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No. 2

NOTES ON THE BIOLOGY OF THE PSYLLIDAE (HOMOPT.)

BY

Errata Slip to Indian Forest Records, Vol. I, No. 2, (Entomology),
1935, entitled "On the Biology of the Psyllidae (Homopt.)."

Page 37, line 12 from bottom, read "psyllid" for "payllid".

Page 47, Table 3, Column 6, read "period" for "perod".

Page 48, line 3 from top, read "leaves" for "leave".

Page 50, line 16 from bottom, insert "1" before ♂.

Page 52, line 15 from top, read "sub-globular" for "sub-blolubar" and
"seldom" for "selodm".

Page 52, line 16 from top, delete "are".

Page 56, line 7 from bottom, read "faintly" for "fantly".

Page 58, line 3 from bottom, read "unicellular" for "unicellular"
and "uninympthal" for "unnymphthal".

Page 66, line 17 from top, read "stages" for "stage".

Page 66, line 7 from bottom, read "Buckton" for "Ruckton".

Page 69, line 9 from top, read "jambolanae" for "jambalanae".

Page 70, line 6 from bottom, read "Injury" for "Inquiry".

annum, viz., One generation: *Phyllopecta gardneri*, (leaf-gall);
Phyllopecta sp. n. (twig-gall); and *Phyllopecta* sp. n. (pit-gall).
Two generations: *Fauropsylla beesonii*, (leaf-gall); *Phyllopecta*
hirsuta, (leaf-gall). Three generations: *Fauropsylla* sp. n. (pit-gall);
Phyllopecta mallotica, (leaf-gall). Five generations: *Phyllopecta*

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No. 2

NOTES ON THE BIOLOGY OF THE PSYLLIDAE (HOMOPT.)

BY

R. N. MATHUR.

I. INTRODUCTION.

This account of the habits of the Psyllidae, or Jumping Plant Lice, living on some Indian forest trees arises out of an item in the research programme of the Branch of Forest Entomology which was commenced in 1928 and concerned the gall-insects of *Populus euphratica* in the poplar forests of the Muzaffargarh district, Multan, Punjab. The gall-making Psyllidae of *P. euphratica* include three species of *Phylloplecta* making the bladder-galls on the leaf, and globular-galls and pit-galls on the twigs together with an acalyprate fly making cushion-galls also on twigs. The failure of repeated attempts to study the life-cycles of these insects in the forest and in the Insectary at Dehra Dun caused attention to be turned to the local species of Psyllidae occurring on trees, in the expectation that a general study of psyllid ecology would assist the poplar gall investigation, and also another problem in the Forest Entomologist's programme—the role of homopterous insects in the transmission of the spike disease of sandal.

The study has revealed the existence of considerable diversity in the habits of species of psyllids that frequent trees and has cleared up obscure features in the ecology of the group. Notes are collected in this *Record* on thirty-four species affecting thirty-one species of trees; they may be grouped roughly as (a) species living under the shelter of a gall or malformation of the plant, and (b) species living freely exposed on the surface of foliage.

The number and sequence of generations in a year, as exhibited in the climate of Dehra Dun, varies within wide limits. The gall-formers are found to include species with one and two generations per annum (as might be expected), but also (more unexpectedly) species with eight generations in one year. The free-living active types pass through a larger number of generations,—up to eleven per annum, viz., One generation: *Phylloplecta gardneri*, (leaf-gall); *Phylloplecta* sp. n. (twig-gall); and *Phylloplecta* sp. n. (pit-gall). Two generations: *Pauropsylla becconi*, (leaf-gall); *Phylloplecta hirsuta*, (leaf-gall). Three generations: *Pauropsylla* sp. n. (pit-gall); *Phylloplecta mallotica*. (leaf-gall). Five generations: *Phylloplecta*

sp. n. (pit-gall); *Euphalerus vittatus*, (free leaf feeder). Eight generations: *Trioza fletcheri minor* (leaf-gall). Nine generations: *Diaphorina* sp. n. (free feeder on leaf); *Paurocephala* sp. n. (pitgall). Eleven generations: *Psylla* sp. n. (free feeder on leaf).

The instar that serves for a resting stage or for hibernation is, in the majority of species, the last stage nymph, but hibernation as an egg is characteristic of *Euphalerus vittatus* and *Phylloplecta hirsuta*, and two other species of *Phylloplecta* with annual cycles have a prolonged egg-stage in the hot weather. A species of *Diaphorina* with nine generations a year passes the coldest period as an inactive adult. It is the renewal of vegetative activity by the host-plant that determines the appearance of adult psyllids of the gall-forming species and fixes the season at which the development of the galls begins. The free-living species which feed on young leaves are able to breed continuously during the growing season so long as new buds or foliage are available, and are only reduced in numbers by the heaviness of the rainfall during the monsoon season.

The psyllid fauna of thirty-one species of local trees is listed below:—

- Albizia procera*: *Arytaina* sp. n.
- Alstonia scholaris*: *Pauropsylla tuberculata*.
- Bauhinia variegata*: *Psylla* sp. n.
- Bombax malabaricum*: *Tenaphalara acutipennis*.
- Cordia cordata*: *Diaphorina cordiae*.
- Cassia fistula*: *Euphalerus vittatus*.
- Chloroxylon swietenia*: *Arytaina ramakrishni*.
- Diospyros melanoxylon*: *Trioza obsoleta*.
- Eugenia jambolana*: *Trioza jambolanae*.
- Ficus asperifolia*: *Paurocephala psylloptera*.
- Ficus glomerata*: *Pauropsylla depressa*, *Pauropsylla* sp. n.
- Ficus hispida*: *Paurocephala psylloptera*.
- Ficus nervosa*: *Dynopsylla grandis*.
- Ficus roxburghii*: *Pauropsylla* sp. n.
- Ficus ulmifolia*: *Paurocephala psylloptera*.
- Garuga pinnata*: *Phacopteron lentiginosum*.
- Gmelina arborea*: *Trioza fletcheri*.
- Kydia calycina*: *Paurocephala* sp. n.
- Litsaea polyantha*: *Pauropsylla beesonii*.
- Mallotus philippinensis*: *Phylloplecta mallotica*, *Phylloplecta* sp. n.

Mangifera indica: *Apsylla cistellata*, *Pauropsylla brevicornis*, *Pauropsylla nigra*.

Murraya koenigii: *Diaphorina* sp. n., *Psylla* sp. n.

Populus euphratica: *Phylloplecta gardneri*, *Phylloplecta* sp. n., *Phylloplecta* sp. n.

Schleichera trijuga: *Phacopteron lentiginosum*.

Shorea robusta: *Cerotrioza* sp. n., *Phylloplecta* sp. n.

Spondias mangifera: *Pauropsylla spondiasae*.

Sterculia foetida: *Tenaphalara acutipennis*.

Strychnos nux-vomica: *Diaphorina truncata*.

Terminalia arjuna: *Phylloplecta hirsuta*.

Terminalia tomentosa: *Phylloplecta hirsuta*, *Trioza fletcheri minor*.

Trewia sp.: *Trioza fletcheri*.

The new species of Psyllidae are under study at the British Museum, Natural History, London, but it is unlikely that description and names will be published in the near future.

In spite of the conspicuous appearance of the damage done by Psyllidae (see Plates) its economic importance on older trees and in mixed forests is negligible. It should be regarded rather as an indication of loss of vitality and neglect in a tree crop. In natural forest the general incidence of psyllids is low, but heavy infestation by leaf-sucking and leaf-galling psyllids is fairly common on individual trees or on small groups, that are subnormal in health. In seed beds and in artificial regeneration areas, on the other hand, the damage done by psyllids can be serious. The gall-forming species appear to be more injurious than the free-living types in that the affected buds, shoots and leaves are put out of action and are not replaced by later growth. The free-living leaf-sucking types with short life-cycles are more characteristic of trees with a prolonged vegetative period and are capable of infesting the successive flushes of foliage under favourable weather conditions. Where psyllid attack on seedlings and young plants is serious and control measures are required it is necessary to resort to methods of spraying similar to those used for agricultural crops.

No variation in the liability of geographical races or strains of trees to psyllid attack has been encountered. A suspected case of racial susceptibility in *Terminalia tomentosa* to the attack of *Trioza fletcheri minor* (see *Ind. For. Rec.*, Silviculture Series, XVII, (5), page 25, 1933) disclosed after botanical identification that the immune race was a separate species of *Terminalia*.

C. F. C. BEESON,
Forest Entomologist.

II. ECONOMICS OF THE SPECIES OF PSYLLIDAE.

1. *Apsylla cistellata* Buckton.

- Cotes: Ind. Mus. Notes. III, pp. 13-14, 1893. From blighted shoots of *Mangifera indica*, Dehra Dun.
- Buckton: (*Psylla cistellata*). Ind. Mus. Notes. III, pp. 91-92, 1893. Damaging Mango trees at Dehra Dun.
- Vosseler: Zeit. Wiss. Insekt. 2, p. 315, 1906.
- Lefroy: Indian Insect Life. p. 743, 1909.
- Crawford: Rec. Ind. Mus. 7, pp. 421-22, 1912. From galls on mango shoots, Dehra Dun; Bettiah, Champaran, Bengal; p. 429, on Mango trees, Pusa, Bihar. U. S. Nat. Mus. Bull. 85, p. 4, 1914.
- Fletcher: Report Proc. Second Ent. Meet. Pusa. p. 221, 1917. Report Proc. Third Ent. Meet. Pusa. 1, p. 277, 1919.
- Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 261, 1924.

Further specimens were bred from mango (*Mangifera indica*) buds at Dehra Dun during 1933 and 1934.

(a) INJURY TO HOST.

(Plate II, Fig. 14.)

This insect develops in cone-shaped galls of overlapping scales formed by malformation of the buds on the twigs of mango trees. The scales or dwarfed leaves are uniform and green or yellow in colour. In length the cone varies when full-grown from about three-fourths to one and one and a half inches. Under the stimulation of the nymphs the growth of the immature leaves is affected but the external appearance of the bud is not altered. When dissected, it presents a central axis surrounded by imbricated scales with free spaces in between. Beneath these scales some individuals are confined and an average sized bud may contain thirty-six nymphs. These stunted growths occur in groups at the tip of the shoot or on the shoot itself. The buds which are exposed to direct sunlight, mature first. The scales flare out from the central axis, leaving the chambers wide open and thus the imagines escape. Later on, the deserted buds dry up. Though the buds are destroyed, the twig is not killed. In some orchards it occurs as a serious pest.

(b) LIFE-HISTORY AND HABITS.

Egg-laying has not been observed. A female on dissection presented 164 fully developed eggs with some ova in various stages of development.

The nymphs are pale yellow, with eyes pinkish red; legs, antennae and wing-lobes light grey. The nymphs produce an abundance of white, cottony wax secretion within which they

become covered and also exude sticky liquid copiously. The nymphs are inactive and did not survive when kept on green twigs. The adults are lethargic and short-lived.

The infestation of buds starts in October. The nymphs winter inside the leaf-buds and develop to maturity in late March and April.

2. *Arytaina ramakrishni* Crawford.

Crawford: Rec. Ind. Mus. 26, p. 618, 1924. In leaves of *Chloroxylon swietenia*, Coimbatore, India.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 624, 1924. On galls in leaves of *Chloroxylon swietenia*, Coimbatore.

3. *Arytaina* sp. n.

(Plate II, Fig. 15.)

This psyllid is found in abundance on *Albizia procera* (white siris) at New Forest, Dehra Dun, U. P., during April—August (R. N. Mathur coll.).

The ravages of the pest are restricted to fresh shoots and buds. The young pinnae droop, turn yellowish brown and gradually drop one by one. The rachis also falls off afterwards. Young buds are killed outright. The greatest injury is done to the seedlings, saplings and coppice shoots. No apparent ill-effect is produced on mature stands.

The eggs are anchored in the plant tissues either singly or in clusters on both the surfaces and axils of the leaflets, folds of new growths and along the grooves of the rachis. The cream-coloured egg is narrowly oval, smooth, 0.30 mm. long and 0.15 mm. broad and is devoid of tail. The egg upon aging turns pale clay yellow.

A freshly emerged pair when released on a plant on 30th May 1933, deposited 430 eggs within a period of 6 days.

The young nymphs are pale yellow, dorsal plates, antennae, legs and caudal plate black; eyes pinkish red. Older stages are pale yellow or yellowish orange with green tinge; eyes silver grey; legs light grey or pale yellow; terminal antennal segments black and abdomen with orange tinge. The body and wing-lobes bear black setae.

The nymphs are exceptionally active, running about to and fro on the plant and exude small white glistening threads of sticky liquid from the anus. The adults are not easily captured on account of their rapid movements.

During May, June and July the insect is at its greatest activity and all stages are met with on the plants and considerable overlapping of broods is exhibited.

4. *Cerotrionia* sp. n.

(Plate II, Fig. 20.)

This psyllid is noticeable from July to next January, between folded leaves of *Shorea robusta* (sal) at New Forest, Dehra Dun, U. P. (R. N. Mathur coll.).

The attack is confined to the top leaves of the developing shoots. The nymphs suck sap generally at the apical portion of the midrib on the upper surface. The mid-rib thickens and the leaf-blade folds upwards forming a groove along the rib. Sometimes the leaves are curled. These insects have at times been responsible for serious injury. When the pest disappears, the leaves assume normal colour but never regain their natural shape. The psyllid is commonly met with in artificial regeneration.

The adults are active and sit at an angle.

The eggs are deposited singly or in batches scattered about on soft leaves and buds. They are oval, papillose and pale brown in colour. The egg is 0.26 mm. long and 0.10 mm. broad and furnished with a basal projection of 0.06 mm. length.

The nymphs are pyriform, slightly flocculent, pale clay yellow in colour, with eyes pinkish red and terminal antennal segments black. A mature nymph measures about 1.9 mm. long and 1.1 mm. broad, having the humeral angles extending to the neck. The wax production is less marked in early stages but in older stages it is profusely produced in long and short filaments sticking out as a dense mass along the abdominal margin. These filaments are easily detachable. The nymphs exude globules of honeydew surrounded with a white substance. The final moult occurs outside on the leaf.

During the rains the pest is less abundant but on the approach of winter it increases in number and all stages are noted on the host. Late in winter again the density of insect population declines.

5. *Diaphorina cordiae* Crawford.

Crawford: Rec. Ind. Mus. 26, p. 617, 1924. On *Cordia cordata*, Coimbatore, S. India.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 624 1924.

6. *Diaphorina* sp. n.

This psyllid occurs on *Murraya koenigii* (gandhi) at Dehra Dun, U. P. (R. N. Mathur coll.).

(a) INJURY TO HOST.

The nymphs cause little damage to the plants if present in small numbers, but when they are numerous, the leaves wilt and fall off gradually. Young growths are killed completely and the tender branches are deformed. The lower branches and leaves bear a sticky coating of honeydew on which a black-fungus grows and the infested trees assume a black appearance.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The female fastens eggs singly, scattered about, in the axils, on the ventral surface of leaflets and tender branches. The eggs are oval, smooth and light yellowish orange in colour. It measures 0.26 mm. long and 0.14 mm. broad, bearing a tail-like filament of 0.03 mm. at the tapering end.

A female deposited 600 eggs within a period of 35 days during June-July.

Hatching.—The hatching occurs in 3 to 5 days in summer, 4 to 6 days in early October and 9 to 14 days in February.

Nymphal instars.—The young nymphs are pale yellow with dark red eyes; tarsi, apical antennal segments and tip of rostrum light black. Half mature stages are light grey with yellow or bluish green tinge; antennae darker. Full-grown nymphs are about 1.63 mm. long, and 1.45 mm. broad, dark grey with bluish green tinge; antennae black, legs pale grey and the wing-pads are produced cephalad at the humeral angles. A fringe of long white filaments is present along the abdominal margin in all the instars.

The nymphs walk with a steady pace and exude large quantities of honeydew in the form of translucent filaments which can be shaken off. Five moults occur before transforming to adult.

The nymphal period varies from 11 to 37 days in summer, 66 to 79 days in winter and 33 to 40 days in spring.

Adults.—They are usually sluggish and sit with heads touching the surface of the host and body raised up at an angle. The longevity of male and female was 59 and 45 days respectively during June-July, but their life is longer during the cold season as they do not lay eggs till the next spring.

Seasonal history.—The insect is represented in all the stages of its development on the host plant from April to October and shows considerable overlapping of broods. From December no oviposition is done and the insect passes the winter as imagines on the under

surface of leaves. The egg-laying commences in February as the season warms up. The number of generations in a year is nine (Table 1). The total life-cycle occupies 14 to 41 days in summer, 70 to 83 days in winter and 47 to 54 days during spring.

TABLE 1.

Statement showing the duration of life-cycles during 1933-34.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	19 May .	22 May .	3	2-15 June	11-24	14-27
2	7-9 June .	10-14 June	3-5	30 June-12 July.	20-32	23-35
3	4-7 July .	8-12 July .	4-5	2-14 Aug. .	25-37	29-41
4	9-12 Aug. .	14-17 Aug.	5	30 Aug.—5 Sept.	16-22	21-27
5	4-6 Sept. .	8-11 Sept.	4-5	22 Sept.—6 Oct.	14-28	18-33
6	27 Sept.—1 Oct.	1-7 Oct. .	4-6	6-19 Dec. .	66-79	70-83
7	9-17 Feb. .	23-26 Feb.	9-14	28 Mar.—4 Apr.	33-40	47-54
8	2-5 Apr. .	6-9 Apr. .	4	26 Apr.—5 May.	20-29	24-33
9	30 Apr.—4 May.	3-7 May .	3	16-23 May	13-20	16-23

7. *Diaphorina truncata* Crawford.

Crawford : Rec. Ind. Mus. 26, p. 617, 1924. On shoots of *Strychnos nux-vomica* Waiyap Forests, Malabar; Southern China.

Ramakrishna Ayyar : Rec. Ind. Mus. 26, p. 624, 1924.

8. *Dynopysylla grandis* Crawford.

Ramakrishna Ayyar : Report Proc. Third. Ent. Meeting, Pusa, p. 1031, 1919. (Figure of insect and gall).

Crawford : Rec. Ind. Mus. 26, pp. 619-620, 1924. Found in galls on *Ficus nervosa*, Taliparauba, N. Malabar; and in Brazil, S. America.

9. *Euphalerus vittatus* Crawford.

Crawford : Rec. Ind. Mus. 7, pp. 423-24, 1912. On *Cassia fistula*, Calcutta; p. 431, on a bush, Naraingunj, Eastern Bengal and Assam.

Ramakrishna Ayyar : Rec. Ind. Mus. 26, p. 623, 1934.

This species is common at Dehra Dun, U. P., on developing buds of *Cassia fistula* (amaltas) during May—July (R. N. Mathur coll.).

(a) INJURY TO HOST.

(Plate I, Fig. 7.)

The vitality of young plants is considerably impaired throughout the growing season by the depredation of the pest. All fresh growths are destroyed by the nymphs which live in the folded leaflets. The buds are deformed, become bunched and stunted. The young leaflets bulge due to the presence of nymphs, copious amount of honeydew and conspicuous wax secretion. The trees recover in August on account of the rains and the continued decline in the psyllid population.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The eggs are placed singly or in rows of varying numbers mostly in the grooves of the rachis. They are also deposited on buds, tender shoots, in the axils and on both the surfaces of leaflets. The eggs of the brood that go in hibernation, are laid in crevices, along scars and other protected situations. The egg is narrowly oval, shining and sculptured. It is 0.29 mm. long and 0.14 mm. broad, possessing a short basal projection of 0.06 mm. When freshly laid, it is almost white, as it grows older it turns cream yellow and finally assumes dark black colour.

The females were not happy in captivity and did not lay their full quota of eggs. The maximum number of eggs deposited was 428 and the minimum was 19. These, however, do not represent the actual reproductive capacity.

Hatching.—The egg-stage occupies 3 days. The eggs laid in August, hatch late in the following April and early May.

Nymphal instars.—The young nymphs are oblong, cream coloured, with pinkish red eyes. Older stages are pale yellow with greenish tinge in the abdomen, tip of antennae and tarsi grey. A mature nymph is about 1.9 mm. long and 1.2 mm. broad. The nymphs are flocculent. When the leaflets wilt, the nymphs desert them and infest other green healthy ones. The final skin is cast off outside on the leaves.

The nymphal period ranges from 14 to 29 days.

Seasonal history.—The nymphs make their appearance from the winter eggs in late April and early May, at the time when the new flush of leaves is put forth, and complete their development by the latter half of May. Between this period and early August, the psyllid undergoes four generations. All stages occur during this active period and no definite brood-limit is recognised. There is a steady reduction in the density of infestation during August as the oviposition ceases. The pest passes the latter part of the rains, the autumn and cold weather in the egg-stage.

Annually, the species carries through five generations (Table 2).

TABLE 2.

Statement showing duration of life-cycles during 1931-32.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	13 July	16 July	3	4-7 Aug.	19-22	22-25
2	8-10 Aug.	4 May	270	18-23 May	14-19	284-289
3	20-22 May	23-25 May	3	9-15 June	17-23	20-26
4	11-13 June	14-16 June	3	29 June-3 July.	15-19	18-22
5	1-3 July	4-6 July	3	21 July-2 Aug.	17-20	20-32

10. *Paurocephala psylloptera* Crawford.

Crawford: Phil. Jl. Sci. 8, p. 294, 1913, Los Banos, F. I.; Phil. Jl. Sci. 10 p. 260, 1915. From shoots of *Ficus hispida* and *Ficus asperima*, Peradeniya, Ceylon; Phil. Jl. Sci. 12, p. 163, 1917; Phil. Jl. Sci. 15, p. 449, 1919. On *Ficus ulmifolia*, Philippines, Borneo; Rec. Ind. Mus. 26, p. 615, 1924. On *Ficus* shoots, Tenmalai, Travancore, S. India.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 621, 1924.

11. *Paurocephala* sp. n.

This psyllid was first recorded in June 1932 (R. N. Mathur coll.) at New Forest, Dehra Dun, U. P., on *Kydia calycina* (pola).

(a) INJURY TO HOST.

The nymphs produce pit-galls on the lower surface of leaves of *Kydia calycina*. The depressions are shallow and yellowish green

in colour. The swellings on the upper surface are light yellow with greenish or brownish tinge which clearly differentiates them from the general colour of the leaf. A leaf is never crowded with these pit-galls which vary from one to eight galls on a leaf. The psyllid subsists on young foliage only. An exceptionally severe attack is figured in Plate I, fig. 2.

(b) LIFE-HISTORY AND HABITS.

Copulation.—The genital segment of the female is deflexed at right angles to the abdomen and the tips of the anal and subgenital valves curve outwards. The male bends the tip of its abdomen to the level of the female aperture and then pairing starts. They seldom move when in *coitu* and their heads point in opposite directions.

Oviposition.—The female scatters eggs on soft buds and the under surface of young leaves. The egg is oval, pale yellow in colour, smooth and fixed in the leaf tissues by means of a small basal process. It is 0.23 mm. long and 0.13 mm. broad and bears a long tail measuring 0.29 mm.

Hatching.—The eggs hatched in 3 to 6 days during April to September.

Nymphal instars.—The young nymphs are oval, yellowish orange in colour, with orange eyes. Half mature nymphs are pale green with pale grey eyes. Mature nymphs are light yellowish orange, with light grey antennae; head, thorax, wing-pads and abdominal segments partially black. All stages bear regularly arranged bristle-like setae on the dorsal surface, along the body margin and antennae. A mature nymph is about 1.21 mm. long and 0.91 mm. broad with the humeral angles reaching the posterior margin of the eyes.

Each pit is inhabited by a nymph which does not roof the pit. It exudes a sugary liquid as short filaments surrounded by white waxy matter.

All the moults, except the last, generally occur within the pit. The final skin is shed anywhere on the leaf, outside the depression.

Seasonal history.—Seven generations have been carried through from April to September. The insect passes the winter in the nymphal stage in pit-galls and reaches maturity in the following spring, and probably undergoes two winter generations.

12. *Pauropsylla beesoni* Laing.

Laing: Ind. Forest Rec. 14, p. 36, 1930, ex galls on leaves of *Litsaea polyantha*, Rangarwala, Dehra Dun.

This species is common throughout the Dehra Dun district, forming galls on *Litsaea polyantha* (karkawa).

(a) INJURY TO HOST.

(Plate I, Fig. 1.)

The nymph upon hatching wanders about for sometime, then settles on the soft tissues of foliage to feed and also burrows its way inside the tissues. The irritation caused thereby results in parenchymatous hypertrophy and gradually the development of the gall starts. These galls are confined to the secondary veins and vary in form from more or less spherical to ovate; frequently two or more galls coalesce to form a large irregular swelling. The galls are green in colour or suffused with reddish brown or chocolate. They are unilocular but may or may not be unilarval and vary in size from a small pea to about three-fourths of a centimeter across; and sometimes about equal proportions of the gall project from each surface of the leaf. Nineteen excrecences or more occur on a leaf. The gall dehisces into three or four lobes and turns dry and brown when vacated. Sometimes the galls become hardened and do not burst although harbouring fully developed insects which later on die inside.

The adults suck sap from buds and young leaves often in sufficient abundance to cause death of young growths.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The eggs are laid scattered about on immature buds and under surface of soft leaves. They are cream coloured and anchored to the plant tissues by means of a short process. The egg is oval, smooth, broadly round at one end and tapering at the other into a short tail. It measures 0.35 mm. long and 0.14 mm. broad.

The egg-laying data of two females are 211 and 304 eggs respectively within a period of 3 to 8 days in March.

Hatching.—The eggs hatch in 3 to 5 days. The nymph comes out through a split at a weak spot as described by Lees (1915) in the case of *Psylla mali*. The deserted egg-shell shrivels up afterwards into a minute scale.

Nymphal instars.—The young nymphs are cream coloured with pinkish red eyes. In the successive stages, the head, thorax, wing-pads, legs and antennae are pale grey; abdominal segments being light grey and yellowish intersegmentally. The wing-pads become more pronounced as development proceeds. A mature nymph is about 3 mm. long and 2 mm. broad and the humeral angles of the wing-lobes are slightly produced forward up to the neck.

No. 2.]

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The nymphs undergo five moults before transforming to adult forms and all the ecdyses are thrown off inside the gall. A thick sugary liquid covered over by waxy secretion is exuded by the nymphs and is seen as globules inside the gall when opened.

The nymphal period ranges from 109 to 120 days from mid-March to mid-July and 245 to 260 days from mid-July to mid-March (Table 3).

Adults.—They are active and jump when disturbed. They move about hurriedly on fresh growths for oviposition. The adults are short-lived.

Seasonal history.—The emergence from the galls coincides with the appearance of fresh growth. Eggs and adults are found in plenty from about mid-February to end of March. Soon after, the gall formation commences and the nymphs attain maturity and emerge in early July. These adults deposit eggs on the second outburst of leaves during the rains. The resulting nymphs from this batch of eggs overwinter inside the galls and complete development in the following spring.

Thus this species possesses two generations a year (Table 3).

TABLE 3.

Statement showing duration of life-cycles during 1933-34.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	18 Mar.	23 Mar.	5	10-21 July	109-120	114-125
2	15-21 July	18-26 July	3-5	20 Mar.-4 Apr.	245-260	248-263

13. *Tauropsysylla brevicornis* Crawford.

Crawford: Phil. Jl. Sci. 15, pp. 142-143, 1919. Tenimber Islands, Larat.

Two females were recorded at Dehra Dun, U. P., on 11th April and 5th June, 1933 respectively (R. N. Mathur coll.). One specimen was bred from deformed leaf-buds of *Mangifera indica* (mango) along with *Apsylla cistellata* Buckt.

14. *Pauropsylla depressa* Crawford.

(Plate II, Fig. 18.)

Crawford: Rec. Ind. Mus. 7, pp. 429-30, 1912. In galls on leave of *Ficus glomerata*, Pusa, Bihar; Rec. Ind. Mus. 26, p. 615, 1924. On *Ficus glomerata*, Coimbatore, on *Cinnamom* shoots, Mangalore.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 622, 1924.

Rahman: Ind. Jl. Agri. Sci. 2, pp. 358-377, 1932. Bred from galls on leaves of *Ficus glomerata*, Pusa, Lahore.

This species is abundant at Dehra Dun and seems to be distributed throughout India. It forms globular galls on the leaves of *Ficus glomerata* (gular). Each gall is a pointed sphere, its base projecting from the upper surface of the leaf, and its apex extending from the under side. They occur in clusters, or singly, and are pale green to reddish in colour. The mature gall, nature of injury and the nymphal stages have been described by Rahman (1932).

The female oviposits on soft buds and on the under surface of young foliage. The eggs are laid singly, scattered about, the projection of each being fastened into the plant tissues separately. The egg is cream coloured, oval, sculptured, having a short filament at the tapering end.

The egg-laying records of two pairs are 308 and 155, within a period of 13 and 5 days in March-April and July respectively.

The eggs began to hatch in 3 to 5 days (March-April and July). During winter the insects remain in the nymphal stage inside the galls and transform into adults with the first warm spring days.

15. *Pauropsylla nigra* Crawford.

Crawford: Phil. Jl. Sci. 15, p. 143, 1919. Found in the laboratory, Pusa, Bihar. Ind. Forest Rec. 14, p. 39, 1930. ex galls on leaves of *Mangifera indica*, Malacca.

16. *Pauropsylla* sp. n.

This species is fairly common at Dehra Dun, U. P., on *Ficus glomerata* (gular) (R. N. Mathur coll.).

(a) Injury to Host.

(Plate I, Fig. 4.)

The attack produces pit-galls on the under surface of leaves, which appear as small, rough elevations or papillae on the opposite side. So numerous are the galls on some leaves that owing to the swelling of their elevated portions the blade of the leaves is caused to curl

up or bend. The conspicuous pitting and folding of the leaves is most evident on young foliage. In severe infestations the leaves droop and become yellow, while some of them succumb. The pits are light yellowish green, somewhat circular or elliptical in plan.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The female deposits eggs in clusters usually near the edges towards the under surface of immature leaves. The eggs are white in colour, free from sculpturing and attached by a slender projection in the leaf tissues. They are oval, 0.22 mm. long and 0.10 mm. broad and bear a long filament, measuring 0.35 mm. Sometimes the eggs are so heavily laid that the leaf margin slightly curls inside.

The numbers of eggs laid by females were 641, 889 and 477 within a period of 19, 17 and 8 days respectively in March-August. The maximum number of eggs recorded in an egg-cluster is 353.

Hatching.—The incubation period varies from 3 to 7 days.

Nymphal instars.—The newly hatched larva punctures the soft, juicy leaf and forms a pit-like depression. Each depression is occupied by one nymph in its various instars. The young nymphs are deeper down in the pits while the older stages have the dorsal surface appressed to the leaf. All the exuviae except the last are cast off while the nymphs remain lodged in the pits. The skin splits mid-dorsally and this moulting process is repeated several times during growth. The final moult takes place outside the pit on the leaf. The nymphs exude large quantities of sugary liquid covered over with white waxy secretion which coats the leaves and branches of infested trees. A black fungus grows in the honey-dew. If the leaf withers the nymphs change their location being able to walk feebly.

The young nymph is oval, cream colour to pale yellow, possessing pinkish red eyes. As development progresses, wing-pads are discernible. Later stages are broadly oval, having pale yellow colour with greenish or brownish tinge; legs and antennae cream white. The body is fringed with a continuous series of stout setae. A mature nymph is about 1.45 mm. long and 1.12 mm. broad, the humeral angles of the wing-pads reach the posterior margin of the eyes.

The nymphal period varies from 71 to 120 days during March to early October and 130 to 141 days from mid-October to February.

Adults.—They are active and the average life of female is 16 days and male 23 days.

Seasonal history.—There are three generations a year (Table 4). The adults began to emerge in the laboratory and in the open from mid-February. The new flush also makes its appearance at this time.

The females lay eggs on them and the nymphs upon hatching remain in pits till mid-May when they transform to imagines. These psyllids continue another cycle, which completes development in late September and early October. Eggs are again deposited and the resulting nymphs overwinter in depressions and attain maturity in next February.

TABLE 4.

Statement showing duration of life-cycles during 1933-34.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	27 Feb.-1 Mar.	2-6 Mar.	3-5	12-25 May	71-81	74-87
2	5-7 June	8-11 June	3-4	22 Sept.-6 Oct.	106-120	109-123
3	4-6 Oct.	10-13 Oct.	6-7	17-28 Feb.	130-141	136-147

17. *Paucopsylla* sp. n.

(Plate I, Fig. 3.)

Leaves of *Ficus roxburghii* bearing somewhat globular galls were received from Lansdowne (elevation 5,500 ft.), U. P. (P. C. Kanjilal coll.) on 3rd October 1931. The galls were mostly immature, but ♂ and 2♀♀ were removed on opening the mature galls.

Young leaves show heavy gall-formation and the excrescences are either separate or form a glomerate mass of four or five galls. The galls are pale green, hard having thick cell-wall, unilocular, usually uninymphal but seldom binymphal. The gall dehisces into lobes on the upper surface of the leaf.

The young nymphs are pale yellow having an orange tinge in the abdomen and with pinkish red eyes. Half mature nymphs are yellowish orange with head, thorax and wing-pads pale grey. The full-grown nymphs are yellowish grey having light black antennae. The abdomen and wing-pads bear setae.

All exuviae are cast off inside the galls.

18. *Paucopsylla spondiifera* Crawford.

Crawford: Phil. Jl. Sci. 10, p. 260, 1915. Peradeniya, Ceylon; ex galls on leaves of *Spondias mungifera*. "Leaves inrolled on the margins."
Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 622, 1924.

19. *Paucopsylla tuberculata* Crawford.

Lefroy: Indian Insect Life, p. 742, plate LXXX.

Crawford: Rec. Ind. Mus. 7, pp. 430-31, 1912. On pumpkin and *Alstonia scholaris*, at Pusa, Bihar.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 622, 1924.

Rahman: Ind. Jl. Agric. Sci. 2, pp. 361-365, 1932. Bred from galls on leaves of *Alstonia scholaris*, Pusa.

The gall is barrel-shaped with the rounded base projecting from the upper surface of the leaf and the major portion projecting from the lower surface and bearing at the end an elongate slit which serves as an exit-hole for the nymphs. About twenty scattered galls occur per leaf on an average. After the escape of the adults the galls harden and blacken. The five nymphal instars are described by Rahman.

20. *Phacopteron lentiginosum* Buckton.

(Plate II, Fig. 16.)

Buckton: Ind. Mus. Notes, III (5), pp. 18-19 1894. From galls on *Garuga pinnata*, Poona, Bombay.

Kieffer: Zeit. Wiss. Insekt. 2, pp. 337-390, 1906.

Lefroy: Indian Insect Life, p. 743, 1909.

Crawford: Rec. Ind. Mus. 7, pp. 420-21, 1912. ex galls on *Garuga pinnata*, Dehra Dun; Phil. Jl. Sci. 15, p. 154, 1919, Coorg.

Ramakrishna Ayyar: Report Proc. Third Ent. Meeting, Pusa, pp. 1030-1031, 1919. Bred from galls on leaves of *Garuga pinnata*, North Malabar; Rec. Ind. Mus. 26, p. 622, 1924. Crawford treats *Phaesusoma* Kieffer as a synonym of *Phacopteron* Buckton.

Laing: Ind. Forest Rec. 16, p. 39, 1920. Bred from galls on *Garuga pinnata* and *Schleichera trijuga*, Dehra Dun, Tonkin, Heabinh.

This species is commonly found with its host-plants. The nymphs puncture the leaf tissues of the mid and secondary veins from the under surface. The veins swell up and form an acorn-shaped gall which remains concealed in the swollen portion. The nymphs at first suck sap at the base of the gall and after attaining the third stage pass into the interior of the excrescence which protrudes from the swollen tissues towards the upper surface. The galls are variously shaped, may be conico-ovoid, ovoid or globose, with a stylet at the apex and a shallow cup at the base. The terminal young leaves are deformed and crumpled into the most grotesque shapes and the leaves of some plants are entirely absorbed by these nut-like galls and resemble a large conglomeration of fruits. The galls are apple green to yellowish green suffused with lilac to reddish brown at places, and are generally multinymphal. Dry galls are hard and deep chocolate in colour.

The eggs are oval, each furnished with a basal protuberance and small tail and are laid in clusters on fresh growths and young leaves. They are white when freshly deposited and turn light black as they grow older.

The young nymphs are pale yellow in colour, with eyes pinkish red; legs and antennae light grey. Mature nymphs are flocculent and about 3.10 mm. long and 2.18 mm. broad, darker in colour having antennae, legs, wing-pads and partial abdominal segments light black.

The adults are active but short-lived.

21. *Phyllopecta gardneri* Laing.

(Plate II. Fig. 12.)

Laing: Ind. Forest Rec. 14 (8), pp. 39-41, 1930, ex leaf-galls on *Populus euphratica* (poplar), Ghazighat, Multan, Punjab.

The galls are sub-blobular, separate, seldom coalesced and are present on both the surfaces of leaves. They present green of every shade, from a pale yellowish to a rich olive, having smooth surface. They are about 5 mm. in length and 4 mm. in diameter and are unilocular and uninymphal. A leaf may contain eighteen or more galls upon it. The galls have been observed on saplings, coppice and mature trees in the forests. The opening of the gall which is just of the thickness of a pin, is circular or oval, bounded by a rim and covered over by a thin delicate membrane. This membrane bursts and allows the tenant to escape. The vacated galls are hard and assume pale brown to dark brown colour.

The nymphs are oval, yellowish in colour, with reddish brown eyes, and appendages are darker. Older stages are yellowish brown. They exude small drops of honey-dew covered over with waxy matter. The exuviae are thrown off inside the gall. The final skin bears a curious funnel-shaped structure with a stalk on the dorsal surface. The stalk is bifurcated and the ends are attached between the thorax and abdomen. Its function is not known and probably acts as a suction in attaching firmly the nymph to the cell-wall through the funnel and thus helps in shedding off the last moult.

The life-cycle appears to be annual. The period of adult emergence coincides with the appearance of new growths which are attacked and galled. The nymphs attain maturity at the time of the leaf-fall and emerge during January and February.

22. *Phyllopecta hirsuta* Crawford.

Crawford: (*Kawayama hirsuta*), Rec. Ind. Mus. 7, p. 427, 1912, Igatpuri, Western Ghats, Bombay; (*Alegutrioza hirsuta*) Phil. Jl. Sci. 15, p. 201, 1919. From galls on *Terminalia tomentosa*, India, Lonavla, Bombay; Rec. Ind. Mus. 26, p. 621, 1924. In galls on leaves of *Terminalia*, Mundakayam, Travancore, S. India.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 625, 1924.

Reared ex leaf-galls on *Terminalia tomentosa* (sain), from Jhajra, Dehra Dun, U. P., on 14th October 1925 (C. F. C. Beeson coll.). Further specimens were bred during October and November, 1932 (R. N. Mathur coll.); ex leaf-galls on *Terminalia arjuna* avenue trees at Amritsar, Punjab, during October-November, 1933 (G. D. Bhasin coll.) and also from North Salem, Madras and Coorg (N. C. Chatterjee coll.).

(a) INJURY TO HOST.

(Plate I. Fig. 9).

The damage is in the form of long galls which are confined to the foliage of terminal branches. By the feeding of the nymphs the leaf margin tends to rise and roll upwards and inwards in the direction of its length, until it meets towards the midrib. The roll gradually swells up into a tight curled up knob which sometimes continues to roll over upon itself. The rolling is very irregular but it is, however, more usual for one half or a portion of the leaf edge to be rolled. Galled leaves are sometimes spirally contorted. The galls are glabrous, pale green sometimes suffused with pink and mauve. The rolls open out slightly when the nymphs reach maturity. Vacated galls are dark brown in colour, shrivelled and woody.

No serious injury is done to old trees but young trees may suffer badly from distortion.

(b) LIFE-HISTORY AND HABITS.

The females lay eggs in cracks, punctures, along scars and loose bark in winter and on twigs and young foliage in summer. They are scattered about fixed in the plant tissues, by means of a basal prominence. The eggs are light buff, with an orange spot at the round end and are devoid of tail.

The hatching of winter eggs occurs almost simultaneously with the flush of new leaves while the summer eggs hatch in early September.

The young nymphs are light orange or pale yellow with orange tinge, with pinkish red eyes. Older stages are yellow with orange tinge having black terminal antennal segments. The body is thickly pubescent and flocculent. A mature nymph is about 3.5 mm. long

and 2.6 mm. broad and the wing-pads are produced cephalad to the eyes. Honey-dew covered over with white matter is exuded by the nymphs in large quantities inside the galls. Four moults occur within the gall and the fifth is undergone on the leaf.

The adults are active and rapidly and continuously wag their body while reposing. They have been observed to live for more than four months on the plants during winter.

The adult emergence took place in October and part of November from galls collected in September-October, 1932. These insects oviposited in safe situations and the eggs passed the winter without hatching. In April 1933, the eggs began to hatch and the nymphs reached maturity in June. Unfortunately these adults did not survive nor lay any eggs. Fresh attempts were made in winter 1933 and the psyllids emerged from the winter brood in early July 1934. These laid eggs in mid-July and the nymphs hatched out in mid-September and formed rolled galls on fresh leaves.

There are thus two generations a year with prolonged egg stages.

23. *Phyllopecta mallotica* Crawford.

Crawford: (*Mygattungia mallotica*) Entom. Mitteil. 17, p. 426, 1923, ex galls on *Mallotus philippinensis*, Port de Kock, Sumatra.

Laing: Ind. Forest Rec. 14 (3), p. 43, 1930. From galls on *Mallotus philippinensis*, Dehra Dun, U. P.

Common in galls on leaves of *Mallotus philippinensis* (raini) at Dehra Dun, in November 1932 and during 1933-34 (R. N. Mathur coll.).

(a) INJURY TO HOST.

(Plate I. Fig. 9.)

The galls are formed on the upper surface of soft leaves and may be separate and more or less globular or coalescent and irregularly shaped. Young galls are pubescent and variously hued, viz., green with pinkish tinge, pale green or pale brown with greenish tinge or reddish brown. The loculi are separate in glomerate galls but contain one to four nymphs in a loculus. Sometimes the galls are so numerously massed together that the leaf blade bends under and a pouch is formed.

The pest is injurious to young trees. At the time of emergence, the ostiole on the under side widens to allow mature nymphs to walk out. Sometimes in glomerate galls, mature nymphs desert their cells when the dehiscence occurs and the remaining unopened ones start rotting away and develop a fungus. Vacated galls are dry and a shrivelled mass of dark brown colour.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The eggs are glued in the tissues on either side of the veins on the under surface of the developing foliage and fresh buds. The egg is oval, smooth, pale brown in colour and measures 0.23 mm. long and 0.13 mm. broad, having a tail of 0.29 mm. length.

A freshly emerged pair deposited 230 eggs within a period of 23 days, during July.

Hatching.—The incubation period ranges from 3 to 6 days.

Nymphal instars.—The young nymphs are pale yellow with pinkish red eyes. Half mature nymphs are elliptical, pale yellow with wing-lobes of lemon colour, antennae at apex light grey and abdomen light orange. Mature stages are pale yellow with greenish tinge, having light grey specks on the thorax, terminal segments of antennae black and abdomen light orange with green tinge. A full-grown nymph is about 2.2 mm. long and 1.6 mm. broad with wing-pads reaching the posterior margin of the eyes.

The nymphs are flocculent and fringed with small white filaments. They profusely exude honey-dew surrounded with white waxy substance. Four moults occur within the gall and the last exuvia is cast off outside. The nymphal period occupies 83 to 111 days in summer and 167 to 177 days in winter.

Adults.—They keep the body slightly raised and constantly move it sideways while walking or at will. The longevity of female was 34 days and male 43 days.

Seasonal history.—There are three generations a year (Table 5). The spring generation matures in early July: The adults lay eggs and the nymphs upon hatching complete their development in October. These individuals give rise to a further generation, the nymphs of which overwinter and attain maturity in the following spring. Their emergence period coincides with the appearance of new growths on the host. The total life cycle occupies 86 to 116 days during summer and 173 to 183 days in winter.

In one of the experimental plants, the nymphs of the second brood instead of emerging during October, overwintered and developed to adult forms in the next spring, thus revealing two generations per annum.

TABLE 5.

Statement showing duration of life-cycles during 1933-34.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	18-22 Mar.	23-27 Mar.	5	5-12 July	104-111	109-116
2	17 July	20 July	3	11-14 Oct.	83-86	86-89
3	24 Oct.	30 Oct.	6	15-25 Apr.	167-177	173-183

24. *Phyllopecta* sp. n.

This species forms pit-galls on the leaves of *Mallotus philippinensis* (raini).

(a) INJURY TO HOST.

(Plate II. Fig. 19).

The pit-galls are formed on the under surface of tender leaves and are at first inconspicuous but gradually become quite pronounced and rise above the leaf surface. The depressions are more or less oval or subcircular, having pale green colour. Elevated portions are bluntly conical or round. A leaf may contain two hundred or more pits irregularly distributed.

The top leaves of young, weak and semi-suppressed trees are more heavily infested. The leaves turn yellow in severe outbreaks but they regain normal green colour with the disappearance of the psyllid. Young expanding buds may be destroyed by the adults.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The female deposits eggs scattered on the under surface of soft, immature leaves. The egg is oval, cream coloured, faintly sculptured, 0.23 mm. long and 0.11 mm. broad and is furnished with a small basal prominence and a long tail-filament of 0.29 mm.

Three females laid 891, 280 and 237 eggs, within a duration of 8 to 19 days. The third female revealed 44 more eggs on dissection.

Hatching.—The egg-stage occupies 3 to 6 days.

Nymphal instars.—The young nymphs are broadly oval, pale yellow with orange tinge, bearing small, dorsal brownish black

patches. Lateral patches extend from the eyes to the junction of the thorax and abdomen and the abdominal patch is situated medially near the caudal margin. Mature nymphs are pale green or pale yellow with light orange tinge in the abdomen, with pinkish red eyes and black apical antennal segments. A median stripe of pale clay yellow colour interspersed with small irregular light black patches is present on the dorsal surface. The outer and inner borders of the wing-pads and the abdominal margin are also ornamented with similar patches. The body is fringed with setae and sparsely threaded with long waxy fibres dorsally. A full-grown nymph is about 1.7 mm. long and 1.2 mm. broad, with the humeral angles extending almost to middle of the eyes.

Occasionally, a depression may contain two nymphs but usually one nymph roofs the pit. The nymphs exude small cylindrical wax covered liquid from the anus.

The nymphal period ranges from 18 to 63 days in summer and 166 to 186 days in winter.

Adults.—They sit at an angle on the plant and vibrate their body constantly when at rest or walking.

Seasonal history.—This psyllid passes through five generations annually (Table 6). The total life-cycle takes 22 to 69 days during summer and 170 to 190 days in winter.

TABLE 6.

Statement showing duration of life-cycles during 1933-34.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	17-20 May	20-24 May	3-4	15-28 June	26-30	29-42
2	21-24 June	25-28 June	4	13-28 July	18-33	22-37
3	21-24 July	25-27 July	3-4	28 Aug.-8 Sept.	4-45	38-49
4	4-7 Sept.	8-11 Sept.	4	21 Feb.-13 Mar.	166-186	170-190
5	11-17 Mar.	17-23 Mar.	6	36 Apr.-19 May.	44-63	50-69

25. *Phyllopecta* sp. n.

(Plate I, Fig. 6.)

Forms pit-galls on the leaves of *Shorea robusta* (sal) at New Forest, Dehra Dun.

The attack commences just after the appearance of new flush of leaves. During summer all stages of the pest are found on the host and the broods overlap considerably. The leaves of some trees are entirely pitted and they cease to function and fall off prematurely. Young buds are destroyed completely by the adults. In the rains and early winter the degree of infestation is sufficiently reduced for the trees to recover their vitality. The insect is not uncommon in the natural forests.

The pits are shallow, pale yellow in colour, and appear like small swellings on the upper surface. Each depression harbours a nymph of different instars, closely appressed against the leaf surface.

The adults jump actively and fly about on the neighbouring branches. They are in the habit of rapidly vibrating their body.

The eggs are deposited singly or in groups on fresh growths. The egg is cream white in colour, oval, slightly curved, faintly sculptured and is furnished with a small basal projection. It is 0.21 mm. long and 0.10 mm. broad, bearing a tail of 0.03 mm. curving upwards.

The young nymphs are cream white, oval in shape, having pinkish red eyes. Later stages are pale yellow, broadly oval and fringed with small setae. A mature nymph is about 1.12 mm. long and 0.8 mm. broad and the humeral angles of the wing-pads reach the eyes.

The nymphs are active and shift when the leaves wither, to other uninfested leaves. They exude white sticky globules of honey-dew from the anus.

26. *Phyllopecta* sp. n.

(Plate II, Fig. 17.)

Forms globular-galls on the twigs of *Populus euphratica* (poplar) at Ghazighat, Multan, Punjab.

The galls vary in size from a small pea to as much as half inch across. Two or exceptionally more galls may coalesce to form a common globular mass. These galls occur anywhere on the shoot and are frequently situated near the branching off another shoot. The gall is unicellular having a relatively thick wall and unympathal. Its inner surface is white suffused with green and is spongy. The ripe galls are rough and shrunken and dehiscence by clefts, the form

edges of which reflex to free the winged insect. With the growth of later years the base of the gall remains and expands into a rough scar. Where galls have fused together, one or two galls may rupture and the others start rotting away due to the interruption to the sap flow caused by the splitting.

Physiologically, the vitality of the plant is affected to a certain extent due to the check of the sap flow, but the shoot is not killed. The gall does not distort the local growth of the twig except when occurring at a bifurcation. The drying up and splitting up of galls situated near bifurcations of shoots may cause distortion of growth by (1) causing the lateral shoot to take off at an obtuse angle or (2) by killing back the leader in the direct line with the survival of a displaced lateral. The dying back of yearling twigs is sometimes due to this insect but is not noticeably *en masse* sufficient to cause wholesale crown dying back.

Galls are not found during the hot season and make their appearance in winter. In February they become prominent and the adult emergence begins in March. The cycle seems to be annual.

The nymphs are pale yellow with greenish tinge in the abdomen, eyes pale grey, antennae and legs light grey. They are flocculent and exude sticky liquid from the anus.

27. *Phyllopecta* sp. n.

(Plate II, Fig. 18.)

Forms pit-galls on the twigs of *Populus euphratica* (poplar) at Ghazighat, Multan, Punjab.

The pit-galls are formed by the thickening of the bark in one or two years old twigs. The depressions are deep, circular or transverse-elliptical in plan, with swollen rim. Each is occupied by a nymph in various instars. When the pits are crowded together they form an alveolate reticulation of the bark which completely checks the longitudinal growth of the twig, although owing to the increase in bark thickness its diameter grows disproportionately. In severe attacks the twig dies in one season; when the insects are in more open formation there is a considerable distortion and swelling of the bark which dies in patches. The internal effect has not been examined but there is a pink stain produced which extends into the cortex for irregular distances and the wood becomes brown in places. A few cases of pit-galls have been seen on branches of one-half inch thickness. The galls are much less common on healthy twigs than on obviously unhealthy plants. Deserted pits become shallow pores and eventually disappear.

This insect may (a) check the growth entirely and kill a twig in one season or (b) reduce its longitudinal growth and cause distortion without killing it in the first season, (c) cause the dying back of the subsequent years shoot (if unattacked) owing to the interference in the sap flow due to the partial death and distortion of the conducting layers in the older part of the branch.

The pest is not visible during summer months and its attack commences in winter. During February and March, nymphs of various stages are found abundantly and they transform into winged adults in March-April.

The nymphs are broadly oval, with flat dorsal surface and bulging venter which occupies the pit. Young nymphs are pink or yellow coloured and rest deep in the pit while the older stages show fuscous markings and completely roof the surface of the pit with the bark level. The sternal region has two pairs of long fleshy protuberances between the legs which evidently press against the sides and bottom of the pit and anchor the insect in position. The nymphs bear a narrow waxy fringe around the margin of the dorsal surface.

The nymph casts off the skins while occupying the pit. It walks with a staggering pace when disturbed and occupies an abandoned pit if near-by. The nymphs exude white sticky drops of honey-dew from the hind end.

22. *Psylla* sp. n.

This is not a gall-forming species and is quite common on the leaves and green twigs of *Bauhinia variegata* (kashnar) at Dehra Dun, U. P. (R. N. Mathur coll.).

(a) INJURY TO HOST.

(Plate II, Fig. 11.)

With the advent of spring when the trees flush and put forth blossoms the pest appears in large numbers. The trees become heavily infested with nymphs of different instars. The flowers shrivel, fail to develop and drop to the ground. Drain of sap from young foliage causes the lobes of the lamina to fold. The leaves appear sickly and eventually succumb to the attack. Thus time after time tender shoots are given out to attack and the tree is defoliated. The injury results in a reduced rate of growth and unthrifty condition of the infested trees. Young plants are dwarfed and stunted. The

degree of infestation drops to a minimum during the rains. The nymphs are washed away and the trees regain their vitality.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The female lays eggs scattered about in the folds of soft buds and on tender leaves. Freshly laid eggs are cream white and upon aging turn black dorsally and light black ventrally. The egg is narrowly oval, 0.30 mm. long and 0.11 mm. broad and is glued in the plant tissues by means of a short basal process.

The total number of eggs laid by four females in confinement, is 991, 1473, 459 and 340 within a duration of 17, 36, 20 and 42 days respectively during April–November.

Hatching.—The incubation period occupies 3 to 5 days in summer and 7 to 10 days in winter.

Nymphal instars.—The young nymphs are pale yellow, sometimes with light orange tinge; thorax bearing small light black plates. Half mature nymphs are light yellow with orange tinge having darker thoracic plates and wing-lobes yellow with black tinge. Mature nymphs are yellowish green or yellowish orange with crimson eyes; head plates, distal half of antennae, wing-pads, thoracic plates, tarsi and caudal plate black, rest of antennae light gray. A mature nymph is about 1.82 mm. long and 1.16 mm. broad, with the wing-lobes projecting well beyond the contour of the body.

The nymphs exude opaque liquid covered with white waxy matter as a projecting cylindrical lump. They do a lot of wriggling, probably to detach this sugary filament from the anus.

The nymphs undergo five moults before adult emergence. The nymphal period occupies 11 to 37 days during summer and 28 to 63 days during winter.

Adults.—The longevity of male and female was 35 and 49 days respectively, but they seem to live longer out-of-door.

Seasonal history.—Adults, nymphs of all stages and eggs are found simultaneously on the trees during spring and summer. The generations overlap and no definite brood can be recognised in the field. The density of population is considerably reduced in the rains. In the cooler months the insects are less active and the generations are much prolonged. At the time of leaf-fall, the nymphs crawl on to the green shoots for nourishment. This psyllid passes through eleven

generations annually (Table 7). Total duration of life-cycles takes 15 to 42 days in summer and 32 to 70 days in winter.

TABLE 7.

Statement showing duration of life-cycles during 1932-33.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	29-30 Apr.	3-5 May	4-5	19-25 May	16-22	20-26
2	23-26 May	26-30 May	3-4	14-30 June	19-35	22-33
3	23-26 June	27-30 June	4	18-29 July	21-32	25-36
4	21-25 July	25-29 July	4	5-15 Aug.	11-21	15-25
5	8-11 Aug.	13-15 Aug.	4	29 Aug.-5 Sept.	17-24	21-28
6	30 Aug.-2 Sept.	3-6 Sept.	4	20-29 Sept.	17-26	21-30
7	21-27 Sept.	28 Sept.-1 Oct.	4	17-25 Oct.	19-27	23-31
8	20-22 Oct.	24-26 Oct.	4	21 Nov.-1 Dec.	28-38	32-42
9	28 Nov.-3 Dec.	5-12 Dec.	7-10	23 Jan.-6 Feb.	49-63	56-70
10	31 Jan.-4 Feb.	6-10 Feb.	6	17-23 Mar.	39-50	45-56
11	22-25 Mar.	27-30 Mar.	5	20 Apr.-3 May.	24-37	29-42

29. *Psylla* sp. n.

This psyllid was recorded on *Murraya koenigii* (gundla) at Dehra Dun, U. P., in early August, 1933 (R. N. Mathur coll.).

Young growths generally suffer from the psyllid attack. The eggs are laid singly or in clusters, scattered about, on fresh growths and axils of young leaflets. The egg is oval, glabrous, shining 2-27 mm. long and 0.14 mm. broad and bears a short process and a long tail-like filament of 0.21 mm. An orange coloured spot is visible when the egg is mature.

The young nymphs are pale yellow with tip of antennae black, legs pale brown, eyes pinkish red, and abdomen partially orange and black. Mature nymphs are yellow with bluish green tinge, antennae pale brown with black apices, legs light brown, abdomen orange with green or brown tinge and wing-lobes light brown. The body with wing-pads is fringed with setae.

The nymphs are active, gregarious and feed at the axils of leaflets and between unfolded buds. They exude white threads of honey-dew.

The egg-stage occupies 4 to 5 days during August and September. The nymphs overwinter from mid-September to mid-March.

30. *Tenaphalara acutipennis* Kuwayama.

Kuwayama: Trans. Sapporo Nat. Hist. Soc. 2, p. 155, 1903. Formosa, Philippines.

Crawford: (*T. elongata*). Rec. Ind. Mus. 7, pp. 432-33, 1912. On silk cotton, Pusa.

Fletcher: Report Proc. Second Ent. Meeting, Pusa, p. 131, 1917.

Crawford: Phil. Jl. Sci. 15, pp. 164-165, 1919. Collected on *Sterculia foetida*, Luzon, Laguna Province, Los Banos.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 623, 1924.

Rahman: (*T. elongata*), Ind. Jl. Agri. Sci. 2 (4), pp. 367-370, 1932. On leaves of *Bombax malabaricum*, Pusa.

Bhatia and M. Shafi: (*Tenaphalara elongata*) Ind. Jl. Agri. Sci. 2 (6), pp. 543-570, 1932.

Collected and bred from nymphs on the leaves of *Bombax malabaricum* (semul) at Dehra Dun, U. P. (B. M. Bhatia coll. and myself) during January and December, 1933.

The infestation begins in winter and the rapid increase in insect population causes the leaflets to wilt and turn yellow. Frequently some of the leaflets or the entire leaf succumb to the attack but the trees are not seriously affected as the leaf-shedding commences soon after.

Rahman describes the five nymphal stages (under the synonym *elongata*).

31. *Trioza fletcheri* Crawford.

Crawford: Rec. Ind. Mus. 7, p. 434, 1912. On *Gmelina arborea*, Pusa, Bihar; Phil. Jl. Sci. 12, p. 173, 1917. In galls of *Trewia* sp., Coimbatore; Phil. Jl. Sci. 15, p. 190, 1919. Singapore; Rec. Ind. Mus. 26, p. 621, 1924. ex galls on leaves of *Trewia*, Coimbatore, S. India.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 624, 1924.

Rahman: Ind. Jl. Agri. Sci. 2 (4), pp. 358-377, 1932. From leaves of *Trewia* sp., Pusa.

32. *Trioxa fletcheri* minor Crawford.Crawford: Rec. Ind. Mus. 7, p. 434, 1912. On *Terminalia arjuna*, Unsa, Bihar.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 624, 1924.

This species is found abundantly at Dehra Dun, U. P., forming galls on soft foliage of *Terminalia tomentosa* (sain). It was bred in September 1929, July 1931 and throughout the year 1932 (R. N. Mathur coll.). It was also recorded ex galls on leaves of a hybrid—*T. tomentosa* × *T. arjuna* at New Forest, Dehra Dun.

(a) INJURY TO HOST.

(Plate II, Fig. 10.)

The galls are present on the upper surface of leaves and some may also be found on the lower surface. An average sized leaf may have as many as five hundred galls upon it and shows a speckled appearance on the under surface. Galls are small papillae, usually separate but sometimes three or four coalesce to form an irregular mass. They are always unilocular containing one individual. Summer galls are pale yellow with greenish tinge and variously shaped, while the winter-galls are brown, yellowish green at the base and generally globular or oval. They are as big or a little smaller than a pea. A slit-like dehiscence occurs on the ventral aspect of the gall and the aperture is clothed with thick white pubescence. The leaf from which emergence has finished, appears completely riddled with exit holes due to the falling off galls. The deserted galls gradually dry up and the tissues surrounding them shrivel up and die back.

The galls are more plentifully formed during April to July. The pest is not particularly injurious to old forest trees but in young plantations and nurseries it is disastrous. It has been observed that *T. crenulata* plants raised from seeds from Coorg (S. India) and Burma, and growing along with *T. tomentosa* in the plantation at New Forest, are practically immune to psyllid attack. The local plants of *T. tomentosa* are the most susceptible and in many places are loaded with galls year after year.

(b) LIFE-HISTORY AND HABITS.

Oviposition.—The eggs are fixed either singly or in clusters, usually scattered about on fresh growths. At the time of leaf-fall, they are deposited on young green shoots. The eggs are 0.30 mm. long and 0.10 mm. broad; smooth, shining, slightly curved and narrowly oval, and are furnished with a small basal process but devoid of tail. They are cream white when first laid and upon aging turn black.

Egg-laying counts revealed 534 the maximum and 59 the minimum number of eggs laid by the females during oviposition period of up to 12 days.

Hatching.—The incubation period lasts from 3 to 6 days. The nymph takes about eighteen minutes to free itself from the shell.

Nymphal instars.—The young nymphs are pale yellow with pinkish red eyes. Later stages are pale yellow with green or brown tinge in the abdomen, broadly oval in shape and fringed with white filaments. A mature nymph is about 1.52 mm. long and 1.1 mm. broad, with the humeral angles reaching the eye.

The nymphs are flocculent and exude globules of sugary fluid. Four moults occur within the gall and the last takes place outside on the leaf.

The nymphal period occupies 13 to 40 days in summer and 161 to 172 days in winter.

Adults.—They are active and have been known to live for 13 days in captivity.

Seasonal history.—The insect emerges from the winter galls late in March and April and passes through seven cycles till October. All stages of the psyllid are met with on the host in the field throughout the warmer period, thus presenting considerable overlapping of broods. The nymphs of the last brood overwinter inside the excrescences. The total duration of life-cycles takes 16 to 46 days in the hot season and 166 to 177 days in cold months (Table 8).

There are eight generations annually of this species.

TABLE 8.

Statement showing duration of life-cycles during 1932-33.

No. generations.	Egg-laying.	Hatching.	Incubation period (Days).	Adult emergence.	Nymphal period (Days).	Total duration (Days).
1	24-29 Mar.	28 Mar.-2 Apr.	4	25 Apr.-2 May.	28-35	32-39
2	29 Apr.-1 May.	2-4 May	3	27-30 May	25-28	28-31
3	31 May-2 June.	3-5 June	3	16-26 June	13-23	16-26
4	19-22 June	22-25 June	3	9-13 July	17-21	20-24
5	12-14 July	15-18 July	3-4	5-15 Aug.	21-31	24-34
6	8-11 Aug.	13-17 Aug.	5-6	2-12 Sept.	20-30	25-35
7	6-9 Sept.	12-15 Sept.	6	11-22 Oct.	29-40	35-46
8	13-18 Oct.	18-24 Oct.	5-6	28 Mar.-8 Apr.	161-172	166-177

33. *Trioza jambolanae* Crawford.

(Plate I, Fig. 8.)

Crawford: Phil. Jl. Sci. 12, pp. 173-174, 1917. On *Eugenia jambolana*, Pusa, Bihar.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 624, 1924.

This species was bred from galls on the leaves of *Eugenia jambolana* (jamban) at Dehra Dun, U. P., during March 1932 and 1934 (R. N. Mathur coll.). It is a rare species.

Galls are formed on the upper surface of leaves and are either separate or coalesced in a mass of two to eight galls having separate loculi. The galls are smooth, hard, of green colour suffused with brown and more or less globular or oblong in shape. A typical gall is about 7 mm. long and 5 mm. in diameter and uninymphal. When mature, it splits in several lobes and turns to dark brown colour on drying.

The young nymphs are pale yellow with orange coloured eyes. Half mature stage are pale yellow with bluish or blackish tinge; antennae and legs grey and abdomen orange yellow ventrally. Full-grown nymphs are broadly oval, yellowish or bluish green with light black tinge; antennae black, legs light black and ventral side of abdomen bluish green. It is about 2.9 mm. long and 2.1 mm. broad, with the humeral angles of the wing-pads extending forward almost to the anterior margin of eyes. The nymphs are slightly flocculent and fringed with small filaments. Drops of honey-dew are exuded by the nymphs inside the galls. Four exuviae have been counted inside a mature gall and the nymph sheds its final skin outside on the leaf.

The adults are active and resemble the surroundings and hence are not easily discernible.

34. *Trioza obsoleta* Buckton.Buckton: (*Psylla obsoleta*) Ind. Mus. Notes, 5 (2), p. 35, 1900. ex leaf-galls on *Diospyros melanocylon*, Thana, Bombay.

Froggat: Ind. Mus. Notes, 5 (3), pp. 111-112, 1900.

Stebbing: Dept. Notes, 1, pp. 130-131, 1902.

Lefroy: Indian Insect Life, p. 743, 1909.

Ramakrishna Ayyar: Rec. Ind. Mus. 26, p. 623, 1924.

Laing: Ind. Forest Rec. 14 (8), p. 44, 1930.

III. PARASITES, PREDATORS AND ANTS.

Parasites and Predators.

These psyllids are subject to attack by parasitic and predacious enemies, which are not yet specifically identified. The percentage of parasitism appears to be fairly high in the case of *Pauropsylla depressa*, *Phacopteron lentiginosum*, *Psylla* sp. (on *Bauhinia variegata*), *Trioza fletcheri* minor and *Phyllopecta* sp. (ex pit-galls, *Shorea robusta*).

The nymphs suffer from many minute foes belonging to Chalcidoid, Braconid, Ichneumonid, some predators and casual enemies such as the caterpillars of moths which destroy the nymphs while feeding. Chalcids are the most common and attack the nymphs in all stages but generally the third and fourth instars are preferred. Parasitised nymphs are distinguishable when the parasite grub pupates, the former appears swollen, brown or black in colour.

Among the predators are Coccinellid (Lady-bird) beetles and their larvae, Chrysopid larvae, Syrphid larvae, Capsid and Pentatomid bugs and their nymphs. They either feed upon the hosts or suck them dry.

The adults are victimised by the several species of Spiders, Mantidae (Mathur, 1934) and by the above predators except Syrphid larvae. Two or three species of ants have also been observed attacking the nymphs and adults.

The rotting galls are invariably found occupied by the larvae of *Dichocrocis punctiferalis* Guen., which are gallivorous. They destroy healthy galls of the conglomeration along with the rotting galls and consequently the nymphs inside are sacrificed.

The parasites and predators reared from the various species of psyllids are mentioned below:—

1. *Apsylla cistellata*:—Chalcid: 1 species. Syrphid: *Bacca pulchifrons* Aust., during April.
2. *Arytaina* sp.:—Coccinellid: *Brumus suturalis* Fab., *Rodolia* sp., *Chilomenes 6-maculata f-undulata* Sch., *Ocnopia sauzeli* Muls. Chrysopid: *Chrysopa* sp. Two larvae were caught on 18th May, 1934, which pupated on 22nd May, 1934. The lacewings emerged on 29th May, 1934, showing a pupal period of 7 days.
3. *Cerotrioza* sp.:—Chalcid: 2 species. Syrphid: *Bacca pulchifrons* Aust.
4. *Euphalerus vittatus*:—Chalcid: 1 species. Syrphid: *Paragus serratus* Fabr. Coccinellid: *Platynaspis lewisi* Crotch. Its grub was captured on 10th June, 1933 and

pupated on 14th June. The beetle emerged on 19th June, a pupal period of 5 days. Mantid: *Creoboter urbana* Fabr., *Deiphobe* sp., *Hierodula westwoodi* Kirby.

5. *Paurocephala* sp.:—Chalcid: 1 rare species.
6. *Pauropsylla becconi*: Chalcid: 2 species. During February, the galls were destroyed by a small bird.
7. *Pauropsylla depressa*:—Chalcid: 3 species. Braconid: 2 species. Ichneumonid: 1 species. Chrysopid: one specimen emerged on 24th March 1932. The nymphs in some of the galls were infested with minute mites.
8. *Pauropsylla* sp. (ex pit-gall, *Picus glomerata*):—Chalcid: 2 rare species.
9. *Phacopteron lentiginosum*:—Chalcid: 1 species. The parasite emerges by gnawing a circular hole at the caudal region of the nymph and boring another in the gall-tissues.
10. *Phylloplecta gardneri*:—Chalcid: 2 species, one of them emerging during February-March.
11. *Phylloplecta hirsuta*:—Chalcid: 2 species. Coccinellid: *Verania cardoni* W.S. One specimen (G. D. Bhasin coll.).
12. *Phylloplecta mallotica*:—Chalcid: 2 species. Braconid: 1 species. Syrphid: *Bacca pulchifrons* Aust.
13. *Phylloplecta* sp. (ex pit-gall, *Mallotus philippinensis*):—Chalcid: 2 species. Pentatomid: one species. Chrysopid: *Ankylopteryx* sp. Its larva was caught on 12th May, 1934, which pupated on 18th May and transformed into lacowing on 26th May, with a pupal period of 8 days.
14. *Phylloplecta* sp. (ex pit-gall, *Shorea robusta*):—Chalcid: 2 species. Coccinellid: *Chilomenes 6-maculata* f. *undulata* Sch., *Coclophora* sp. Its larva was found devouring the nymphs on 26th June, 1933. It pupated on 3rd July and on 7th July the beetle emerged indicating 4 days pupal period. Syrphid: *Sphaerophoria javana* Wied. Mantid: *Creoboter urbana* Fabr., *Deiphobe* sp., *Hierodula westwoodi* Kirby.
15. *Psylla* sp. (on *Bauhinia variegata*):—Chalcid: 2 species. Syrphid: *Bacca pulchifrons* Aust. and *Sphaerophoria javana* Wied. Coccinellid: *Coccinella septempunctata* Linn., *Oenopia sauzei* Muls., *Chilomenes 6-maculata* f. *undulata* Sch. Mantid: *Creoboter urbana* Fabr., *Deiphobe* sp., *Hierodula westwoodi* Kirby.

16. *Tenaphalara acutipennis*:—Chalcid: 1 species. Syrphid: *Bacca pulchifrons* Aust. and *Sphaerophoria javana* Wied. These have been recorded at Pusa, feeding on the nymphs, during November—February and November respectively (Bhatia and M. Shafi, 1932).
17. *Trioza fletcheri minor*:—Chalcid: 3 species. Mantid: *Creoboter urbana* Fabr., *Deiphobe* sp., *Hierodula westwoodi* Kirby.
18. *Trioza jambalanac*:—Chalcid: 2 species. Braconid: 1 species. Chrysopid: one specimen of *Chrysopa* sp. Capsid: 1 species.

Ants.

The specimens of ants associated with psyllids were sent to Mr. D. D. Mukerji of Calcutta University for determination, who notes, "the symbiotic relationship of ants to Homoptera, called trophobiosis, is well known. The ants feed on the excrement of the Homoptera, and in return afford them protection. We do not, however, possess exact information of the species of our Indian ants that attend Psyllids. Wheeler (1910, p. 350) remarks, "the recorded observations on the relations of these insects to Psyllids appear to be rather meagre." The collection on which this note is based, though small, is important in as much as it represents examples of ants that were found in association with Psyllids. It is also of interest from the point of view of local fauna. The collection contains examples of five species, four of which belong to *Camponotinae* and one to *Dolichoderinae*. They were collected by Mr. R. N. Mathur during the month of June, 1934, from New Forest, Dehra Dun, U. P."

The species of ants are mentioned below:—

1. *Camponotus milis* Smith. These were suspected to predate upon nymphs of *Paurocephala* sp. on *Kylia calycina*.
2. *Camponotus compressus* Fabr.
3. *Acantholepis pulchella* Forel.
4. *Tapinoma indicum* Forel.
5. *Camponotus paria* Emery., attends *Arytaina* sp. on *Albizia procera*.

} These were found to attend *Psylla* sp. on *Bauhinia variegata*; *Euphalerus vittatus* on *Cassia fistula* and *Phylloplecta* sp. on *Shorea robusta*.

Grove and Ghosh (1914) records six kinds of ants attending *Arytaina punctipennis* Crawl. viz., *Camponotus compressus*, *C. sericeus*, *Tapinoma melanocephalum*, *Monomorium indicum*, *M. gracillimum* and *Occophylla smaragdina*.

IV. REFERENCES.

Several references to various species have been noticed in the text. The following are additional references:—

1. Bhatia, H. L. and Mohammad Shafi (1932). *Ind. Jl. Agri. Sci.* 2, pp. 563-570.
2. Crawford, D. L. (1914). *Bull. U. S. Nat. Mus.* 85, pp. 1-186.
3. Grove, A. J. and Ghosh, C. C. (1914). *Mem. Dept. Agri. India*, 4 (6), pp. 329-357.
4. Lees, A. H. (1915). *Ann. Appl. Biol.* 2, pp. 251-257.
5. Mathur, R. N. (1934). *Ind. Forest Rec.* 20 (3), pp. 1-25.
6. Wheeler, W. M. (1910). *Ants*. New York.

EXPLANATION OF PLATES.

Plate I.

- Fig. 1. Galls of *Pauropsylla beesoni* on leaves of *Litsaea polyantha*.
 Fig. 2. Pit-galls of *Paurocephala* sp. n. on leaves of *Kydia calycina*.
 Fig. 3. Galls of *Pauropsylla* sp. n. on leaves of *Ficus roxburghii*.
 Fig. 4. Pit-galls of *Pauropsylla* sp. n. on leaves of *Ficus glomerata*.
 Fig. 5. Galls of *Phyllopecta mallotica* on leaves of *Mallotus philippinensis*.
 Fig. 6. Pit-galls of *Phyllopecta* sp. n. on leaves of *Shorea robusta*.
 Fig. 7. Inquiry caused by *Euphalerus vittatus* to leaves of *Cassia fistula*.
 Fig. 8. Galls of *Trioza jambolanae* on leaves of *Eugenia jambolana*.
 Fig. 9. Leaves of *Terminalia tomentosa* rolled by *Phyllopecta hirsuta*; also bear galls of *Trioza fletcheri minor*.



Plate II.

- Fig. 10. Galls of *Trioxa fletcheri minor* on leaves of *Terminalia tomentosa*.
- Fig. 11. Injury caused by *Psylla* sp. n. to *Bauhinia variegata*.
- Fig. 12. Galls of *Phylloplecta gardneri* on leaves of *Populus euphratica*.
- Fig. 13. Pit-galls of *Phylloplecta* sp. n. on twig of *Populus euphratica*.
- Fig. 14. Buds of *Mangifera indica* deformed by *Apsylla cistellata*.
- Fig. 15. Injury caused by *Arytaina* sp. n. to *Albizia procera*.
- Fig. 16. Galls of *Phacopteron lentiginosum* on leaves of *Garuga pinnata*.
- Fig. 17. Galls of *Phylloplecta* sp. n. on twigs of *Populus euphratica*.
- Fig. 18. Galls of *Pauropsylla depressa* on leaves of *Ficus glomerata*.
- Fig. 19. Pit-galls of *Phylloplecta* sp. n. on leaves of *Mallotus philippinensis*.
- Fig. 20. Leaves of *Shorea robusta* folded by *Cerotrionia* sp. n.