shaped and setose.

32. **Bemisia tabaci** (Gennadius, 1889)
(Text-fig. 27a)

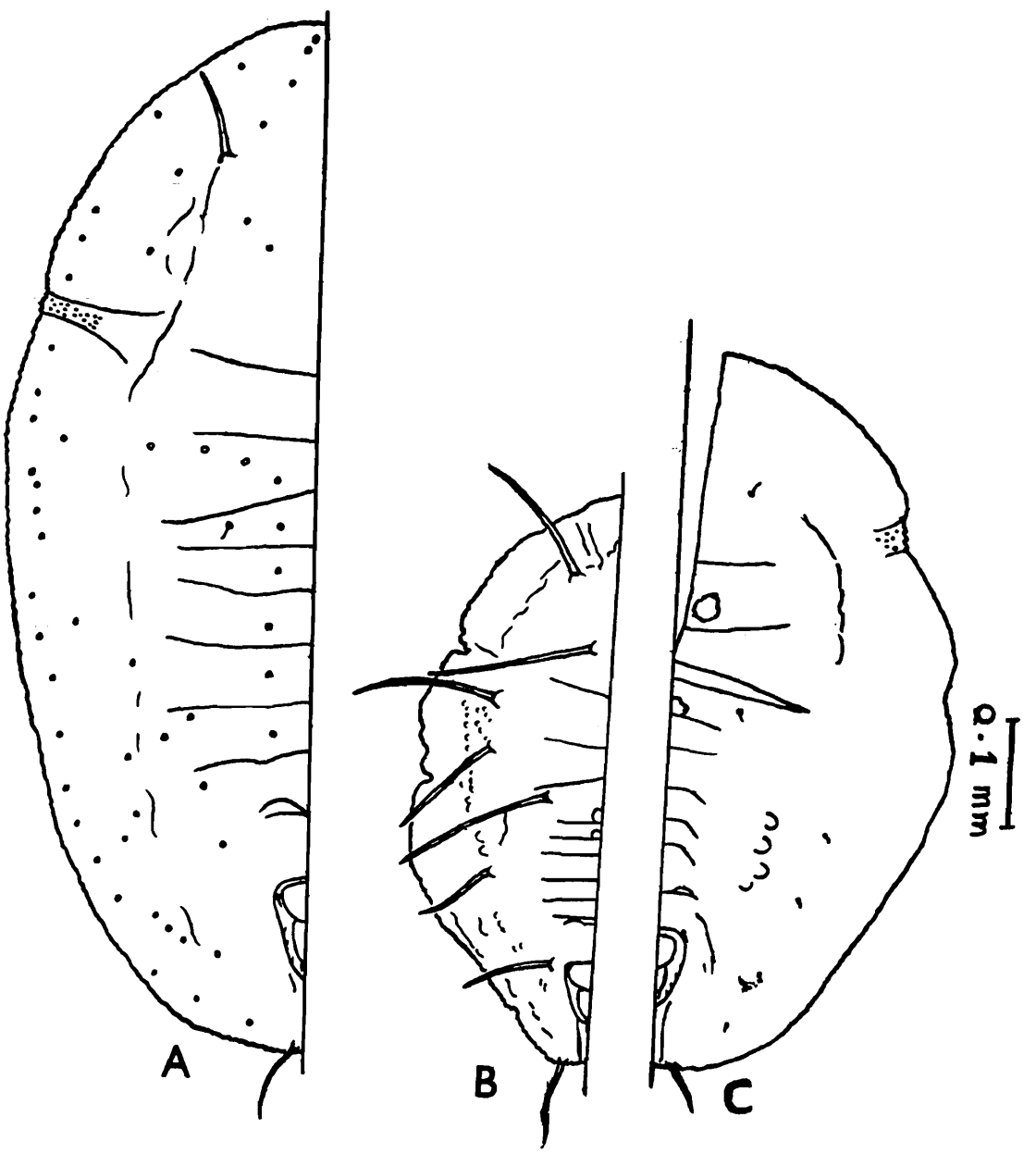
1889. *Aleyrodes tabaci* Gennadius, *Ellenike Georgia* (Greek *Agriculture*) (*Athens*): (1)-3.
1900. *Aleyrodes inconspicua* Quaintance, *U.S. Dept. Agr., Div. Ent., Tech. Ser.* **8:** 28-29.
1914. *Bemisia inconspicua* (Quaintance) Quaintance and Baker, *U.S. Dept. Agr., Bur. Ent., Tech. Ser.* **27:** 99-100.
1928. *Bemisia costa-limai* Bondar, *Aleyrodideos do Brasil* (*2nd Contrib.*) : 27-29.
1928. *Bemisia signata* Bondar, Aleyrodideos do Brasil (2nd contrib.) : 29-30.
1928. *Bemisia bahiana* Bondar, 1928. *Aleyrodideos do Brasil* (*2nd contrib.*) 30-31.
1929. *Bemisia gossypiperda* Misra and Lamba, *Agr. Res. Inst. Pusa, Bull. No.* **196:** 7.
1933. *Bemisia hibisci* Takahashi, *Dept. Agro Gov. Res. Inst. Formosa Rpt.* **60:** 17-18.
1934. *Bemisia gossypiperda* Misra and Lamba var. *mosaicivectura* Ghesquiere, *Ann. de Gembloux* (*Bruxelles*),: 30-31.
1934. *Bemisia longispina* Priesner and Hosny, *Egypt. Min. Agr., Tech. and Scien. Service* (*Ent. sec.*) *Bul.* **139:** 6.
1935. *Bemisia goldingi* Corbett, *Ann. Mag. nat. Hist.* (*ser 10*). **16:** 249-250.
1935. *Bemisia nigeriensis* Corbett, *Ann. Mag. nat. Hist.* (*ser. 10*) **16:** 250-252.
1936. *Bemisia rhodesiaensis* Corbett, *Proc. R. ent. Soc. London* (*B*) **5:** 22.
1936. *Bemisia tabaci* (Gennadius), Takahashi, *Tenthredo*, **1**(2): 110-111.

Bemisia tabaci (Gennadius) is well-known as a pest of cotton, tobacco and cassava, and also as a vector of virus diseases of crops. It was established by a few workers (*loc. cit.*) that in some aleyrodids considerable variations could occur in the structural details of setae, papillae, vasiform orifice, etc., in relation to hairy or glabrous nature of leaves of hosts, and as a result of detailed study a number of species of *Bemisia* were synonymised by Russell (1957).

Hosts.—*Abelmoschus esculentus*, *Achyranthes aspera*, *Brassica campestris* (Mustard), *B. campestris* van. *rapa* (turnip), *Brassica cleracea* (cabbage and cauliflower), *Citrullus colocynthis*, *Cleome viscosa*, *Clerodendron infortunatum*, *Corchorus trilocularis*, *Cucumis melo*, *Euphorbia pilulifera*, *Gossypium* sp. (cotton), *Lannia asplenifolia*, *Lippia geminata*, *Nyctanthes arbortristis*, *Physalis peruviana*, *Solanum melongena*, *S. tuberosum*, *S. xanthocarpum*, *Trewia nudiflora*, *Trichosanthes dioica* (Misra and Singh, 1929); *Saccharum officinarum* (Usman and Puttarudraiah 1955); *Acalypha indica*, *Aristolochia labiosa*, *Datura fastuosa*, *Gauzuma tomentosa*, *Ipomoea batatas*, *I. cairica*, *Lantana camara*, *Macuna cochinchinensis*, *Morinda tinctoria*, *Ocimum sanctum*, *Oryza sativa*, *Phyllanthus niruri*, *Rhynchosia minima* (new records), *Dolichos lab-lab*, *Gossypium arboreum* and *G. hirsutum*.

Material examined.—Nineteen pupal cases mounted, on *Cossypium hirsutum*, Rajapalayam, 8-6-1966, D. S. Aaron; five pupal cases mounted, on *Physalis peruviana*, Coimbatore, 25-10-1966; I. P. Janaki; two pupal cases mounted, on *Achyranthes aspera*, Coimbatore, 18-11-1966, B. V David; two pupal cases mounted, on *Acalypha indica*, Coimbatore, B. V David; seven pupal cases mounted, on *Rhynchosia minima* Coimbatore, 22-11-1966, B. V David; eight pupal cases mounted, on *Ocimum sanctum*, Coimbatore, 13-3-1967, B. V David; two pupal cases mounted,

on *Datura fastuosa*, Coimbatore, 25-3-1967, B. V David, three pupal cases mounted, on *Ipomoea cairica*, Coimbatore, 30-3-1967, B. V. David; eighteen pupal cases mounted, on *Aristolochia labiosa*, Coimbatore, 3-4-1967, B. V David; four pupal cases mounted, on *Lantana camara*, Coimbatore, 5-4-1967, B. V David; six pupal cases mounted, on *Phyllanthus niruri*, Coimbatore, 5-4-1967, B. V David; six pupal cases mounted, on *Gossypium arboreum*, Coimbatore, 25-4-1967, B. V David; three pupal cases mounted, on *Macuna cochinchinensis*, Coimbatore, 25-7-1967, B. V David; two pupal cases mounted, on *Ipomoea batatas*, 1-9-1967, B. V David; twenty-seven pupal cases mounted, on *Dolichos lab-lab*, Vellore, 5-10-1969, B. V David; twelve pupal cases mounted, on *Oryza sativa*, Kayarambedu (Madras), 21-8-1970, B. V David; fifteen pupal cases mounted, on *Gauzuma tomentosa*, Madras, 19-7-1971, B. V David; fourteen pupal cases mounted, on *Morinda tinctoria*, Madras, 21-9-1971, B. V David; five pupal cases mounted, on *Solanum melongena*, Madras, 4-10-1971, B. V David.



27a

Text-fig. 27a. Host related variation in the pupal case of *Bemisia tabaci* from *A. Oryza sativa*, B. *Gauzuma tomentosa*, C .*Aristolochia labiosa*.

On *Achyranthes aspera* the aleyrodid has been found to cause beautiful scarlet red irregular patch-like galls on the undersurface of leaves and the aleyrodid larva remains in a clear area inside the pitted surface.

Key to Indian Species of **Bemisia**

1. Case elongately elliptic with scanty waxy secretion, dorsum with a pair of sublateral longitudinal tuberculate lines running all along the length of body bearing long setae.. 3

   Case not elongately elliptic, without any waxy secretion, sublateral longitudinal tuberculate lines absent. ..

2. Elongate dorsal setae vary in number (including usual 13 pairs dorsal setae) from none to seven pairs depending upon the hairy or glabrous nature of leaf of host plant.. ... .*tabaci* (Gennadius)

   Dorsum with 8 pairs of setae-3 pairs on cephalothorax and 5 pairs sublaterally on abdomen in addition to usual 3 pairs of dorsal setae. .*hancocki* Corbett

3. Sublateral tuberculate line with four pairs of setae... .*giffardi* (Kotinsky)*
   Sublateral tuberculate line terminating in a pair of long setae at cephalic end.. .*jasminum* sp. n.

XII. Genus **Dialeurodes** Cockerell, 1902

Type species.—Aleyrodes citri Ashmead, 1885, *Florida Dispatch. ns.*, **11** (ex Quaintance and Baker, 1917).

The species included in this genus are characterised by their pupal cases possessing well developed tracheal pores usually with internal teeth and tracheal folds with many fine tubercles. Vasiform orifice small, often with a row of teeth within its caudal margin; lingula concealed. Seventh abdominal segment equal in length to sixth; submarginal papillae wanting.

33. **Dialeurodes armatus** sp. n.

(Text-fig. 28)

Pupal case.—Pale brownish, oval, slightly constricted at thoracic pores without any waxy secretion; 1.58 mm long, 1.21 mm wide. Found on the lower as well as upper surface of leaflets of *Azadirachta indica.*

Margin.—Irregularly crenulate with paired anterior and posterior marginal setae of 13-21 long. Thoracic and caudal pores distinct and invaginated without any comb or teeth.

Dorsal surface.—Dorsum with three pairs of setae—cephalic setae, 8 long; first abdominal setae, 18 long and eighth abdominal setae cephalad of vasiform orifice, 13 long. A pair of minute submarginal caudal setae on either side of caudal pore. Subdorsum with a series of minute setae, 5 long—four pairs of setae anterior to thoracic tracheal furrows, two pairs of setae in between thoracic tracheal furrows and thoraco-abdominal suture, and eight pairs on either side in the abdominal region. Transverse moulting suture not reaching margin, bends to anterior; abdominal segments distinct; submargin with radial striations.

Vasiform orifice subcordate; 91 long, 88 wide; its posterior lateral inner margin with a row of ridges. Operculum similarly shaped, broad

cephalad and slightly constricted at half of its length; caudal end setose; 78 long and 65 wide at base; fills almost the orifice obscuring the lingula. Caudal furrow narrow and distinct, length from caudal end of orifice to pore 232.

Ventral surface.—A pair of ventral abdominal setae cephalad of vasiform orifice, 16 long, 73 apart. Thoracic and caudal folds distinct with small tubercles, caudal fold broader, dotted; thoracic fold with tubercles from pore to base of pro- and mesothoracic legs; antennal tips reaching a little behind the base of mesothoracic legs. Mesothoracic, first abdominal and posterior abdominal spiracles are distinctly visible. Towards the inner aspect of each of the legs a stout spine, 13 long, present which is a distinctive feature. A seta, 8 long, present at the base of each of meso- and metathoracic legs. In the mesothorax cephalad of the basal seta another smaller seta, 3 long, present.

Host plant.—*Azadirachta indica* (Neem).

Holotype.—One specimen mounted, on *Azadirachta indica* (Neem), Coimbatore, 5-11-1966, B. V David.

Paratypes.—Seven specimens mounted bearing the same details. [Deposited in the collections of the Zoological Survey of India, Calcutta.]

Pupal cases on leaflets in writer's collections, on *Azadirachta indica*, Coimbatore, 28-10-1966 and 4-12-1966, B. V David. Material of the latter in the collections of the British Museum (Natural History), London.

This species in general resembles *Dialeurodes bassiae* sp. n., but differs in the arrangement of fourteen pairs of minute subdorsal setae, in having the thoracic tracheal folds dotted and in the absence of waxy markings on dorsum. Further, this species is easily separated from the other known Indian species by the presence of a stout spine on the inner aspect of each of the legs.

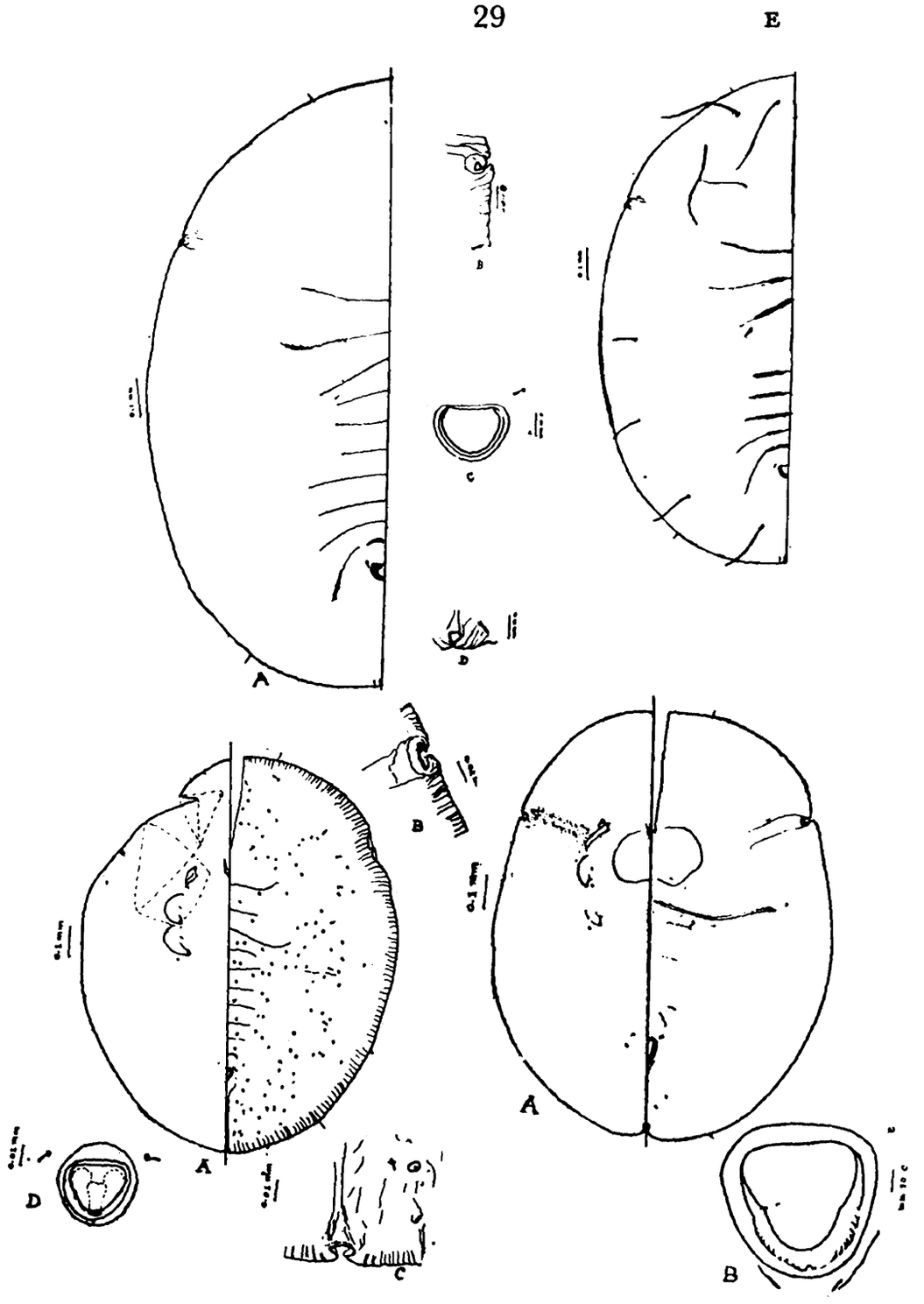
34. **Dialeurodes bassiae** sp. n.
(Plate II; Text-fig. 29)

Pupal case.—Light brownish, roundly elliptic, devoid of any waxy secretion, 1.56-1.63 long, 1.25-1.30 mm wide. Infects both surfaces of leaves but predominant on the under-surface.

Margin.—Crenulate, 17 crenulations in 0.1 mm; thoracic and caudal tracheal pores small, smooth with a distinct chitinised rim. Paired anterior and posterior marginal setae 19-25 long.

Dorsal surface.—Three pairs of dorsal capitate setae—cephalic setae 8 long, first abdominal setae 11 long and eighth abdominal setae laterad of base of vasiform orifice 8 long; a pair of caudal submarginal capitate setae 8 long; fourteen pairs of subdorsal capitate setae 5-8 long —four pairs on cephalic region, four pairs on thorax and six pairs on abdomen; some pupal cases from the undersurface of leaf with a few

subdorsal normal short capitate setae elongated into pointed slender hair-like setae of 25-83 long. Dorsal disc with wavy markings and clear dot-like pores sparsely distributed all over. Thoracic tracheal furrows indicated; caudal tracheal furrow fairly distinct.



Text-figs. 28-30. (28) *Dialeurodes armatus* sp. n. A. Pupal case, B. Vasiform orifice; (29) *Dialeurodes bassiae* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, D. Caudal tracheal pore, E. Pupal case with elongated setae from undersurface of leaf; (30) *Dialeurodes cardamomi* sp. n. A Pupal case, B. Thoracic tracheal pore, C. Caudal tracheal pore. D. Vasiform orifice.

Vasiform orifice subcircular with cephalic margin straight; wider than long, 47×33. Operculum similarly shaped, wider than long, 33×25, covering the orifice obscuring the lingula.

Ventral surface.—Ventral abdominal setae pointed, 19 long, 36 apart. All four pairs of spiracles visible. Thoracic and caudal tracheal folds not dotted or tuberculate. A minute seta of 8 long at base of meso- and metathoracic legs; setae at base of rostrum wanting.

Host.—*Bassia latifolia* and *B. longifolia.*

Holotype.—One pupal case mounted, on *Bassia longifolia*, Madras, 31-7-1971, B. V David.

Paratypes.—Sixteen pupal cases mounted bearing the same details. Numerous pupal cases on leaves in collections—on *Bassia latifolia*, Coimbatore, 7-11-1966, B. V David; on *Bassia longifolia*, Kovilpatti, 31-1-1967, B. V David. [Deposited in the collections of the British Museum (Natural History), London and the Zoological Survey of India, Calcutta].

This species in general appearance resembles *Dialeurodes hexouncta* Singh, but differs considerably in size, number and arrangement of setae on dorsal surface.

35. **Dialeurodes cardamomi** sp. n.

(Text-fig. 30)

Pupal case.—Pale white, without any secretion of wax; elliptic, thin and flattened; 1.58 mm long, 1.22 mm wide. Found on the undersurface of leaf.

Margin.—Not toothed but slightly crenulate, 18 crenulations in 0.1 mm. Paired pointed anterior and posterior marginal setae, 21-23 long. Thoracic and caudal pores distinct and invaginated without any comb or teeth; pore not closed.

Dorsal surface.—A pair of cephalic capitate setae, 10 long and a pair of eighth abdominal capitate setae, 8 long, caudad of vasiform orifice. Setae on first abdominal segment absent. Dorsal disc with numerous very short rounded papillae. Fourteen pairs of capitate setae, 10-13 long, arranged in a row on subdorsum. Submargin with radial striations extending from marginal crenulations. Thoracic transverse suture not reaching margin but bends to anterior; abdominal segments distinct.

Vasiform orifice small, subcordate, as long as wide (52×52), rounded on the hind margin. Operculum wider than long; 36×29, narrower at the distal part, 13 wide, covers over half the orifice exposing a little of setose lingula tip. Caudal furrow distinct and narrow; length from caudal end of orifice to caudal pore 265.

Ventral surface.—A pair of ventral abdominal pointed setae, 21 long, 49 apart. Thoracic tracheal folds faintly discernible. First abdominal

and posterior spiracles evident. Tip of antennae reaching base of prothoracic legs; a minute seta 16 long, at base of each of meso- and metathoracic legs; Cephalad a little above of the metathoracic leg seta another minute seta is present.

Host plant.—*Eletteria cardamomum* (Cardamom).

Holotybe. One pupal case mounted, on cardamom, Valparai, 16-4-1967, B. V David.

This species resembles *Dialeurodes tetrastigmae* Takahashi in possessing dorsal papillae, capitate setae on dorsal disc and pointed marginal setae but differs in the absence of chitinised irregular sculptures in the caudal fold and closed thoracic tracheal pores with four rounded chitinised teeth.

36. **Dialeurodes dissimilis** Quaintance and Baker, 1917.

1917. *Dialeurodes* (*Dialeuronomada*) *dissimilis* Quaintance and Baker, *Proc. U.S. natn. Mus.*, **51**: 424.

The following additional description is provided to the description of the species by Quaintance and Baker.

Pupal case.—0.771-0.772 mm long; 0.612-0.613 mm wide.

Margin.—Marginal setae 14-28 long.

Dorsal surface.—Cephalic setae 5-8 long; first abdominal setae 14 long; eighth abdominal setae 11 long. Pockets contiguous. Vasiform orifice longer than wide (39 × 36); operculum wider than long (22 × 19).

Ventral surface.—Ventral abdominal setae 17 long, 33 apart. Venter of case with circular markings. All the four pairs of spiracles visible. A seta of 8 long at base of each of meso- and metathoracic legs.

Host.—*Ixora* sp. (Singh, 1931); *Pavetta* sp. (new host record).

Distribution.—Pusa (Bihar) (Singh, 1931); Madras (Tamil Nadu) (new distribution record).

Material examined.—Five pupal cases mounted, on *Pavetta* sp., Madras, 31-7-1971, B. V David.

37. **Dialeurodes distinctus** sp. n.

(Text-fig. 31)

Pupal case.—Pale brown without any waxy secretion; oval; 2.08-2.12 mm long, 1.69-1.89 mm wide; found on the undersurface of leaves.

Margin.—Margin with a row of rounded teeth, 10 teeth in 0.1 mm. Paired anterior and posterior marginal setae are small, 14-17 long. Thoracic and caudal tracheal pores distinct and slightly invaginated, more or less closed. Caudal setae not discernible.

Dorsal surface.—Usual three pairs of dorsal setae evident but very minute; eighth abdominal setae laterad of base of vasiform orifice. Dorsum with very small pores and porettes distributed all over. Thoracic and caudal tracheal furrows visible. A distinct narrow transparent patch on cephalothorax demarcates subdorsum and dorsum. The transverse moulting suture runs to posterior and then bends to anterior extending upto subdorsum. Abdominal segments distinct, pockets well developed but not contiguous.

Vasiform orifice small, subcircular, 22 long and 30 wide; caudal edge and lateral walls ridged or tuberculate. Operculum trapezoidal, transverse cephalad, 17 long, 25 broad, nearly filling the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 28 long, 56 apart. Mesothoracic, anterior abdominal and posterior abdominal spiracles visible. Antennae slender and long extending upto base of mesothoracic legs. Thoracic and caudal tracheal folds distinct with minute tubercles. A small seta at base of each of meso- and metathoracic legs. Setae at base of rostrum absent.

Host.—Elaeodendron glaucum.

Holotype.—One pupal case mounted, on *Elaeodendron glaucum*, Coimbatore, 7-4-1969, B. V David.

Paratypes.—Ten pupal cases mounted bearing the same details. Pupal cases on dry leaves in the collections of the senior author.

This species in general appearance resembles *Dialeurodes radiilinealis* but distinct in the margin being toothed, in the structural details of vasiform orifice and in the pattern of the transparent area demarcating dorsum from subdorsum in the cephalic region.

38. **Dialeurodes eugeniae** (Maskell)

1896. *Aleurodes eugeniae* Maskell, *Trans. N. Zealand Inst.*, **27**: 430.
1917. *Dialeurodes* (*Rusostigma*) *eugeniae* (Maskell), Quaintance and Baker, *Proc. U.S. Nat. Mus.*, **51**: 421.
1931. *Dialeurodes eugeniae* (Maskell), Singh, *Mem. Dept. Agric. India, Ent. Ser.*, **12**(1): 24.

The following notes are added to the description of the species provided by Singh (1931).

Pupal case.—1.86-1.96 mm long, 1.56-1.69 mm wide. The dorsal disc area of the specimens mounted somewhat darker.

Margin.—Anterior and posterior marginal setae 14-17 long.

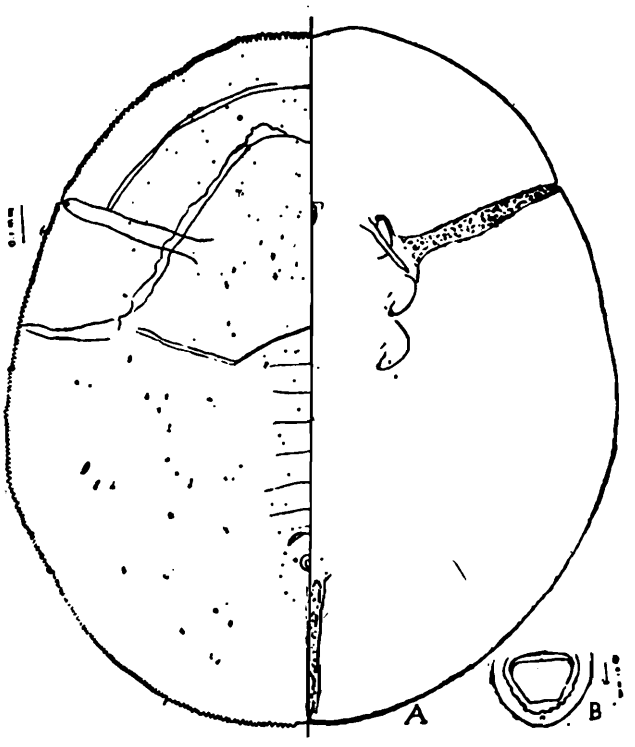
Dorsal surface.—Paired cephalic, first abdominal and eighth abdominal setae 11 long. Setae on dorsal disc and submargin 8 long. Vasiform orifice 63 long, 55 wide; operculum 36 long, 44 wide.

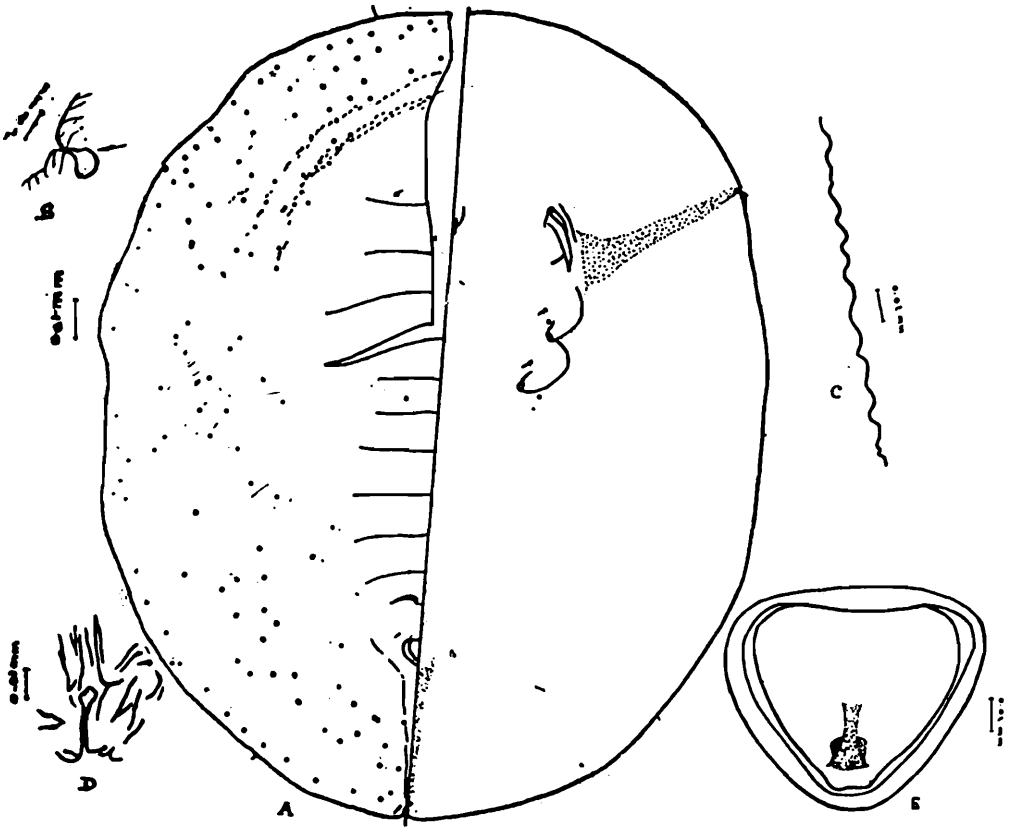
Ventral surface.—Ventral abdominal setae 22-25 long, 58-61 apart. A seta of 22 long at base of meso- and meta-thoracic legs evident.

Host.—*Syzigium jambolanum* (Singh, 1931); *Eugenia* sp.

Material examined.—Eleven pupal cases mounted, on *Eugenia* sp., Saklaspur (Karnataka), 31-3-1969, B. V David.

31





32

Text-figs. 31-32. (31) *Dialeurodes distinctus* sp. n. A Pupal case, B. Vasiform orifice (32) *Dialeurodes indicus* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Margin, D. Caudal tracheal pore, E. Vasiform Orifice.

39. **Dialeurodes indicus** sp. n.

(Text-fig. 32)

Pupal case.—Pale white, oval; 2.02-2.09 mm long, 1.59-1.76 mm wide. Found on the lower surface of leaves.

Margin.—Broadly crenulate with rounded teeth, 13-14 in 0.1 mm. Paired anterior and posterior marginal setae 19 long on tubercles. Thoracic and caudal tracheal pores quite distinct, invaginated, more or less closed, without any teeth-like projections.

Dorsal surface.—Paired setae on cephalic region and on the eighth abdominal segment cephalad of base of vasiform orifice very minute; setae on the first abdominal segment absent; caudal setae minute on either side of caudal pore. Thoracic tracheal furrow not discernible; caudal furrow with reticulate markings. Dorsum and submarginal area with papillae like pores and porettes found scattered all over excepting the submedial part of cephalothorax and abdomen; a pair of pores on the median area of abdominal segments 1-6. A narrow transparent area demarcating submarginal area and dorsum in cephalothorax. Transverse moulting suture short. Abdominal segments distinct. Pockets well developed but not continguous.

Vasiform orifice small, subcordate, wider than long, 63 × 55; lateral walls of orifice lacking ridges or tubercles. Operculum similar shaped but caudad narrowed and transverse; wider than long, 52 × 41; filling the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 25 long, 55 apart; cephalad of base of orifice. All four pairs of spiracles visible. Antenna extends to base of mesothoracic leg. A seta at base of each of meso- and metathoracic legs distinct. Thoracic and caudal tracheal folds with minute tubercles.

Host.—*Syzigium jambolanum.*

Holotype.—One pupal case mounted, on *Syzigium jambolanum*, Coimbatore, 8-10-1967, B. V David.

Paratypes.—Pupal cases on leaves in collection; mounted specimens deposited in the collections of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington, the British Museum (Natural History), London and the Zoological Survey of India, Calcutta.

This species in general appearance resembles *Dialeurodes pallida* Singh, but differs in size, in both thoracic and caudal tracheal folds being tuberculate and in the absence of subdorsal spines.

40. **Dialeurodes ixorae**, Singh, 1931.

(Plate III; Text-fig. 33)

Dialeurodes ixorae Singh, 1931, *Mem. Dept. Agric. India, Ent. Ser.*, **12**(1): 38.

The following notes are added to the description of the species by Singh.

Pupal case.—Oval, anterior part slightly narrowing with constrictions at thoracic and caudal tracheal pores. Length 1.05 mm; width 0.87 mm at the broadest point at the level of the third abdominal segment.

Margin.—Paired anterior and posterior marginal setae 18-26 long; 12 pairs of marginal setae 23-26 long-five pairs cephalad of thoracic tracheal pores and seven pairs caudad of it.-

Dorsal surface.—Three pairs of dorsal setae—cephalic setae 31 long, first abdominal setae 42 long and eighth abdominal setae laterad of vasiform orifice 26 long. A row of minute papillae-like wax pores evident on periphery of dorsal disc on each side which is very characteristic of the species. Caudal setae submarginal, 26 long.

Vasiform orifice oval, 41 long, 39 wide; operculum 25 wide and 22 long with cephalic margin transverse.

Ventral surface.—Ventral abdominal setae laterad of base of vasiform orifice, 10 long, 42 apart. All the four pairs of spiracles visible. Antenna with its finger-like terminal and slightly protruding beyond base of fore leg. Thoracic and anal tracheal folds distinct, dotted and terminating in small invaginated pores on margin. Meso- and metathoracic legs each with a small seta at base of leg. Venter reticulated.

Host.—*Ixora coccinea* (Singh, 1931) and *Mimusops hexandra* (Rao, 1958).

Distribution.—Madras (Tamil Nadu) (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958).

Material examined.—Fortyfour specimens mounted, on an unidentified shrub, Kayarambedu (Madras), 6-3-1971, B. V David. Numerous cases on leaves of *Ixora* sp., Thanjavur, 1-6-1969, B. V David; on *Ixora coccinea*, Madras, 4-1-1970, B. V David.

The upper surface of leaves of the unidentified shrub with *D. ixorae* are invariably infested with *Rhachhispora trilobitoidea* (Quaintance and Baker) along the midrib and veins in rows.

41. **Dialeurodes kirkaldyi** (Kotinsky), 1907
(Plate II)

1907. *Aleyrodes kirkaldyi* Kotinsky, *Bd. Comm. Agric. and Forestry, Div. Ent., Hawaii, Bull.*, **2**: 95.
1914. *Dialeurodes kirkaldyi* (Kotinsky), Quaintance and Baker, *U. S. Dept. Agric., Bur. Ent., Tech. Ser.* **27(2)**: 98; 1917, *Proc. U.S. natn. Mus.***5 1**: 416.
1934. *Dialeurodes kirkaldyi* (Kotinsky), Priesner and Hosny, *Ministry of Agric., Egypt. Tech. and Sci. Service, Ent. Sect., Bull. No.* **139**: 2.

This species, well known as a serious pest of jasmine the world over, is also found in South India causing serious damage to this flowering shrub.

The following additional notes are provided to the description of the species by Quaintance and Baker.

Dorsal surface.—A few minute pores scattered on dorsal disc.

Ventral surface.—Ventral abdominal setae 14 long, 28 apart. Antenna slender, finger-like tip extending slightly beyond base of foreleg; a minute seta at base of meso- and metathoracic legs. All the four pairs of spiracles visible.

Host.—*Jasminum auriculatum* (David, 1958).

Distribution.—Coimbatore (David, 1958) and throughout Tamil Nadtu.

Material examined.—Fourteen pupal cases mounted, on jasmine, Coimbatore, 11-11-1966, B. V David; three pupal cases mounted, on jasmine, Neyveli, 22-1-1967, B. V David. Numerous pupal cases on leaves in collection.

Key to Indian Species of **Dialeurodes**

1. Pupal case bluish black or jet black.. . .. 2
   Pupal case not bluish black or jet black.. 3
2. Pupal case bluish black; dorsum with clear transparent dots, subdorsum with 9 pairs of spines; tracheal pore with 14-16 rounded teeth; thoracic and caudal tracheal folds spinulose. .. *.eugeniae* (Maskell)
   Pupal case jet black; dorsum reticulately sculptured; thoracic tracheal pores minute, circular, rimmed.. *.rotunda* Singh*
3. Margin of pupal case toothed. .. 4
   Margin of pupal case crenulate or entire.. 5
4. Pupal case pale white; thoracic folds terminating on margin in shallow concavities; operculum roundly sub-cordate with its distal end setose projecting a short distance beyond the edge of orifice; anal tracheal fold tuberculate ending in an indentation.. . ... *.fletcheri* Singh*
   Pupal case pale brown; thoracic and caudal tracheal pores distinct; slightly invaginated, more or less closed; a distinct narrow transparent patch on cephalothorax demarcating subdorsum and dorsum; operculum trapezoidal obscuring lingula. .. ..*.distinctus* sp. n.
5. Margin with 12 pairs of setae (excluding usual 2 pairs). 6
   Margin with only 2 pairs of usual setae. 7
6. Pupal case with thick bands of white waxy fluff; dorsum with a single row of minute papillae-like pores. *.ixorae* Singh
   Pupal case free from waxy exudation except a short filament from each af tracheal pores; dorsum with a group of closely set papillae like structures. .... .. *.dissimilis* Quaintance & Baker
7. Tracheal folds tuberculate or dotted or with semicircular markings.. 10
   Tracheal folds not showing the above. 8
8. Dorsal disc without rounded papillae. 9
   Dorsal disc with rounded papillae; 14 pairs of subdorsal capitate setae of which 7 pairs on abdominal region.. .. *.cardamomi* sp. n.
9. Dorsal disc with wavy markings; 14 pairs of subdorsal setae of which 6 pairs on abdomen. .....*.bassiae* sp. n.
   Dorsal disc with somewhat crescentic suture-like chitinous markings; setae on subdorsum, cephalic region and first abdominal segment wanting. *.vulgaris* Singh*
10. Either thoracic tracheal folds only dotted or caudal tracheal fold only with semicircular markings.. 11
    Thoracic and caudal tracheal folds dotted.. . .. 12
11. Thoracic tracheal folds only dotted; dorsal disc without circular pores; subdorsal setae 14 pairs; inner aspect of each leg with a thick pointed spine. *armatus* sp. n.

Caudal tracheal fold only with semicircular markings; dorsal disc with a series of circular pores; subdorsal setae 6 pairs; inner aspect of legs without thick spines..... .. ..*pallida* Singh*

12. Operculum filling the orifice obscuring the lingula.. 13

Operculum filling three-fourth orifice leaving swollen tip of lingula exposed; 8 pairs of sublateral short spines and a pair of submedial aggregations of small wax pores on dorsum. .*glomerata* Singh*

13. Dorsal disc without prominent papillae-like pores; caudal margin of orifice with well-defined fimbriae or teeth. .. 14

Dorsal disc with prominent papillae like pores; first abdominal setae absent; caudal end of orifice lacking fimbriae or teeth. .*indicus* sp. n.

14. Vasiform orifice cordate, somewhat rounded; operculum similarly shaped but indented on lateral margins; caudal margin of orifice with 16-18 well-defined fimbriae or teeth. .. ..*kirkaldyi* (Kotinsky)

Vasiform orifice almost circular; operculum semicircular; caudal margin of orifice with short acute irregular teeth. .*citri* (Ashmead)*

XIII. Genus **Dialeurolonga** Dozier

Type species.—*Dialeurodes* (*Dialeurolonga*) *elongata* Dozier, 1928, *J. agric. Res.* **36**: 1001-1005.

Takahashi (1951) redefined the genus although not all the species included are closely related. The important characters by which it is separated from *Dialeurodes* are: seventh abdominal segment shorter than the sixth; vasiform orifice subcordate, usually large; lingula knobbed; submargin with a series of pores or papillae.

42. **Dialeurolonga elongata** Dozier, 1928

1928. *Dialeurodes* (*Dialeurolonga*) *elongata* Dozier, *J. agric. Res.* **36**: 1001-1005.
1931. *Dialeurodes elongata* Dozier, Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 36.
1952. *Dialeurolonga elongata* (Dozier), Takahashi and Mamet, *Mem. Inst. scient, Madagascar*, **6A**(2): 354.

The redescription of the species provided by Singh (1931) appears to be adequate.

Host.—*Citrus* sp., *Ixora coccinea*, *I. parviflora* and *Litchi chinensis* (Singh 1931), *Murraya exotica* (new host record)

Material examined.—Three pupal cases mounted, on *Ixora coccinea*, Madras, 22-7-1971, B. V David; two pupal cases mounted, on *Murraya exotica*, Madras, 22-7-1971, B. V David.

43. **Dialeurolonga fici** sp. n.

(Plate III; Text-fig. 34)

Pupal case.—Pale white without any waxy secretion; oval; 1.31-1.43 mm long, 1.11-1.25 mm wide; found in groups on the undersurface of leaves.

Margin.—Margin finely crenulate, 27-28 crenulations in 0.1 mm. Anterior and posterior marginal setae 22-25 long. Caudal setae small,

5 long, on either side of caudal end. Slightly indented at caudal tracheal end; thoracic and caudal tracheal pores wanting but represented by about six minute teeth.

Dorsal surface.—The paired dorsal setae are minute, the cephalic setae 14 long, the first abdominal setae 8-11 long, and the eighth abdominal setae laterad of base of vasiform orifice 8 long. Thoracic tracheal furrow not discernible; caudal tracheal furrow evident, narrow and long. Transverse moulting suture runs posteriorly and bends to anterior extending upto the submargin. Abdominal segments distinct, seventh abdominal segment shorter than the sixth; pockets not developed well. Submargin with striations running mesad from margin and with a row of minute pores.

Vasiform orifice more or less subcircular, 25 long and 30 wide. Operculum trapezoidal with lateral sides rounded, 14 long and 25 wide. Lingula setose with tip expanded and rounded caudad, long terminal setae wanting, exposed and included or slightly protruded beyond posterior margin of orifice.

Ventral surface.—Ventral abdominal setae laterad of base of vasiform orifice, 17 long, 39 apart. All the four pairs of spiracles visible. Antenna does not extend beyond foreleg. A seta at base of each of meso- and metathoracic legs and a pair of setae at base of rostrum present. Thoracic tracheal folds and caudal tracheal fold minutely tuberculate, the latter 223 long from posterior end of orifice to caudal end.

Host.—Ficus religiosa.

Holotype.—One pupal case on slide, Madras, on *Ficus religiosa*, 3-8-1971, B. V David.

Paratypes.—Twenty four pupal cases on slides bearing same details and pupal cases on leaves in collection. [Deposited in the collections of the B.M., London and the Z.S.I., Calcutta.]

This species in general appearance resembles *Dialeurolonga ambilaensis* Takahashi but differs in having a row of minute pores on submargin and in the structural details of vasiform orifice.

Key to Indian Species of **Dialeurolonga**

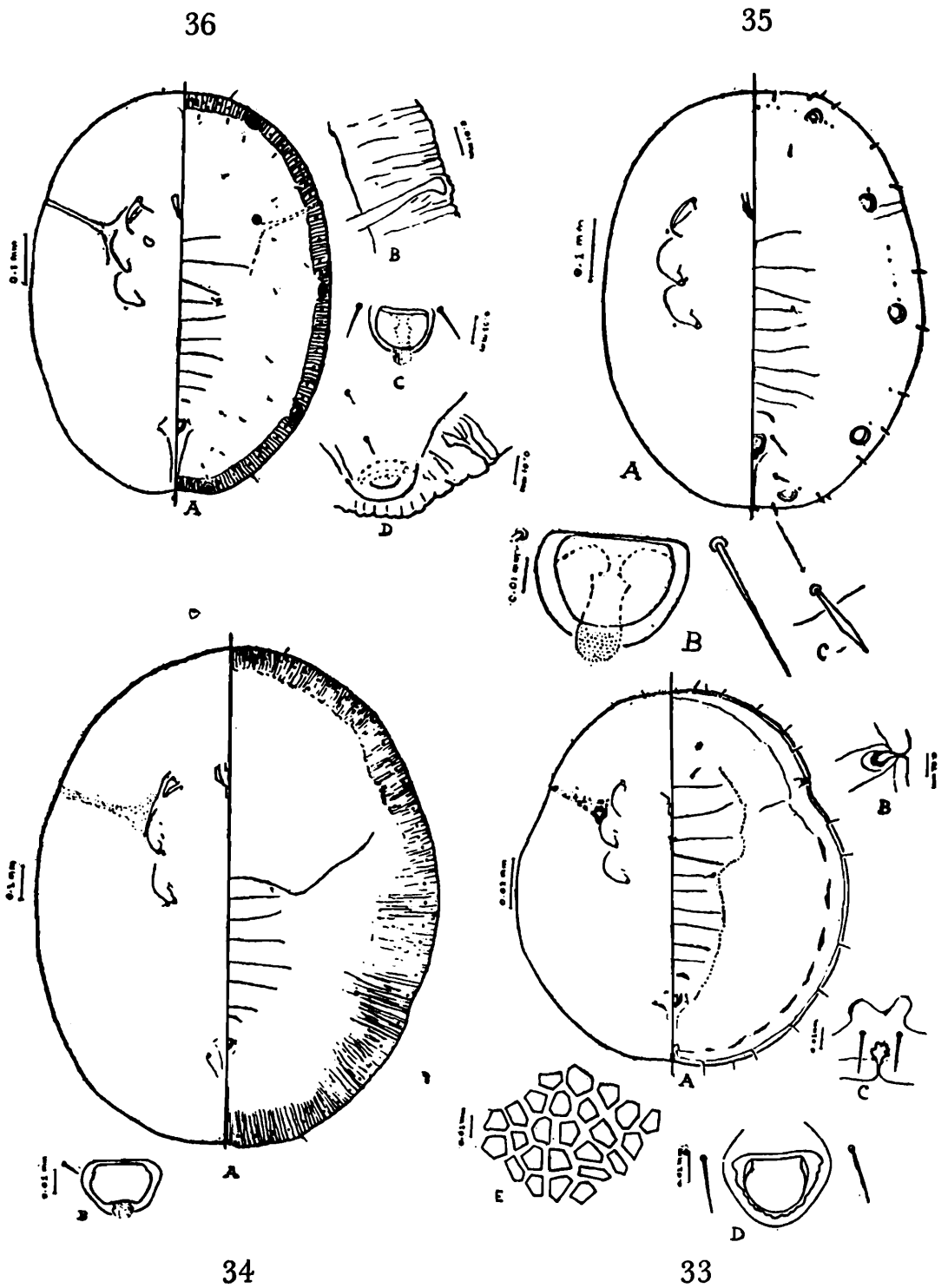
1. Pupal case elongately subelliptical; submargin with a row of conical papillae; cephalad of orifice a median large pore with a thickly chitinised rim evident *elongata* (Dozier)

   Pupal case oval; submargin with a row of pores; median posts cephalad of orifice wanting. ...*fici* sp. n.

XIV Genus **Dialeuropora** Quaintance and Baker, 1917

Type species: Dialeurodes (Dialeurobora) decempuncta Quaintance and Baker, 1917. *Proc. U. S. natn. Mus.*, **51**: 434.

Pupal case elliptic and medium-sized; margin crenulate; submargin with a ring of large simple pores. Thoracic tracheal folds and pores, and anal fold and pore evident. Vasiform orifice subcordate. Operculum subcordate nearly filling orifice. Lingula setose, concealed or exposed.



Text-figs. 33-36. (33) *Dialeurodes ixorae* A. Pupal case, B. Thoracic tracheal pore, C. caudal tracheal pore, D. Vasiform orifice, E. Reticulated ventral surface; (34) *Dialeurolonga fici* sp.n. A Pupal case B. Vasiform orifice. (35) *Dialeuropora decempuncta* A. Pupal case B. Vasiform orifice, C. Spearhead seta; (36) *Dialeuropora pterolobiae* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, D. Circular pore.

44. **Dialeuropora decempuncta** (Quaintance and Baker), 1917

(Text-fig. 35)

1917. *Dialeurodes* (*Dialeuropora*) *decempuncta* Quaintance and Baker, *Proc. U.S. Nat. Mus.*, **51**: 434 (subgenus).

1934. *Dialeuropora decempuncta* (Quaintance and Baker) Takahashi, *Rept. Dept. Agric., Formosa* **63**: 46.

Pupal case.—Lemon yellow, lying in a fluffy mass of iridescent blue glassy waxen filaments; empty case transparent, oval; 0.93 mm long, 0.68 mm wide; found on the undersurface of leaves.

Margin.—Irregularly crenulate. Paired anterior and posterior marginal setae 21-23 long. Thoracic tracheal pores indistinct.

Dorsal surface.—Four pairs of pointed setae evident; cephalic setae 21 long, first abdominal setae 13 long, eighth abdominal setae laterad base of vasiform orifice 44 long, and caudal setae cephalad of the caudal submarginal circular pores 23 long. Transverse moulting suture not reaching margin of dorsal disc; abdominal segments fairly distinct. Submargin with 12 pairs of spearhead-like setae—five anterior to thoracic fold and seven posterior to it on each side, 29 long, and with five pairs of large circular pores—the first anterior pair just below the second and third submarginal spines, the second pair immediately anterior to thoracic tracheal folds, the third pair opposite the transverse suture, the fourth pair opposite the eighth abdominal segment, and the fifth pair cephalad of the last submarginal spine. A row of minute pores in between the large circular pores in the dorsum evident.

Vasiform orifice subsemi-elliptical with the cephalic margin practically straight, 39 long and 50 wide. Operculum similarly shaped, 29 long and 42 wide, nearly fills the orifice. Lingula subcylindrical, constricted near base, 23 long, caudal end setose, protruding a short distance caudad of orifice.

Ventral surface.—Smooth. Spiracles not evident. Ventral abdominal setae 21 long, 44 apart. Setae at base of legs absent.

Host plants.—*Anona squamosa*, *Dalbergia sissoo*, *Ficus religiosa*, *Morus* sp. (Mulberry), *Prunus* sp., *Streblus asper* (Singh, 1931); *Anona cherinoya*, *Avocado*, *Cordia myxa*, *Euphorbia pilulifera*, pear, *Rosa* sp. (Rao, 1958); *Anona reticulata*, *Polyalthia longifolia* and *P. pendula* (new host records).

Distribution.—Pusa (Bihar), Lucknow (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958); throughout Tamil Nadu.

Material examined.—Five pupal cases, on *Anona reticulata*, Coimbatore, 27-4-1967, B. V David; three pupal cases, on *Polyalthia pendula*, Coimbatore, 5-4-1967, B. V David; one pupal case, on *Polyalthia longifolia*, Coimbatore, 12-11-1966, B. V David; and two pupal cases, on *Rosa* sp. (Rose), Madurai, 27-5-1969, B. V David; five pupal cases, on *Streblus asper*, Madras, 19-7-1971, B. V David; seven pupal cases, on *Cordia myxa*, Madras, 19-7-1971, B. V David; two pupal cases on *Avocado*, Coimbatore, 14-8-1971, B. V David.

45. **Dialeuropora pterolobiae** sp. n.

(Text-fig. 36)

Pupal case.—Lemon yellow but empty case transparent, oval, 1.15 mm long and 0.86 mm wide; lying in a fluffy mass of iridescent blue glassy waxen filaments, found on the undersurface of leaflets of the host plant.

Margin.—Margin with minute irregular crenulations; paired anterior and posterior marginal setae 18-39 long. Thoracic tracheal pores indistinct but margin indicated by about four teeth-like prolongations.

Dorsal surface.—Dorsum with three pairs of setae—a pair of cephalic setae, 13 long; a pair of first abdominal setae, 16 long; and a pair of setae on eighth abdominal segment cephalad of vasiform orifice, 13 long. Sixteen pairs of setae, 5-8 long, on subdorsum—six anterior to thoracic fold and the remaining posterior to it (including the one cephalad of caudal submarginal pores, 10 long. Transverse suture not reaching margin of dorsal disc. Segmentation and dermic pockets distinct. A small circular pore (18 diameter) in the subdorsum on prothorax distinct. Four more larger circular pores evident on submarginal area —a pair of anterior cephalic circular pores (31 × 36), a pair (31 × 31) opposite the transverse suture, a pair (31 × 34) opposite the eighth abdominal segment and a pair (28 × 31) near the caudal end. Submarginal ridges well defined, dense corresponding to each tooth. A submarginal series of pores present.

Vasiform orifice subcordate or subcircular and transverse cephalad; length 36, breadth 42. Operculum similarly shaped, nearly fills the orifice and 29 × 34. The setose lingula exposed and protrudes beyond the orifice. Caudal furrow indistinct.

Host plant.—*Pterolobium indicum.*

Holotype.—One pupal case mounted, Kallar (The Nilgiris), on *Pterolobium indicum*, 4-9-1966, B. V David.

Paratypes.—Four pupal cases mounted bearing the same details. [Deposited in the collections of the Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington, B.M., London and the Z.S.I., Calcutta.]

Some pupal cases on leaves of *Pterolobium indicum.* Marudamalai (Coimbatore), 22-10-1966, B. V David.

This species is quite distinct in possessing four sub-marginal circular pores and is easily recognised from the only other known species in India *Dialeuropora decempuncta* (Quaintance and Baker) which has five submarginal circular pores and submarginal spearhead-like setae. This species closely resembles *Dialeuropora cogniauxiae* Cohic in the arrangement of the five circular pores but differs considerably in the structural details of the vasiform orifice and in not possessing the minute setae on the subdorsum.

Key to Indian Species of **Dialeuropora**

1. Submargin with 5 pairs of large circular pores and 12 pairs of spearhead-like setae .. .. *decempuncta* Quaintance and Baker

   Submargin with 4 pairs of large circular pores and a smaller circular pore in the subdorsum on prothorax; dorsum with 16 pairs of minute setae in addition to usual 3 pairs of dorsal setae.. . . . . *pterolobiae* sp. n.

XV. Genus **Indoaleyrodes** n.

Pupal case.—Oval or subcircular, slightly constricted at thoracic and caudal tracheal pore areas, pores invaginated and inset; tracheal furrows reticulate for short distance; thoracic tracheal folds with minute tubercles. Margin smooth; marginal setae, cephalic setae, first abdominal setae, eighth abdominal setae laterad of vasiform orifice and caudal setae very small; transverse moulting suture not reaching margin; abdominal segment seven much shorter than six and eight. Vasiform orfice longer than wide, subtriangular, rounded apically; operculum semicircular; lingula with lateral knob on either side at base without terminal paired setae, exposed, included.

Type of the genus.—*Indoaleyrodes pustulatus* gen. et sp. n.

Indoaleyrodes pustulatus appears to be quite close to *Parabemisia reticulata* Dumbleton reported from New Caledonia. This species differs considerably in many structural details from the genera *Parabemisia* Takahashi and *Dialeurodes* Cockerell and a new genus is defined here for accommodating it. This genus is readily recognised from *Parabemisia* in not possessing a single row of teeth with a row of fine setae just behind base of teeth, and in the presence of well defined caudal furrow though closely resembling it in the structural details of vasiform orifice. It resembles *Dialeurodes* in the presence of tracheal pores but differs considerably in the structural details of dorsum and vasiform orifice.

46. **Indoaleyrodes pustulatus** sp. n.
(Plate II; Text-fig. 37)

Pupal case.—Case pale brown or white, subcircular, flat, constricted at thoracic and caudal pore areas, invaginated, pores deeply set in submargin, open and not closed; 1.46 mm long, 1.31 mm wide; occurs in small pits on the undersurface of leaves of *Morinda tinctoria* which results in formation of pustule-like eruptions on the upper surface of leaves.

Margin.—Smooth but with narrow short ridges immediately mesaid of margin. Anterior and posterior marginal setae 10-13 long. Thoracic tracheal cleft distinct, invaginated ending in a pore with about nine irregular teeth-like projections. Caudal cleft invaginated, pore indistinct with irregular teeth-like projections.

Dorsal surface.—Minute paired setae on cephalic region and first abdominal segment and a pair of small setae (13) on the eighth abdominal segment laterad of base of orifice. A pair of very small caudal setae on either side of tracheal pore, 5 long. Transverse moulting suture not reaching margin, short but reaches outer margin of legs. Thoracic tracheal furrows that follow the pores immediately are hexagonally reticulate. Caudal furrow immediately after pore reticulate for a short distance (70), continues into a narrow fold (161 long) till the apex of vasiform orifice. Abdominal segment seven much shorter than segment six; pockets distinct and not contiguous.

Vasiform orifice longer than wide; 104 long, 72 wide; subtri angular but rounded apically, floor with subparallel transverse ridges.

Operculum sub-semicircular, wider, length 42, width 60. Lingula with lateral knob at base on each side, exposed, included, terminal setae wanting.

Ventral surface.—Ventral abdominal setae 25 long, 80 apart. Anterior and posterior abdominal spiracles evident. Thoracic and caudal tracheal folds with minute tubercles. Setae at base of legs absent. A pair of small setae anterior to rostrum evident.

Host plant.—Morinda tinctoria.

Holotype.—One pupal case, on *Morinda tinctoria,* Coimbatore, 25-3-1967, B. V David.

Paratypes.—11 pupal cases mounted bearing the same details.

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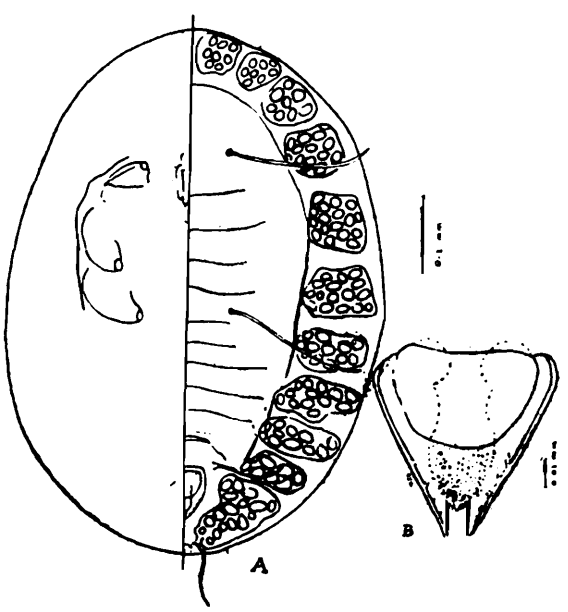

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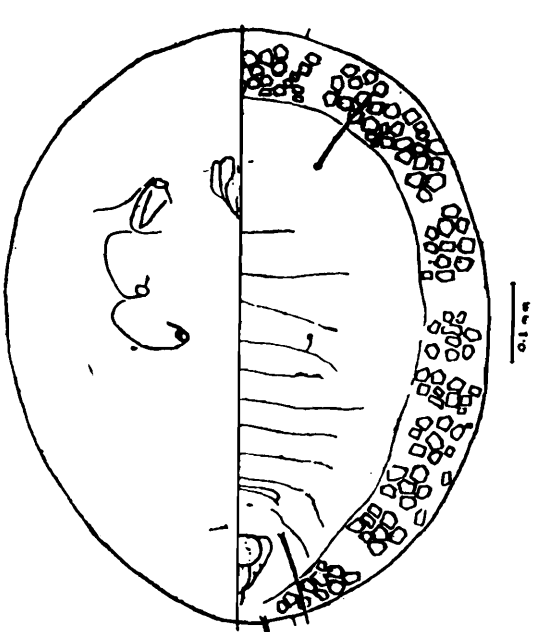

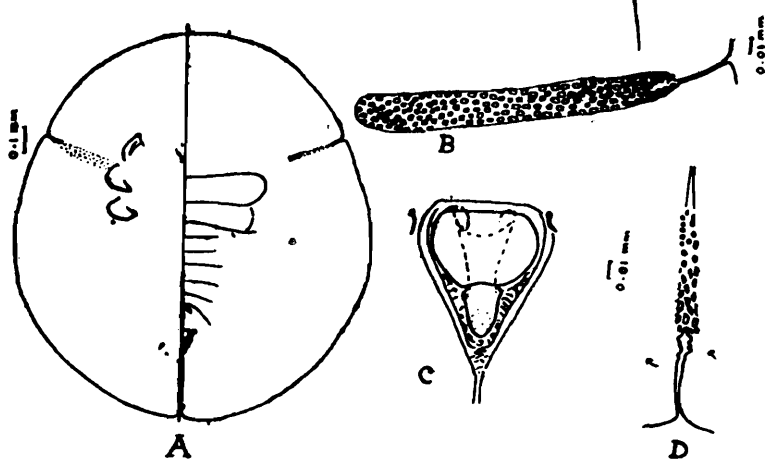

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Text-figs. 37-39. (37) *Indoaleyrodes pustulatus* gen. *et* sp. n. A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice, D. Caudal tracheal pore; (38) *Lipaleyrodes crossandrae* sp. n. A. Pupal case, B. Vasiform orifice; (39) Pupal case of *Lipaleyrodes euphorbiae* sp. n.

Numerous cases on leaves in collection. Pupal cases on leaves in the collections of Systematic Entomology Laboratory, Entomology Research Division, United States Department of Agriculture, Washington and the British Museum (Natural History), London, Mounted specimen deposited in the collection of the Z.S.I., Calcutta.

XVI. Genus **Lipaleyrodes** Takahashi, 1962

Type species.—Lipaleyrodes phyllanthi Takahashi, 1962, *Proc. R. ent. Soc. Lond.* (**B**) **31**(7-8): 100.

Pupal case with submarginal area distinctly defined from dorsal disc; abdominal segment seven much shortened medially; submargin broad with wax plates in large clusters arranged in a row; marginal teeth, submarginal ridges and furrows, and tracheal pores, or combs wanting; vasiform orifice large, subcordate; operculum occupying over half length of orifice; lingula knobbed, etose.

47. **Lipaleyrodes crossandrae** sp. n.

(Plate II; Text-fig. 38)

Pupal case.—Found in groups on the undersurface of leaves in dense white fluff of fleecy curled filaments of wax. Oval in shape. Length 0.58-0.72 mm. Width 0.41-0.50 mm.

Margin.—Margin finely crenulate. Paired anterior and posterior marginal setae 11-22 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—Three pairs of long dorsal setae are quite characteristic—the cephalic setae 127 long, the first abdominal setae 146-160 long and the eighth abdominal setae laterad to base of vasiform orifice 88 long. The caudal setae submarginal in position 80 long. Transverse moulting suture short. Abdominal segments distinct, seventh abdominal segment medially shortened. Dorsal disc separated from submargin by a distinct line. Submargin broad with 11 pairs of clusters of wax plates, each cluster consisting of 8-17 irregularly oval wax plates. Thoracic and caudal furrows absent.

Vasiform orifice bluntly pointed at caudal end, a little broader than long (52×47) with lateral ridges. Operculum wider than long (39×28). Lingula large, more or less club-shaped, setose, exposed, bearing a pair of long setae subapically, included.

Ventral surface.—A pair of ventral abdominal setae 36 long, 28 apart. Setae at base of legs and rostrum wanting. Antenna not extending beyond fore leg. Prothoracic, mesothoracic and posterior abdominal spiracles visible. Thoracic and caudal tracheal folds absent.

Host.—Achyranthes aspera and *Crossandra undulaefolia.*

Holotype.—One pupal case mounted, on *Crossandra undulaefolia*, Coimbatore, 15-11-1966, B. V David.

Paratypes.—Thirteen pupal cases mounted, bearing the same details as that of Holotype. Nineteen pupal cases mounted, on *Achyranthes aspera*, Coimbatore, 18-11-1966, B. V David. [Deposited in the collections of the Entomology Research Division, U.S.D.A., Washington and the B.M., London].

This species is easily separated from *L. euphorbiae* sp. nov. by the long setae on first abdominal segment and the irregularly oval submarginal wax plates.

48. **Lipaleyrodes euphorbiae** sp. n.

(Text-fig. 39)

Pupal case.—Pupal cases found in groups on the undersurface of leaves and to a limited extent on the upper surface also in dense white fluff of fleecy curled filaments of wax. Case white, becomes transparent on clearing. Oval in shape. Length 0.78 mm. Width 0.60 mm.

Margin.—Margin finely crenulate. Paired anterior and posterior marginal setae, 5-11 long. Thoracic and caudal tracheal pores or combs absent.

Dorsal surface.—Three pairs of dorsal setae present; the cephalic setae 74 long, the first abdominal setae minute 11 long and the eighth abdominal setae laterad of base of vasiform orifice 80 long. Caudal setae at hind end of body, 80 long. Transverse moulting suture extends upto subdorsum; abdominal segments distinct. Seventh abdominal segment medially shortened; pockets well developed and contiguous; eighth segment much longer than sixth. Dorsal disc separated from submargin by a distinct line. Submargin broad with a series of wax plates in clusters of about 11 pairs, each cluster consisting of 5 to 16 polygonal wax plates. Thoracic and caudal tracheal furrows absent.

Vasiform orifice bluntly pointed at caudal end, a little wider than long; width 61 and length 58; lateral ridges indistinct. Operculum wider than long, 47×30. Lingula large, more or less club-shaped, exposed, bearing a pair of long setae subapically; included but sometimes extended beyond the posterior margin of the orifice.

Ventral surface.—A pair of ventral abdominal setae cephalad of base of vasiform orifice 8 long, 25 apart. A minute pair of setae at basd of rostrum present. Setae at base of legs wanting. Antenna not extending beyond fore leg. Anterior and posterior abdominal spiracles visible. Thoracic and caudal tracheal folds absent.

Host.—Euphorbia prostrata

Holotype.—One pupal case mounted, on *Euphorbia prostrata*, Madurai, 28-1-1967, B. V David.

Paratypes.—Seventeen pupal cases mounted, bearing the same details. [Deposited in the collections of the Entomology Research Division, U.S.D.A., Washington, and the B.M., London].

This species is easily distinguished from other known species of *Lipaleyrodes* in the presence of small setae on first abdominal segments and in the arrangement of polygonal submarginal wax plates.

Key to Indian Species of **Lipaleyrodes**

1. Setae on first abdominal segment wanting; each submarginal cluster with 4 or 5 wax plates in close apposition. ..... *.breyniae* (Singh)*

   Setae on first abdominal segment present; each submarginal cluster with 5-17 wax plates.. 2

2. Setae on first abdominal segment very short; wax plates polygonal in shape, numbering 5-16 in each cluster.. ..... *.euphorbiae* sp. n.

   Setae on first abdominal segment very long; wax plates irregularly oval numbering 8-17 in each cluster.. ..... *.crossandrae* sp. n.

XVII. Genus **Neomaskellia** Quaintance and Baker, 1913

Type species.—*Aleyrodes comata* Maskell, 1896.

The quite distinctive feature of the species included in this genus is possession of transversely oval vasiform orifice with a very short operculum exposing a broader than long lingula.

49. **Neomaskellia bergii** (Signoret, 1868)
(Plate II)

1867. *Aleyrodes bergii* Signoret, *Soc. Ent. France, Ann.* **IV**, 8: 395.
1914. *Neomaskellia bergii* (Signoret), Quaintance and Baker, *U.S. Dept. Agric., Bur. Ent., Tech. Ser.* **27**(2): 104.

A well known pest of sugarcane in the tropics from Mauritius to the Pacific, this species is the most widely spread one in India.

Hosts.—Sugarcane (*Saccharum officinarum*), *Sorghum vulgare* (Singh, 1931), *Cenchrus ciliaris* and *Setaria italica* (new hosts).

Distribution.—Throughout India.

Material examined.—Seven pupal cases, on *Cenchrus ciliaris*, Coimbatore, 14-7-1960, B. V David; five pupal cases, on *Setaria italica*, Tudiyalur (Coimbatore), 27-8-1967, V T Sundaramurthy; fifteen pupal cases, on sugarcane, Cuddalore, 12-9-1967, G. Varadarajan; twenty-seven pupal cases, on *Sorghum vulgare*, Coimbatore, 7-2-1970, B.V David.

XVIII. Genus **Neopealius** Takahashi

Type species.—*Neopealius rubi* Takahashi, 1954, *Insecta Matsumurana*, **18**(3-4): 50-52.

Pupal case elliptic; marginal teeth short and rounded; tubercles, papillae and rhachis on dorsum lacking; submarginal area not defined from dorsal disc; tracheal folds or pores or clefts wanting, combs not well differentiated; seventh abdominal segment much shorter than the sixth; vasiform orifice much longer than wide, rounded at posterior end, not elevated; lingula setose, knobbed, exposed, included.

50. **Neopealius nilgiriensis** sp. n.
(Text-fig. 40)

Pupal case.—Pale brown, oval, with slight waxy secretion from margin; 0.66-0.78 mm long, 0.40-0.46 mm wide. Occurs on both surfaces of leaf.

Margin.—A row of rounded marginal teeth irregular in width, 21-22 teeth in 0.1 mm. Paired anterior and posterior marginal setae 8-21 long. Thoracic ends differentiated from the other part of margin in having a few very small rounded teeth. Caudal end not indented but distinct in having about twelve narrow ridges.

Dorsal surface.—Dorsum with three pairs of setae—the cephalic setae 130 long; the first abdominal setae short, 18 long and eighth abdominal setae laterad of base of vasiform orifice 57 long. Submarginal caudal setae on tubercles, 86 long. Dorsum lacking tubercles, papillae and rhachis. Transverse moulting suture bends to anterior slightly but does not extend beyond subdorsum. A pair of submedial depressed markings evident on the first four abdominal segments. Pockets not contiguous. Abdomen widely segmented, suture between second and third segments extends latero-anteriorly at the lateral part; seventh abdominal segment much shorter than the sixth.

Vasiform orifice longer than wide, 63 long and 44 wide; rounded posteriorly, lateral walls ridged. Operculum transverse cephalad, narrowed and rounded caudad, wider than long (30 × 25) occupying more than half the orifice. Lingula setose, knobbed, a pair of small setae subapically, exposed and included.

Ventral surface.—Ventral abdominal setae 26 long, 36 apart. Anterior and posterior abdominal spiracles visible. Thoracic and caudal tracheal folds and setae at base of legs and rostrum wanting.

Host.—Azalea indica.

Holotype.—One pupal case mounted, on *Azalea indica*, Ootacamund (The Nilgiris), 7000 ft., 3-7-1969, B. V David.

Paratypes.—Twelve pupal cases mounted, bearing the same details. Numerous pupal cases on dry leaves in collection. [Deposited in the collection of the B. M., London and the Z.S.I., Calcutta.]

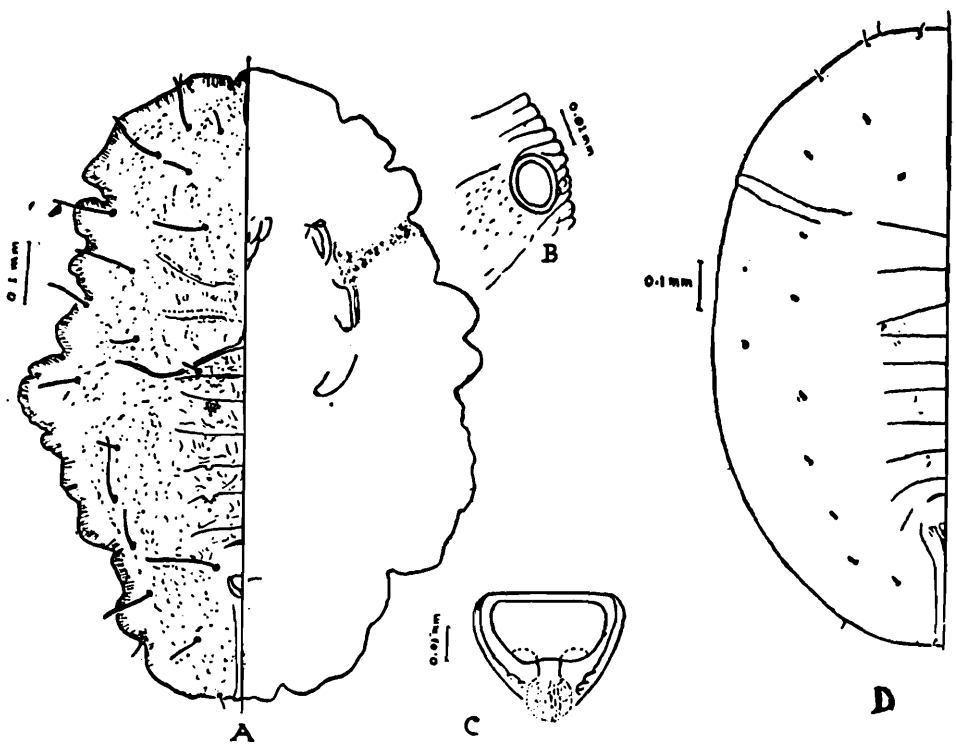
This species is distinct from *Neopealius rubi* Takahashi in the details of vasiform orifice, in not possessing a caudal furrow and in the length of dorsal setae.

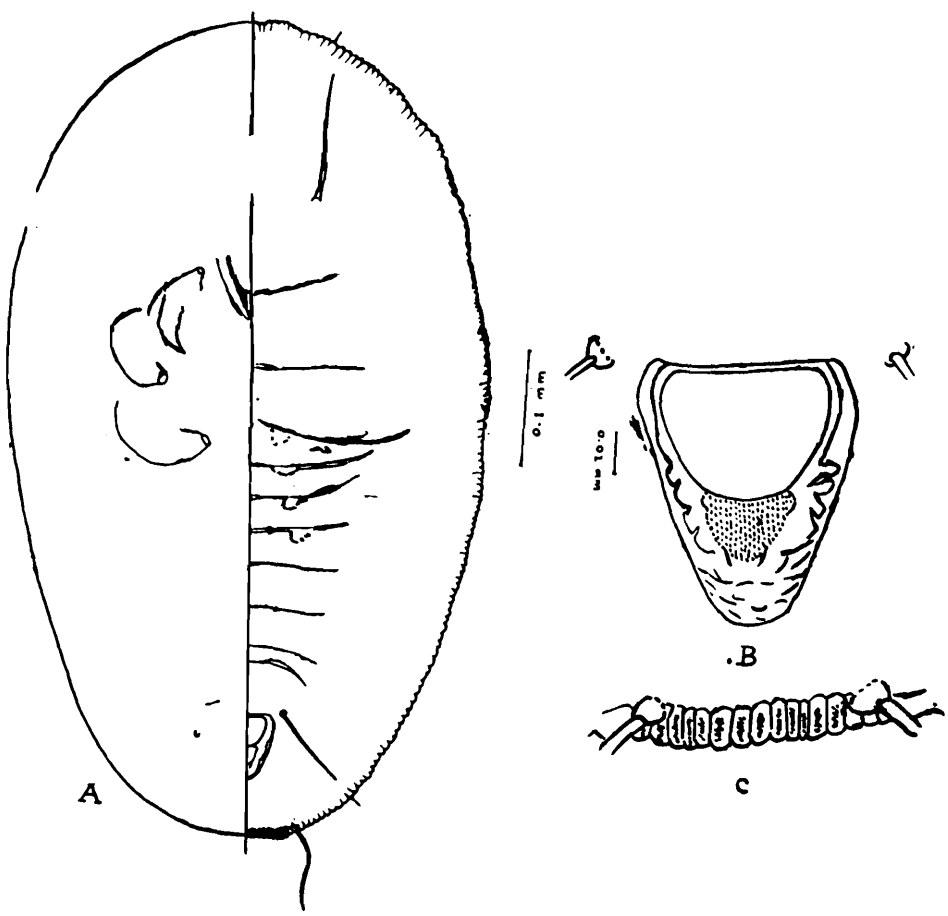
XIX. Genus **Pealius** Quaintance and Baker, 1914

Type species.—Aleyrodes maskelli Bemis, 1904, *Proc. U.S. natn. Mus.*, **27** : 471-537.

Species included in this genus are characterised by the vasiform orifice situated in a ribbed pyriform pit; operculum subrectangular; lingula exposed, usually with a D-shaped tip; thoracic tracheal combs indicated; submargin with a series of setae.

41





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Text-figs. 40-41. (40) *Neopealius nilgiriensis* sp. n. A. Pupal case B. Vasiform orifice, C. Caudal tracheal pore; (41) *Pealius indicus* sp. n. A. Pupal case, B. Thoracic tracheal end, C. Vasiform orifice, D. Pupal case from the upper surface of *Ficus bengalensis* leaf.

51. **Pealius indicus** sp. n.

(Text–fig. 41)

Pupal case.—White without any waxy secretion; oval; 0.68-1.09 mm long, 0.48-0.79 mm wide; occurs on both surfaces of leaf.

Margin.—Smoothly crenulate; pupal case from upper surface of leaf broadly oval with margin smooth; margin deeply indented in pupal case from undersurface of leaf. Thoracic and caudal combs indicated by slightly strengthened marginal crenulations numbering 3 to 5 and 7 to 12 crenulations respectively; an oval pore with a rim evident in some specimens. Paired anterior and posterior marginal setae 14-19 long.

Dorsal surface.—Setae on pupal cases from hairy undersurface of leaf long and of those from glabrous upper surface of leaf short (measurements indicated in brackets). Cephalic setae 72(17) long; first abdominal setae 40 (broken) long; eighth abdominal setae a short distance and cephalad of orifice 99 long (11 long but placed laterad of base of orifice on the elevated sides; submarginal caudal setae at caudal end 58(28) long. In addition, subdorsum with nine pairs of long blunt setae on tubercles, 40-88 long-two pairs on cephalic region, one pair on each of meso- and metathorax and five pairs on abdominal segments four to eight. Subdorsal setae on pupal cases from upper surface of leaf short, spearhead-like or spindle-shaped, 11-22 long. Submarginal setae five pairs—three pairs on cephalic region, a pair on thorax and a pair at anterior part of abdomen; setae 40-53 long; on pupal cases from upper surface of leaf pointed, 22-25 long. Transverse moulting suture extending to submargin; second abdominal suture bends latero-anteriorly; seventh abdominal segment medially shortened. Dorsum tuberculate and pores and porettes distributed all over body. Paired submedian depressed markings on meso- and metathoracic segments and on first six abdominal segments. Thoracic tracheal and caudal furrows indicated.

Vasiform orifice in a pit, subcircular, wider than long (39×28 in pupal case from hairy surface and 39×36 in pupal case from glabrous surface); floor of orifice with ridges. Operculum subrectangular, rounded laterally, wider than long, 28×19 in pupal case from hairy surface and 28×25 in pupl case from glabrous leaf surface. Lingula tip D-shaped, exposed.

Ventral surface.—Ventral abdominal setae cephalad of orifice, 22-25 long, 30 apart. Anterior and posterior abdominal spiracles visible. Antenna not extending beyond fore leg. A pair of minute setae at base of rostrum; setae at base of legs wanting. Thoracic and caudal tracheal folds indicated, tuberculate.

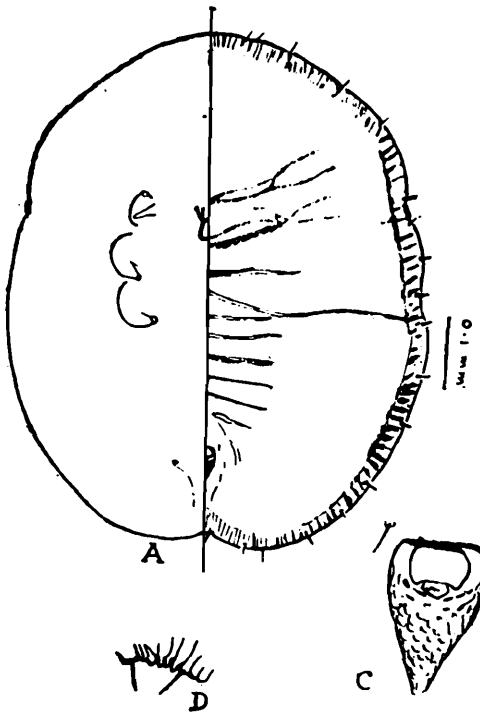
Host.—Ficus bengalensis.

Holotype.—One pupal case mounted, on *Ficus bengalensis*, Coimbatore, 10-4-1967, B. V David.

Paratype.—Fourteen pupal cases mounted, bearing the same details. Pupal cases on leaves in collection.

This species comes close to *Pealius misrae* Singh and *Pealius bengalensis* (Peal) but differs from them considerably in the number and arrangement of submarginal and subdorsal setae, in the tuberculate nature of dorsum and in the structural details of vasiform orifice.

42



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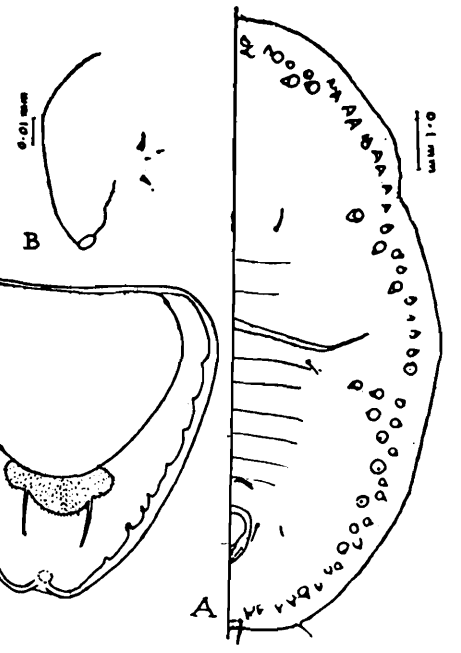
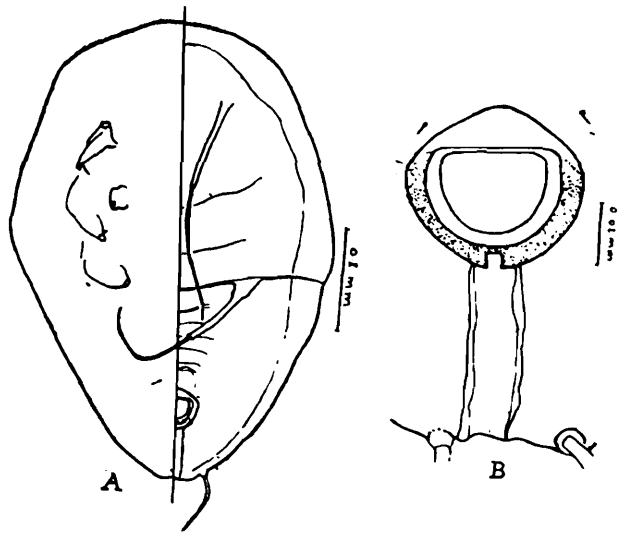




44

Text-figs. 42, 44-45. (42) *Pealius schimae* A. Pupal case, B. Thoracic tracheal comb, C. Vasiform orifice, D. Caudal tracheal end; (44) *Taiwanaleyrodes indicus* A. Pupal case, B. Vasiform orifice; (45) *Trilaleurodes rara* A. Pupal case; B. Mesothoracic leg with conical spines, C. Vasiform orifice.

52. **Pealius schimae** Takahashi

(Text-fig. 42).

1950. *Pealius schimae* Takahashi, *Annotnes zool. Japan*, **23**: 88,

Pupal case.—Pale brownish or pale brownish red, oval, broadest across transverse moulding suture, slightly constricted at thoracic and

caudal tracheal pores; 1.00 mm long, 0.76 mm wide; found on the undersurface of leaves.

Margin.—Irregularly crenulate. A pair of anterior and posterior marginal setae, 13 long, a pair of caudal submarginal setae on either side of caudal tracheal combs, 18 long. Thoracic tracheal combs with six teeth, caudal tracheal comb with four teeth.

Dorsal surface.—Fifteen pairs of submarginal setae, 5 pairs anterior to thoracic tracheal combs and ten pairs posterior to them, 16 to 18 long, evident. A pair of setae laterad of the base of vasiform orifice, 18 long. Setae on cephalic region and first abdominal segment wanting. All the setae on distinct tubercles. Dorsal disc granulated and slightly darker on dorsum with sutures well indicated. Transverse thoracic suture reaching margin of case. Pockets contiguous and well indicated. Submargin with narrow striations running mesad from margin. Thoracic tracheal furrows discernible.

Vasiform orifice in a cordate pit which includes eighth abdominal setae. Space between the caudal end and pit of orifice 104 long. Vasiform orifice longer than wide (65×42), roughly triangular, inner surface clearly dissected into small areas by ridges. Operculum rectangular, wider than long (21×36), postero-lateral corners pronounced. Lingula setose, short, exposed and tip D-shaped. Caudal furrow indicated, not reaching the margin.

Ventral surface.—A pair of ventral abdominal setae cephalad of vasiform orifice, 13 long, 47 apart. Mesothoracic and abdominal spiracles visible; setae at base of legs and rostrum wanting.

Host plant.—*Artocarous heterophyllus* (Jack tree) and *Ipomoea* sp.

Distribution.—Coimbatore (Tamil Nadu).

Material examined.—Thirtyone pupal cases mounted, on *Artocarous heterophyllus*, Coimbatore, 22-4-1961, B. V David; sixteen pupal cases mounted on *Ipomoea* sp., Coimbatore, 6-6-1957, S. K. David.

Pupal cases on dry leaves of *A. heterophyllus*, Coimbatore, 30-3-67, B. V David.

Takahashi in his original description of the species has stated that the dorsum lacks submarginal setae and the thoracic tracheal combs less distinct. However, it is clear from the series of specimens examined that fifteen pairs of submarginal setae are evident and the tracheal combs are well indicated.

The identity of the species was confirmed by L. A. Mound of the British Museum (Natural History), London, who studied co-types from Borneo.

This species is a new addition to the Aleyrodid fauna of India and so far known only from N. Borneo on *Schima robustum*.

53. **Pealius spina** (Singh, 1931) comb. n.
(Text-fig. 43)

1931. *Dialeurodes spina* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(1): 27.

Singh described this species from *Ficus religiosa*, through his description and figures are rather meagre in detail. In the present study specimens collected from the same host compare well with Singh's species. However, in view of the characters observed in the present material such as medially shortened seventh abdominal segment, presence of submarginal setae, vasiform orifice in a pit with floor dissected into ridges, sub-rectangular operculum and tip of lingula D-shaped and exposed, the species is referred to the genus *Pealius* and the new combination is suggested here.

Though Singh does not make any detailed reference to the tracheal combs and medially shortened seventh abdominal segment, he refers to the exposed tip of lingula in his description, and his figure indicates the submarginal position of the two posterior pairs of setae. A redescription of the species with detailed illustrations is provided here.

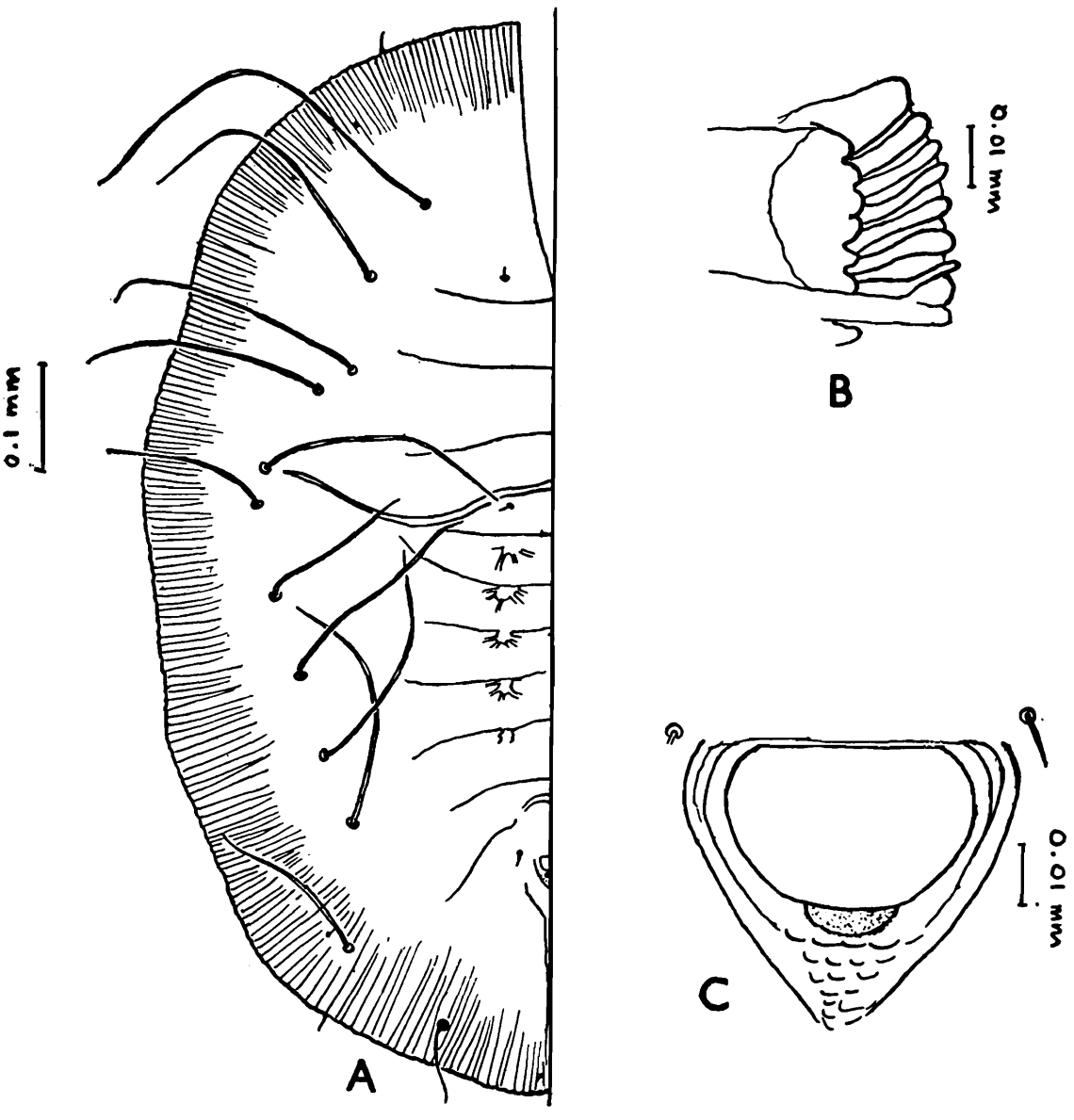
Pupal case.—Pale yellow, roundly elliptic, without any waxy secretion; 1.20-1.46 mm long, 1.00-1.28 mm wide; found on both upper and lower surfaces of leaves and a severe infestation causes yellowing of leaves.

Margin.—Crenulate, 15-16 crenulations in 0.1 mm; not indented; paired anterior and posterior marginal setae minute, 8-11 long; thoracic and caudal tracheal combs indicated by thickened marginal crenulations.

Dorsal surface.—Usual paired dorsal setae minute—cephalic setae, 5 long; first abdominal setae, 5 long; eighth abdominal setae laterad of base of orifice, 8 long. Dorsum lacking tubercles but minute pores and porettes distributed sparsely all over; submedial depressed markings evident on cephalic region, on all thoracic segments and on the first six abdominal segments; second abdominal suture bends latero-anteriorly; seventh abdominal segment medially shortened; pockets well developed; contiguous. Submargin broad with radial striations running mesad of margin. Twelve pairs of long setae on distinct circular tubercles evident on dorsal surface—two pairs posteriorly submarginal in position; five pairs subdorsally on abdomen and five pairs subdorsally on cephalothorax; 199-332 long. A pair of submarginal caudal setae on either side of caudal end, 5 long. Thoracic tracheal furrows not indicated but a distinct rimmed pore ending in combs evident in a few pupal cases; caudal tracheal furrow indicated.

Vasiform orifice small, situated in a shallow pit, floor dissected into ridges, subsemicircular, wider than long (41 × 30), rounded posteriorly. Operculum subtrapezoidal, transverse cephalad, wider than long (30 × 19), filling two-third orifice; lingula tip D-shaped, exposed, included.

Ventral surface.—A pair of ventral abdominal setae 28 long, 44 apart. Thoracic and caudal tracheal folds minutely tuberculate. Antenna



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Text-fig. 43. *Pealius spina* A. Pupal case, B. Thoracic tracheal pore, C. Vasiform orifice.

not extending beyond fore leg; setae at base of legs wanting; a pair of minute setae at base of rostrum seen. All the four pairs of spiracles visible.

Host.—*Ficus religiosa* (Singh, 1931).

Distribution.—Mirpur Khas, Daulatpur (Singh) (Singh, 1931), Salem (Tamil Nadu) (new distribution record).

Material examined.—Fourteen pupal cases mounted, on *Ficus religiosa*, Salem, 21-7-1968, B. V David. Numerous pupal cases on dry leaves in collection.

Key to Indian species of **Pealius**

1. Transverse moulting suture not reaching margin.. 2
   Transverse moulting suture reaching margin; usual paired cephalic and first abdominal dorsal setae absent; submarginal setae 15 pairs; vasiform orifice in a distinct pyriform pit.. .. .*schimae* Takahashi

2. Submarginal setae more than ten pairs, in a distinct row.. 3
   Submarginal setae less than ten pairs, not in a distinct row.. 4
3. Submarginal setae fifteen pairs.. *.misrae* Singh*
   Submarginal setae thirteen pairs.. .. *.bengalensis* (Peal)*
4. Pupal case roundly elliptic; dorsum not tuberculate; ten pairs of sub-dorsal and two pairs of submarginal setae evident.. *.spina* (Singh)
   Pupal case oval; dorsum tuberculate; nine pairs of subdorsal and five pairs of submarginal setae present; shape and length of setae varies depending on hairy or glabrous nature of the leaf surface on which it develops.. *.indicus* sp. n.

XX. Genus **Rhachisphora** Quaintance and Baker, 1917

Type species.—*Dialeurodes* (*Rachisphora*) *trilobitoides* Quaintance and Baker, 1917, *Proc. U. S. natn. Mus.*, **51**: 430.

The species included in this genus are characterised by the pupal case with a row of submarginal spines; dorsal disc with a prominent rhachis, often with thickened ridges radiating from it; thoracic tracheal pores armed with teeth, folds distinct.

54. **Rhachisphora trilobitoides** (Quaintance and Baker), 1917 (Plate III)

1917. *Dialeurodes* (*Rachisphora*) *trilobitoides* Quaintance and Baker, *Proc. U.S. natn. Mus.* **51**: 433.
1931. *Dialeurodes trilobitoides* Quaintance and Baker, Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12**(**1**): 28.
1952. *Rhachisphora trilobitoides* (Quaintance and Baker), Takahashi, *Mushi*, **24**(**6**): 22

The description of the species provided by Quaintance and Baker (1917) seems adequate.

Host.—*Cordia myxa. Syzigium jambolanum* (Singh, 1931), *Achras zapota, Mimusops hexandra* (Rao, 1958) and *Xeromphis malabarica* (new host).

Distribution.—Pusa (Bihar) (Singh, 1931); Hyderabad (Andhra Pradesh) (Rao, 1958); Kayarambedu and Madras (Tamil Nadu) (new distribution record).

Material examined.—Nine pupal cases mounted, on an unidentified shrub, Kayarambedu (Chingleput district), 6-3-1971, B. V David; five pupal cases on *Xeromphis malabarica*, 8-7-1971, B. V David.

On the unidentified shrub invariably the upper surface of leaf was found infested by *R. trilobitoides* (Quaintance and Baker) and the lower surface of the same leaf by *Dialeurodes ixorae* Singh.

XXI. Genus **Siphoninus** Silvestri, 1915

Type species.—*Siphoninus finitimus* Silvestri, 1915, *Boll. Lab. Zool. Portici*, **9**: 245.

The distinctive feature of the species included in this genus is the possession of numerous dorsal tubes, each with an open tip, on pupal case. Adults lack paronychium between the tarsal claws.

55. **Siphoninus phillyreae** (Haliday), 1835

1835. *Aleyrodes phillyreae* Haliday, *Entom. Mag.* **2**: 119-120.
1931. *Siphoninus finitimus* Silvestri, 1915, Singh, 1931, Mem. Dept. *Agric. India, Ent. Ser.* **12(1)**: 12.
1966. *Siphoninus phillyreae* (Haliday), Mound, *Bull. Br. Mus. nat. Hist., Ent.* **17(9)**: 419.

Recently Mound (1966) provided a detailed description of the species. In India it is a common pest on pomegranate.

Host.—Prunus persica (peach), *Punica granatum* (pomegranate) and *Pyrus communis* (pear) (Singh, 1931).

Distribution.—Pusa (Bihar) (Singh, 1931); Bangalore (Karnataka State) (Usman and Puttarudraiah, 1955); Hyderabad (Andhra Pradesh) (Rao and Rao, 1962); Coimbatore (Ayyar, 1923) and throughout Tamil Nadu.

Material examined.—Eleven pupal cases, on *Punica granatum*, Coimbatore, 27-11-1966, B. V David; nine pupal cases, on *Pyrus communis*, Yercaud (Salem district), 14-8-1968, B. V David.

XXII. Genus **Taiwanaleyrodes** Takahashi, 1932

Type species.—Taiwanaleyrodes meliosomae Takahashi, 1932, *Rept., Dept. Agric.* **59**: 28.

The species included in this genus are characterised by the pupal case with a single row of marginal teeth; marginal area bent downward; submarginal area not separated from dorsal disc; thoracic tracheal folds and pores absent; caudal tracheal fold and pore distinct; dorsum with a pair of long 2-segmented setae on cephalic region and a pair on first abdominal segment; vasiform orifice notched on posterior margin; operculum nearly filling orifice, concealing the lingula.

56. **Taiwanaleyrodes indicus** (Singh, 1931) comb. n.
(Text-fig. 44)

1931. *Aleurothrixus indicus* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12(1)**: 84.

Singh recorded the above species from *Ficus carica* and *Michelia champaka* and in his description refers to "margin finely crenulate; dorsum with two pairs of long spine-like hairs, a pair on head and one on first abdominal segment; each of these hairs usually composed of two parts, the distal thinner half socketed into the end of the proximal thicker half; vasiform orifice subcircular; operculum subcordate, almost entirely filling the orifice, obscuring the lingula; a broad groove runs from the end of the orifice to the caudal margin" In view of these characters satisfying the definition of the genus *Taiwanaleyrodes* the new combination is suggested here.

In the present study also specimens were collected from *Ficus* sp. at Madras which agree with the description given by Singh for his *Aleurothrixus indicus* and hence they are all included under *Taiwanaleyrodes indicus* (Singh).

Pupal case.—Small, convex, subelliptic, yellowish with a flocculent mass of bluish wax on dorsum and a palisade round the margin; empty pupal case colourless; 0.53 mm long, 0.31 mm wide.

Margin.—Finely crenulate; paired anterior and posterior marginal setae, 3-5 long. Thoracic tracheal combs or pores wanting, caudal tracheal pore indicated.

Dorsal surface.—Two pairs of 2-segmented setae—a pair on cephalic region, 264 long and a pair on first abdominal segment, 231 long; distal segment of 2-segmented setae thinner and socketed into the end of the proximal thicker segment; a pair of minute setae cephalad of vasiform orifice. A pair of submarginal caudal setae, 93 long, on either side of caudal furrow. Transverse moulting suture almost straight; cephalothorax much longer than abdomen; abdominal segments distinct; pockets evident, not contiguous.

Vasiform orifice subcircular (43×43), notched at caudal end; operculum subcordate, wider than long (33×26), nearly filling the orifice obscuring the setose lingula, rarely lingula tip exposed. Caudal furrow is quite distinct.

Ventral surface.—A pair of ventral abdominal setae 8 long, 14 apart. All the four pairs of spiracles and adhesive sac visible. A minute seta at base of mesothoracic legs; setae at base of rostrum wanting. Antenna short with a finger-like tip, not extending beyond fore leg.

Host.—*Ficus carica*, *Michelia champaka* (Singh, 1931) and *Ficus* sp.

Distribution.—Pusa (Bihar) (Singh, 1931) and Madras (Tamil Nadu) (new distribution record).

Material examined.—Twentyfive pupal cases, on *Ficus* sp., Madras, 25-7-1971, B. V David.

XXIII. Genus **Trialeurodes** Cockerell, 1902

Type species.—*Aleurodes pergandei* Quaintance, 1900, *Bull. U.S.Bur. Ent.* **8:** 1-43.

The dorsal surface of pupa is usually elevated from leaf surface and a vertical waxy palisade is evident. The most conspicuous features by which it is recognised from other genera are the presence of submarginal papillae with wax secreting pores and trilobed lingula in the cordate orifice.

57. **Trialeurodes rara** Singh, 1931

(Plate III Part, Text-figs. 45 & 46)

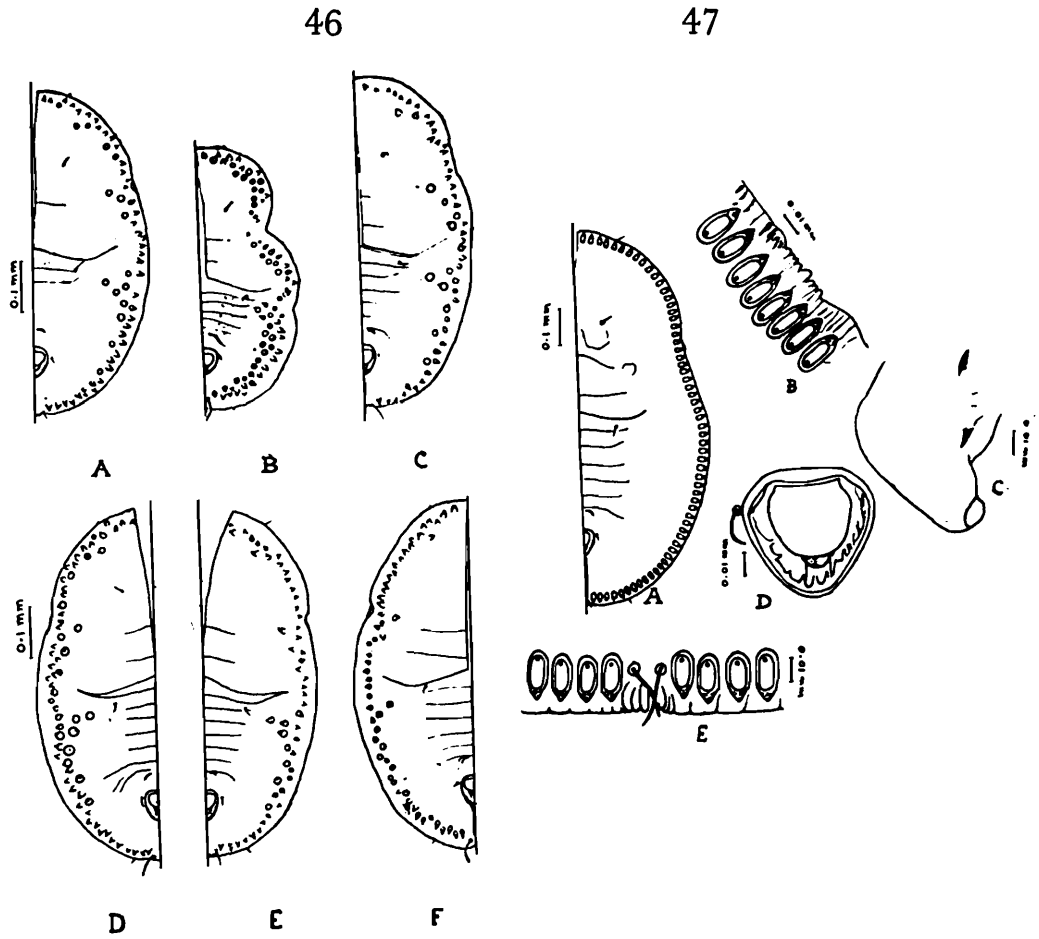
1931. *Trialeurodes rara* Singh, *Mem. Dept. Agric. India, Ent. Ser.* **12(1)**: 47.

The following additional description is provided to the original description of the species by Singh.

Pupal case.—White with a palisade of wax and long marginal waxy filaments; elliptic; 0.44-0.64 mm long, 0.30-0.41 mm wide.

Margin.—Irregularly crenulate. Thoracic and caudal tracheal pores indicated by strong marginal crenulations.

Dorsal surface.—Submargin with 30 to 59 papillae on glabrous leaves submarginal papillae arranged in a single row; five to eight pairs of papillae on subdorsum. On hairy leaves papillae apparently in two or three rows, many being found on subdorsum. Submarginal disc pores mesad of papillae. Transverse moulting suture bends latero-anteriorly extending upto sub-dorsum. Seventh abdominal segment very much shortened medially; eighth abdominal setae arising postero-laterally to anterior margin of operculum. Vasiform orifice cordate, longer than wide, emarginate posteriorly, margin curving to anterior to meet an internal tooth; lateral margins with fine teeth internally. Lingula with the subapical paired setae and paired lobes exposed.



Text-figs. 46-47. (46) Host correlated variations as seen in the pupal causes of *Trialeurodes rara* from A. *Aristolochia labiosa*, B. *Bauhinia* sp., C. *Dolichos lab-lab*, D. *Gossypium hirsubum*, E. *Phyllanthus acidus*, F. *Richinus communis;* (47) *Trialeurodes cicini* A. Pupal case, B. Thoraci tracheal end, C. Mesothoracic leg with conical spine, D. Vasiform orifice, E. Caudal tracheal end.

Ventral surface.—Ventral abdominal setae 17 long, 28 apart. Two stout setae at base of meso- and metathoracic legs; two minute setae at base of mesothoracic legs evident. Anterior abdominal spiracles not seen.

The variations noticed in the structural details of pupal cases from different host plants are discussed elsewhere.

Host.—*Breynia* sp. (Singh, 1931), *Euphorbia* sp., *Murraya koenigi*, *Ricinus communis* (Rao, 1958), *Phyllanthus acidus* (Sundara Babu, 1971)*, *Anona glabra*, *Aristolochia bracteata*, *Bauhinia* sp., *Dolichos lab-lab*, *Gossypium hirsutum* and *Moringa oleifera* (new hosts).

Distribution.—Saharanpur (Singh, 1931), Hyderabad (Rao, 1958), Kunigal (Karnataka State) and Coimbatore (Tamil Nadu).

Material examined.—Twentyfive pupal cases, on *Ricinus communis*, Coimbatore, 27-10-1966, B. V David; nine pupal cases, *Phyllanthus acidus*, Coimbatore, 30-3-1967, B. V David; thirty pupal cases, on *Aristolochia labiosa*, Coimbatore, 3-4-1967, B. V David; twentyfive pupal cases, on *Bauhinia* sp., Coimbatore, 8-4-1967, B. V David; three pupal cases, on *Anona glabra*, Coimbatore, 10-4-1967, B. V David; three pupal cases, on *Moringa oleifera*, Coimbatore, 17-4-1967, B. V David; thirty-five pupal cases, on *Dolichos lab-lab*, Coimbatore, 18-11-1967 B. V David; five pupal cases, on *Ricinus communis*, Kunigal (Karnataka State), 28-3-1969, B. V David; fifty pupal cases, on *Gossypium hirsutum*, Coimbatore, 8-4-1969, B. V David.

58. **Trialeurodes ricini** (Misra), 1923

(Text-fig. 47)

1923. *Aleyrodes ricini* Misra, *Proc. 5th ent. Mtg. Pusa.*, 129-135.
1931. *Trialeurodes ricini* (Misra), Singh, *Mem. Dept. Agric., India, Ent. Ser.* **12**(1): 46.

The following additional notes are provided to the original description of the species by Singh.

Pupal case.—0.62-0.63 mm long and 0.39-0.40 mm wide.

Margin.—Irregularly crenulate with 25 crenulations in 0.1 mm. Tracheal pore areas strongly marked by narrowness and depth of 6-8 crenulations. Anterior and posterior marginal setae 11-14 long.

Dorsal surface.—A row of submarginal papillae, 68-73 evident; none on subdorsum. Three pairs of dorsal setae—cephalic setae 22 long; first abdominal setae 19 long; eighth abdominal setae lateral of anterior margin of operculum, 14 long. A pair of submarginal caudal setae 25 long. Seventh abdominal segment medially very much shortened. Vasiform orifice with fine teeth internally on posterior margin and lateral walls; 50 long, 50 wide; operculum 28 long, 30 wide; lingula with a pair of setae subapically, exposed.

Ventral surface.—Two thick conical setae at base of legs. All the four pairs of spiracles evident.

Host.—*Achras zapota*, *Breynia rhamnoides*, *Ricinus communis* (Singh, 1931), *Euphorbia* sp., *Murraya koenigii*, *Phyllanthus* sp., *Rosa* sp. (Rao, 1958), *Anona glabra* and *Gossypium hirsutum* (new hosts).

Distribution.—Pusa (Bihar), Nadiad (Bombay), Baroda, Bhagalpur (Singh, 1931), Hyderabad (Andhra Pradesh) (Rao, 1958), Coimbatore and Madras (Tamil Nadu).

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* Reported as *Aleyrodes sizoukinensis* Kuwana due to misidentification of the species.

Material examined.—Three pupal cases on *Ricinus communis*, Coimbatore, 27-10-1966, B. V David; one pupal case, on *Anona glabra*, Coimbatore, 10-4-1967, B. V David; five pupal cases, on *Gossypium hirsutum*, Coimbatore, 8-4-1969, B. V David; one pupal case, on *Murraya koenigii*, Madras, 25-7-1971, B. V David.

59. **Trialeurodes vaporariorum** (Westwood), 1856
(Text-fig. 48)

1856. *Aleurodes vaporariorum* Westwood, 1856, *Gdnr's Chron.* **1856**: 852.
1914. *Asterochiton vaporariorum* (Westwood), Quaintance and Baker, *Tech. Ser. Bur. Ent. U.S.* **27**(*11*): 95-114.
1948. *Trialeurodes vaporariorum* (Westwood), Russell, *Misc. Publs. U.S. Dep. Agric.* **635**: 85 pp.

Russell (1948) has provided a detailed description of the species. The material collected during the present study from the undersurface of leaves of potato (*Solanum tuberosum*) agrees well with the illustration and description by Russell of pupal case of *I. vaporariorum* from moderately hairy leaf.

Pupal case.—Length 0.78-0.83 mm; width 0.48-0.53 mm.

Dorsal surface.—Submarginal papillae more than 50; 6 large pairs are evident—2 pairs on cephalic region, 1 on prothoracic segment, 1 just posterior to transverse moulting suture, and 1 each on sixth and eighth abdominal segments; submarginal disc pores mostly distad of papillae, a few usually mesad or laterad. Four pairs of subdorsal papillae, one pair on each of cephalic, mesothoracic and third and fourth abdominal segments evident; papillae directed vertically, nearly uniform in size.

Ventral surface.—A minute seta at base of meso- and metathoracic legs present.

Host.—*Solanum tuberosum.*

Distribution.—Thummanatty (6500 feet, Nilgiris).

Material examined.—Eleven pupal cases, on *Solanum tuberosum*, Thummanatty (Nilgiris), 4-8-1969, B. V David.

This is a new addition to the alleyrodid fauna of India.

Key to Indian species of **Trialeurodes**

1. Submarginal papillae not all equal in size; variable number of sub-dorsal papillae evident... 2
   Submarginal papillae all equal in size; papillae wanting on subdorsum...*ricini* (Misra)
2. Submarginal disc pores mesad of papillae; two stout and two thin minute setae at base of middle legs.. .. ..*rara* Singh
   Submarginal disc pores mostly distad of papillae, a few usually mesad or laterad; a thin seta at base of middle legs.. .*vaporariorum* (Westwood)

XXIV Genus **Zaphanera** Corbett, 1926

Type species.—*Zaphanera cyanotis* Corbett, 1926, *Bull. Ent. Res.* **16**: 267-284.

Pupal case oval with two rows of marginal teeth; submarginal area not separated from dorsal disc. Thoracic and caudal pores or combs

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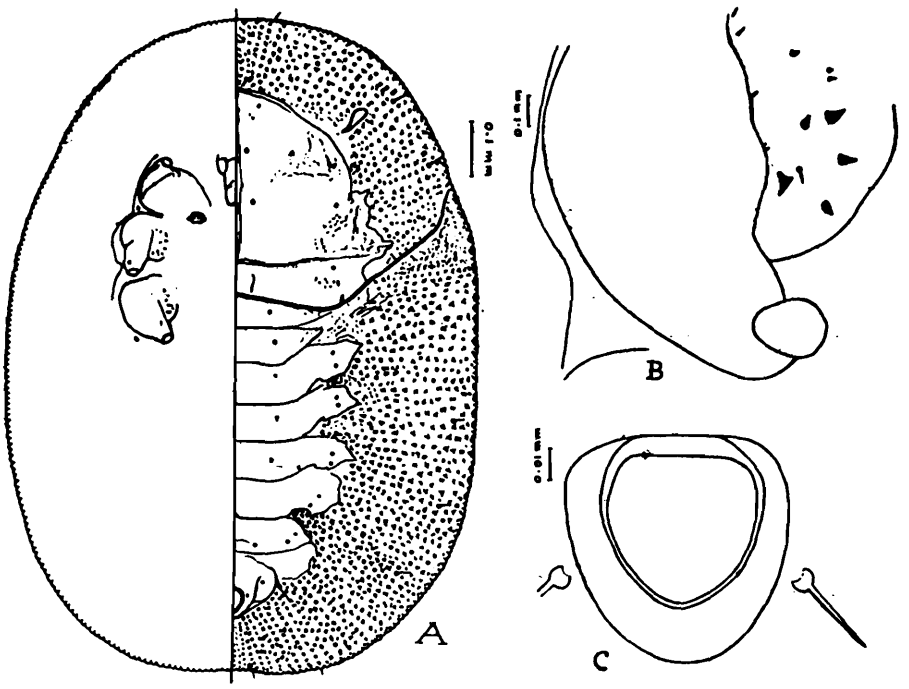

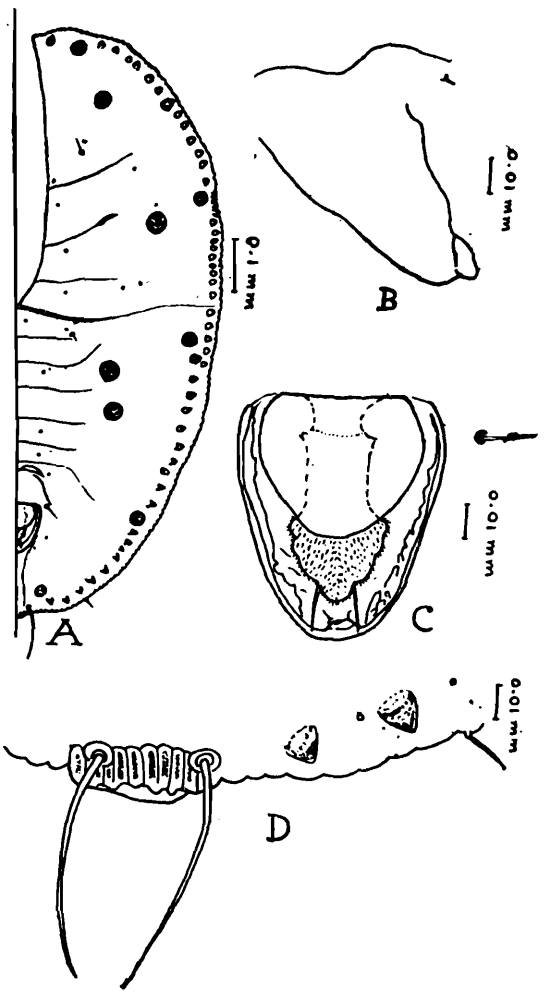

48

Text-figs. 48-49. (48) *Trialeurodes vaporariorum* A. Pupal case, B. Mesothoracic leg, C. Vasiform orifice, D. Caudal tracheal end. (49) *Zaphanera publicus* A. Pupal case, B. Mesothoracic leg, C. Vasiform orifice.

absent, folds indistinct. Dorsum with small circular pores and without prominent setae. Cephalo-thoracic region with a well defined median area; rhachis prominent and abdominal sutures with a well defined median area. Vasiform orifice subcordate, elevated; operculum similarly shaped filling the orifice; lingula hidden.

60. **Zaphanera publicus** (Singh, 1938) Comb. n.
(Plate III, part; Text-fig. 49)

1938. *Aleuroputeus publicus* Singh, *Rec. Indian Mus.*, **40**: 189-192.

Singh described *Aleuroputeus publicus* from Nagpur (Maharashtra State) on *Tephrosia purpurea* infesting the under-surface of leaf and occasionally the petiole. He referred the species to the genus *Aleuroputeus* inspite of the elevated vasiform orifice with the operculum filling the orifice and concealing the lingula which is characteristic of *Zaphanera*.

In the present study specimens were collected from the same host from South India as well as from Maharashtra State (Badnera) infesting the same parts of the plant. The specimens were referred to Dr. L. M. Russell, Systematic Entomologist, Entomology Research Division, United States Department of Agriculture, Washington, who identified it as belonging to the genus *Zaphanera*. A comparison of the species with the type available with the Zoological Survey of India, Calcutta confirmed that the species is assignable to the genus *Zaphanera*.

In view of certain other characters like double row of marginal teeth and number and arrangement of submarginal setae being not adequately given by Singh, a detailed description is provided below to supplement the description of the species by Singh.

Pupal case.—Black with white marginal fringe of wax and pronounced wax secretion along mid-dorsal line; oval, 1.18-1.29 mm long, 0.88-0.90 mm wide. Found on the undersurface of leaflets and on petioles and stem. On *Commelina* sp. it occurs only on stem portion of the plant.

Margin.—Margin with a double row of rounded teeth, 8 in 0.1 mm. Thoracic and caudal tracheal pores or combs absent. Paired anterior and posterior marginal setae 17 and 55 long respectively.

Dorsal surface.—A pair of setae on the eighth abdominal segment laterally on tubercles on the elevated part of vasiform orifice, 28-30 long. A pair of caudal setae on tubercles, submarginal in position, 124 long. Dorsal setae on cephalic segment and first abdominal segment not discernible. The cephalothorax with a well defined median area and rhachis prominent. Transverse moulting suture runs posteriorly for a short distance and bends sharply to anterior extending upto margin; the thoraco-abdominal suture extends upto subdorsum. A pair of light eye spots on cephalic region evident. No trace of thoracic and caudaltracheal furrows. Minute circular pores about 9 pairs (varies occasionally) within the well defined median area of cephalothorax; a pair of pores medially on each of abdominal segments 3-7 (occasionally being three pairs or two on one side and three on the other on segments 3 and 4) arranged in rows. Small circular pores are also seen scattered on the subdorsal and submedial areas. Submargin with five pairs of minute setae, 28 long

—a pair on cephalic region just opposite eye spots; a pair on the prothoracic segments and three pairs on the abdomen corresponding to the level of abdominal segments 4, 6 and 8. Minute pores, about forty pairs, found at shorter intervals at base of marginal teeth in a row. Subdorsal and submarginal area ornamented with paired dark markings arranged in a more or less radial fashion.

Vasiform orifice subcordate, 47 long, 44 wide; elevated. Operculum similarly shaped (41 long, 39 wide) filling the orifice and obscuring the lingula.

Ventral surface.—Ventral abdominal setae 28 long, 61 apart. Thoracic and caudal tracheal folds not evident. Rostrum large and truncate without any setae at base. Antenna normal extending upto base of fore leg. All four pairs of spiracles discernible. Adhesive sacs well developed. Base of legs with peg-like spines; meso- and metathoracic legs with a thin spine at base of each leg.

Host.—*Tephrosia purpurea* (Singh, 1938) and *Commelina* sp. (new record).

Distribution.—Nagpur (Singh 1938); Badnera (Maharashtra State), Neyveli, Sawyerpuram, Kayaramabedu (Madras) and Thimbam (Tamil Nadu State) (new distribution records).

Material examined.—Nine pupal case, on *Tephrosia purpurea*, Neyveli, 23-1-1967, B. V David; Twentynine pupal cases, on *Tephrosia purpurea*, Sawyerpuram, 29-7-1969, B. V David; eight pupal cases, on *Tephrosia purpurea*, Badnera, (Maharashtra), 30-8-1969, B. V. David; twentytwo pupal cases, on stem of *Commelina* sp., Thimbam (Coimbatore district), 2000 feet, 10-8-1971, B. V David.

Collections in the Systematic Entomology Laboratory, United States Department of Agriculture, Washington D. C. Pupal cases on dry leaves in collection.

DISCUSSION

Our meagre knowledge of the family Aleyrodidae an economically important group of insects, as evident from the literature appears to be due to paucity of sufficient morphological characteristic features of all the postembryonic stages. This also restricts to a great extent the accurate definition of the various taxa. The scarcity of positively associated stages with the adults of both sexes and the remarkably little variation shown by the adults of very few species studied, have naturally led to the recognition of the so-called pupal cases, the exuviae of the fourth instar nymphs, in the matter of generic and specific classification of the aleyrodids—a rather unusual procedure in the taxonomic study of these insects. This stage is the one most often collected and known for the majority of world species and also possesses a multitude of diagnostic features than any other stage.

This insufficient knowledge of this group in this country is evident from the fact that eventhough taxonomic studies on this group have been commenced as early as 1903, only 23 genera and 62 species were known upto 1958. As such, judged by the limitations of the scope of this work the present investigations have contributed substantially to

the taxonomic study of this group in as much as 30 new species have been added, including in it a new genus and five genera reported for the first time in this country and three species newly recorded in India. The genera *Lipaleyrodes* hitherto known from Madagascar and Malaya, *Neopealius* from Japan, *Aleurocybotus* and *Zaphanera* from Ceylon and *Asterochiton* from New Zealand form important additions to the aleyrodids of India. The record of the cosmopolitan species *Trialeurodes vaporariorum* (Westwood). *Pealius schimae* Takahashi from North Borneo and *Aleurotrachelus multipapillus* Singh from Burma and *Bemisia hancocki* Corbett from Western Africa in South India is another addition.

The present investigations have also brought to light the following three new combinations of Singh's species:

Dialeurodes spina Singh = *Pealius spina* (Singh)

Aleurothrixus indicus Singh = *Taiwanaleyrodes indicus* (Singh)

Aleuroputeus publicus Singh = *Zaphanera publicus* (Singh)

In this connection it may be added that the genera *Aleuroguteus* and *Aleurothrixus* are not represented in India.

Some of the economically important cosmopolitan species—the citrus blackfly *Aleurocanthus woglumi* Ashby, the cotton whitefly *Bemisia tabaci* (Gennadius), the jasmine whitefly *Dialeurodes kirkaldyi* (Kotinsky), the sugarcane whitefly *Neomaskellia bergii* (Signoret) and the greenhouse whitefly *Trialeurodes vaporariorum* (Westwood) have been known to have a wide range of hosts (Russell, 1963), and the last species in particular has been noticed to infest *Solanum tuberosum* (potato) in the Nilgiris in this country. Hence the recording of this economically important species for the first time appears to be of significance.

The identity of the pomegranate whitefly, earlier placed by Singh (1931) in *Siphoninus finitimus* has now been confirmed as *Siphoninus phillyreae* (Haliday), known commonly as the Phillyrea whitefly elsewhere.

Another important observation relates to the castor whitefly hitherto frequently reported as *Trialeurodes ricini* (Misra). However, detailed examination of very large populations has brought to light the coexistence of two closely allied species *T rara* Singh and *T ricini* (Misra), the former being more predominant. This is again confirmed by observations on the occurrence of the two species together on *Anona glabra* and *Gossypium hirsutum*, *T rara* Singh being predominant. In as much as these two forms appear to coexist on leaves of the same host plant, the possible conclusion regarding their structural similarity in many respects especially in the arrangement of conical spines at the base of legs, cannot be overlooked. Differences in the size and arrangement of submarginal papillae and presence or absence of subdorsal papillae [equal sized and arranged in a regular row in *T ricini* (Misra) and variously sized and arranged irregularly in *T rara* Singh; absence of subdorsal papillae in the former and presence in the latter] defy attempts at synonymising *T rara* Singh with *T ricini* (Misra) and it remains to be demonstrated experimentally as was established for *Bemisia tabaci* (Gennadius) by Mound (1963). Further in view of *T rara* Singh agreeing in all respects with *T desmodii* Corbett, the synonymy of the latter with *T rara* Singh remains to be confirmed.

The aleyrodids *Lipaleyrodes crossandrae* sp. nov. on the flowering shrub *Crossandra undulaefolia*, and *Neapeolius nilgiriensis* sp. nov. on *Azalea indica* also appear to be interesting additions to the list of economically important aleyrodids.

Host correlated variation.—Interesting data have been gathered in the present studies as regards host correlated variation in aleyrodids and the discovery of host correlated variation appears to be an important contribution to our knowledge of this group in this country particularly because this relates to the ability of some species to develop on particular types of leaves leading to the development of plasticity of the species concerned as a direct reaction to the change of immediate environment as revealed by studies on (a) *Bemisia tabaci* (Gennadius) on *Aristolochia labiosa*, *Gauzuma tomentosa* and *Oryza sativa;* (b) *Trialeurodes rara* Singh on *Aristolochia labiosa*, *Bauhinia* sp., *Dolichoslab-lab*, *Gossyoium hirsutum*, *Phyllanthus acidus* and *Ricinus communis;* (c) *Dialeurodes bassiae* sp. nov on *Bassia longifolia;* and (d) *Pealius indicus* sp. nov. on *Ficus bengalensis*. Results presented herein show that the pupal cases developing on hairy leaves are comparatively smaller in size with deeply indented margin, more number of subdorsal papillae and elongated dorsal setae as against large sized pupal case with smooth margin, less number of subdorsal papillae and very short dorsal setae which confirm the views of earlier workers. Mention may be made of variations correlated with the structure of the host leaf by Russell (1948) in *Trialeurodes vaporariorum* (Westwood). Several species of *Bemisia* were sunk in *B. tabaci* (Gennadius) for the same reason by Russell (1957) and more recently Mound (1963) has also synonymised several African species of *Bemisia* with *B. tabaci* (Gennadius). This naturally reveals that in order to reach the nature of species stability, an understanding of structural variations in response to change of host appears necessary. The observation that aleyrodids infesting both sides of leaves show no structural variations of significance and the development of striking differences in species normally inhabiting the lower surface of leaves moving to the upper side as in *Dialeurodes bassiae* sp. nov. and *Pealius indicus* sp. nov. is interesting.

Association with other insects.—The occurrence of aleyrodids along with members of the same group as also with members of other groups of insects are on record. Rao (1958) mentions of association of *Dialeurodes ixorae* Singh with *Rhachisphora trilobitoides* (Q. & B.). Singh (1931) makes reference to association of different species of ants with *Neomaskellia bergii* (Signoret) and *Rhachispora trilobitoides* (Q. & B.). Quaintance and Baker (1917) have recorded *Aleurocanthus citricolus* (Newstead) and the scale insect *Aonidiella aurantii* (Maskell) on citrus.

In the present study also interesting association of aleyrodids with other insects has been observed. *Aleurotrachelus caerulescens* Singh is found with the thirips *Rhipiphorothrips cruentatus* Hood on rose, and *Neomaskellia bergii* (Signoret) with black ant on *Cenchrus ciliaris*, *Saccharum officinarum* and *Sorghum vulgare*. *Dialeurolonga fici* sp. nov. occurs along with the scale *Icerya* sp. (Plate III) on *Ficus religiosa*. *Dialeuropora decempuncta* (Q. & B.) and the scale *Aonidiella* sp. occur together on *Streblus asper*. Interesting inter-specific aleyrodid associations have been observed in a few species. *Bemisia tabaci* (Gennadius) has been noticed

to be in association with *Lipaleyrodes crossandrae* sp. nov. on *Achyranthes aspera*, while it is found with *Trialeurodes rara* Singh on *Aristalochia labiosa*. The associations of *Dialeurodes bassiae* sp. nov. with *Aleurolobus moundi* sp. nov. on *Bassia* spp., and *Dialeurodes kirkaldyi* (Kotinsky) with *Bemisia jasminum* sp. nov. on jasmine are interesting. Similarly, *Dialeuropora decempuncta* Q. & B. has been found in association with *Aleurocanthus loyolae* sp. nov. on *Streblus asper* and with *Aleurocanthus rugosa* Singh on *Anona* sp. On *Polyalthia longifolia* and *P. pendula* it is found with *Aleuroplatus alcocki* (Peal) and *Aleurocanthus rugosa* Singh and on *Cordia myxa* with *Aleurotuberculatus takahashii* sp. nov. and *Asterochiton cordiae* sp. nov. The associations of *Dialeuropora pterolobiae* sp. nov. with *Aleuromarginatus kallarensis* sp. nov. on *Pterolobium indicum*, and *Zaphanera publicus* (Singh) with *Bemisia hancocki* Corbett on *Tephrosia purpurea* are also interesting. In aleyrodid taxonomy, as it is customany to preserve leaves with pupal cases, information on the occurrence of two or more species together on the same leaf would be of much significance.

Summary

1. A study of the some Indian Aleyrodids in the background of a review of literature is presented taking into account the conventional classificatory system and the economic importance of this group of insects.
2. A total of sixty species representing 24 genera is dealt with. Of these, 30 species are described as new to science and 4 species as new records to India. Of the genera recorded, one is described as new and five as generic records new to this country.
3. Keys are provided for the genera and species of Indian Aleyrodidae.
4. Information on host correlated intraspecific variations is given in this work with reference to the four species, *Bemisia tabaci*, *Trialeurodes rara*, *Dialeurodes bassiae* and *Pealius indicus*. These observations tend to emphasise caution in determining the status of these species.
5. Inter-specific associations within the family of Aleyrodidae as well as with other insects are discussed.
6. A relevant list of references pertaining to this study is annexed.

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