

OCCASIONAL PAPER NO. 181

**RECORDS OF THE
ZOOLOGICAL SURVEY OF INDIA**

**Studies on some Indian Pyralid species
of Economic Importance, Part-1**

Crambinae, Schoenobiinae, Nymphulinae, Phycitinae and Galleriinae

(Lepidoptera : Pyralidae)

G.S. ARORA

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G.S. ARORA*
Emeritus Scientist



सत्यमेव जयते

**ZOOLOGICAL SURVEY OF INDIA
CALCUTTA
2000**

* Address for Correspondence: Dr. G.S. Arora, G-175, Preet Vihar, Vikas Marg, Delhi-110092

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INTRODUCTION

The Pyralid moths constitute an important group of insects in the order Lepidoptera, and comprise several species of great economic importance. There are several well established and well known pest-species like yellow stem borer, top borer, shoot borer, stalk borer, white borer, internode borer, root borer, pod & capsule borer, fruit borer, fruit-tree pests, wax-moth, rice moth, Indian meal moth and number of leaf folders and case worms. The pest-species, when increase in population beyond a certain level, in nature, cause serious economic losses to the nation and miseries to the farmers in respect of their own welfare, or even their survival. Several of these well known species occur simultaneously with lesser known pests which, therefore, stand neglected both in respect of their identity and monitoring. Since these species cause a very little loss or damage, these remained practically unknown to agricultural or field entomologists, taxonomically. Besides, even the well known species like top borer, *Scirpophaga excerptalis* (Walker) in sugarcane, and *S. nivella* (Fabr.) in rice, had often been confused till very recently. It was only through taxonomic studies that these species were clearly differentiated. Similarly, the other species, yellow stem borer, *Scirpophaga incertulas* (Walker) has always dominated the field, the males of which resemble closely with males of *S. gilviberbis* (Zeller) and *S. nivella* (Fabr.), and have often been confused. The females of these three latter species, are quite different and are easily separable. In fact, the males of *gilviberbis* and *nivella*, infesting rice, have often been wrongly assumed as "*incertulas*" To keep the check on their population, it is essential to make exhaustive studies on various aspects involved, including population dynamics, bionomics, behaviour, habits, host-preference, etc., under various climatic or controlled conditions. And unless their identity is clearly known, all the efforts to control the pests will remain fruitless. Although, a large number of papers have been published on important crop-pests, either singly or on the group as a whole, these are mostly scattered, and some inadequate to identify the pests.

The present study was aimed at studying the important pests, both major as well as minor, in the family Pyralidae, so as to provide an easy key as an identification guide, not only to the taxonomists but to the agricultural entomologists also to make them aware of the entire pest-complex in their field of work. Once the field entomologists are aware of the pest-complex, they can plan their strategy to suppress the pest population. It was also with this object in view that the studies were undertaken to consolidate all the relevant information by studying their colouration & pattern, morphological characters and wing venation. The present studies contribute towards bringing the pests species at one place, in two parts. While Part I deals with subfamilies Crambinae, Schoenobiinae, Nymphulinae, Phycitinae, and Galleriinae, the Part II will deal exclusively with Pyraustinae (*Sensu* Hampson, 1896) including other subfamilies like, Odontiinae, Glaphyriinae, Noordinae and Evergestinae (*Sensu* Munroe, 1972).

HISTORICAL ACCOUNT

(a) Agricultural Entomology

Cotes (1889-1896) and Barlow (1899, 1903) published notes on the pests in Indian Museum. Lefroy (1909), however, made an outstanding contribution by presenting a book, the first ever, *Indian Insect Life*, where all the major as well as minor pests, then known, along with their hosts, status, habits and biological information were given, for the various orders of insects, including various families in each order. In the family Pyralidae, about eighty species were recorded, though several names of these species, presently, stand changed or synonymised. Nevertheless, the work stands as an important landmark in agricultural entomology in India, before undertaking any study on Indian pests of economic importance. This was followed by Fletcher (1914) who published *Some South Indian Insects* ----- and, similarly, dealt with pests of economic importance, particularly prevailing in southern India. Fletcher, being associated with the Imperial Agricultural Research Institute, Pusa (Bihar), continued to monitor all the research work in connection with pests on various crops, throughout its centres and presented results in the *Proceedings of Entomological Meetings* (1917-20), held at Pusa, and finally in 1921, prepared and published an *Annotated List of Crop Pests*, which included some 440 lepidopterous pests of economic importance, both moths and butterflies. This also included some 75 species of Pyralidae, with notes on their host-records, distribution and some biological notes. The collection, thus built up, formed an important repository of pests of agricultural importance, bearing data of their rearing, hosts, date of collection or the emergence of adults in laboratory. This came to be known, later, as *The National Pusa Collection*, presently at the Indian Agricultural Research Institute, Division of Entomology, New Delhi (India).

Ayyar (1940) published yet another book entitled "*Handbook of Economic Entomology for South India*", and covered all the additional knowledge gained since publication of *Indian Insect Life*, and thus presented an updated information on pests of economic importance in southern India, particularly on paddy; millets, wheat and sugarcane; pulses & oilseeds; fibre-crops; vegetables; fruits & fruit-trees; plants yielding dyes, drugs, narcotics, spices, etc.; garden plants; fodder crops; and other useful trees; and stored products/grain pests. Besides, information was also provided on house-hold and disease carrying insects and some valuable/beneficial insects. Later, Pruthi (1969) published a text book entitled *Agricultural Entomology*, and Nayar, Ananthakrishnan & David (1976) published *General & Applied Entomology*, with an object to provide study material to students of Entomology, and covered most of the aspects in agricultural as well as applied entomology, with Indian conditions in view.

Besides these landmark publications, several other publications also came out dealing with local fauna. A few of these are: Janjua & Nasir (1948) on stored grain pests, in Baluchistan; Lal (1955) on pests and diseases of agricultural importance in India; Khan & Murthy (1955) on pests in Hyderabad; Sen (1956) on pests in Bihar; Sardar Singh & Sohi (1957) on pests in Punjab; Sengupta & Behura (1957) on pests in Orissa; Alam (1967) on pests of rice in East Pakistan; Farnando (1967) on pests of rice in Ceylon; Kalra (1965) on

pests of sugarcane in North India; Verma (1986) on pests in Haryana; and Singh (1994) on pests in U.P.

As the concern grew due to the heavy losses some pests were causing to the farmers, as well as to the nation, more and more attention was being paid to control these by organising seminars/conferences both nationally and internationally. As for example, the symposium at International Rice Research Institute, Manila, in 1964, discussed several aspects in relation to rice, rice-pests, etc., and valuable contributions were made by Kapur (1967), Banerjee & Pramanik (1967) and Farnando (1967). Similarly, several contributions were made at the symposium on the stalk borer, (Chaudhary, 1981), held at CCS HAU, Regional Research Station for Sugarcane, Uchani; and several other papers on pests of various crops, published by All India Scientific Writers' Society (1983).

In view of the changed cropping pattern in India and the changed ecological conditions due to several factors, the pest complex has since changed tremendously. As a result, of late attempts have been made to study insect pests either in isolation, as has been done in case of stalk borer, "*auricilius*", at Uchani, Dist. Karnal (Haryana), or in totality, keeping one crop-pest in mind, i.e., sugar-cane, paddy, oil-seeds, cereals, etc. These attempts have brought out several valuable contributions, either as separate papers or in a consolidated form like, *Rice Research in India*, *Sugarcane Entomology in India* (Both ICAR publications), *Agricultural Entomology* (published by All India Scientific Writers' Society), and *Entomology in India* (I.C.A.R.). Although there are number of pests on other crops, there is hardly any significant information except what has been given by Lefroy (1909), Fletcher (1914, 1921), Ayyar (1940), Pruthi (1969) and Nayar *et al.* (1976).

(b) Taxonomic History

Kollar (1844-1848) and Moore (1865, 1867, 1872, 1877) were probably amongst the firsts to deal with the fauna from India, including, Lepidoptera from Kashmir, Bengal and Andaman & Nicobar Islands, respectively. Walker (1863, 1864) also published a list of specimens in the collection of British Museum. But the landmark publication by Moore was *Lepidoptera of Ceylon* (1884-87), including pyralid fauna. The lepidopterous fauna was also dealt with by Zeller (1863) and Butler (1879a, b). The latter not only dealt with the N.E. fauna but also illustrated the typical specimens of Lepidoptera-Heterocera in the collections of British Museum. Besides, Swinhoe (1884-1900) contributed a series of papers dealing with lepidopterous fauna from various areas, i.e., Kurrachee (1884), Bombay & Deccan (1885), southern India (1891) and Khasi Hills (1891-1895). Later, Swinhoe & Cotes (1889) published for the first time a Catalogue of Moths of India (Pyralidae), in the Indian Museum. He placed the whole pyralid fauna under (a) *Pyrales*, including the following families: Botydidae, Margaronidae, Asopidae, Spilomelidae, Ennychidae, Hercynidae, Stenidae, Siculidae, Hydrocampidae, Pyralidae and Scoparidae and (b) *Crambites*: which included Phycitidae (Subfamilies Phycitinae and Anerastiinae), Schoenobiidae, Crambidae and Galleriidae. Hampson's contribution on *Fauna of British India*, Moths (Volumes 1-4, 1892-96), is the most important and valuable on the Indian fauna. His work (1896, Vol. 4) on the Indian Pyralidae is an important landmark and no work on Indian fauna is complete without making a reference to the work by Hampson (1896). He classified the family into twelve subfamilies viz., Galleriinae, Crambinae, Anerastiinae, Phycitinae, Schoenobiinae,

Epipaschiinae, Chrysauginae, Endotrichinae, Pyralinae, Hydrocampinae, Scopariinae and Pyraustinae. He continued to work on the Lepidoptera till about 1930, and produced several important publications.

Because of the economic importance and the concern these pests were causing to entomologists, these continued to attract the attention for their study involving identity. Some of these publications were on (i) *Sugarcane* by: Fletcher & Ghosh (1920), Gupta, and Gupta *et al.* (1940-1959); Isaac & Rao (1941); Isaac & Venkatraman (1941); Kapur (1950); Cheema (1951); Narayanan & Venkatraman (1951); Butani (1956-1983); Agarwal, and Agarwal *et al.* (1966-1983); Avasthy and Avasthy *et al.* (1969-1986); Bradley (1982); Chaudhary *et al.* (1981, 1986); David and David *et al.* (1986); Easwaramoorthy and *et al.* (1986); Mukanthan (1986); Garg & Chaudhary (1979); and Madan *et al.* (1995); and on *Paddy* by Fletcher (1921); Kinoshita & Kawada (1932); Narayanan (1953); Khan & Murthy (1955); Latif (1956); Sen (1956); Nair (1957, 1958); Martin (1958); Rao & Nagaraja (1966); Kapur (1967); Banerjee & Pramanik (1967); Farnando (1967); Grist & Lever (1969); Ghai *et al.* (1979); and Seshagiri Rao & Kulshreshtha (1985). There are several other contributions which are mainly taxonomic and deal with the group as a whole, eg., Marion (1955) on Pyraustidae; Bleszynski (1960-1970) on Crambinae; Munroe (1951-76) on Pyraustinae; Whalley (1964) on Galleriinae and Phycitinae (1970); Roesler (1967-1974) on Phycitinae; Lewvanich (1981) on *Scirpophaga*; and a series of papers by Rose and Rose *et al.* (1973 - date) on Lepidoptera. Corbet & Tams (1943) contributed on the identity of pests of stored grains and products.

MATERIAL AND METHODS OF STUDY

In order to study various species as pests of economic importance in the family Pyralidae, the study was not limited to the collections present only in Zoological Survey of India, as *National Zoological Collections*, but in other important repositories like F.R.I., Dehra Dun, I.A.R.I., New Delhi, and other research institutes, university departments of agricultural entomology, etc.

The collections in connection with this Project were examined at the following places (arranged alphabetically, along with abbreviations used in the text):

1. Aligarh Muslim University, Department of Zoology, Aligarh (U.P.).
2. Andhra Pradesh Agricultural University, Hyderabad (A.P.Ag.Univ.).
3. Central Rice Research Institute, Cuttack (Orissa). (C.R.R.I.)
4. College of Agricultural Sciences, Kerala Agricultural University, Vellayani (Kerala). (Coll. Ag. Sci. K. Ag. Univ.)
5. Chaudhary Charan Singh Haryana Agricultural University, Department of Entomology, Hisar (Haryana), (C.C.S.H.Ag. Univ.)

6. Forest Research Institute, Dehra Dun (U.P.) (F.R.I.)
7. Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore (Karnataka). (G.K.V.K.)
8. Indian Agricultural Research Institute (*National Pusa Collections*), New Delhi. (I.A.R.I.)
9. Institute of Forest Genetics & Tree Breeding, Coimbatore (Tamil Nadu) (I.F.G.T.B.)
10. Indian Institute of Sugarcane Research, Lucknow (U.P.). (I.I.S.R.)
11. Punjab Agricultural University, Ludhiana (Punjab) (Pb.Ag. Univ.)
12. Punjabi University, Department of Zoology, Patiala (Punjab) (Pbi. Univ.)
13. Project Directorate of Biological Control, Bangalore (Karnataka). (P.D.B.C)
14. Regional Rice Research Station for Sugarcane, C.C.S.H.Ag.Univ., Uchani, Dist. Karnal, (Haryana). (R.R.Stn., Uchani)
15. Rice Research Station, Chinsura (W.B.) (R.R.Stn., Chinsura)
16. Rice Research Station, C.C.S.H.Ag.Univ., Kaul (Haryana). (R.R.Stn. Kaul)
17. Sugarcane Breeding Institute, Coimbatore (T.N.) (S.B.I.)
18. Tamil Nadu Agricultural University, Department of Agricultural Entomology, Coimbatore (Tamil Nadu). (T.N.Ag. Univ.)
19. Zoological Survey of India (*National Zoological Collections*), Calcutta (W.B.). (Z.S.I.)

About six thousand six hundred ninety specimens, representing about 80 species were available in the above mentioned research institutes/agricultural universities and repositories, for study under the Project. The Part I, however, includes about three thousand eight hundred examples, representing forty four species. The summary of the collections examined at each place is given in the accompanying table (I).

For the purpose of study of morphological characters, often scrapping of scales on head was resorted to study the shape of frons, presence or absence of ocelli, etc. As far as possible, the scrapping was avoided by applying toluene by a fine sable hair brush. The wing-venation, in both fore- and hind wings was also studied by applying toluene, which did not disturb or remove scales.

TABLE - 1

SUBFAMILIES	No. of Species		MATERIAL EXAMINED AT VARIOUS INSTITUTES / UNIVERSITIES																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
I. CRAMBINAE	11		-	2	5	122	9	725	-	188	9	7	132	32	6	2	12	224	1475
II. SCHOENOBINAE	10		-	-	6	19	7	323	-	116	-	-	25	11	55	5	53	115	735
III. NYMPHULINAE	2		-	-	-	1	-	124	-	-	-	-	-	-	-	-	-	33	158
IV. PHYCITINAE	15		-	-	1	55	-	592	2	9	16	-	8	4	-	-	29	78	794
V. GALLERINAE	6		3	-	19	55	-	422	7	-	7	-	10	-	-	-	39	84	646
	44		3	2	31	252	16	2186	9	313	32	7	175	47	61	7	133	534	3808

1. Andhra Pradesh Ag. Univ. Hyderabad.
2. C.C.S. H. Ag. Univ., Hisar.
3. College of Agr. Sci. Kerala Univ. Vellayani.
4. Forest Research Institute, Dehra Dun.
5. Gandhi Krishi Vigyan Kendra, U. Ag. Sci., Bangalore.
6. I.A.R.I., New Delhi.

7. I.F.G. & T.B. Coimbatore.
8. I.I.S.R. Lucknow.
9. Pb. Ag. Univ. Ludhiana.
10. Punjabi University, Patiala.
11. P.D.B.C. Bangalore.
12. R.R. Stn. CCS Uchani(Haryana).

13. R.R. Stn. Kaul (Haryana).
14. SBI Coimbatore.
15. T.N. Ag. Univ., Coimbatore.
16. Z.S.I., Calcutta.

SYSTEMATIC ACCOUNT

Family PYRALIDAE

The family Pyralidae comprises mostly small to moderately-sized moths. Although a majority of these are dull coloured, brilliant colouration is not an exception, with several species having contrasting or complicated patterns.

Diagnosis. Head with the frons variable, being smooth, moderately rounded to acute protuberance, with or without corneous point distally. Proboscis, when present and prominent, coiled between labial palpi, or reduced and rudimentary, or completely absent. Labial palpi three segmented, often very long and porrect, giving an appearance of a snout at the front, or moderately long to very short, upturned or porrect, or slightly downcurved distally, often clothed with short or long scales, or even hollowed to receive the maxillary palpi. Maxillary palpi three to four segmented, often dilated with scales at extremity and prominent, or reduced to brush-like structure, hidden in the hollowed labial palpi. Compound eyes large and prominent, or reduced. Ocelli well developed, reduced or completely absent. The chaetosema, when present, are represented by a patch of short, parallel or radiating setae, arising from a bare or weakly scaled part of vertex but never from a tubercle. Antennae variable, either simple and filiform in both the sexes, or slightly thickened, weakly or strongly serrate, laminate or pectinate in males, and possess two rows of scales to each segment dorsally, but uniformly pilose, ciliate or fasciculate on underside; in some males the antennal segments at base, fused or distorted or incised and bear specialised tufts of scales. Wings vary considerably in venation, and offer a very useful character in identity of species. Fore wing with Cu_2 considerably reduced to just a tubular vein in terminal part of the wing, or completely absent; Vein 3A nearly always present, either free and ending at or near the anal margin, or meets 2A at base. Hind wing with the vein Sc always free from base to a little beyond angle, beyond which it anastomoses with Rs, either for a short distance or nearly to margin; vein Rs mostly stalked with M_1 at base; cell closed or open. Abdomen with tympanic bullae in the ventral part of basal segment along the mid-line and in front of them hangs a median, longitudinal, chitinous flap into the cavity between thorax and abdomen. This flap, praecinctorium, may be well developed, transversely flattened, strongly bilobed or weakly divided distally, or singly lobed, or simply may have more or less developed tufts of scales distally. The praecinctorium may be completely absent and the tympanic bullae separate or weakly apposed.

The following key to identification of various subfamilies dealt with in this part has been adapted and modified from Munroe (1972).

Key to identification of various subfamilies of *Pyralidae* of economic importance

1. Praecinctorium present. Tympanic bullae fused medially 2
- Praecinctorium absent. Tympanic bullae separate or approximated 4
2. Cubital vein in hind wing pectinated on upper side **Crambinae**
- Cubital vein in hind wing not pectinated 3

3. Vein Cu_2 in fore wing present only in the terminal part. Proboscis absent **Schoenobiinae**
- Vein Cu_2 in forewing absent. Proboscis when present well developed, or rudimentary **Nymphulinae**
4. Proboscis well developed when present or rudimentary. Ocelli present. Vein R_5 in forewing absent; frenulum spine single in both sexes **Phycitinae**
- Proboscis and ocelli absent. Vein R_5 in forewing present; frenulum spines more than one in female **Galleriinae**

A. Subfamily CRAMBINAE

The subfamily Crambinae contains species whose larvae feed mainly on grasses, seeds, some cultivated graminaceous plants like sugarcane, jowar, maize, paddy etc. and deals with six genera viz., *Ancylolomia* Hübner, *Chilo* Zincken, *Chilotraea* Kapur, *Girdharia* Kapur, *Bissetia* Kapur and *Borer* Guenee. While Kapur's work (1950) has been extensively followed here for the taxonomic characters as well as the nomenclature, as has also been highly appreciated by Jepson (1954) and Agarwal & Tiwari (1969), the species *Proceras indicus* Kapur has been treated under a new taxonomical combination. This may be mentioned that the genus *Proceras* Bojer was "incorrectly included by the authors in the Pyralidae, Crambinae, the placement being based on incorrect type species designations." (Vide Fletcher & Nye, 1984). They further point out that the correct type-species designation of *Proceras* Bojer is *Pyralis saldonana* Fabr. and not *Proceras sacchariphagus* Bojer. Fletcher & Nye (1984) also suggest that "Commission be asked to designate as type species of *Borer*, the nominal species actually involved, namely *Proceras sacchariphagus* Bojer (1856)" Since *Phalaena saccharalis* Fabr., *sensu* Guenee 1862, was designated as type of the genus *Borer* Guenee (1862), and is now a synonym of *Proceras sacchariphagus* Bojer, the correct type species designation of the genus *Borer* Guenee is, therefore, *Borer sacchariphagus* (Bojer).

In view of Fletcher & Nye's observation (1984), under present circumstances, it is not proper to consider *Proceras* Bojer, as a synonym of the genus *Chilo* Zincken, under Crambinae, Pyralidae, *vide* Bleszynski, 1970, who had transferred *Proceras sacchariphagus* to *Chilo sacchariphagus*, with *indicus* Kapur, as its subspecies. This is now being treated under the genus *Borer* Guenee, with *sacchariphagus indicus* (Kapur), as a new combination.

The genus *Chilotraea* Kapur has been revived presently. It may be mentioned that Kapur's work (1950) is still very much relevant and holds good for the differentiation and identification of Crambinae genera. Bleszynski (1962) treated the genus *Chilotraea* Kapur as a synonym of *Chilo* Zincken, and later in 1970, also synonymised the genus *Proceras* Bojer to the genus *Chilo* Zincken, besides several other genera as latter's synonyms. As a result, Bleszynski (1969, 1970) had to revise the definition of *Chilo*, enlarging it to such an extent that his key to identification of various *Chilo* species became unworkable in some cases. In his (1969) paper on ".... taxonomy of the Crambine moth borers of sugarcane...."

Chilo Zincken was placed in a key at two different categories i.e. with and without ocelli. The latter character led to an old world species "*indicus* Kapur" which Kapur (1950) had placed under the genus *Proceras*. Similarly, Bleszynski (1970a) while giving key to identification of various species under *Chilo* Zincken, faltered and mentioned "*ceylonicus*" under both the categories of the characters i.e. " R_1 free" as well as " R_1 coincident with Sc.", though he mentioned in the text about the vein R_1 only being coincident with Sc : A character typical of *Chilotraea* Kapur. He also mentioned (1970a) about the vein R_1 being "coincident" in the key but "free" in the text, in the species *diffusilineus* Joannis.

It is obvious that clubbing of several heterogeneous species under one genus, viz. *Chilo* Zincken, does not seem to solve taxonomic problem. In fact Bleszynski (1970a) admits that Kapur (1950) gave a good definition of *Chilo* and this was also the opinion of Jepson (1954). The latter, had also stated that Kapur's work (1950) had resolved a lot of chaos in the identity of Crambinae not only in India but also in Mauritius. Obviously, it referred to all the genera presently dealt with here. By reverting back to a single genus *Chilo* Zincken - concept, the confusion has stayed on (vide Bleszynski, 1970a). Further, perusal of his work (1970a) has shown that the vein R_1 in forewing whenever has been reported "free" in species, its frons is produced forward, conical and invariably with a corneous point, a character typical of *Chilo* (sensu Kapur, 1950) and whenever coincident with Sc, the frons is found to be smooth, subrounded, sometimes produced forward but invariably without corneous point, a character typical in genus *Chilotraea* (sensu Kapur, 1950).

It would be pertinent to mention that Kapur (1950) had also mentioned about these abnormalities and exceptions with regard to frons and venation in forewing, which existed in several other species of the subfamily. He particularly mentioned about these abnormalities in *Chilotraea infuscatellus* (Snellen), *Chilotraea ceylonicus* (Hampson) and *Chilotraea auricilia* (Dudgeon). Nevertheless, he (1950) stresses that *Chilotraea* Kapur is definitely a distinct genus from *Chilo* Zincken. In the present situation it would be more appropriate to follow what Kapur (1950) had established, followed by Rao & Nagaraja (1966), Banerjee & Pramanik (1967) and Agarwal & Tiwari (1969).

Accordingly, following Kapur (1950), the keys to identification of various genera and the species within each genus have been provided, adding some more external characters. It is hoped that it will continue to serve not only the taxonomists but the agricultural entomologists also.

Diagnosis : Head with the frons smooth, subrounded, or produced forward into a conical protuberance, with or without corneous point; labial palpi well developed, dilated with scales at extremity; antennae variable, being simple in both sexes, or minutely serrate, laminate, or shortly pectinate in male, simple and setaceous in female. Proboscis reduced. Forewings variable in shape, being long and narrow to short and broad, or with apices acute; 11 veins present; R_1 either free, closely approximated or anastomosed with Sc; R_{3+4} always stalked; R_5 free or stalked with R_{3+4} ; 3A rudimentary or absent. Hind wing with the median nervure always pectinated on upper side; Rs anastomosed with Sc beyond the upper cell angle. Praecinctorium present; tympanic bullae medially fused. Chaetosema present.

Key to identification of *Crambinae* genera

1. Head with ocelli 2
- Head without ocelli 5
2. Forewing with the vein R_5 stalked with R_{3+4} *Ancylolomia* Hübner
- Forewing with the vein R_5 free from R_{3+4} 3
3. Frons produced forward, conical and with a corneous point. Antennae always minutely serrate in male. Forewing with vein R_1 nearly always free *Chilo* Zincken
- Frons smooth, or produced and subrounded, without corneous point. Antennae variable. Forewing with vein R_1 nearly always coincident with, or closely approximated to Sc 4
4. Antennae minutely serrate in male. Forewings without stripes; hindwings with the cell closed *Chilotraea* Kapur
- Antennae distinctly pectinate in male. Forewings with two longitudinal stripes; hindwings with the discocellulars weak, with the cell open *Girdharia* Kapur
5. Frons distinctly produced forward, conical and with a corneous point at apex. Forewings with the vein R_1 free; hindwing cell open *Bissetia* Kapur
- Frons not produced, broadly subrounded to flat. Forewings with the vein R_1 coincident with Sc ; hindwing cell closed *Borer* Guenee

Genus *Ancylolomia* Hübner

1818. *Ancylolomia* Hübner. *Verz. bek. Schmett.* : 363.

Type species *Tinea palpella* Denis & Schiff.

Diagnosis. Head with the frons smooth and oblique; labial palpi porrect, thickly clothed with hairs; shorter in male; maxillary palpi triangularly dilated with scales; ocelli well developed; antennae unipectinate in male, minutely serrate in female. Tibial spurs unequal. Forewings with apex produced, the outer margin incurved below the apex; veins R_{3-5} stalked.

Distribution India; Bangladesh; Myanmar; Pakistan; and Sri Lanka.

Remarks Only one species, *Ancylolomia chrysographella* (Kollar), which is of economic importance, is included here.

***Ancylolomia chrysographella* (Kollar)**

(RICE ROOT CATERPILLAR)

(Plate I, figs. 1-3; Text Figs. 1A-D)

1844. *Chilo chrysographella* Kollar, In Hügel's *Kaschmir Und das Reich Siek.*, 4 : 494.

Diagnosis : Head with the antennae unipectinate, branches longer in middle, the longest one about the length of two antennal segments, gradually the length reducing towards base and the tip, and about or over half the length of forewing costa, labial palpi a little over one-and-a-half times the diameter of eye; outer tibial spurs about two thirds the length of inner ones. **Females** : Larger. Differ in the palpi being longer, about twice the diameter of eye; antennae being less than half the length of forewing costa, the serrations very minute and gradually tapering apically.

Upperside : Head, thorax and abdomen brownish ochreous. Forewing with brown, longitudinal fasciae from base, diffusing beyond middle, with streaks of silvery stripes and black scales in cell and in the interspaces beyond and below it; a minute dentate submarginal silvery line, with a prominent tooth at vein Cu_{1a} , a whitish marginal band with a series of dark specks on it, the cilia silvery. Hindwing : Whitish, pale fuscous, or dark fuscous in *taprobanensis* form, which is common in southern India. **Underside** : Male with dark suffusion on the forewing upto a little beyond cell and along costal area on the hindwing. Without characteristic stripes or any other markings of the upper side. Females paler, wings without markings.

Venation : **Forewing** : Vein R_1 confluent with Sc; R_2 free, from a little before angle; R_{3+5} stalked, R_3 close to apex and along with R_4 ending at costal margin before apex, R_5 arising closer to upper angle, nearly half way between the cell angle and origin of R_{3+4} and ending at outer margin below apex; M_1 from below the upper angle of cell; M_2 - M_3 separate at origin, from above the lower angle; Cu_{1a} from lower angle; Cu_{1b} from much before the angle, in line with origin of vein R_1 above. **Hindwing** : Vein Sc anastomosed shortly with Rs after latter's origin from cell angle, and ending before the apex; Rs ending below the apex; M_1 much below the upper angle; lower angle narrowed and produced, with veins M_2 - M_3 arising from it either free or shortly stalked; Cu_{1a} , Cu_{1b} from before the lower angle. Cell closed.

Genitalia : Vide Kapur (1967) and Bleszynski (1970c),

Material examined : INDIA : MADHYA PRADESH : Nainpur, 1 ♂, 25-ii-1907, G.R.D. coll.; UTTAR PRADESH : Dehra Dun, 4 exs., - vii. 1923; *student* coll.; 1 ♂ 1 ♀, 15.vii.1925, A.J. Robinson coll.; FRI Campus, Dehra Dun, 1 ♂, 2.ix.1926, G.D. Bhasin coll.; New Forest, Dehra Dun, 1 ♀, 4.viii.1929. A.M. Postford coll.

(In F.R.I. Dehra Dun).

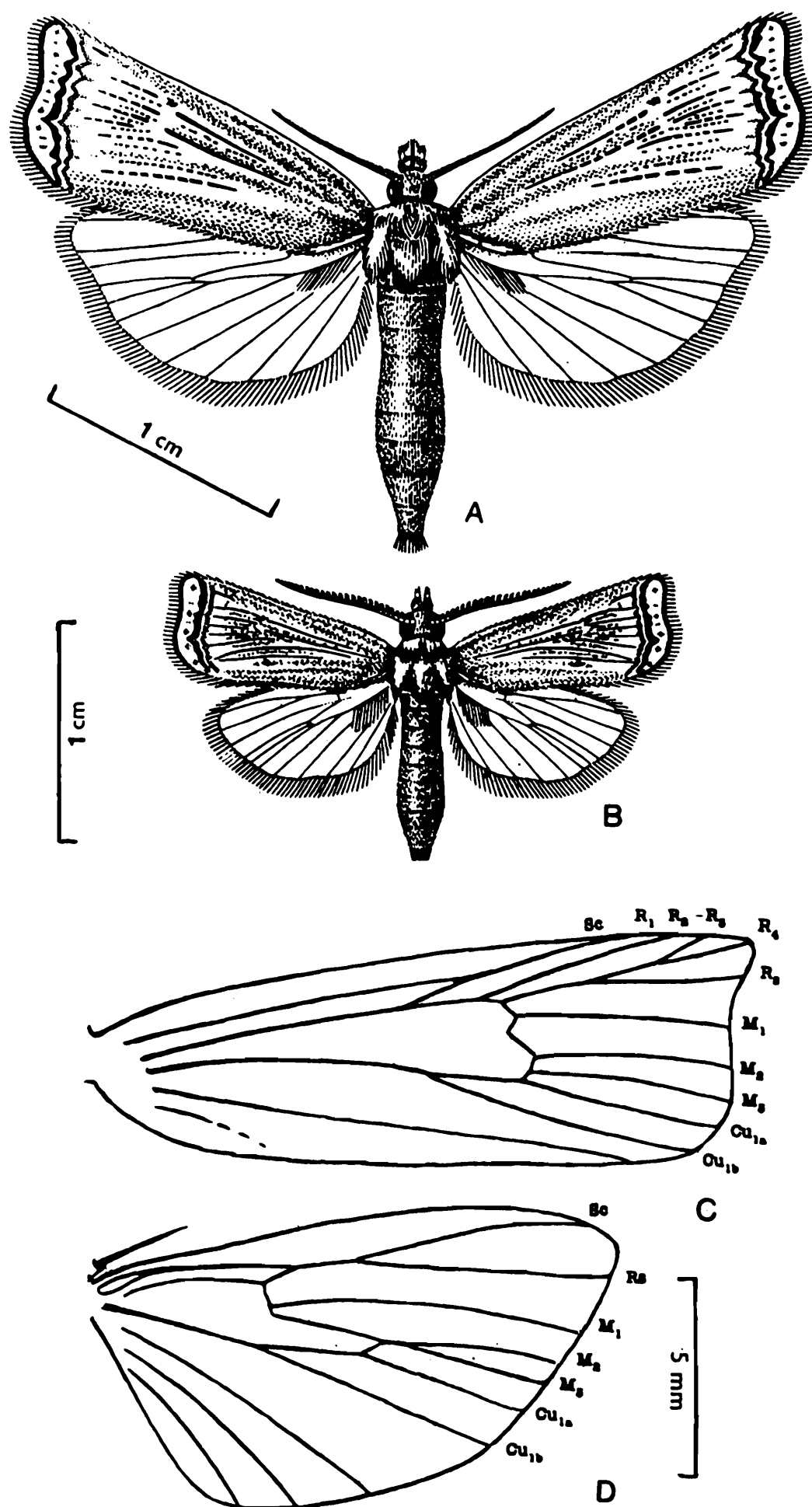


Fig. 1. *Ancyrolomia chrysographella* (Kollar) : Adult ♀ (A) and ♂ (B) with wings spread, showing wing pattern and other features. (C) Fore - and (D) hindwing venation (Magnification of C same as of D)

INDIA : ANDAMAN Is. : Mt. Harriet, 1200 3 ♂ 6, 7. iv. 1927, no coll.; ASSAM: Guwahati, 1 ♂ -iv.1908, *A.M.* coll.; Sibsagar, 1 ♀, 26. x. 1911, *C.C.G.* coll.; BIHAR: Chakradharpur, 1 ♂ -ix.1907, *A.M.* coll.; Hazaribagh, 1 ♀, 16-25.III.1928, *P.V. Isaac* coll.; Pusa, 1 ♀ 20.vii.1910, 1 ♂, 21.x.1910, 1 ♂ 1.iv.1911, 1 ♂, 22.iii.1915, 1 ♀, 22.x.1927, *all T.B.F.* coll.; 1 ♀, 29.iii.1914, 1 ♂, 28.v.1914, 1 ♂, 20.iii.1915, 1 ♂, 20.iv.1915, 2 ♂, 8,10.viii. 1915, 1 ♂, 24.ix.1915, 2 ♀, 2.x.1915, 2 ♂ - iii. 1916, *all Boy* coll.; 2 ♂, 27, 28. iv. 1916. *U. Bahadur* coll.; 3 ♂, 5.vi.1916, *H. Singh* coll.; 5 ♂, 4.viii. 1916, 1 ♀, 5. viii 1916, 1 ♀, 19. xi. 1916, 2 ♂, 23. xii. 1916, *all on rice stem*, no coll.; 3 ♂, 3 ♀, 25, 26, 27, 31 viii. 1916, *all D. Nandan* coll, on Dabli grass; 1 ♀ - v.1917. *H.M.L.* coll., 2 ♀, 13.viii.1921, 1 ♂, 1 ♀, 22. iv. 1924, *Rangi* coll.; 1 ♂, 29.x.1923, *Peries* coll., 1 ♂, 7.viii.1924, *Krishna* coll.; 1 ♂, 4.x.1928, boring *Andropogon* stem, no coll.; 1 ♂, 22.ix.1931, *D.P. Singh* coll.; 1 ♂, 4.viii.1932, *Bose* coll.; 1 ♂, 19.iv.1935, 2 ♀, 18, 23. viii. 1935, at light, *H.S. Pruthi* coll.; Ranchi, 2 ♂ - ix, 1907, 2 ♂, 1 ♀, 26, 30.iii.1928. MADHYA PRADESH : Nagpur, 1 ♂ -iii.1907, *Fletcher* coll.; 1 ♂ - ii. 1908, *C.S.M.* coll.; Balughat, 1 ♂, 1 ♀ -iii. 1907. *A.M.* coll.. MEGHALAYA : Shillong, 5000 , 1 ♀ - ix. 1917, 2 exs, - viii,ix. 1919, 1 ♂, - vi. 1920, 2 ♂, 20.v.1924, 1 ♂, 12.x.1924, 1 ♂, 6.xi.1924, *all Fletcher* coll.; 4 ♂, 3.vi. 1918, *Y.R.* coll.. ORISSA : Balasore, 2 ♂, 1 ♀ -x.1906, *A.M.* coll.; Cuttack, 1 ♂ -x.1906, 1 ♂, - ii. 1907. *A.M.* coll.; 1 ♂, 23.V 1941, *Panda* coll.. WEST BENGAL : Calcutta, 1 ♀, 7.xi. 1924, *C. Mukherjee* coll. (All I.A.R.I., New Delhi).

INDIA : ANDHRA PRADESH : Samalkot, 1 ♂, -vi.1922, on paddy, *C.V.C.* coll.; BIHAR . Pusa, 1 ♂, -x.1909, *K.S.P.* coll.; 1ex, 6.ix.1910, *T.B.F.* coll.

(In T.N.Ag. Univ. Coimbatore)

INDIA : KARNATAKA : Bangalore, 1 ♂, 12.iv.1980, at light : 1 ♂, 25.xii.1994, *M. Thippaiah* Coll. (In Univ. Ag. Sci.G K.V.K., Bangalore)

INDIA ASSAM N. LAKHIMPUR Dist. : Army Officers' Mess, 1 ♂, 3.x.1966, *S.K. Tandon & G.S. Arora* coll., at light. BIHAR : BHAGALPUR : Sabour, 1 ♂, no other data; Champaran, 1 ♂, -.viii.1907, no coll.; Ranchi, 1 ♂, no other data. HARYANA : KARNAL Dist.; Uchani, Sugarcane Res. Station Campus, 1 ♂, at light, 5.ix. 1996, *G.S. Arora* coll.. HIMACHAL PRADESH : Kulu, 1 ♂, 1 ♀, no other data ; Kangra Valley, 4500 , 1 ♂, - vi, vii. 1899. *G.C. Dudgeon* coll.. MAHARASHTRA : Poona, 1 ♂, -.viii.1882, no coll.. UTTAR PRADESH : Lucknow, 2 exs., 20.viii.1996, at light, *G.S. Arora* coll.. WEST BENGAL : Calcutta, 2 ♂, - v.-, lex., i. ii.1871; 1 ♂, - .vii. 1901 *Young* coll.. 1 ♀, -.vii. 1907; 1 ♂, 10. viii. 1957, *A.P. Kapur* coll.; 1 ♂, 20.v.1967. *H.C. Ghosh* coll.; Kalyani, 5 ♂, 5 ♀, 15.vii. 1972, *S. Chakravarti* coll.; Purulia, 1 ♂, 21. xi. 1985, *S. Sen & Party* coll.

BANGALADESH : Dacca, 1 ♂, 19.1.1906; Khulna, 2 ♂, - ii. 1908;

MYANMAR Lashis, 3000 1 ♂, 17. iv. 1918; *Y.R. Rao* Coll.; Moulmein, 2 ♂, -.viii. 1911; Totkon, 2 ♂, -.ix. 1914, *Fletcher* coll.

PAKISTAN : N.W.F.P. ; Peshawar; Tara, 1 ♂, 2 ♀ - v.1916, *Fletcher* coll.; Karachi, 2 ♂, 2 ♀, - v. 1886, no coll.

SRI LANKA : Eppawala, 2 ♂, -.ix.1905, *N.C.P.* coll; Peradeniya, 3 ♂, 14-17. iv. 1914, *Fletcher* coll. (All in Z.S.I. Calcutta)

Wing expanse : ♂ 16 - 30 mm; ♀ 22-40 mm.

Distribution : INDIA : Andaman Is.; Andhra Pradesh; Assam; Bihar; Haryana; Himachal Pradesh; Karnataka; Madhya Pradesh; Maharashtra; Meghalaya; Orissa; Uttar Pradesh; West Bengal *Elsewhere* : Bangladesh, Myanmar, Pakistan and Sri Lanka.

Host : Paddy. *Alternative Hosts* : Grasses; *Imperata cylindrica*, *Paspalum dilatatum*.

Status : Moderate

Remarks : Commonly known as "The Root Caterpillar", the species feeds at the root during night, the adults of which are very beautiful, with streaks of silvery and black scales on forewing.

The species is distinct from all the other species by the stalking of vein R_5 with that of R_{3+4} , (which is free in other species) and by the presence of longitudinal silvery streaks on the forewing.

Genus *Chilo* Zincken

1817. *Chilo* Zincken, *German's Mag. Ent.*, 2 : 34

Type species *Tinea phragmitellus* Hübner

Diagnosis Head with the frons produced forward and conical, with a distinct corneous point at the apex, sometimes with a part of ventral surface flattened and produced as an indistinct ridge; ocelli well developed; labial palpi porrect, slightly down-curved and covered with long scales and hairs and almost three to three-a-half times the diameter of eye; maxillary palpi triangularly dilated with scales at extremity; proboscis poorly developed; antennae minutely serrate and ciliate in male, simple in female.

Forewing with the vein R_1 generally running free, or curved and approximated to Sc.

Genitalia For male and female genitalic studies reference may be made to Kapur (1950), Gupta (1958) and Bleszynski (1969, 1970a).

Distribution : Cosmopolitan.

Remarks : Only three species, viz., *Chilo partellus* (Swinhoe), *Chilo suppressalis* (Walker) and *Chilo tumidicostalis* (Hampson) have been included (*sensu* Kapur, 1950) here for the purpose of study, as the material of *Chilo tamsi* Kapur, was not available for study. For nomenclature, Kapur (1950), Jepson (1954), Gupta (1958), Agarwal & Tiwari (1969) and Rao & Nagaraja (1966) have been followed. As mentioned above under the "Remarks"

in Crambinae, the genus *Chilotraea* Kapur has again been treated independently of the genus *Chilo* taking into account the excellent descriptions and definition of the genus *Chilo* given by Kapur. Even Bleszynski (1970a) admits that Kapur (1950) gave a good definition of *Chilo* Zincken, and is still very much relevant in differentiating the genus *Chilo* from *Chilotraea* and *Borer* (*Proceras*, *sensu* Kapur, 1950). Kapur (1950) had also mentioned about the abnormalities, in wing venation, which have been observed presently, but taking into account the characteristic features of the genus *Chilo*, in totality, both external as well as genitalic, there seems to be no difficulty in separating genera as well as keeping their identity distinct from that of the genus *Chilo*. As for example, during study it was noticed that one of the examples in *Chilo tumidicostalis* (Hampson), had its vein R_1 clearly anastomosed with Sc upto costa, in the left-side forewing (in I.A.R.I. New Delhi), but the right-side forewing presented a clear and normal characteristic venation of *Chilo*. Coupled with other features of frons, which is relatively a constant character (admits Bleszynski, 1970a), labial palpi, etc., there seems to be no doubt in placing this species in *Chilo*.

All the species presently dealt with under the genus *Chilo* Zincken, are differentiated by the following key

Key to identification of *Chilo* Zincken Species

1. Ventral surface of the frons flattened and produced as a ridge. Forewing with dark specks irregularly dispersed all over the area, sometimes forming patches; terminal dots black and distinct; fringe not shining..... *Chilo suppressalis* (Walker)
- Ventral surface of the frons smooth and without any ridge 2
2. Forewing whitish brown; dark brown to piceous scales usually forming streak on costa; with three rather diffused spots on discocellulars and a shadowy patch from apex towards middle of hind margin, but stopping half way; a series of terminal spots small, entire and black; fringe not shining, slightly darker near base *Chilo partellus* (Swinhoe)
- Forewing cinnamon brown, suffused with reddish to dark brown, with a few irregularly dispersed scales and a diffused dark brown fascia on the median nervure, extending to a little beyond the cell; a series of terminal black spots, with silvery white point; fringe shining, much darker at base *Chilo tumidicostalis* (Hampson)

Chilo suppressalis (Walker)

(RICE STEM BORER/PALE - HEADED STRIPED BORER)

(Plate I, figs. 4-6; Text figs. 2A-D)

1863. *Crambus suppressalis* Walker, *List Lep. Ins. Br. Mus.*, 27 : 166.

Diagnosis: Head with the frons strongly produced forward beyond eye, with a very distinct corneous point, with a small ridge on the underside; labial palpi three to three-and-a-half times the diameter of eye; ocelli well developed; antennae serrate in male, simple in

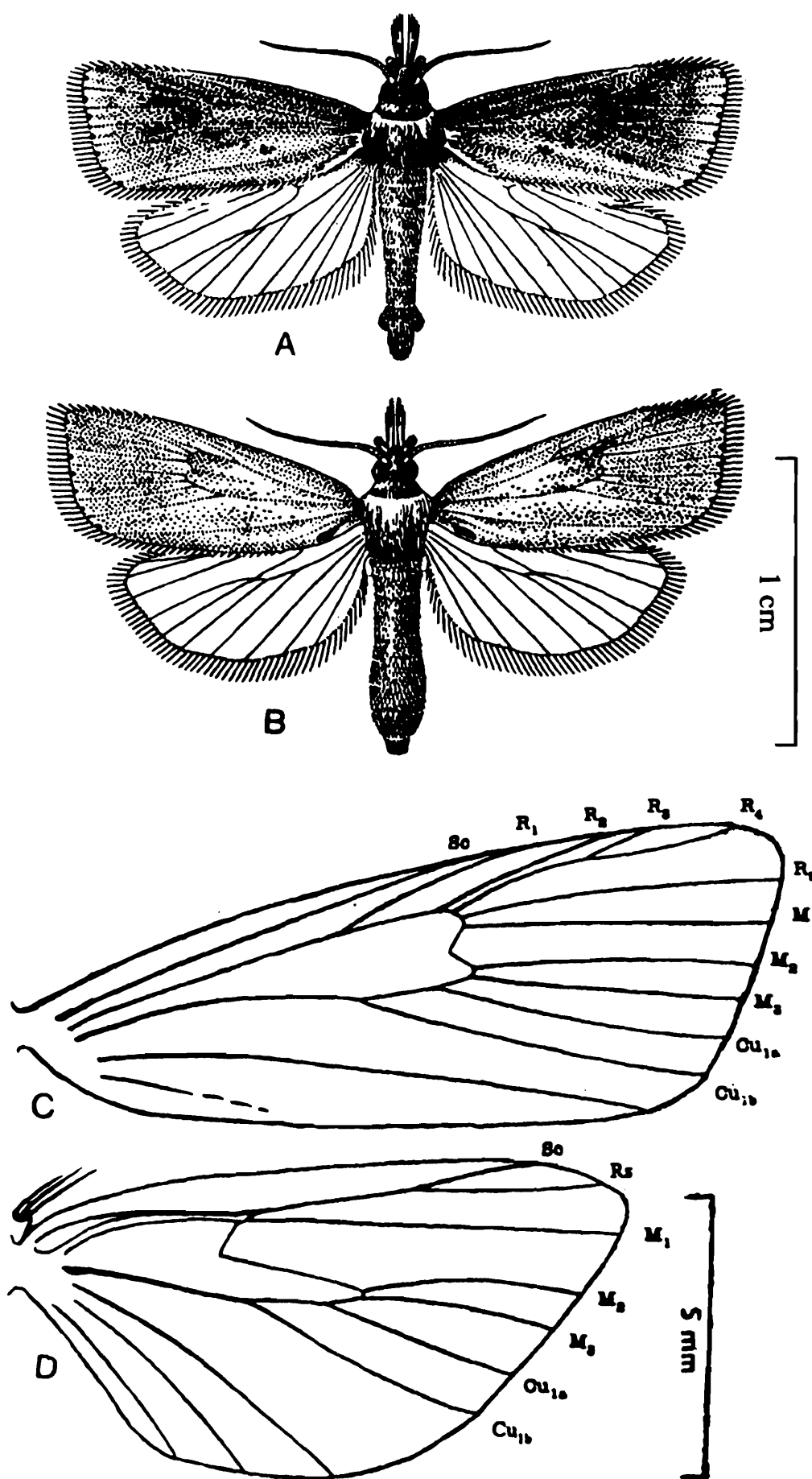


Fig. 2. *Chilo suppressalis* (Walker): Adult ♂ (A) and ♀ (B) with wings spread, showing wing pattern and other features, (C) Fore - and (D) hindwing venation (Magnification of A and C same as of B and D, respectively).

female, about two-thirds the length of forewing costa in male, about half the length in female. Hindwing underside with Sc dilated at base, prominently in male than in female; frenulum spines three in female.

Forewings straw coloured, suffused with light brown, with dark scales scattered irregularly all over, usually forming patches; medial line ill-defined; discal spots usually ill-defined and diffused; sub-terminal line ill-defined or absent, rather diffused, darker than the terminal line; a series of dark brown to piceous dots on termen; metallic spots absent. Hind wings whitish to yellow brown, particularly near the costa and the apex.

Females : Slightly larger, paler and with less dark scales; the dark discal patches absent.

Venation : Forewing : R_1 generally always free; R_2 just before the upper angle; R_{3+4} stalked, R_3 shorter than R_4 which is nearly equal to the common stalk, both ending at costal margin; R_5 from below the upper angle in between the origin of R_{3+4} and M_1 below; M_2-M_3 separate but close, from the lower angle; Cu_{1a} and Cu_{1b} from before the angle, and in line with the origin of R_2 and R_1 above, respectively. *Hindwing* : Vein Sc anastomosed with Rs beyond the angle to nearly half the distance to costa; Rs from upper angle and connate at origin with M_1 , or slightly stalked; M_2-M_3 connate at lower angle or sometimes slightly stalked.

Genitalia : Vide Kapur (1950), Bleszynski (1969, 1970a).

Material examined : INDIA : KERALA : Sembukudipatti, boring sugarcane, 1 ex., 24.ix.1930, C.S. Nath coll.; Arichampatti, 1 ♀, 20.v.1934, Neelandhan coll.
(In Coll. Ag. Sci.K.Ag. Univ., Vellayani, Trivandrum, Kerala)

INDIA BIHAR : Pusa, 1 ♀, 14.iii.1914, 1 ♂, 18.iii.1914, 1 ♂, 3.x.1917, 1 ♂, 5.x.1917, (FIGURED), 1 ♀, 8.x.1917 (FIGURED), 3 ♀, 17.x.1917, (one ♀ FIGURED), 1 ♂, 18.x.1917 1 ♂ 21.x.1917, 2 ♀, 23.x.1917, 1 ♀, 25.x.1917, 1 ♂, 13.i.1918, 2 ♀, 5,20.i.1918, 1 ♀, 20.ii.1918, 1 ♂, 9.iii.1918, 1 ♂, 2 ♀, 12.iii.1918, 2 ♂, 13,18. iii.1918,1 ♂, 2.iv.1918, without collector data, all on rice stubbles (and labelled *Chilo oryzae* Fletcher).

(In I.A.R.I., New Delhi).

INDIA ASSAM : Kamalpur, 1 ♂, -- 1962, on Paddy; Jorhat, 5 ♂ - vi.1962, on Maize, 1 ♂, 4.x. 1962, on Paddy; Guahati, 2 ♂, 4 ♀, 2.iii.1962, 1 ♀, 14.iii.1962, 4 ♀, 15.ii.1963, all on paddy; Titabar, 1 ♂, -.x.1962, on paddy; Bharbara, 1 ♀ -- 1963, on paddy; Shila, 1 ♂ -.iv.1963, on paddy, no other data. RAJASTHAN : Sriganganagar, 1 ♀, 3.iii.1963, on sugarcane. UTTAR PRADESH: Lucknow, 1 ♀, 13.iv.1962, on sugarcane. WEST BENGAL : Srirampur, 1 ♀, 3.xii.1963, on paddy, no coll.

(In P.D.B.C., Bangalore)

INDIA : BIHAR : Champaran, 2 ♀, 4.v.1898, 1 ♂, -.vii.1907, on sugarcane, 2 ♂, 1 ♀, - viii.1907, on sugarcane, 3 ♂, 3.viii.1907, on Juar, 4 ♂, 3 ♀, 15,16.ix.1907, on maize, no coll.; Pusa, 1 ♂, 7. iii.1930, Samuel coll.. HIMACHAL PRADESH : Kangra Valley, 4500 ,

1 ♂, -viii. 1899, 2 ♀, -viii, ix.1899, all *G.C. Dudgeon* coll.. MADHYA PRADESH : Nagpur, 1 ♂, 2 ♀, no more data; Seone, 9 ♀, on maize, no more data, 2 ♀, 4.v.1898, on juar & moth, *W.D. Hooper* coll.. MAHARASHTRA : Dhulia, 2 ♀, 24.ix.1885, on sugarcane. *L.de. Niceville* coll.. ORISSA : Berhampur, 2 ♀, 25.vi.1892, no coll.. PUNJAB : Amritsar, 2 ♂, 2 ♀, on sugarcane, no more data, 1 ♀, 31.iii.1891. on Maize, *Municipal Secretary* coll.. SIKKIM : 1 ♂, - vi.1896, 1 ♀, x.1896, *G.C. Dudgeon* coll.. WEST BENGAL : Burdwan, 1 ex., 4. vii.1890, no coll.; Murshidabad Dist. Berhampur, 2 ♀, no more data; Calcutta, 1 ♀, 26.x.1949, *A.P. Kapur* coll., 3 ♂, 4 ♀, 10.ii.1959, *A.R. Bhaumik* coll.

MALAYSIA : Kuala Lumpur, 2 ♂, 1 ♀, - 1937 *H.T. Pagden* coll.

PAKISTAN : Karachi, 1 ♂, *G.C. Dudgeon* coll.; (All in ZSI, Calcutta)

Wing expanse ♂ 13-25 mm.; ♀ 15-32 mm.

Distribution : INDIA : Assam; Bihar; Himachal Pradesh; Kerala; Madhya Pradesh; Maharashtra; Orissa; Punjab; Rajasthan; Sikkim; Uttar Pradesh; W. Bengal. *Elsewhere* : Azerbaijan; Cambodia; China; Formosa; Hawaii; Indonesia; Japan; Korea; Laos; Malaysia; Pakistan; Philippines; Siberia; Sri Lanka; Taiwan; and Thailand.

Hosts : Sorghum; Maize; Rice; and Sugarcane. *Alternative Hosts*. - *Coix lachrymajobi*, *Echinochloa colona*, *E. crusgalli*, *Miscanthus sinensis*, *Oryza latifolia*, *O. minuta*, *O. ridleyi*, *Panicum miliaceum*, *Phragmites communis*, *Sclerotachya fusca*, *Typha latifolia* and *Zizania aquatica*.

Status : Serious.

Remarks Most commonly known as "RICE CHILO", or "THE STRIPED BORER", it has recently been given another name as "PALE HEADED STRIPED BORER", by Grist & Lever (1969), particularly to differentiate *Chilo suppressalis* larvae from those of *Chilo traxa* polychrysa Meyrick, whose larvae are also striped but with the head "darker" Nayar *et al.* (1976) called it as 'Asiatic Rice Borer' because of its wide distribution in Asia and restrict its occurrence to Assam, Bihar, Orissa and W.B. in India. The present study includes the material from other states like, Kerala, Rajasthan and Uttar Pradesh, and it is of interest.

Although Kapur (1950) studied this species as one of the Crambinae associated with sugarcane in India, he did not include sugarcane as its host, neither subsequent workers like Kapur (1967), Banerjee & Pramanik (1967), Grist & Lever (1969) and Barrion & Litsinger (1994) mentioned sugarcane as its host. It is of ecological interest to mention here that several examples, on sugarcane, have been studied, present in College of Agricultural Science, Kerala Agricultural University, Vellayani (collections made in 1930 from Kerala), in P.D.B.C., Bangalore (collections made in 1962, 1963 from U.P. and Rajasthan) and in Z.S.I., Calcutta (collections made in 1885, 1891 and 1907 from Bihar and Maharashtra). But it is believed that the species is a major pest only on paddy, sorghum and maize.

The species *Chilo suppressalis* (Walker) is characterised by the presence of well developed ocelli, conical frons with a corneous point and the vein R₁ in forewing generally

being free from Sc. Besides, the forewings are completely devoid of any metallic scales, and the terminal dots dark and complete. The species differs externally from the following species by the presence of a small ridge from ventral surface of frons, and by the dark scales on forewing dispersed irregularly unlike in *partellus* where these are concentrated in the costal area and with a shadowy patch from apex running towards hind margin, but stopping halfway; in *Chilo tumidicostalis*, the scales are scattered all over and also form a diffused dark brown fascia below the median nervure to a little beyond the cell. The latter species further differs from both viz., *Chilo suppressalis* and *Chilo partellus* by the terminal dots being larger and broken externally by a small silver white point.

Kapur (1950) and Bleszynski (1970a) gave very good male and female genitalic descriptions, and clearly differentiated them from both *partellus* and *tumidicostalis*.

On hatching, the caterpillars bore into the stem and cause dead hearts and white ears in the early and later stages of crops, respectively. Several plants are reported to be attacked by a single caterpillar. When crop is harvested, the caterpillars if present in stem remain there and enter into diapause till favourable conditions are available after sowing.

Chilo partellus (Swinhoe)

(THE SORGHUM STEM BORER / MAIZE BORER / JOWAR BORER / PINK BORER)

(Plate I, figs. 7-8; Text figs. 3A-D)

1885 *Crambus partellus* Swinhoe, *Proc. zool. Soc. Lond.* : 879.

Diagnosis : Head with the frons conical, produced forward into a corneous point, ventral surface without a ridge, or the ridge very slight; labial palpi three to four times the diameter of eye; antennae minutely serrate, thickened and laterally flattened nearly upto the tip, about half the length of forewing-costa in male; antennae simple and less than half the length in female.

Forewing apices narrow. Hind wings with the vein Sc dilated at base in male, very slightly or nearly normal in female; frenulum spines three in female, one of which is stout. Outer tibial spurs about half the length of inner spurs in middle leg and two thirds of inner spurs in hind legs.

Forewings pale brown to straw coloured, with dark brown black scales concentrated over costal area, giving an appearance of costal streak; discal spots three, diffused, or sometimes indistinct; a shadowy patch running from apex towards middle of hind margin but stopping half way; sometimes an additional subterminal line present, followed by a series of terminal black dots; fringe not shining, slightly darker at base. Hindwings pale straw coloured, or slightly darker.

Females generally pale and with fewer dark scales which are more diffused; bands or patches usually indistinct, hindwings paler.

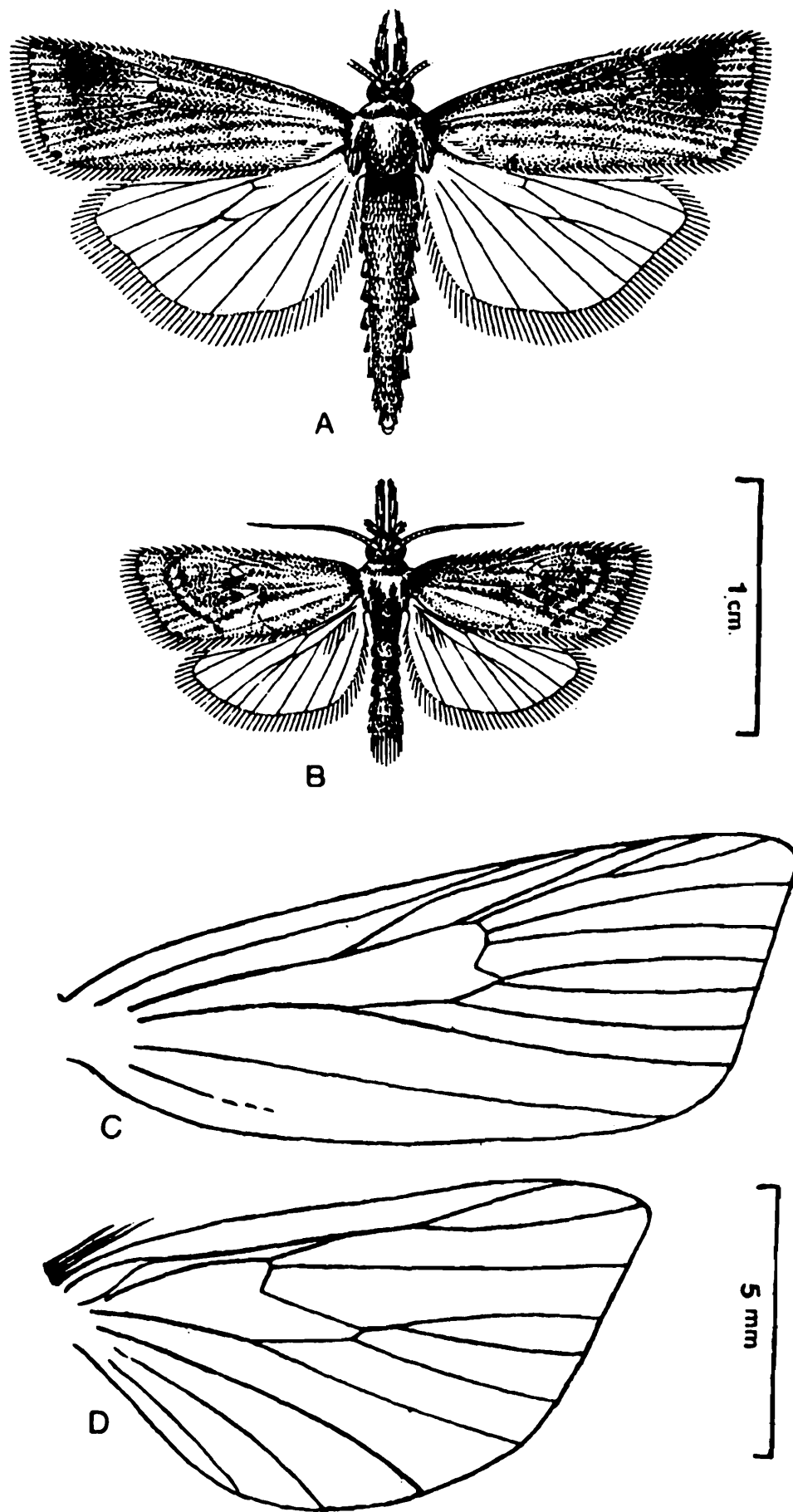


Fig. 3. *Chilo partellus* (Swinhoe): Adult ♀ (A) and ♂ (B) with wings spread, showing wing pattern and other features, (C) Fore and (D) hindwing venation (Magnification of A and C same as of B and D, respectively).

Venation : Forewing : Vein R_1 free, straight to costa or curved and approximated to Sc but not coincident; R_2 free, very close to angle; R_{3+4} stalked, the stalk as long as R_4 , R_3 shorter and along with R_4 ending at costal margin; R_5 from below the angle and closer to M_1 below than to R_{3+4} ; M_2-M_3 close at origin, from the lower angle; Cu_{1a} and Cu_{1b} much before the angle, Cu_{1b} in line with the origin of R_1 above. **Hindwing :** Rs from upper angle, anastomosing with Sc for a short distance, both ending at costal margin; M_1 free from below the upper angle; M_2-M_3 shortly stalked, from the lower angle of cell.

Genitalia : Vide Kapur (1950) and Bleszynski (1969-1970a).

Material examined – INDIA : BIHAR : Saran, 1 ♂ – 1904, Mackenzie coll on maize; Pusa, 3 ♀, 25.v.1905, 1 ♀, 27.x.1905, on maize stalk, all C.S.M. coll.; 3 ♂, 18,19, 22.v.1905, on maize, K.D.S coll.; ; 1 ♀, 10.v.1906, no coll.; 1 ♂, 1 ♀, 20.v.1907, B.S. coll., 3 ♂, 26, 27, 30.viii.1907, on maize, 1 ♀, 6.ix.1907, on maize, 1 ♂, 1 ♀, 23.vi.1908, hibernating in jowar, all M.Singh coll.; 1 ♂, 10.viii.1908, sorghum stem, S.Kar coll.; 1 ♀, 27.viii.1909, chichera fruit; 1 ♂, 1 ♀, 4.v.1912, 1 ♀, 26.v.1912, 2 ♀, 1, 9.vi.1912, 1 ♀, 21.vi.1915, 1 ♂, 13.vii.1918, 2 ♀, 22, 23.vii.1918, 2 ♀, 26, 28.vii.1918, 2 ♀, 3, 16.x.1918, 1 ♀, 26.iv.1919, 1 ♀, 16.vi.1919, all on rice, no coll.; 2 ♀, 19.vii.1912, 2 ♂, 12.viii.1912, R.M.P. coll., 1 ♂, 2 ♀, 12.vi.1915, 1 ♂, 1 ♀, 14.vi.1915, on sugarcane ; 2 ♂, 15.vi.1915, 1 ♂, 16.vi.1915, 1 ♂, 1 ♀, 17.vii.1915, 1 ♀, 20.vii.1915, 1 ♂, 2 ♀, 21.vii.1915, all DPS coll., on maize ; 2 ♀, 22.vii.1915, 1 ♀, 27.vii.1915, 2 ♀, 5.viii.1915, 1 ♂, 25.viii.1915, 2 ♀, 10, 23.ix.1915, all T. Ram coll., on maize ; 2 ♀, 26, 27.viii.1915, 1 ♂, 13.ix.1915, 4 ♂, 23.ix.1915, 3 ♂, 1 ♀, 25.ix.1915, 3 ♀, 27.ix.1915, 3 ♂, 28,29.ix.1915, 1 ♂, 1 ♀, 30.ix.1915, 3 ♂, 1, 2.x.1915, 2 ♀, 2.x.1915, all T. Ram coll., on jowar ; 1 ♀, 31.v.1915, 2 ♀, 8.vi.1915, 2 ♂, 9, 17.vi.1915, 1 ♀, 29.vi.1915, 2 ♂, 22, 26.vii.1915, 2 ♀, 23, 30.vii.1915, 3 ♀, 14.viii.1915, 1 ♂, 28.ix.1917, 2 ♂, 8, 12.x.1917, 1 ♂, 1 ♀, 13.x.1917, 4 ♀, 14, 16, 21.x.1917, 2 ♀, 11.v.1918, 1 ♀, 12.vii.1918, 2 ♂, 9, 30.ix.1918, 1 ♀, 20.x.1918, 1 ♂, 22.x.1918, 1 ♂, 1 ♀, 9.xi.1918, 1 ♀, 14.xi.1918, 1 ♂, 8.vi.1919, 1 ♀, 17.vi.1919, all on jowar, no coll.; 2 ♂, 6, 29.viii.1914, 1 ♂, 13.ix.1914, 1 ♀, 15.ix.1914, 1 ♀, 7.x.1914, 1 ♀, 15.vi.1915, 4 ♂, 10,11, 12, 14.viii.1915, 1 ♀, 18.viii.1915, 2 ♂, 1 ♀, 1.v.1917, 1 ♂, 1 ♀, 4.v.1917, 2 ♀, 8, 9.v.1917, 1 ♂, 10.v.1917, 2 ♂, 1 ♀, 11.v.1917 [♀ Red Labelled (Figured)], 3 ♂, 1 ♀, 14.v.1917, 1 ♂, 1 ♀, 17.v.1917, 1 ♂, 1 ♀, 18.v.1917, 3 ♂, 19.v.1917 [one ♂ Red labelled (Figured)], 6 ♀, 21,23,24, 25.v.1917, 1 ♂, 26.v.1917, 3 ♂, 9, 12.vi.1917, 1 ♀, 16.vi.1917, 3 ♂, 17, 18.vi.1917, 4 ♀, 20,23, 26.vi.1917, 2 ♂, 22, 24.vi.1917, 3 ♂, 2 ♀, 26.vi.1917, all on maize, no coll., 1 ♀, 16.vii.1917, 1 ♀, 12.x.1918, 1 ♂, 28.vii.1927, 1 ♀, 30.vii.1927, 1 ♀, 17.viii.1927, 1 ♀, 3.ix.1927, 1 ♂, 1 ♀, 4.ix.1927, 1 ♂, 11.ix.1927, 1 ♀, 29.x.1927, all Haq coll on maize; 1 ♂, 2 ♀, 30.iii.1927, 1 ♂, 31.iii.1927, all Haq coll on Sorghum; 1 ♂, 18.iii.1928, 2 ♀, 16, 17.vii.1928, all H.H. Singh coll on maize; 1 ♂, 7.x.1917, 1 ♀, 11.ix.1917, 1 ♂, 29.xi.1917, 1 ♂, 21.xii.1917, all boring Sudan grass, no coll.; 1 ♂, 22.iii.1926, Chatterjee coll on jowar. DELHI : 1 ♀, 16.vii.1938, H.L. Bhatia coll.; 1 ♂, 1.viii.1940, on maize, 1 ♀, 31.viii.1940, on jowar, all R. Saran coll.. GUJARAT : Surat, 1 ♂, 25.vi.1904, on maize, 1 ♂, 13.vii.1904,

1 ♀ 18.vii.1904, 1 ♀ 21.vii.1904, all *F.U.X.* coll.; on jowar. KARNATAKA : Bellary Dist.; Hagari, 1 ♂ 19.iii.1907, *Y.R.* coll.; on maize; Jhalrapatam, 1 ♀, 27.viii.1917, on maize and jowar, *S.M.H.* coll.. MADHYA PRADESH : Jabalpur, 1 ♀, 18.vii.1904, on jowar, no coll.; Gwalior, 1 ♀ 1.xi.1940, on maize, 1 ♂ 4.ix.1941 on jowar, all *H.L. Rattan* coll.. ORISSA : Cuttack, 2 ♀ 24, 26.vii.1907, *D.N.P.* coll., on rice. TAMIL NADU : Coimbatore, 1 ♂, 20.iii.1907 on cholam, no coll.. UTTAR PRADESH : Cawnpore [Now Kanpur], 2 ♀, 25.viii.1914, 1 ♂ 26.viii.1914, 2 ♂ 1.ix.1914, 2 ♂, 2, 3.ix.1914 all *E.S. Daniel* coll.; on sugarcane; 1 ♂ 1 ♀ 17.viii.1914, 1 ♀ 18.viii.1914, all *E.S. Daniel* coll.; on jowar; Jalaun, 1 ♀ 25.viii.1917 2 ♂ 2 ♀ 27.viii.1917, 1 ♀, 29.viii.1917, 1 ♀, 31.viii.1917, 1 ♀, 1.ix.1917, all *E.S. Daniel* coll., on jowar; Hapur, Remount Depot, 2 ♂, 2 ♀, 30.v.1917, 1 ♂, 1 ♀ 5.vi.1917, 1 ♂ 1 ♀ 6.vi.1917, 1 ♀, 14.vi.1917, all on Scindhia jowar stem, no coll.; 1 ♂ 21.vii.1918, 1 ♀ 3.viii.1918, all *C.S. Misra* coll., on jowar; 1 ♂, 1 ♀, 1.viii.1918, 2 ♀, 2, 6.viii.1918, all *C.S. Misra* coll on *Andropogon sorghum*.

PAKISTAN : Sakkur : 1 ♂, 31.v.1904, on jowar, no coll.; 1 ♂, 28.ix.1918, 1 ♀, 22.ix.1918, boring Sindli jowar, no coll.; Sibi, 1 ♂, 1 ♀, 7.vi.1911, 1 ♂, 8.vi.1911, on jowar, no coll.; Nasirabad, 1 ♂ 13.v.1911, 1 ♂, 31.v.1911, 1 ♀, 4.vi.1911, all on cotton seed, 2 ♂, 1 ♀, 7.vi.1911, 1 ♂, 12.vi.1911, all on jowar, no coll.; Larkana, 2 ♂, 7.x.1918, on jowar; Mirpur Khas (Sind), 1 ♂ 23.x.1918, 2 ♀, 7, 18.x.1918, no coll.

[All in I.A.R.I., New Delhi]

INDIA : UTTAR PRADESH : Lucknow, 1 ex, 20.iii.1958, 1 ♂, 14.viii.1972, on sweet sorghum, 1 ♂ 1 ♀ 12.ix.1972, 2 ♀, 13.ix.1972, 1 ♀, 7.ii.1974, all *B. Pant* coll., on Maize [In I.I.S.R. Lucknow]

INDIA : PUNJAB : Ludhiana, 1 ex., 3 ♀, 18.ix.1964, on maize, *M. Ramzan* coll.; 1 ♀, 13.viii.1981 Maize Lab, reared on maize, *K.K. Sharma* coll.; 1 ♀, 13.viii.1981, Maize Lab. on maize, *Paramjeet Singh* coll.

[In Pb.Ag.Univ. Ludhiana]

INDIA : ASSAM : Gauhati, 1 ♂, -. iii.1993, 1 ♂, 12.iv.1963, on paddy. HIMACHAL PRADESH : Chamba, 5 ♂ 1 ♀, -. viii.1962, on maize; Dalhousie, 2 ♂, 6 ♀, -.viii.1962, on maize. MEGHALAYA : Cherrapunji, 1 ♂, 6.ix.1962, on maize. ORISSA: Bhubaneshwar, 1 ♂ 8.iii.1963, on sugarcane. RAJASTHAN : Sriganganagar, 1 ♂, 20.ii.1963, on sugarcane; Jaipur, 1 ♂ 2.iii.1963, on jowar. UTTAR PRADESH: Lucknow, 2 ♀, 27.vi.1965, no other data. WEST BENGAL. Kalimpong, 5 ♂, -. vi.1962, on maize, 1 ♀, -. ix.1962, on maize, 2 ♂, 3.xi.1962, feeding inside ragi stem, 1 ♀, -. v.1963, on maize, 1 ♂, 1 ♀, -.vi.1963, on maize; Plassey, 2 ♀ 16.i.1963, on paddy; Chandannagar, 2 ♀, -.viii.1963, on paddy; Pedong, 1 ♂, -.iii.1962, on maize, no other date; Mahadanapuram, 2 ♂, 1 ♀, -.viii.1962, on maize, 2 ♂, 14.viii.1962, on jowar, 2 ♂, 2 ♀, -.ix.1962, on jowar, no other data; Betuli Bari, 1 ♀, 2.ix.1968, ex *Vetiveria zezanioides*, no other data; Sabour, 1 ♀, -.ii.1962, on paddy, 1 ♀,

24.ii.1963, on sorghum.; Bodhan, 1 ♂, 2 ♀, 9.iii.1963, 1 ♂, 11.iii.1963, 1 ♀ 13.iii.1963, 2 ♀, 17.iii.1963, all on jowar, no other data; Motipur, 1 ex., -.ii.1969, on sugarcane.

[All In P.D.B.C., Bangalore]

INDIA : TAMIL NADU : Coimbatore, 1 ex., 6.iii.1901, boring stem of sorghum, Y.R. coll.; 1 ♀, from ragi, 8.x.1909, T.V.R. coll.; 2 ♂, 18.ii.1914, from cholam stubbles, Y.R. coll., 1 ♂, 16.xii.1938, from cholam stem, Y.R. coll.

[All in T.N.Ag. Univ. Coimbatore and labelled as *Chilo simplex*]

INDIA : TAMIL NADU : Coimbatore, 1 ex, 5.xii.1932, M.S.K. coll.; 1 ex., 8.xii.1931, 2 exs., 10.xii.1931, 1 ♂, 2.ii.1932, all P.S.N coll.; boring cholam stem; Naduvattam (Nilgiris), 1 ♀, 23.x.1964, on *Citronella* grass, no coll.

[All in T.N.Ag. Univ., Coimbatore]

INDIA : KARNATAKA : Kemmangurdi, 1 ♀, 9.iv.1975, C.A. Viraktamath coll.

[In Univ. Ag. Sci. GKVK, Bangalore]

INDIA : BIHAR : Champaran, 1 ♂, - - .1907, on sugarcane; Pusa, 1 ♂ 2.v.1917, on maize, no coll.; 1 ♂, 18.vi.1918, on jowar; 1 ♂, 4.iii.1926, on sugarcane Haq coll.; 1 ♂ 13.ix.1933, at light, H.N. Batra coll.; 1 ♀, 24.vii.1935, Rangi coll., on maize. MADHYA PRADESH : Mhow, 1 ♀, - - 1881, no coll.. NEW DELHI : 1 ♂, 18.vii.1937, 1 ♂, 5.iii.1938, 2 ♂, 8.iii.1938, on cholam, 1 ♂, 20.viii.1938, on maize, all M. Ahmad coll.; (all det K.V. Rao); 1 ♀, 24.ix.1943, Bose coll.; 60 ♂ ♀, 21.v.1996, all Bred in Bio. Control Maize Lab., I.A.R.I., New Delhi. TAMIL NADU : Coimbatore, 1 ♂, 5.iii.1914, on cholam, D.P. coll., 1 ♂, 26.iii.1940, on sugarcane. UTTAR PRADESH : Lucknow, 6 ♂ ♀, 22.viii.1996, all Bred in Bio. Control Lab., I.I.S.R., Lucknow. WEST BENGAL Mohanpur, 1 ♂, 26.vii.1966, on paddy no coll.

[All in Z.S.I., Calcutta]

Wing expanse : ♂ 18-25 mm; ♀ 23-28 mm.

Distribution : INDIA : Andhra Pradesh; Assam; Bihar; Delhi/New Delhi; Gujarat; Haryana; Himachal Pradesh; Karnataka; Madhya Pradesh; Maharashtra; Meghalaya; Orissa; Punjab; Rajasthan; Sikkim; Tamil Nadu; Uttar Pradesh and West Bengal. *Elsewhere*. Afghanistan; Comoros Is.; Japan; Indonesia; Iraq; Malawi; Nepal; Nyasaland; Pakistan; Sri Lanka; Sudan; Tanzania; Taiwan; and Uganda.

Hosts : Maize; Paddy; Pearl Millet (*Pennisetum typhoideum*); Sorghum; Baru or cholam (*Sorghum vulgare*) and Sugarcane. *Alternative Hosts*.—Burgur (*Polytoca barbata*); Finger Millet (*Eleusine indica*; *E. coracana*); Johnson grass (*Sorghum halepense*); Sudan grass (*S. sudanense*); *Pennisetum frumantaecum*; Job's Tears (*Coix lachrymajobi*); *Saccharum sera*; *Rottboellia compressa*; *Vossia cuspidata*; *Setaria splendida*; *Chichera* fruit (colln. IARI); *Vetiveria zezanioides* (colln. PDBC)

Status : Serious.

Remarks Commonly known as maize and sorghum *Chilo*, the jowar stem borer and the pink borer, the species is principally a stalk borer of sorghum (*Sorghum vulgare*). While maize is attacked when the plant is young, sorghum is attacked at all stages. Paddy is attacked in Assam, WB, Bihar and Orissa in all seasons but the attack is serious when plants grow ears. Sugarcane does not appear to be the main host of this species and is attacked in the vicinity of infested paddy, maize or sorghum crops. Banerjee & Pramanik (1967) are of the view that the species "possibly tends to establish itself as virulent rice-pest in a region where maize and sorghum are not cultivated widely, because in the western parts where these crops are widely grown, the species is not reported to attack rice extensively" They further add that the species has become a serious menace on rice possibly due to absence of their major hosts like maize, jowar or sorghum and the attack may go upto 80%.

On hatching, the caterpillars feed for sometimes on the epidermis, but later bore into the stem, and feed mainly on the central tissue, killing the plant, if young, or decreasing the vigour in older plants which develop deadhearts. The caterpillars pupate within the hollow of the stem and emerge through an exit-hole made by caterpillars before pupation.

The species resembles very closely to *Chilo suppressalis*, to which it was confused. However, as already mentioned under "Remarks" in *Chilo suppressalis*, it can be separated by the absence of ridge on ventral surface of frons; by the presence of shadowy patch on forewing and the costal suffusion. Besides, the genitalic differences are quite distinct, for which reference to studies by Kapur (1950) and Bleszynski (1969, 1970a) be made.

Although Pruthi (1969) states that the pest breeds between April and October, and the caterpillars hibernate in colder months to emerge as moths in March, the collection examined shows its occurrence throughout the year, from February to December, particularly in warmer region like Tamil Nadu and Rajasthan.

***Chilo tumidicostalis* (Hampson)**

(THE PLASSEY BORER)

(Plate I, figs. 9-10; Text figs. 4A-D)

1919. *Argyria tumidicostalis* Hampson, *Ann. Mag. nat. Hist.*, (9) 3 : 448-449.

Diagnosis Head with the frons produced forward, widely conical, with a distinct corneous point at the apex and directed antero-distally, ventral surface without ridge; labial palpi 2.5 times the diameter of eye in male and about 3.5 to four times in female; ocelli well developed; antennae minutely serrate, laterally flattened in male, simple in female, about two-thirds the length of forewing costa in male and half the length in female. Legs with the outer tibial spurs about half the length of inner ones in middle legs and about two-thirds the length in hind legs. Frenulum spines three in female, one of the spines is stout.

Male Forewing cinnamon brown, suffused with reddish to dark brown, with a rather

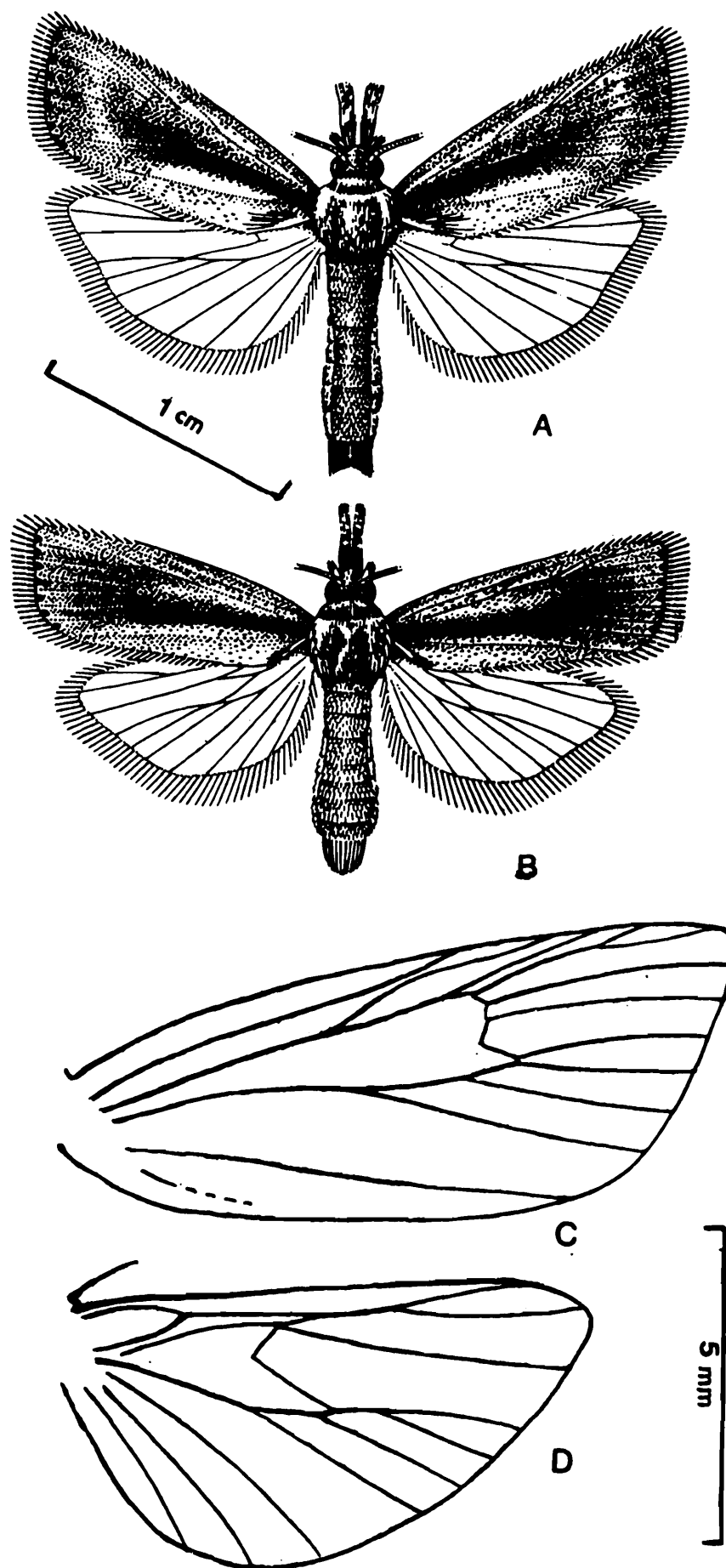


Fig. 4. *Chilo tumidicostalis* (Hampson): Adult ♂ (A) and ♀ (B) with wings spread, showing wing pattern and other features, (C) Fore - and (D) hindwing venation (Magnification of B and C same as of A and D, respectively) (A and B, ex. sugarcane, Jorhat, 27.vi.1938, N. Ahmad coll.)

diffused dark-brown fascia below the median nervure to a little beyond the cell, and a number of dark-brown scales scattered all over irregularly except on the area below the median fascia and along the posterior margin; termen with series of large black spots which are usually broken externally, by small silvery white points (from center of the spots) making the spots look like in pairs; fringe rather shiny, light brown and with a darker line at the base. Hind wings whitish, except for a few light brown scales in the costal area.

Females : Similar to males, particularly by the presence of fascia below the median nervure, but with the rest of scales usually lighter and fewer. Hindwing whitish.

Venation : Forewing : Vein R_1 free, but curved towards Sc and approximated to it; R_2 free, a little before the upper angle; R_{3+4} on a long stalk, the latter about twice the length of R_3 , both ending at costa; R_5 from below the upper angle and about equidistant between R_{3+4} and M_1 ; $M_2 - M_3$ separate, from angle; Cu_{1a} , Cu_{1b} from before the angle and nearly in line with the origin of R_2 and R_1 , respectively. *Hindwing* : Sc dilated at base; Vein Rs from upper angle, anastomosing for a short distance with Sc, both ending before apex at costa; M_1 from angle; $M_2 - M_3$ shortly stalked.

Genitalia : For genitalic studies reference may be made to Kapur (1950), Gupta (1958), Bleszynski (1969, 1970) and Avasthy & Tiwari (1986).

Material examined : INDIA : ASSAM : Jorhat, 2 ♀, -.vii.1918, 3 ♀, 30.viii.1918, 2 ♂, 3 ♀, 31.viii.1918, 3 ♀, 1.ix.1918, 3 ♂, 7 ♀, 2.ix.1918, 2 ♀, 3.ix.1918, 1 ♂, 4.ix.1918, 2 ♂, 2 ♀, 5, 6.ix.1918, 2 ♂, 7.ix.1918, 3 ♀, 9,10, 11.ix.1918, 1 ♂, 22.ix.1918, 1 ♂, 1 ♀, 23.ix.1918, 1 ♀, 25.ix.1918, all on sugarcane, C.S.No. 1832, S.R. Gupta coll.

BANGLADESH : Pabna, 2 ♂, 28.viii.1911, C.S.No. 914, Paratypes; Kulaura, 2 ♀, in sugarcane, 17.viii.1921, no coll.; Dacca, 1 ♀, 21.ix.1917, in sugarcane, P.C. Sen coll.; "FIGURED", C.S.NO. 1610, 1 ♂, 27.ix.1917, P.C. Sen Coll.; 1 ♂, 23.vii.1917, on sugarcane, "FIGURED", 1 ♂, 23.vii.1917, 1 ♀ 24.vii.1917, 1 ♀, 18.viii.1917, 1 ♀, 27.ix.1917, 1 ♀, 2.x.1917, all Ghosh coll., on sugarcane.

[All in I.A.R.I., New Delhi]

INDIA : WEST BENGAL : Plassey, 1 ♂, 3.iii.1956, 1 ♀, 11.iii.1956, no coll.; 1 ♂, 1.vii. 1957, J.P.K. coll.; 1 ♀, 7.viii.1956, 2 ♂, 11, 13.viii.1956, 1 ♂, 1 ♀, 15.viii.1956, 1 ♂, 19.viii.1956, 2 ♀, 22, 30.viii.1956, 4 ♂, 1,4,5, 7.ix.1956, 2 ♀, 13.ix.1956, 1 ♂, 14.ix.1956, 3 ♀, 24,27, 29.ix.1956, 1 ♂, -.ix.1956, no coll.

[All in I.I.S.R., Lucknow]

INDIA : ASSAM : Barbhera, 5 ♂, -.vi.1963, on sugarcane; Gauhati, 2 ♂, 3 ♀, -.vi.1969, on sugarcane, no coll.,

[All in P.D.B.C., Bangalore]

INDIA : ASSAM Jorhat, 2 ♂, 27.vi.1938, boring stem of sugarcane, *N. Ahmad* coll.
[In Z.S.I., Calcutta]

Wing expanse : ♂ 21-27 mm; ♀ 26-35 mm.

Distribution : INDIA : Assam; Bihar; Nagaland and West Bengal. *Elsewhere* : Bangladesh; Myanmar and Nepal.

Hosts : Sugarcane. *Alternative Hosts* : *Saccharum spontaneum* and *Sclerotachya fusca* in Assam.

Status : Serious pest of sugarcane, particularly at the initial stage of plant; otherwise of "Minor" status in grown up plants.

Remarks : The newly hatched larvae concentrate to three to five top internodes of cane and feed inside, pushing fresh wet frass of shiny-red in colour through entry holes. Although, Gupta & Avasthy (1957) recorded an average of 50 larvae in a single internodes, Avasthy & Tiwari (1986) put the figures of larvae in a single internode to as many as 156. Tunnelling of the internode is so serious that the top leaves of the shoot dry-up and top-portion itself breaks off easily. They also mention about polymorphism in the larvae where the tubercles may be faint and stripes faint and absent.

When grown older, the caterpillars disperse and lead a solitary phase, and move to healthier adjacent internode, downwards, or migrate to adjacent canes. However, the infestation by grown-up larvae does not cause any drying-up of the top leaves.

Popularly known as a "The Plassey Borer", the name given by Gupta (1957) when it became an "epidemic stem borer" in Plassey (WB), the species is characterised by the presence of dark-brown fascia below the median nervure to beyond the cell and by the terminal dots being large and with silvery white point in center extending outwards, unlike in both the preceding species. However, like in other species, this also has the frons produced forward, conical and with a corneous point.

The male genitalia is also different from both the preceding species (vide Kapur, 1950; Bleszynski, 1969-1970a).

The material present at the Indian Institute of Sugarcane Research, Lucknow showed some variation in respect of the frons, which in some cases was subrounded to conical but with a corneous point; and the vein R_1 anastomosing in forewing of one side. Obviously, these variations are quite abnormal and interesting but not sufficient enough to give any consideration for synonymising other genera like *Chilotraea* and *Borer* with *Chilo*. While Pruthi (1969) stated that the species is common in Bihar, Bengal and Assam, Khanna *et al.* (1957) were of the opinion that the species was a serious pest of sugarcane in Bihar but in recent years it has become scarce. The material examined at various repositories, however, did not have any representative collection from the State of Bihar.

Genus *Chilotraea* Kapur

1950. *Chilotraea* Kapur, *Trans. R. ent. Soc. Lond.*, 101 (Part II) : 402.

Type species : *Chilo infuscatellus* Snellen

Diagnosis : Head with the frons produced forward, subrounded, usually smooth and without a corneous point; labial palpi porrect, covered with long scales and hairs and about three to three and a half times the diameter of eye; maxillary palpi triangularly dilated with scales at extremity; proboscis poorly developed; ocelli present; antennae minutely serrate in male and ciliate, laterally flattened, simple in female. Forewing with vein R_1 anastomosed with Sc. Hindwing with vein $Rs - Sc$ stalked; M_1 from angle of cell; $M_2 - M_3$ stalked.

Genitalia : Vide Kapur (1950), Gupta (1958) and Bleszynski (1970)

Distribution : India. *Elsewhere* : Celebes; Formosa; Indonesia; Korea; Malaysia; Moluccas; Myanmar; Nepal; Philippines; South China; Sri Lanka; Thailand; and Tongkin.

Remarks : Bleszynski for the first time (1962) synonymised *Chilotraea* Kapur to the genus *Chilo* Zincken and followed (1970a) while dealing with revision of the world species of *Chilo*. He synonymised as many as seven other genera, including *Proceras* Bojer. Bleszynski (1970a) admits that "Very good specific characters are offered by the shape of face", and again he says "The shape of the face is a relatively constant character in most species of *Chilo*. However, *orichalcociliellus* Strand shows face variable; it may be slightly or strongly conical, with or without sharp point." The species cited above, viz., *C. orichalcociliellus* and its closely allied species viz., *aleniellus* Strand and *thyrsis* Blesz. show similar face, but with R_1 anastomosed with Sc. About vein R_1 , he (*loc. cit.*) says "The position of R_1 may vary within individual species. Moreover, several species, i.e. *pulverosellus*, *agamemnon* and *ceylonicus* have the face rounded as in *Chilo*, *sensu* Kapur and R_1 in the forewing free as in *Chilotraea*." The fact is that Kapur (1950) never mentioned R_1 free in *Chilotraea*, and Bleszynski (1970a) included *ceylonicus* in the key under couplet "Free" as well as "coincident with Sc" (Couplet No. 25 and 36, respectively). The text, however, shows that while the first two species have the vein R_1 free, *ceylonicus* has the vein R_1 confluent with Sc, a character of *Chilotraea*. In fact, the persusal of the work shows that majority of the species with the vein R_1 confluent with Sc, have their frons produced forward but without corneous point as a general rule (except *orichalcociliellus* and its allies).

Keeping in view the taxonomic workability in species included by Kapur (1950) under the genus *Chilotraea*, it is proposed to revalidate the genus with all the following species. The future workers may include several species treated by Bleszynski (1970) to their right placement under *Chilotraea* Kapur.

The genus is very important from the point of view of economic importance, particularly *Chilotraea auricilia* (Dudgeon) which is a serious pest of paddy in one region and sugarcane in another, besides several others like *infuscatellus*, *ceylonicus*, *polychrysa*, etc. These are distinguishable by the following key.

Key to identification of *Chilotraea* Kapur Species

1. Forewing deep straw-coloured to light fuscous; without metallic scales and spots; a pair of discocellular blackish spots and a subterminal pale line or a series of spots present; terminal series of small black spots, with minute white spots on inner side, present; fringe matt, with two dark lines *Chilotraea infuscatellus* (Snellen)
- Forewing straw coloured, irrorated with ochreous brown to fuscous; metallic scales or spots present; terminal series of spots either ill defined, absent or well developed; fringe shiny 2
2. Terminal series of spots well developed, large, black, with silver-white centre; fringe silvery, with a darker streak at base; forewing with fuscous irroration, tending to form streaks in interspaces, and with a pair of discoidal spots; subterminal line silvery *Chilotraea ceylonicus* (Hampson)
- Terminal series of spots ill defined or absent; fringe glossy or golden 3
3. Forewing with dark metallic spots in the cell, at the origin of vein M_2 , M_3 and one below the origin of vein Cu_{1a} extending to below Cu_{1b} ; a few metallic scales in and beyond the cell; a subterminal series of darker, metallic spots; fringe golden *Chilotraea auricilia* (Dudgeon)
- Forewing with discal dots reduced, line glossy; subterminal line ill defined, white, with a few silvery scales; fringe glossy *Chilotraea polychrysa* (Meyrick)

Chilotraea infuscatellus (Snellen)

(THE SHOOT BORER)

(Text figs. 5A-C)

1890. *Chilo infuscatellus* Snellen, *Meded. Proefst. Kagok* : 94.

Diagnosis : Head with the frons produced forward, rounded, without any point; labial palpi three times the diameter of eye in male and three-and-a-half times in female; ocelli well developed; antennae minutely serrate and laterally flattened, serration stopping about four segments short of the apex, which is thin; antennae gradually tapering to the apex and simple in female; about half to one-third the length of forewing-costa; frenulum spines three in female; outer tibial spurs half the length of inner ones in middle legs and 2/3rds in hind legs.

Male : Head and thorax fuscous; labial palpi whitish, mixed with fuscous; antennae with dark and whitish- brown rings. Forewing deep straw-coloured to light fuscous, the latter

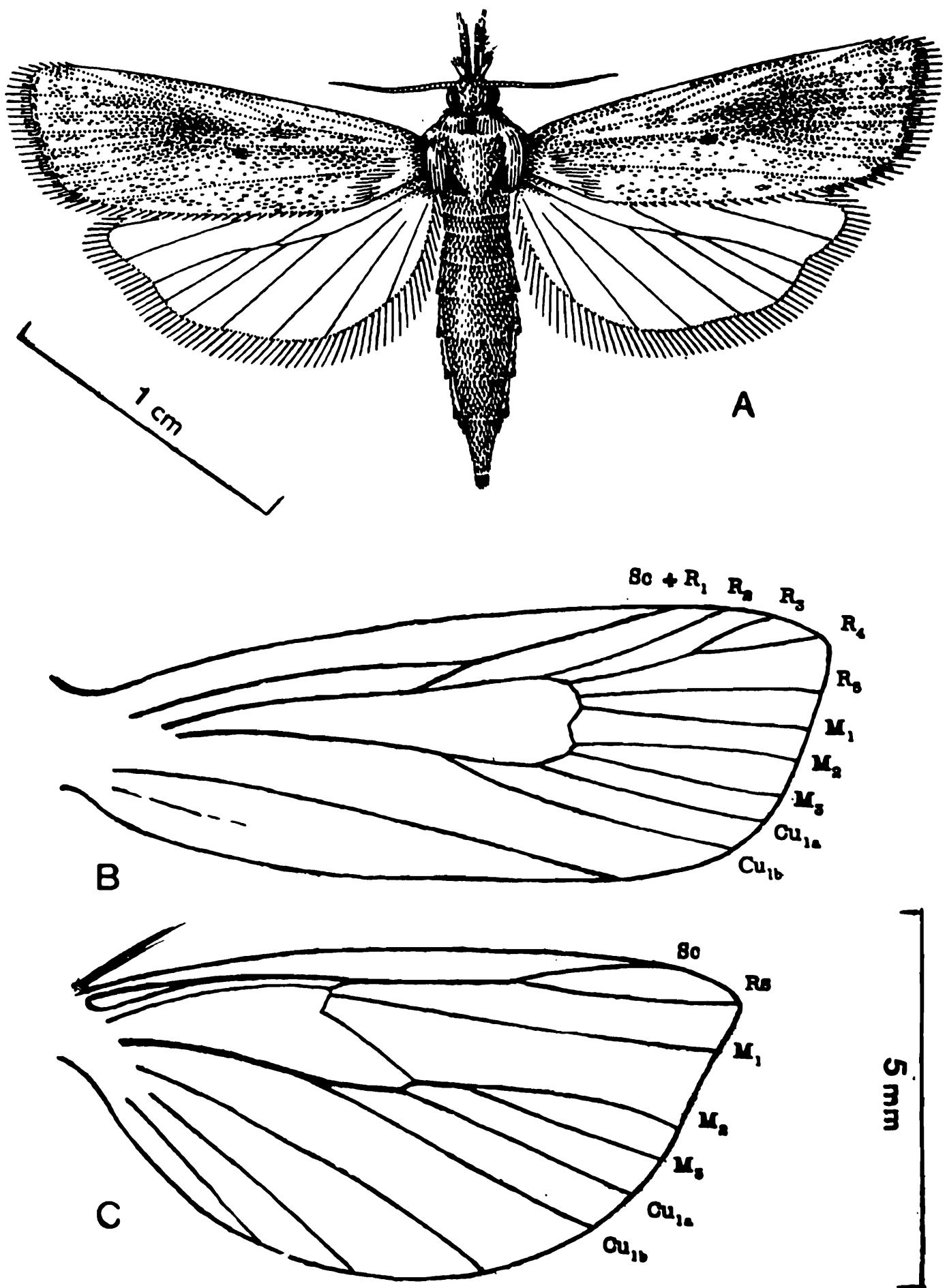


Fig. 5. *Chilotraea infuscatellus* (Snellen) ♀ : (A) with wings spread, showing wing pattern and other features (ex. sugarcane, 30.iii.1938, *Prakasam* coll.), (B) Fore - and (C) hindwing venation (Magnification of B same as of C).

especially along median nervure and in & beyond the cell.; usually two discocellular spots present, the lower one defined on outer side by white; a subterminal line pale fuscous, or with a series of spots sometimes mixed with whitish scales; a terminal series of minute black spots, defined on inner side by minute white spot; fringe straw coloured, with darker lines. Hindwing whitish, with the apical area, a part of termen and base of fringe light buff.

Female : Larger than male and lighter in colouration.

Venation : Forewing : R_1 confluent with Sc; R_2 free, close to upper angle; R_{3+4} stalked, stalk longer than R_4 and both ending at costa before apex; R_5 and M_1 from below the upper angle, with R_5 equidistant between R_{3+4} and M_1 ; $M_2 - M_3$ separate but close, from the lower angle; Cu_{1a} from a little before lower angle and in line with R_2 above; Cu_{1b} twice as far from Cu_{1a} as the latter from M_3 , and in line with the origin of R_1 above. *Hindwing* : Sc anastomosed with Rs beyond the cell angle to about $1/2$ the distance between cell angle and apex; Sc dilated at base; M_1 from a little below the angle; $M_2 - M_3$ stalked; Cu_{1a} close to lower angle.

Genitalia : Vide Kapur (1950), Gupta (1958) and Bleszynski (1970a)

Material examined : JAVA : Paseoroean, 3 ♂, - .viii.1918, no other data

[In I.A.R.I., New Delhi]

INDIA : Lucknow, 1 ♂, 27.iv.1957, 1 ♀, 12.vi.1957, 1 ♀, 15.iv.1959, all on sugarcane, M.C. coll.;

[In I.I.S.R., Lucknow]

INDIA : PUNJAB : Ludhiana, 1 ♂, no more data

[In Pb.Ag. Univ., Ludhiana]

PUPUA NEW GUINEA : GUSAP; Lanu Ramu Site, 1 ♂, -.iv.1981, Bred from sprouting sugarcane

[In P.D.B.C., Bangalore]

INDIA : KARNATAKA : Kothalagere, 2 ♂, 2 ♀, 1.vi.1995, *Chinnamade Gowade* coll.; on sugarcane

[In Univ. Ag. Sci. G.K.V.K., Bangalore]

INDIA : BIHAR : Pusa, 1 ♂, 11.viii.1926, on sugarcane, *Haq* coll.; 1 ♂, 15.vi.1934, on sugarcane, *R. Saran* coll.; 1 ♂, -.x.1934, on sugarcane, *G.D. Ojha* coll.. HARYANA Hissar, 1 ♂, 5 ♀, bred on sugarcane, - iv - ix. 1985, *J.C. Mahala* coll.. TAMIL NADU : Coimbatore, 1 ♂, 18.iv.1939, on sugarcane, *Venkatraman* coll.; 1 ♀, 30.iii.1938, 1 ♀, 9.iv.1939, 1 ♂, 12.iv.1939, 1 ♂, 12.vi.1939, all boring stem of sugarcane, all *Prakasam* coll.; 1 ♀, 29.xii.1995, on sugarcane at Sugarcane Breeding Institute, *G.S. Arora* coll.. (all except the last 1 ♀, labelled as *Argyria sticticraspis* Hampson, det A.P. Kapur)

(In Z.S.I., Calcutta)

Wing expanse ♂ 20 - 26 mm.; ♀ 28 - 33 mm.

Distribution : Widely distributed in India. Material studied from INDIA : Bihar; Karnataka; Punjab; Tamil Nadu; U.P.. *Elsewhere*: Afghanistan; Formosa; Indonesia; Korea; Malaysia; Papua New Guinea; Philippines; and the USSR

Hosts : Sugarcane; Sorghum; Rarhi and Batri (*Saccharum spontaneum*); Ikri (*S. fuscum*) and Jove grass (*Rottboellia compressa*). **Alternative Hosts** : Oats (*Avena sativa*); Barley (*Hordeum vulgare*); Rice (*Oryza sativa*); pearl millet (*Pennisetum typhoideum*); Maize (*Zea mays*) and finger millet (*Eleusine coracana*). Avasthy & Tiwari (1986) have also recorded several alternative host-plants occurring in wild, like Baijanti, Doob grass; Wild rice; Guinea grass etc.

Status : Serious.

Remarks : Commonly known as the "The Shoot Borer", the species is widely distributed in India, particularly in sugarcane growing areas. The larvae, on hatching, generally feed on outer leaves upto 2nd instar, but the third instar larvae bore into the stem of one to three month-old plants near the ground level and start feeding on the central shoot which begins to wilt and ultimately dries up, causing "dead hearts." The infested portion within the stem starts decaying and when pulled out emits foul smell. Once the shoot is wilted and unfit for caterpillars' sustenance, these migrate to newer ones and thus the attack is spread.

The species occurs on sugarcane simultaneously along with other pests like, *Chilo traea auricilia*, *Emmalocera depressella* and *Raphimetopus ablutella*. Of these, only *C. auricilia* belongs to Crambinae, but the other two to Phycitinae. From the point of symptoms of infestation by *C. infuscatellus* and *C. auricilia*, the "dead-hearts" can be pulled out easily, unlike in the Phycitinae species. However, when pulled out, the infested shoots emit offensive smell only in *infuscatellus* and *ablutella*.

Easwaramoorthy (1986) observes that the species is active under the conditions of high temperature and low humidity, particularly at Lucknow (U.P.) during May and June, and in Sriganganagar (Rajasthan) till the end of October. This explains the continued activity of the pest at two different places in different months, but under similar climatic conditions, i.e. high temperature with low humidity, the latter conditions continuing till about October in Rajasthan. This obviously explains its occurrence and prevalence in different states and extending to newer areas due to climatic factors.

The species, designated as type of the genus *Chilo traea* Kapur, is characterised by the complete absence of silvery scales and fringe unlike in other species. Besides, the anastomosis of vein R_1 with Sc and the frons without corneous point is typical of the genus. For further differentiation, the genitalic studies are very useful for which Kapur (1950), Gupta (1958) and Bleszynski (1970) may be referred to.

***Chilotraea ceylonicus* (Hampson)**

(Plate I, figs. 11-12; Text figs. 6A-B)

1895. *Chilo ceylonicus* Hampson, *Proc. zool. Soc. Lond.* 957.

Diagnosis : Head with frons produced forward, subrounded and without corneous apical point; labial palpi shorter in male than in female, about 2.5 to 3 times the diameter of eye in male and 3.5 times the diameter of eye in female; ocelli well developed; antennae thickened, laterally flattened and minutely serrate nearly to tip in male, gradually tapering in female; frenulum spines double in female.

Male : Head, labial palpi and thorax straw coloured, mixed with fuscous; antennae with dark and whitish-brown rings. Forewing straw coloured irrorated with fuscous tending to form streaks in interspaces except on the inner margin; a pair of discocellular spots present, one at base of vein M_2 and another below Cu_{1a} ; medial line indistinct, fulvous curved below costa and with a few silvery scales on its edge; subterminal line silvery, bent inwards below costa, faintly margined by fulvous; a series of terminal spots large, black and with silvery white centres; fringe rather silvery, with a darker streak at the base. Hindwing Light buff to fuscous, except near base which is whitish; termen with dark patches.

Female : Larger than male; colouration as in male, particularly of the forewing Hindwings whitish, with light buff termen.

Venation : *Forewing* : R_1 confluent with Sc; R_2 free, from close to upper angle; R_{3+4} on a long stalk, the latter longer than the free part of R_4 , both ending at costal margin before apex; R_5 , M_1 from below the upper angle; $M_2 - M_3$ separate from the lower angle, which is produced; Cu_{1a} from before the angle, but nearly in line with origin M_1 above; Cu_{1b} similarly not in line with R_1 above, but in between R_1 and R_2 above. *Hindwing* : Sc dilated at base; anastomosing with Rs after its origin from upper angle for some distance; both ending at costal margin before the apex, with the free part of Rs a little over the length of common stalk; M_1 from a little below the angle; $M_2 - M_3$ stalked, from lower angle.

Genitalia : Vide Kapur (1950) and Bleszynski (1970a).

Material examined : INDIA : BIHAR : Pusa, 1 ♂, 20.x.1918, 1 ♂, 24.x.1918, 1 ♀, 28.ii.1927, on sugarcane, all R. Saran coll.. MAHARASHTRA : Bombay, Bassein Fort, 4 ♀, - .ix - x.1909, [misidentified as "*Chilo suppressalis* Wlk".] S. INDIA : Courtlam, 3 ♀, 1-6.iii.1927, no other data [misidentified as *Chilo suppressalis* Wlk.]

[In I.A.R.I., New Delhi]

INDIA : ASSAM : Navikoli, 1 ♂, 1 ♀, - vi.1967, on sugarcane, no. coll.; WEST BENGAL : Plassey, 1 ♂, - .vii.1968, on *Vetiveria zizanioides* and sugarcane.

[In P.D.B.C., Bangalore]

INDIA : KERALA : Vellayani, 1 ♀, 2.xi.1955, G.K. Nair coll.; "Lemon grass Borer."

[In Z.S.I., Calcutta]

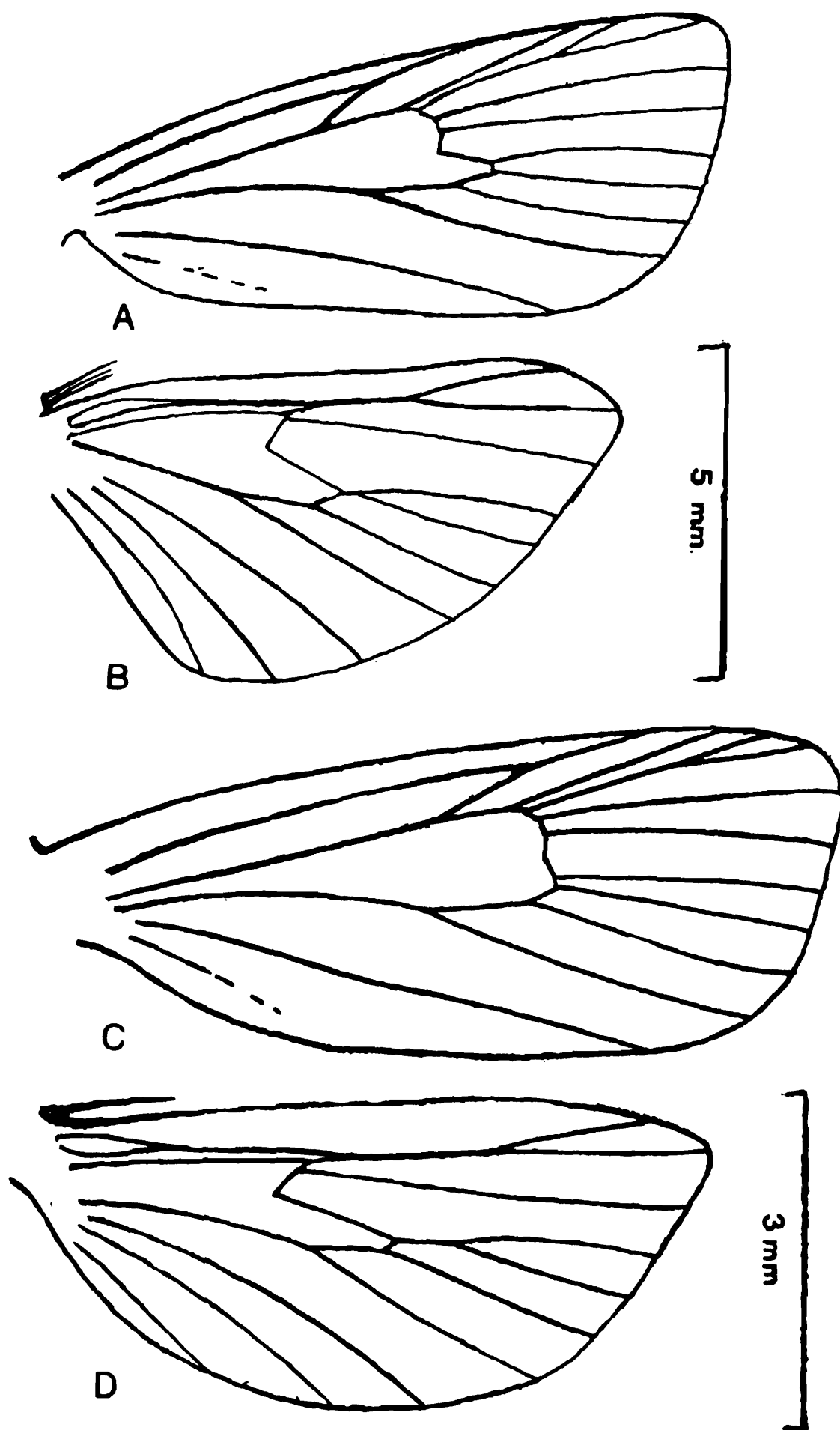


Fig. 6. *Chilotraea ceylonicus* (Hampson): (A) Fore - and (B) hindwing venation; *Chilotraea polychrysa* (Meyrick): (C) Fore - and (D) hindwing venation (Magnification of A and C same as of B and D, respectively).

Wing expanse : ♂ 20 - 22 mm; ♀ 22 - 28 mm

Distribution : INDIA : Assam; Bihar; Kerala; Maharashtra; S. India; and WB.
Elsewhere : Sri Lanka.

Host : Sugarcane. *Alternative Hosts* : *Vetiveria zizanioides*; Lemon grass.

Status : Minor.

Remarks : Kapur (1950) and Bleszynski (1962) recorded the species from Ceylon, but later (1970a) Bleszynski synonymised *torquatellus* Joannis, from Tongking, to *ceylonicus*, thus extending its distribution to that region. The material studied from various repositories, represented the species from Assam, Bihar, Kerala and West Bengal, extending its occurrence to the Indian mainland. This record of the species is, thus, the first ever of the species from the Indian mainland.

The species may be confused with that of *Chilotraea polychrysa* (Meyrick), due to the glossy fringed forewings and by the presence of silver scales on median and subterminal lines but differs by the presence of terminal dots with silvery white centre.

Some examples in National Pusa Collections, IARI, New Delhi, were found to be misidentified as "*Chilo suppressalis* Wlk.", but due to confluence of vein R_1 with Sc, character of frons and by presence of large terminal dots with white centre, the material is assigned to this species.

Chilotraea auricilia (Dudgeon)

(THE STALK BORER / FIVE STRIPED BORER / GOLD FRINGED BORER)

(Plate I, figs. 13-14; Text figs. 7A-D)

1905. *Chilo auricilia* Dudgeon, *J. Bombay nat. Hist. Soc.*, 16 : 405.

Diagnosis : Head with the frons produced forward, subrounded, smooth or sometimes with a point but without corneous point; ventral ridge absent; labial palpi bushy at apex, shorter in male, about three times the diameter of eye, longer in female and about four times the diameter of eye; antennae minutely serrate, thickened, laterally flattened and reaching half the length of forewing costa in male, simple in female; ocelli small and reduced but distinct; frenulum spines three in female, two of which are stout; outer tibial spurs less than half of inner spurs in middle leg and more than half of the inner spurs in hind legs.

Male : Head and thorax straw coloured, sometimes irrorated with fuscous; antennae with dark and whitish-brown rings; palpi irrorated with fuscous. Forewing straw coloured, irrorated with fuscous; a dark metallic spot in the cell, another at origin of vein M_2 and M_3 , an oblong spot below the origin of Cu_{1a} and extending a little below the vein Cu_{1b} ; a few metallic scales present in and beyond the cell; a subterminal series of darker mostly metallic spots incurved towards costa; a terminal series of black spots rather small, without any white at the centre, and ill defined; fringe golden, with a dark streak along the base. Hindwing light straw coloured; fringe rather silvery.

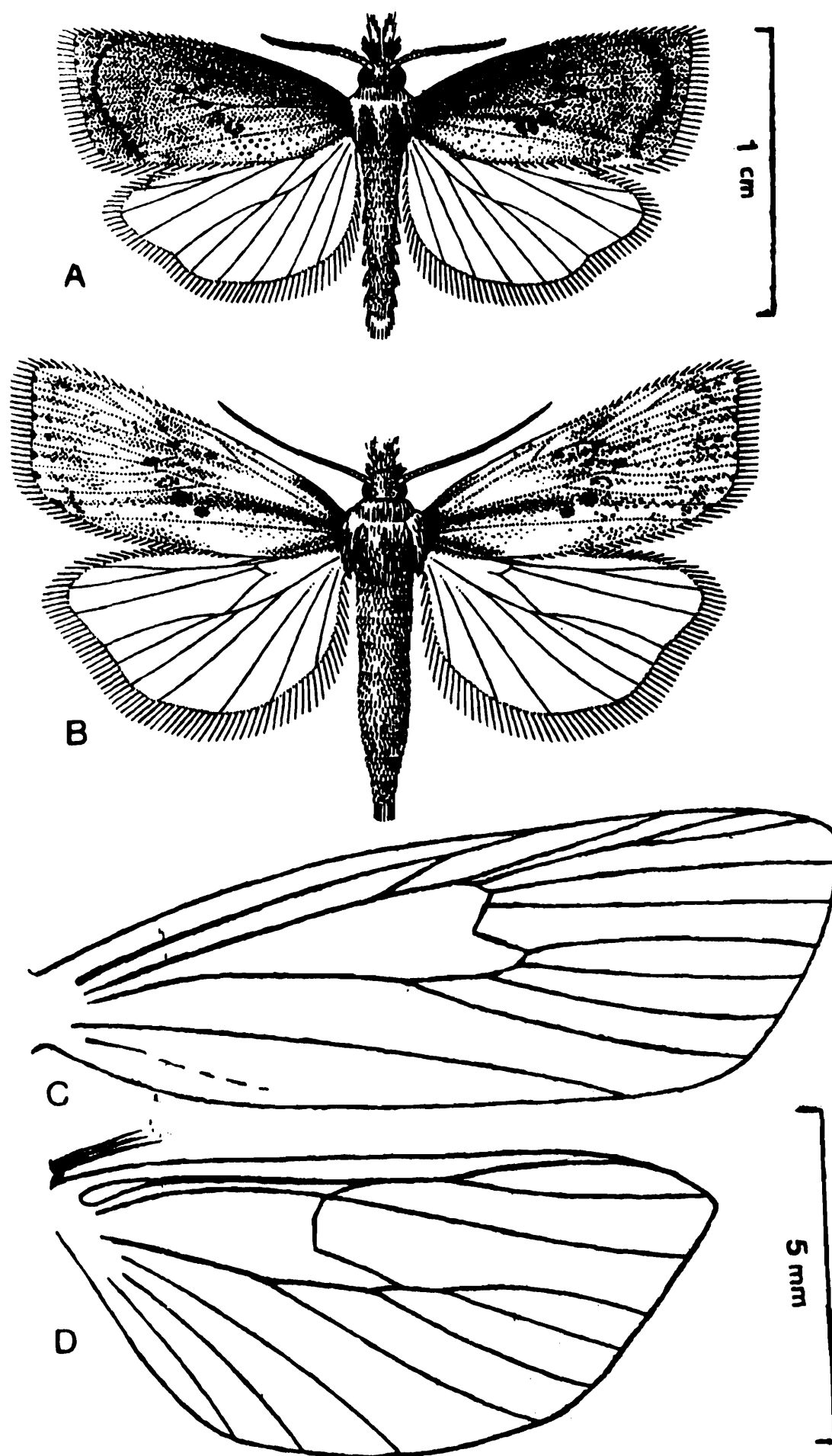


Fig. 7. *Chilotraea auricilia* (Dudgeon): Adult ♂ (A) and ♀ (B) with wings spread, showing wing pattern and other features, (C) Fore - and (D) hindwing venation (Magnification of B and C same as of A and D, respectively).

Female : Usually much larger, the colouration generally lighter and the metallic spots smaller, when present.

The colouration is, however, quite variable, being ochreous irrorated with brown or pale fuscous in both male and female; fuscous and shiny scales may be scattered all over, and instead of spots in and beyond cell, shining scales may form medial series/lines similar to those of subterminal lines.

Venation : Forewing : Vein R_1 usually confluent with, or running closely approximated to Sc ; R_2 from a little before angle; R_{3+4} stalked, from the upper angle, both ending at costal margin, the stalk nearly as long as, or slightly longer than R_4 ; R_5 and M_1 from below the upper angle; R_5 equidistant between origin of R_{3+4} and M_1 below; $M_2 - M_3$ quite separate at origin, M_3 from the lower angle; Cu_{1a} from before the angle and in line with the origin of R_2 above; Cu_{1b} twice as far from Cu_{1a} , as the latter for M_3 and in line with the origin of R_1 above. **Hindwing** : Sc anastomosed with vein Rs after the latter's origin from angle, both ending at costal margin; M_1 from angle; $M_2 - M_3$ shortly stalked, from lower angle.

Genitalia : Vide Kapur (1950), Gupta (1958) and Bleszynski (1970a).

Material examined : INDIA : ASSAM : Rangpur, on rice, 1 ♀, 7.viii.1909; Tinsukia, 1 ♂, 12.x.1928 (Misidentified in the colln. as "*Chilo suppressalis* Wlk." BIHAR : Saran, 3 ♂, - .iii.1903, 4 ♂, - .1904, all Mackenzie coll.; Dalsing Sarai, 2 ♀, 9.iii.1905, on cane; Pusa, 1 ♂, 15.vi.1910, 2 ♂, 6, 9.vii.1910, 1 ♂, 5.ix.1910, 1 ♀, 1.vii.1911, 1 ♀, 1.ix.1916, all T.B.F. coll.; (all misidentified in colln. as "*Chilo suppressalis*"); Pusa, 1 ♀, 20.ii.1918, 1 ♂, 26.vii.1918, on rice; 1 ♂, 3.viii.1918, 2 ♀, 4, 9.viii.1918, 1 ♂, 22.x.1918, all on sugarcane, no coll.; Karimganj, 1 ♂, 28.xi.1917, W. Mekey coll., on rice. PUNJAB : Rajapatti, 2 ♂, 28.ii.1907, 1 ♂, 13.iii.1907, all on sugarcane, no coll.

BANGALADESH : Dacca, 1 ♀, 5.ix.1917, 1 ♂, 9.ix.1917, on sugarcane, P.C. Sen coll.;
Labelled "FIGURED" [All in I.A.R.I., New Delhi]

INDIA : U.P. : Lucknow, all on sugarcane, 1 ♂, 26.ii.1951, 2 ♂, 1 ♀, 6.v.1955, 2 ♀, 6.ix.1955, 2 ♀, 11.ii.1956, 2 ♀, 14, 30.vii.1956, 2 ♀, 30.viii.1956, 1 ♀, 2.ii.1957, 2 ♀, 7.ii.1957, 1 ♂, 11.ii.1957, 1 ♂, 2 ♀, 16.ii.1957, 2 ♀, 17.ii.1957, 1 ♂, 19.ii.1957, 2 ♂, 2 ♀, 20.ii.1957, 1 ♂, 2 ♀, 21.ii.1957, 3 ♂, 2 ♀, 26.ii.1957, 1 ♀, 8.iii.1957, 2 ♂, 9, 19.iii.1957, 1 ♂, 29.vii.1959, 1 ♂, 1 ♀, 3.viii.1957, 2 ♀, 21, 22.i.1958, 1 ♂, 28.i.1958, 1 ♀, 31.i.1958, 1 ♀, 4.ii.1958, 1 ex, 9.ii.1958, 1 ♀, 11.ii.1958, 1 ♂, 13.ii.1958, 1 ♀, 14.ii.1958, 1 ♀, 15.ii.1958, 1 ♂, 2 ♀, 17.ii.1958, 1 ♂, 20.ii.1958, 1 ♀, 5.iii.1958, 2 ♂, 9.vi.1958, 1 ♂, 21.viii.1958, 2 ♂, 22.viii.1958, 1 ♂, 9.ix.1958, 1 ♂, 8.x.1958, 2 ♂, 10.x.1958, 1 ♂, 15.ii.1959, all K.S.S. coll.; 2 ♂, 11.ii.1955, 1 ♂, 1 ♀, 14.ii.1955, 1 ♂, 30.iii.1955, 1 ♂, 1 ♀, 6.v.1955, 1 ♂, 20.vii.1955, 3 ♂, 22, 25.viii.1955, 2 ♀, 12, 16.ix.1955, 2 ♂, 23, 26.ix.1955, 1 ♂, 14.ii.1958, 1 ♂, 28.viii.1962, all on sugarcane J.P.K. coll.; 4 ♂, 20, 27, 28, 30.viii.1956, 1 ♀, 4.ix.1956, 1 ♂, 28.ix.1956, 1 ♀, 29.ix.1956, 1 ♂, 1 ♀, 19.ii.1957, 1 ♂, 1.iii.1957, 4 ♂, 2 ♀, 15.ii.1958, 1 ♀, 16.ii.1958, 1 ♂, 9.ix.1958, 2 ♂, 1.x.1958, 3 ♂, 3.x.1958, all on sugarcane, M.C.G. coll.; 1 ♂, 23.ii.1961, 1 ♂, 24.vii.1961, 1 ♂, 10.viii.1961, 1 ♂, 18.ix.1961, 1 ♂, 9.ii.1963, 1 ♀, 8.x.1963, 1 ♀, 22.v.1964, 1 ♂, 30.v.1964, 1 ♂, 2.vi.1964,

1 ♂, 29.ix.1964, 1 ♂, 4.i.1965, 1 ♀, 25.ii.1965, 1 ♀, 19.iii.1965 all on sugarcane, *T.N.Ś.* coll.; 1 ♂, 29.x.1971, 1 ♂, 25.viii.1972, 1 ♂, 1 ♀, 27.xi.1972, 2 ♂, 28.xi.1972, 1 ♂, 13.ii.1973, 1 ♀, 26.ii.1973, all on sugarcane, *B. Pant* coll.; 1 ♂, 6.v.1955, 2 ♂, 3.vii.1956, 1 ♀, 24.ii.1958, 2 ♀, 3, 7.iii.1958, 1 ♂, 13.iii.1958, 1 ♂, 4.viii.1958, 1 ♀, 22.viii.1958, 1 ♂, 29.viii.1958, all on sugarcane without collector data. [All in I.I.S.R., Lucknow]

INDIA : ASSAM : Jorhat, 1 ♀, 4.x.1962, on Paddy. JAMMU & KASHMIR : Srinagar, 1 ♂, 1.x.1962, on paddy, no coll.. MEGHALAYA : Shillong, 3 ♀, - .viii.1962, 1 ex., 2.xii.1962, all on paddy, no coll.. ORISSA : Bhubaneswar, 2 ♂, 24, 25.iv.1962, 1 ♀, - iv.1962, all on paddy. RAJASTHAN : Sriganganagar, 1 ♂, 3.iii.1963, on sugarcane. UTTAR PRADESH : Lucknow, 5 ♂, 1 ♀, 11.i.1963, all on sugarcane, no coll.. WEST BENGAL : Kalimpong, 3 ♀, 27.xi.1963 on paddy, no coll. [All in P.D.B.C. Bangalore]

INDIA PUNJAB : Ludhiana, 1 ♀, 3.ii.1978, *G.C. Varma* coll., on sugarcane.

[In Pb.Ag. Univ., Ludhiana]

INDIA : HARYANA : KAITHAL Dist.; Kaul, 6 exs., at light, no other data.

[Rice Res. Stn., Kaul]

INDIA : HARAYANA : KARNAL Dist.; Uchani, 32 ♂ ♀, all on sugarcane (badly damaged), - iii.1996, no other data [In Sugarcane Res. Stn., Uchani]

INDIA : ASSAM : Sibsagar, 1 ex., 16.xi.1978, *C.P. Kapur* coll.. BIHAR : Pusa, 1 ♂, 5.iii.1934, *E.S.N.* coll.; 1 ♀, 11.ii.1935, *N. Ayyar* coll.; on sugarcane; 1 ♂, 26.ii.1935, *E.J. Vevel* coll.; at light; 1 ♂, 4.viii.1937, 1 ♀, 31.viii.1937, 1 ♀, 11.ix.1937, all *E. Hassan* coll.; boring stem of sugarcane; 1 ♂, 1 ♀, 6.iii.1938, 1 ♀, 11.iii.1938, from pupa of stem borer, no coll.; (det K.V. Rao). HARYANA : KAITHAL Dist.; Kaul, 2 ex. at light, no other data. KERALA : Vellayani, 1 ex., 28.x.1955, *G.K. Nair* coll.; on paddy. ORISSA : Cuttack, 2 ♂, CRR I Fields, - 1964, *G.S. Arora* coll.. SIKKIM : 1800, 1 ♀, - viii.1897, *G.C. Dudgeon* coll.. UTTAR PRADESH : Gorakhpur, 1 ♂, 23.ii.1940, 1 ♀, 8.iii.1940, boring stem of sugarcane, *V.P. Rao* coll.. WEST BENGAL : Chinsura, 2 ♀, - .ix.1965, reared from paddy, *L. Pramanik* coll.

BHUTAN : 1 ♂, 3.viii.1894, 2 ♀, 13, 14.vii.1895, all *G.C. Dudgeon* coll.

[All in Z.S.I., Calcutta]

Wing expanse : ♂ 15- 27 mm; ♀ 15 - 30 mm

Distribution : INDIA : Assam; Bihar; Gujarat; Haryana; Himachal Pradesh; J. & K.; Kerala; Madhya Pradesh; Maharashtra; Meghalaya; Naga Hills; Orissa; Punjab; Rajasthan; Sikkim; Tamil Nadu; Uttar Pradesh; and West Bengal. *Elsewhere* : Bangladesh; Bhutan; Formosa; Java; Malaysia; Myanmar; Papua New Guinea; Philippines; Sri Lanka; Taiwan; and Thailand.

Hosts : Paddy and sugarcane. *Alternative Hosts*.—*Dactyloctenium aegyptium* ; *Echinochloa colona* ; *E. frumentacea*, *E. stagnina* ; *Eleusine indica* ; *Erianthus munja* ;

Ischaemum sugosum ; *Pennisetum purpureum* ; *Sacciolepis interrupta*; *Saccharum spontaneum* ; *Sclerotachya fusca* ; *Sporobolus diander* ; *S. indicus*; *Sorghum halepense*, *S. vulgare* and *Zea mays*. (vide Chaudhary & Sharma, 1986)

Status : Serious on both paddy and sugarcane.

Remark : The species has assumed a great significance due to its peculiar habit of causing serious damage to paddy in the eastern region, extending to Assam, Sikkim, WB, Bihar, Orissa, Madhya Pradesh, Jammu & Kashmir and to Tamil Nadu & Kerala. Further, it has spread to Nagaland, Uttar Pradesh, Punjab, Haryana, H.P., Gujarat and Rajasthan, causing serious damage to sugarcane. In fact, in latter states it does not attack paddy even it is in an adjoining field as an alternative host. Chaudhary (1981), as all other agricultural entomologists, wonders about its peculiar habit and opines that “...there is every possibility of its being a sub-species, different strain or may even be sibling species.”

Commonly known as “The Stalk Borers”, Gupta (1957) gave it the name of “Gold Fringed Moth of India”, because of the golden luster of its metallic spots on the forewings and the marginal fringe.

The caterpillars, on hatching, feed on the leaf for a week or so before making an entry into the soft stalk. The tunnels, thus formed extend several internodes, and the infested shoots show deadhearts, but if the caterpillars bore near the root, the deadhearts may not appear at all.

Kapur (1950) states that he did not observe any abnormality in wing venation when he examined 104 examples of the species, but in case of frons, Kapur (*loc. cit.*) states that certain examples have minute to very small point (which is not corneous) at the apex. Similarly, Bleszynski (1970a) does not mention any abnormal venational variation in this species, like Kapur (1950), and mentioned about the frons with a small point. Due to these characteristic features besides confluence of vein R_1 with Sc in forewing, it has been considered again to reassign the species from *Chilo* Zincken (*Sensu* Bleszynski, 1962, 1969, 1970a) to *Chilotraea* Kapur (*Sensu* Kapur, 1950, 1967, Gupta, 1958, Banerjee and Pramanik, 1967, Agarwal & Chaudhary, 1966 and Agarwal & Tiwari 1969)

Besides, the species is characterised by the presence of metallic spots, scales and golden fringe on the forewing and silvery fringe on the hindwing. The caterpillars are five striped unlike *C. infuscatellus* larvae which are four striped.

During the course of present study, out of several specimens examined at I.A.R.I., New Delhi, some were found to be misidentified (as mentioned in material examined). However all these had their vein R_1 confluent with vein Sc on the forewing; the frons produced forward into a conical projection but without any corneous point, a character unlike that of *Chilo suppressalis* (Walker), and forewing with some silvery scales. Hence, these examples were placed in *Chilotraea auricilia* (Dudgeon).

Nearly 115 examples were examined in the collections of Indian Institute of Sugarcane Research, Lucknow. Out of these, only 9♂, 8♀ were observed with variation in the shape

of frons (but without corneous point), and confluence of vein R_1 with Sc on forewing, either on one of the wings or on both the wings, and have been assigned to *Chilotraea auricilia* (Dudgeon).

***Chilotraea polychrysa* (Meyrick)**

(DARK HEADED STRIPED BORER)

(Plate I, fig. 15; Text figs. 6C-D)

1932. *Diatraea polychrysa* Meyrick, *Exot. Microlep.*, 4 : 321

Diagnosis : Head with the frons smooth, not produced forward; labial palpi porrect, bushy, shorter in male than those in female, about two and a half times to three times the diameter of eye; ocelli reduced; antennae minutely serrate, thickened and laterally flattened in male, normal in female; outer tibial spurs about half the length of inner ones; frenulum spines double in female.

Male : Antennae with white and brown rings. Forewing whitish to pale ochreous, irrorated with ochreous brown scales; an oblique ochreous-brown median suffusion present, irrorated with silvery scales; discal dots reduced, but metallic and raised in the cell; subterminal line ill-defined, with a very few silvery scales, subterminal area darkened; terminal dots ill-defined or absent; fringe slightly golden and glossy. Hindwing : Colour varying from whitish to dirty cream, with apical area suffused with dark scales; fringe whitish. Underside both wings without any pattern or shiny scales and lighter in the tinge; forewings nearly uniformly pale - ochreous, except at the apical and anal margins which are paler.

Females : Slightly larger and paler.

Genitalia : Vide Bleszynski (1970a).

Venation : *Forewing* : R_1 confluent with Sc; R_2 from before angle, free; R_{3+4} from angle, on a long stalk which is about twice the length of R_3 , both ending at costal margin before apex; R_5 closer to R_{3+4} than to M_1 ; $M_2 - M_3$ separate, from the lower angle, Cu_{1a} , Cu_{1b} from before the lower angle and in line with R_2 and R_1 , above. *Hindwing* : Sc stalked with Rs after latter's origin from angle, the stalk about the length of vein Sc; Rs ending at apex; M_1 from below the angle; $M_2 - M_3$ stalked, from lower angle.

Material examined : INDIA : TAMIL NADU : Madras, Kudikapalayam, 1 ♂, -. iii. 1962, on paddy.

HONGKONG : Castle Park, 1 ♀, 17.x. 1961

[All in P.D.B.C. Bangalore]

INDIA : KERALA : Vellayani, 1 ♂, 20.x.1955, 1 ♂, 22.x.1955, 1 ♀ ♂, 22.x.1956 all M.R.G.K. Nair coll.. WEST BENGAL : Nilaganj, 1 ♂, 3.i.1970, 3 ♀, 7.i.1970, all J.A.R.S. coll. on paddy.

[All in Z.S.I. Calcutta]

Wing expanse : ♂ 14-25 mm; ♀ 22-30 mm

Distribution : INDIA : Assam; Kerala; Orissa; Tamil Nadu; and West Bengal.
Elsewhere : S.China; Indonesia; Laos; Malacca; Malaysia; Myanmar; Pakistan; Philippines; Sabah; Vietnam.

Host : Paddy. *Alternative Hosts* : Maize, Sugarcane; *Cyperus digitatus*; *Echinochloa crusgalli*; *Hymenachne pseudointerrupta*; *Sacciolepis myosuroides*; *Scirpus grossus*; *Setia italica*; *S. pallidefusca*.

Status : Minor.

Remarks : The species is much smaller, compared to other borers and is characterised by the presence of glossy fringe, silvery scales along median area, discal rounded spots and by the terminal dots being ill-defined or absent on the forewings.

On hatching, the caterpillars either bore directly into the outer leaf sheath or first bore into the mid-rib and then reach the leaf-sheath, which turns yellow due to infestation, ultimately drying-up. The grown up larvae may be several in numbers in a single shoot, bore right into the central shoot, making these hollow at the internodes as well as at the growing points, causing death to the whole plant. The grown-up larvae are reported to migrate to other plants and infest them, causing serious damage, which may run to about 60% of crop loss. Before pupation, each larva makes an exit hole and pupates in a silken cocoon inside the hollowed out central shoot.

Genus *Girdharia* Kapur

1950. *Girdharia* Kapur, *Trans. R. ent. Soc. Lond.*, 101 (Part II) : 427-428

Type species : *Girdharia tauromma* Kapur

Diagnosis : Head with the frons produced forward, conical, the apex with a corneous point, the underside flattened near base and usually produced into a conical ridge, with the apex lying directly below that of the frons; ocelli well developed; labial palpi about three and a half times the diameter of eye, porrect, slightly narrowed and downcurved distally and covered with long scales; maxillary palpi triangularly dilated with scales. Antennae pectinate and ciliate in male, each segment appearing triangular when viewed laterally and entirely clothed with scales; Forewings long and rather narrow.

Female differs from male in the antennae being simple and without pectination. Hind wing with the frenulum spines double.

Genitalia : Vide Kapur (1950), Bleszynski (1969).

Distribution : India; Brazil; and W. Africa.

Remarks : The genus was erected by Kapur (1950) for a "Pyralid Borer" of *Saccharum spontaneum* in India, whose biology was studied and described by Fletcher & Ghosh (1920) and later by Ghosh (1921). This was misidentified as *Chilo torrentellus* by Ghosh (1921)

owing to the resemblance to an Australian species. Kapur (1950) described this species as *tauomma* as a new from India, and differentiated this from *Chilo torrentellus* externally by stripes on forewings as well as other characters. Other species known under the genus are *G. leucomeralis* (Hampson) from W. Africa and *G. berthellus* (Dyar) from Parana (*vide* Bleszynski & Collins, 1962).

Bleszynski (1967) synonymised the genus *Girdharia* Kapur to *Acigona* Hübner, but Fletcher & Nye (1984) have pointed out that the genus *Acigona* Hübner is a noctuid genus, which has been incorrectly placed in Pyralidae, due to incorrect type - species designation of *Tinea cicatricella* Hübner (*vide* Bleszynski & Collins, 1962). This name is therefore, revived here to include *tauomma* Kapur.

Girdharia tauomma Kapur

(STRIPED-WING BORER)

(Plate I, figs. 16-17; Text figs. 8A-B)

1950. *Girdharia tauomma* Kapur, *Trans. R. ent. Soc. Lond.*, 101 (part II): 428-429

Diagnosis : Head pale ochreous; labial palpi irrorated with fuscous. Thorax pale ochreous, suffused with pale fuscous on the sides. Forewing with the apex narrowed and produced; with a white costal stripe, narrowed at either end and is interrupted by a pair of oblique brown lines, a little before apex; behind this white stripe, a cupreous brown fascia passes from base through the cell and expanding to apex and one third of termen, the lower part not touching the terminal margin; immediately below the cupreous brown fascia runs another pure white fascia, below the cell, from base to terminal margin; with three pairs of brown and very fine streaks in the interspaces between the post-median and subterminal areas, a thin brown subterminal wavy line and with a similar but paler line bordering it on the inner side, and faint brown colouration at the termen and a series of darker terminal spots; the posterior area, from base to the tornal area of the termen, cupreous brown, with the terminal spot above the tornus larger than the rest; white stripe and fascia sometimes irrorated with fuscous; fringe white, with a similar line through the middle, as far as the vein Cu_{1a} .

Female : Larger than male and paler; antennae simple; frenulum spines double.

Venation : **Forewing** : Vein R_1 anastomosing with Sc; R_2 from a little before upper angle and stalk of R_{3+4} ; R_{3+4} stalked, R_3 shorter than R_4 and nearly half of the common stalk, both ending at costa; R_5 from below the upper angle and as far from origin of R_{3+4} as the latter from R_2 ; M_1 further down, from below the upper angle; $M_2 - M_3$ from lower angle, close to each other; Cu_{1a} from before the angle and almost in line with the origin of R_2 above; Cu_{1b} nearly twice as far from Cu_{1a} as the latter from $M_2 - M_3$, and in line with origin of R_1 above. **Hindwing** : Vein Sc anastomosed, beyond cell angle, with Rs to nearly half the distance from costal margin; M_1 from upper angle; discocellulars weak, leaving the cell rather open; $M_2 - M_3$ from angle, or slightly stalked; Cu_{1a} b from before the lower angle.

Material examined : INDIA : BIHAR : Pusa, 2 ♀, 23, 29. vi. 1916, 1 ♂, 1 vi. 1917, all Fletcher coll.; 1 ♂, 4. vi. 1920, 1 ♂, 8. vi. 1920, 1 ♂, 18. vii. 1920, 1 ♂, 1 ♀, 26. vii.

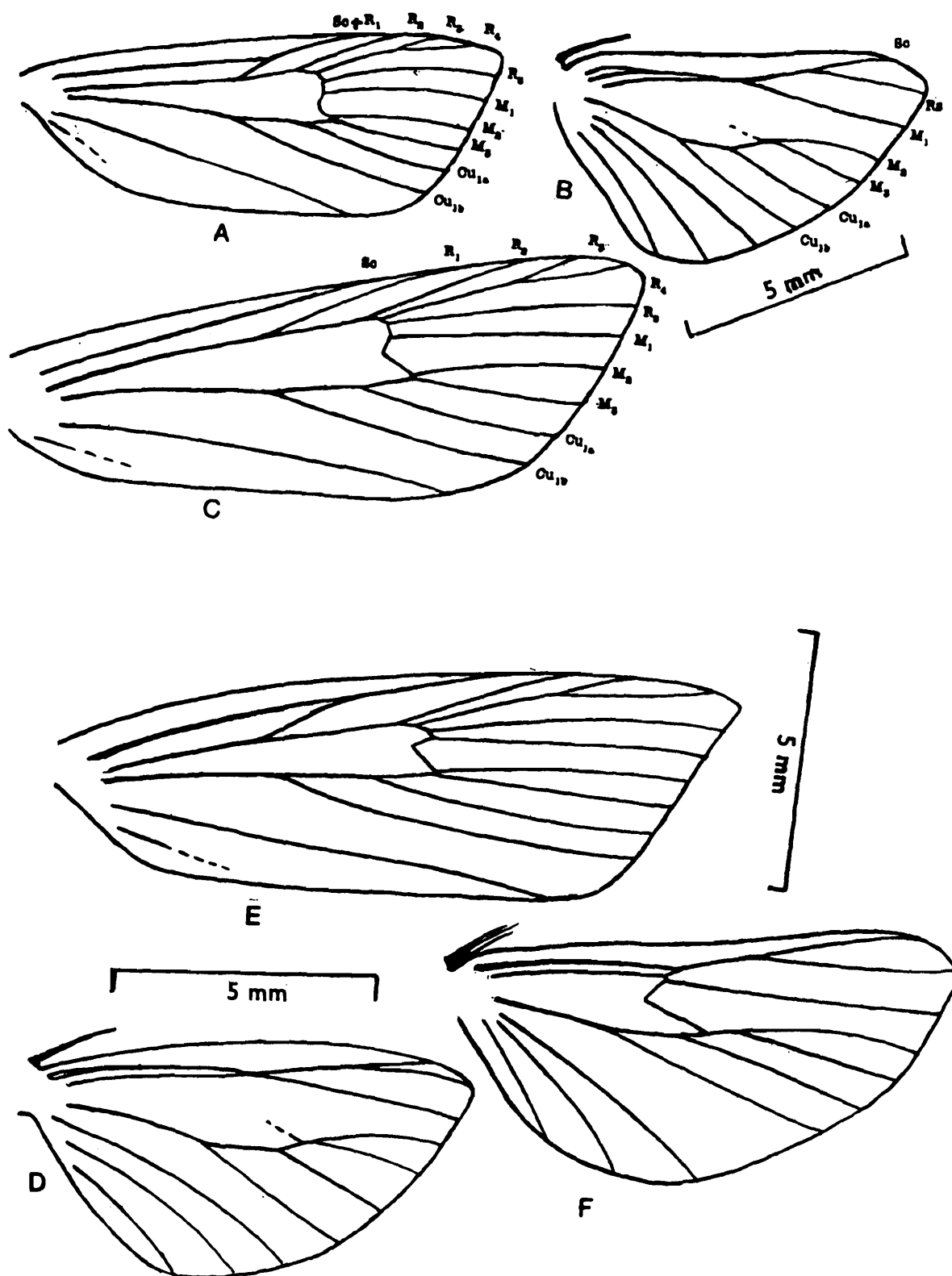


Fig. 8. *Girdharia tauomma* Kapur ♀ : (A) Fore - and (B) hindwing venation; *Bissetia steniellus* (Hampson) ♂ : (C) Fore - and (D) hindwing venation; *Borer sacchariphagus indicus* (Kapur) ♀ : (E) Fore - and (F) hindwing venation (Magnification of A, C and F same as of B, D and E, respectively).

1920, all *Rangi* coll., on *Saccharum spontaneum*, Batri & Rahri stem; Chapra, 1 ♀, *Mackenzie* coll.; no other data.

[In I.A.R.I., New Delhi]

INDIA : HIMACHAL PRADESH : Kangra Valley, 4500 , 1 ♀ , - vi. 1899, G.C. Dudgeon Coll. (In Z.S.I., Calcutta)

Wing expanse ♂ 20 - 28 mm; ♀ 22 - 30 mm

Distribution INDIA : Bihar; HP; and Tamil Nadu. *Elsewhere* : Indo-China.

Hosts *Saccharum spontaneum*.

Status : Minor.

Remarks : Kapur (1950) described the species, based on males, from Madras (Tamil Nadu), Kangra Valley (H.P.) and Indo-China, the types of which are deposited in BM (N.H), London, N.M. Natural History, Paris.

Presently, the author had an opportunity to study the pyralid collections from all the major repositories and research institutes, universities, etc. and came across collections from Bihar, in the I.A.R.I., New Delhi. Besides, the collections at I.A.R.I. and ZSI, Calcutta also had females, about which Kapur (1950) had mentioned as "Unknown" This constitutes the first ever record of the females in *tauromma* Kapur, as well as the first locality record of the species from Bihar. The females are exactly similar to males in colouration but with simple antennae and larger in size. The present study also records smaller males, as compared to the minimum expanse of "25 mm" by Kapur (1950)

The species is very beautiful due to the presence of white fasciae and cupreous brown fasciae on forewings, making the species conspicuously different from other species studied under Crambinae.

Avasthy & Tiwari (1986b) report only one generation in a year. The freshly emerged larvae appearing only in the month of July and becoming full grown by November, when these hibernate till next June every year.

Genus *Bissetia* Kapur

1950 *Bissetia* Kapur, *Trans. R. ent Soc. Lond.*, **101** : 412.

Type species *Chilo steniellus* Hampson

Diagnosis Head with the frons produced forward, conical, with a large corneous pointed apex; the underside of frons flattened near the base and produced into a conical ridge; ocelli absent; labial palpi very long, about thrice the diameter of eye, porrect, narrowed and curved downwards apically and covered with long and compact scales; maxillary palpi triangularly scaled and dilated with scales apically; antennae distinctly serrate in male, minutely serrate in female and setaceous. Hind wing with the cell open.

Distribution : India; Tongking.

Remarks : Only single species is known under this genus and is being included here as under. For genitalic studies, reference may be made to Kapur (1950), Gupta (1958) and Bleszynski (1969).

***Bissetia steniellus* (Hampson)**

(GURDASPUR BORER)

(Plate I, figs. 18-19; Text figs. 8C-D)

1898. *Chilo steniellus* Hampson, *J. Bombay nat. Hist. Soc.*, 12 : 305

Diagnosis : Head and thorax whitish to pale greyish brown; abdomen whitish, dorsally ochreous towards base, longer than the length of hind wings; labial palpi mixed with scales varying from reddish brown to fuscous, over thrice the diameter of eye. Forewings pale greyish brown, irrorated with fuscous and suffused with fuscous in interspaces, leaving the veins slightly paler; about three times as long as broad at the discocellulars; the terminal series of dots dark and small, the fringe shiny, pale fuscous to fuscous. Hindwings whitish. Underside generally paler compared to that of upperside. Females : Larger and generally paler in general colouration.

Venation : *Forewing* : Vein R_1 free; R_2 free and close to angle of cell and the origin of the stalked R_{3+4} , the common stalk longer than R_4 which is longer than R_3 ; R_5 from below the angle, close to the origin of R_{3+4} than to the origin of M_1 ; $M_2 - M_3$ connate, arising from lower angle of cell; Cu_{1a} , Cu_{1b} from before angle, and before the origin R_2 and R_1 above, respectively. *Hindwing* : Vein Sc on a long stalk with Rs from beyond the angle from which also arises vein M_1 ; upper discocellulars untraceable, lower weak and only traces at lower angle, leaving the cell wide open; $M_2 - M_3$ slightly stalked at origin; Cu_{1a} close to angle than to Cu_{1b} , as in forewing.

Genitalia : Vide Kapur (1950) and Bleszynski (1969)

Material examined : INDIA : PUNJAB : Gurdaspur, 3 ♂, 16. ix. 1928, 1 ♂, 2 ♀, 4. viii. 1933. all *D. Nath* coll.; on sugarcane.

(In I.A.R.I., New Delhi)

INDIA : UTTAR PRADESH : Lucknow, 1 ♂, 22. viii. 1956, no coll; Jagadhari, 1 ♀, 17. viii. 1993, *O.S.J. coll.*; on Sugarcane, 1 ♂, 19. viii. 1994. On sugarcane, *A. Verma* coll.
(In I.I.S.R. Lucknow)

INDIA : PUNJAB : Ludhiana, 1 ex. no more data.

(In Pb. Ag. Univ., Ludhiana)

Wing expanse : ♂ 25 – 27 mm.; ♀, 29 – 40 mm.

Distribution : INDIA : Assam; Haryana; Himachal Pradesh; Maharashtra; Punjab; Rajasthan; and Uttar Pradesh. *Elsewhere* : Indo-China; Pakistan; and Vietnam.

Hosts : Sugarcane. Also *Sorghum halepense*, *S. vulgare*, *Zea mays* and paddy.

Statue. : Serious.

Remarks : Popularly known as "The Gurdaspur Borer", the species is so named as it was discovered for the first time from Gurdaspur (Punjab). Bleszynski (1970a) transferred this species to the genus *Acigona* Hübner and has, since, been treated as such. But recently Fletcher & Nye (1984) stated that the genus *Acigona* is a noctuid genus and not Pyralid. Hence, inclusion of *steniellus* Hampson under *Acigona* Hübner, is not proper and is being reassigned to *Bissetia* Kapur.

Kapur (1950) reported distribution of this species only from Assam and Punjab. However, the species is now reported from Haryana, H.P., Maharashtra, Rajasthan and Uttar Pradesh (*Vide* Easwaramoorthy & Agarwal, 1986).

Detailed studies have been made, particularly by Kapoor (1957) on seasonal history; and Gupta & Garg (1943), Gupta (1954), Chand & Deshmukh (1973), Kumar (1975), Garg & Chaudhary, (1979), Singh *et al.* (1980) on Nature and Symptoms of damage. The studies show that the species is very active between June and October, particularly in Punjab and U.P. The larvae, while in early stages upto fourth instar, are gregarious, the later stages become solitary, and the full grown caterpillar migrates downwards from September onwards and by November, the caterpillars enter into a hibernation period in the ground portion of the cane. The larvae remain hibernated till about June, when these pupate and the moths emerge soon afterwards (*Vide* Easwaramoorthy & Agarwal, 1986).

The adults are characterised by the absence of ocelli like that in *Borer sacchariphagus indicus* (Kapur) but unlike in latter species this has a well produced conical frons, with a corneous point, the vein R_1 being free in forewing (vs coincident with Sc in *indicus*) and the hindwing cell being open (vs closed in *indicus*).

Genus *Borer* Guenee

1862. *Borer* Guenee, In Maillard, *Notes sur l'île de la Reunion* (Bourbon), (2) Annexe G : 68.

Type species : *Phalaena saccharalis* Fb. (*Sensu* Guenee 1862 (= *Proceras sacchariphagus* Bojer, 1856) (*vide* Fletcher & Nye, 1984, 5 : 23)

Diagnosis : Head with the frons, smooth, subrounded to flat; ocelli absent; proboscis reduced; labial palpi shorter in male, about thrice the diameter of eye, and longer in female upto four times the diameter of eye; maxillary palpi dilated with scales at tip; antennae minutely serrate in male, about half the length of costa in forewing, and simple and setaceous in female, less than half the length of costa. Forewing with the vein R_1 coincident with Sc; apex narrow and produced. Hindwing with the cell closed. Outer tibial spurs half the length of inner spurs.

Distribution : India. *Elsewhere* : Borneo; China; East Indies; Japan; and Mauritius.

Remarks : Only single species, *Borer sacchariphagus* Bojer, is being included here, which was hitherto referred as *Proceras sacchariphagus* Bojer, till Bleszynski (1966, 1970a) transferred the species to the genus *Chilo* Zincken. However, Fletcher & Nye (1984) state that the genus *Proceras* was “Incorrectly included by authors in the Pyralidae, Crambinae, the placement being based on incorrect type species designations.” They further point out (1984 : 125, 133) that the correct type species designation of *Proceras* Bojer, is *Pyralis saldonana* Fabr. and the genus *Proceras* Bojer “is a junior objective synonym of *Procerata* Berthold” of the family Brachodidae, and not Pyralidae. About *Phalaena saccharalis* Fabr, Fletcher & Nye (1984) suggest that “Commission be asked to designate as type species of *Borer*, the nominal species actually involved, namely *Proceras sacchariphagus* Bojer *et al.* 1856”, and record that, “*Phalaena saccharalis* Fabr. *sensu* Guenee 1862, is *Proceras sacchariphagus* Bojer *et al.* 1856.”

Accordingly, the species *sacchariphagus* Bojer is included here under the genus *Borer* Guenee, (*vide* Fletcher & Nye, 1984) and *indicus* Kapur as its subspecies. A reference may also be made to Tams (1942) who discussed in details about the taxonomy of *Proceras* and *Borer*. In the changed present situation, when the genus *Proceras* has already been removed from the Pyralidae, the genus *Borer* Guenee, the next available and valid name (*vide* Tams 1942), takes its valid place to give due and new taxonomic status to *Borer sacchariphagus indicus* (Kapur).

***Borer sacchariphagus indicus* (Kapur) n. comb.**

(THE INTERNODE BORER)

(Plate I, figs. 20-21; Text figs. 8E-F)

1950. *Proceras indicus* Kapur, *Trans. R. ent. Soc. Lond.*, **101** (Part II) : 414-415.

Diagnosis : Forewing pale ochreous brown to pinkish buff with dark brown to cinerous scales arranged in rows parallel to costa on and between veins; one discal spot in the cell; terminal series of black spots small but more distinct in female than in male; fringe dark along the basal half. General colouration lighter in females, which are slightly larger in size, with the spots faint. Hindwing : Lighter than forewing, suffused with light to dark brown towards costa and termen.

Venation : Forewing : Vein R_1 coincident with Sc, rarely diverging from the latter near the margin into Sc and R_1 ; R_2 close to upper angle; R_{3+4} stalked, the common stalk slightly longer than, or as long as R_4 , R_3 shorter than R_4 and both the veins ending at costa; R_5 from below and close to upper angle, about as far from the stalked R_{3+4} , as the latter from R_2 ; M_1 from below the upper angle; $M_2 - M_3$ close to each other, from lower angle; Cu_{1a} from before the angle and before the origin of R_2 above; Cu_{1b} from before Cu_{1a} , nearly twice as far from Cu_{1a} as the latter from M_3 . **Hindwing :** Vein Sc stalked with Rs after the origin of Rs, the stalk shorter, nearly half the length of free Sc; M_1 from below the upper angle; $M_2 - M_3$ shortly stalked, at lower angle; Cu_{1a} slightly before the angle and in line with the origin of M_1 above; Cu_{1b} from before the angle; frenulum spines three in female.

Genitalia Vide Kapur (1950), Gupta, (1958) and Bleszynski (1969, 1970a)

Material examined INDIA : KERALA : Trivandrum, Vellayani, College Farm, 1 ♀
6. ii. 1933, reared on sugarcane

(In Coll. Ag. Sci. K. Ag. Univ., Vellayani. Trivandrum).

INDIA BIHAR Pusa, 2 ♀, 23. iii. 1915, 8 ♀, 17, 18, 21 viii. 1917, 1 ♂ 1 ♀, 30. viii. 1917, all on Juar stem, all R.S. coll.; 1 ♀, 26. ix. 1917, 1 ♂, 28. ix. 1917, 1 ♂, 25. iii. 1918, all on juar. no coll.; 1 ♀ 14. vii. 1917, 2 ♀, 27. viii. 1917, 1 ♂ 23. ix. 1917, 1 ♀, 19. iii. 1918, all on sugarcane, no coll.; 2 ♂, 16, 22. iii. 1918, on Rahri stem, Boy coll [All labelled as *Diatraea venosata*, with remark on label "But this is different from *D. venosata*"]

[All in I.A.R.I., New Delhi).

INDIA : UTTAR PRADESH : Lucknow, 1 ♂, 26. viii. 1960, 1 ♀, 5. vi. 1964, on sugarcane, coll.; T.N.S.

[In. 1 I.S.R. Lucknow]

INDIA : KARNATAKA : Mandya, 2 ♂, 2 ♀, 12. iv. 1965, on sugarcane, no. coll..
TAMIL NADU : CHENNAI : Pugalur, 2 ♂, 1 ♀, —xii. 1962, 1 ♀, 2. v. 1965, no coll.;
Tiruvarur, 1 ♂, 14. iii. 1963, on sugarcane, no coll.; Koothanallur, 2 ♂, 2 ♀, 21. v. 1965, on sugarcane, no coll.

[In P.D.B.C. Bangalore]

INDIA KARNATAKA : Kathalagere, 3 ♀, 1. vi. 1995, *Chinnamade Gowde* coll.

[In Univ. Ag. Sci, GKVK, Bangalore]

INDIA : TAMIL NADU : Coimbatore, 1 ♀, 14. X. 1938, 1 ♀, 2 i. 1939, 1 ♀ 6. ii. 1939, 1 ♀, 9. iv. 1939, 1 ♂, 3. X. 1939, 1 ♀, 18. xii. 1939, all *Prakasam* coll, boring internodes of sugarcane and labelled "*Paratypes*", det. "A.P. Kapur"

[All in Z.S.I. Calcutts]

Wing expanse ♂ 20 - 27 mm; ♀ 26 - 36 mm

Distribution India Andhra Pradesh; Assam; Bihar; Haryana, Karnataka; Kerala; Maharashtra; Orissa; Tamil Nadu; and Uttar Pradesh. *Elsewhere* : Pakistan and Sri Lanka. The species is reported to be distributed all over India.

Hosts : Sugarcane. Also *Saccharum spontaneum* (Rahri and batri); *Sclerotachya fusca*. *Andropogan sorghum* (Juar); *Pennisetum typhoideum* (Bajra) and *Oryza sativa* (rice)

Statue : Serious pest on sugarcane in peninsular India, and minor in North India. Serious mostly in southern India (Pruthi, 1969).

Remarks : Fletcher (1914) reported this species as *Diatraea venosata* Hampson, from south India, about which Tams (1942) suggested it to be a synonym of *Proceras*

TABLE 2. Distribution of Crambinae in States of India and some adjacent countries.

Names of States Names of Species	Andaman & Nicobar Is.	Andhra Pradesh	Assam	Bihar	Delhi	Gujarat	Haryana	Himachal Pradesh	Jammu & Kashmir	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Meghalaya	Nagaland	Orissa	Punjab	Rajasthan	Sikkim	Tamil Nadu	Uttar Pradesh	West Bengal	Bangladesh	Java	Malaysia	Myanmar	Pakistan	Papua New Guinea	Sri Lanka	Nepal
<i>Ancylolomia chrysographella</i> (Kollar)	±	+	±	±			±	±		±		±	±	±		±					±	±	±			±	±		±	
<i>Chilo suppressalis</i> (Walker)			±	±				±			±	±	±			+	±	±	±		±	±			±		±			
<i>Chilo partellus</i> (Swinhoe)		+	±	±	+	±	+	±		±		±	+	±		+	±	±	+	±	±	±					±		+	+
<i>Chilo tumidicostalis</i> (Hampson)			±	+											+							±	±			+				+
<i>Chilotraea infuscatellus</i> (Snellen)		+	+	±			±			±			+			+	±	+		±	±	+		±				±		
<i>Chilotraea ceylonicus</i> (Hampson)			±	±							±		±							±		±							+	
<i>Chilotraea auricilia</i> (Dudgeon)		+	±	±		+	±	+	±		±	+	+	±	+	±	±	±	±	+	±	±	±	+	+	+		+	+	
<i>Chilotraea polychrysa</i> (Meyrick)			+								±					+				±		±			+	+	+			
<i>Girdharia tauomma</i> Kapur				±			+	±												+										
<i>Bissetia steniellus</i> (Hampson)			+				+	+					+				±	+			±						+			
<i>Borer sacchariphagus indicus</i> (Kapur)		+	+	±			+			±	±		+			+				±	±						+		+	

± = Based on material examined

+ = Based on literature.

TABLE 3. Occurrence of Crambinae in Nature

[illegible]

sacchariphagus Bojer. Kapur, later (1950), renamed the material from India as a new species as "*Proceras indicus*", as being different from *Diatraea venosata* Hampson and *Proceras sacchariphagus* Bojer. However, Bleszynski (1970a) considered *Proceras indicus* (*sensu* Kapur, 1950) as a subspecies of *sacchariphagus* Bojer, and transferred to the genus *Chilo* Zincken, as *Chilo sacchariphagus indicus* (Kapur) (also *vide* David, 1986).

As discussed above in "*Remarks*" under the genus and following Fletcher & Nye, (1984), who have recorded that the genus *Proceras* is not a Pyralid genus, this species has been treated as *Borer sacchariphagus* and *indicus* Kapur as the subspecies under a new combination.

The species, like *Bissetia steniellus* (Hampson), is characterised by the absence of ocelli. but with the frons smooth and flat, without corneous point and the vein R_1 coincident with Sc. Further, the species is also characterised by the presence of streaks parallel to costa on and between veins, and the forewing apex narrowed and produced (Unlike in *Bissetia steniellus*)

The newly hatched larvae feed on leaf- spindle or leaf sheath by scrapping the tissue, as a result characteristic white streaks are formed on the leaf- lamina. Subsequently, the larvae bore into the tender and formative internodes around top of the cane. In the young shoots, the internodes are damaged, resulting in "deadhearts;", and when pulled out do not emit offensive smell, (unlike in shoot borer, *Chilo traea infuscatellus* Snellen) as in Root Borer, *Emmalocera depressella* (*vide* David, 1986). In later stages of crop-growth, the borer-attack may cause drying-up of the thin and weak canes, which may be easily blown off, or the damaged internodes get hardened. Generally, only one larva is found in each infested cane and damages one to three internodes but as many as nine internodes have been found to be attacked by the borer (*vide* David 1986, quoting an unpublished data by Jayanti & Mehta). The larvae when moving from one internode to another, generally move in an upward direction, in a characteristic spiral fashion.

B. Subfamily SCHOENOBIINAE

The subfamily Schoenobiinae deals here with only one genus, *Scirpophaga* Treitschke which includes all the species of economic importance presently being dealt with, hitherto known under different genera. While Hampson (1896) treated these under two genera, *viz.*, *Scirpophaga* Treitschke and *Schoenobius* Duponchel, Common (1960) erected two more genera *viz.*, *Niphadoses* and *Tryporyza*. The latter genera included well known economically important species like *gilviberbis* Zeller, and *innotata* (Walker) and *incertulas* (Walker), respectively. When Butani (1970) discussed systematic position of sugarcane top-borers in India, he opined that there is only one top-borer in sugarcane in India, *viz.*, *Tryporyza nivella* (Fabr.) and treated *auriflua* Zeller, *excerptalis* Walker, *intacta* Snellen, *rhodoproctalis* Hampson and *monostigma* Zeller, as its synonyms. But he treated *gilviberbis* Zeller under *Niphadoses* Common, *bisignata* Swinhoe under *Scirpophaga* Treitschke and *xanthogastrella* Walker under *Apurima* Walker.

The genus *Tryporyza* Common continued to be recognised as a valid name to include important species like Yellow Stem Borer and the Top Borer (*vide* Kapur, 1967; Banerjee & Pramanik, 1967; Grist & Lever, 1969; Butani, 1970; Nagaraja, 1972; and several others) till 1981, when Lawvanich contributed studies on the genus *Scirpophaga* Treitschke and synonymised several genera including *Tryporyza* Common and *Niphodoses* Common. He created as many as eight groups, based on external as well as genitalic features.

Accordingly, following Lawvanich (1981), the subfamily Schoenobiinae, deals only with one genus *Scirpophaga* Treitschke, and has the following main characteristic features.

Head with the frons rounded; ocelli present; labial palpi generally porrect, sometimes upturned or turned downwards distally, size variable; maxillary palpi present, generally porrect and do not exceed half the length of labial palpi; proboscis absent; antennae filiform, finely ciliated, or weakly serrate in male; ciliation confined to ventral surface, the dorsal surface smoothly scaled. chaetosema present. Hindwings with frenulum spine single in male and held by a well developed retinaculum process or bar from subcostal vein of forewing underside; in female, the spine is single or more but held by a cluster of bristles from cubital vein of forewing underside. Fore tibiae with a lamellate spur at middle of inner surface; mid and hind tibiae with unequal pair of spurs, the outer ones being the shorter. Abdomen slender; tympanal organs present and located near the base of abdomen; Praecinctorium present, simple, with the tympanic bullae medially fused; a large flattened scale-tuft generally present in male, extending from the posterior median region of 7th sternite to 8th sternite; this membranous area possesses another tuft of flattened and shorter scales; female devoid of any such tufts, but with anal tufts at the posterior tip mainly to cover eggs during oviposition. The tufts in female variously coloured, which help in identifying various species.

Venation Forewing Vein R_1 free, or confluence with Sc; R_2 , R_5 free, or stalked with R_{3+4} ; Cu_2 (Cu_p of Lewvanich, 1981) generally developed only near the margin. *Hindwing*: Vein Sc stalked with Rs for a short distance beyond angle, after latter's origin; $Rs-M_1$ shortly stalked, from angle of cell; Cu_2 only developed near margin.

Genitalia Genitalic features prove very useful in identifying various Schoenobiinae genera, or the species within a single genus. Even some external characters are correlated to the features of genitalia, e.g., the articulation of gnathos with uncus is directly related to anastomosis of veins R_2 and R_5 with R_{3+4} i.e., when articulated, these veins are stalked with R_{3+4} . Besides, the characters of subtegumen process, juxta, etc. provide very useful features. Lewvanich (1981) has also associated the presence of coremata with that of flattened scale-tuft in male, i.e., wherever the coremata are absent, the flattened scale-tuft is also reportedly missing. The female genitalic characters include the characters of papillae anales, the long anterior and posterior apophyses, and the corpus bursae generally being without signa.

Genus *Scirpophaga* Treitschke1832. *Scirpophaga* Treitschke, *Die Schmetterlinge von Europe*, (9) 1 : 55*Type species. Phalaena praelata* Scopoli

Diagnosis : Head with the frons rounded; labial palpi and maxillary palpi generally porrect, the length variable; proboscis very much reduced; ocelli present; eyes large, rounded and prominent; antennae filiform or weakly serrated, the length variable. The legs relatively long; fore tibiae with a lamellate spur at the middle of inner surface; mid and hind tibiae with unequal pair of spurs, the outer ones being shorter than inner spurs.

Wings with a single frenulum spine in male, held by a retinaculum bar or process from subcostal vein and the cubital tuft of the forewing underside; frenulum spine in female either single or more, held by cluster of bristles from cubital vein of forewing underside; vein R_1 free or confluent completely or partially with Sc ; R_2 free; R_{3+4} always stalked; R_5 free, usually approximated to R_{3+4} at base; M_1 close to R_5 ; M_2 from above the lower angle; M_3 from angle; Cu_{1a} , Cu_{1b} from before the angle; Cu_2 (Cu_p of Lewvanich, 1981) developed only near the margin; 1A complete, 2A short and incomplete and only at base. *Hindwing* Vein Sc anastomosing shortly with R_s after latter's origin; R_s shortly stalked with M_1 from upper angle; M_2 - M_3 closer at origin but free from lower angle; Cu_{1a} , Cu_{1b} from before the angle; Cu_2 weakly developed near the margin; 1A+2A complete; 3A present.

Abdomen with flattened scale-tuft on 7th abdominal sternite in male, and tufts in female, with colour of tuft in female varying in different species.

Genitalia Vide Lewvanich (1981) for male as well as female genitalic studies.

Distribution : Palaearctic; Ethiopian; Oriental; and Australian Regions. The genus is widely distributed in Indian Subregion, particularly due to being pest on rice and sugarcane. Although, Lewvanich (1981) is doubtful if the pattern of distribution and diversity of *Scirpophaga* follow distribution of their hosts' cultivation, the coincidental incidences (vide, Kratochvil, 1956) suggest this trend.

Remarks : Lewvanich (1981) has subdivided the genus *Scirpophaga* Treitschke into eight groups with 35 species, seven of which, representing eighteen species, are distributed in Indian region, including India, Pakistan, Sri Lanka, Myanmar, Nepal, Bangladesh and Bhutan. During the present study, material of only nine species under five groups, was available. The species, *S. magnella* de Joannis has been included presently on the basis of published literature, due to being sugarcane pest, to differentiate from *excerptalis*. The key to identification of various species has been based on external characters so as to give quick identity. More characters have been included to give credence to the key, particularly in view of variation in wing-venation. Lewvanich (1981) has already provided the genitalic studies in this genus, hence reference has been made to his studies. Besides, Kapur (1967) provided illustrations of two species viz., *Tryporyza incertulas* (Wlk.) and *T. innotata* (Wlk) and keys on the basis of external as well as genitalia to both the above species and one viz., *gilviberbis* Zeller under *Niphadoses* Common. Both these genera have since been synonymised to *Scirpophaga* (vide Lewvanich, 1981).

Various groups have been proposed by Lewvanich (1981) in the genus *Scirpophaga* Treitschke. While all the sugarcane pests, viz., *excerptalis* (Walker), *xanthogastrella* (Walker) and *magnella* de Joannis have been included in *Excerptalis* group, all other species as pests on paddy and related crops, have been included in remaining groups.

The key to identification of various species is as given below.

Key to identification of *Scirpophaga* species of economic importance

1. Forewing with the vein R_1 anastomosed with Sc 2
 - Forewing with the vein R_1 free from Sc 5
2. Forewings upperside ochreous in both sexes; hindwing with the frenulum spine single in male, double fused in female. Labial palpi twice the diameter of eye. Anal tufts in female ochreous white *Scirpophaga whalleyi* Lewvanich
 - Forewings upperside ochreous only in male, or white in both sexes; hindwings with the frenulum spines single in both sexes 3
3. Forewings upperside ochreous white to yellowish in male, white in female; underside fuscous in male, white in female. Labial palpi about 2.5 times the diameter of eye. Anal tufts in female yellowish *Scirpophaga xanthogastrella* (Walker)
 - Forewings upper and underside white in both sexes. Labial palpi 1.5 times the diameter of eye 4
4. Anal tufts orange red in female *Scirpophaga excerptalis* (Walker)
 - Anal tufts yellowish in female *Scirpophaga magnella* de Joannis
5. Forewings upperside ochreous yellow in male, with, or without spots on submedian area and lower angle of all; with an oblique series of spots from apex in male; ochreous yellow or whitish in female, with or without spot at lower angle of all 6
 - Forewings upperside pale ochreous or white in both sexes, without any markings .. 8
6. Labial palpi much longer, about 3 to 4 times the diameter of eye, and porrect. Forewings with the vein R_1 curved, running close to Sc, sometimes touching it; upperside ochreous in both sexes; hindwing with the frenulum spine double in female; anal tufts pale ochreous in female *Scirpophaga incertulas* (Walker)
 - Labial palpi shorter, not more than twice the diameter of eye. Forewings with the vein R_1 running close to Sc, without touching it; upperside whitish in female; hindwing with the frenulum spine single or double in female 7

7. Labial palpi 1.3 times the diameter of eye. Hindwing with the frenulum spine double in female. Anal tufts ochreous yellowish in female. *Scirpophaga nivella* (Fabr.)
- Labial palpi 1.5 times the diameter of eye. Hindwings with the frenulum spine single in female. Anal tufts greyish in female *Scirpophaga gilviberbis* Zeller
8. Labial palpi about twice the diameter of eye. Hindwings with the frenulum spine double in female. Anal tufts whitish in female *Scirpophaga innotata* (Walker)
- Labial palpi equal to diameter of eye. Hindwings with frenulum spine single in both sexes. Anal tufts whitish to pale ochreous in female 9
9. Specimens larger *Scirpophaga fusciflua* Hampson
- Specimens smaller *Scirpophaga virginia* Schultze

I. WHALLEYI Group

Only one species has been described under this group, and is known from India and Sri Lanka. Lewvanich (1981) record this species from the rice fields, but without any specific record based on rearing. The species is described below.

Scirpophaga whalleyi Lewvanich

(Plate II, fig. 1; Text figs. 9A-B)

1981. *Scirpophaga whalleyi* Lewvanich, *Bull. Br. Mus. nat. Hist.*, **42** (4): 250-251, Figs. 43, 94, 124, 159-158, Map 5.

Diagnosis : Head with the frons smooth, rounded; labial palpi porrect, about twice the diameter of eye; antennae simple, filiform and minutely ciliate, covered with whitish scaling throughout dorsally, about one-fourth the length of forewing costa; ocelli present. Hindwings with the frenulum spines double in ♀, but fused. Legs with an epiphysis on the inner surface of fore tibia; mid-tibiae and hind tibiae with unequal spurs, the outer ones about half the length of inner spurs. Abdomen shorter than hindwings, with anal tuft.

Male : Ochreous yellow. Labial palpi suffused with yellow. Forewings ochreous yellow, without any markings. Underside ochreous. Hindwings white on upper and underside; underside with pale yellow suffusion in costal half. Abdomen pale ochreous. **Female** : Colouration as in male except being more paler; forewing underside not suffused with ochreous, Abdomen pale ochreous; anal tuft pale-yellowish white.

Venation : **Forewing**: Vein R_1 anastomosed with Sc; R_2 free, close to R_{3+4} for some distance, arising from a little before upper angle; R_{3+4} stalked; R_5 free, from close to the upper angle and diverging terminally; M_1 free, from a little below the upper angle; M_2 - M_3

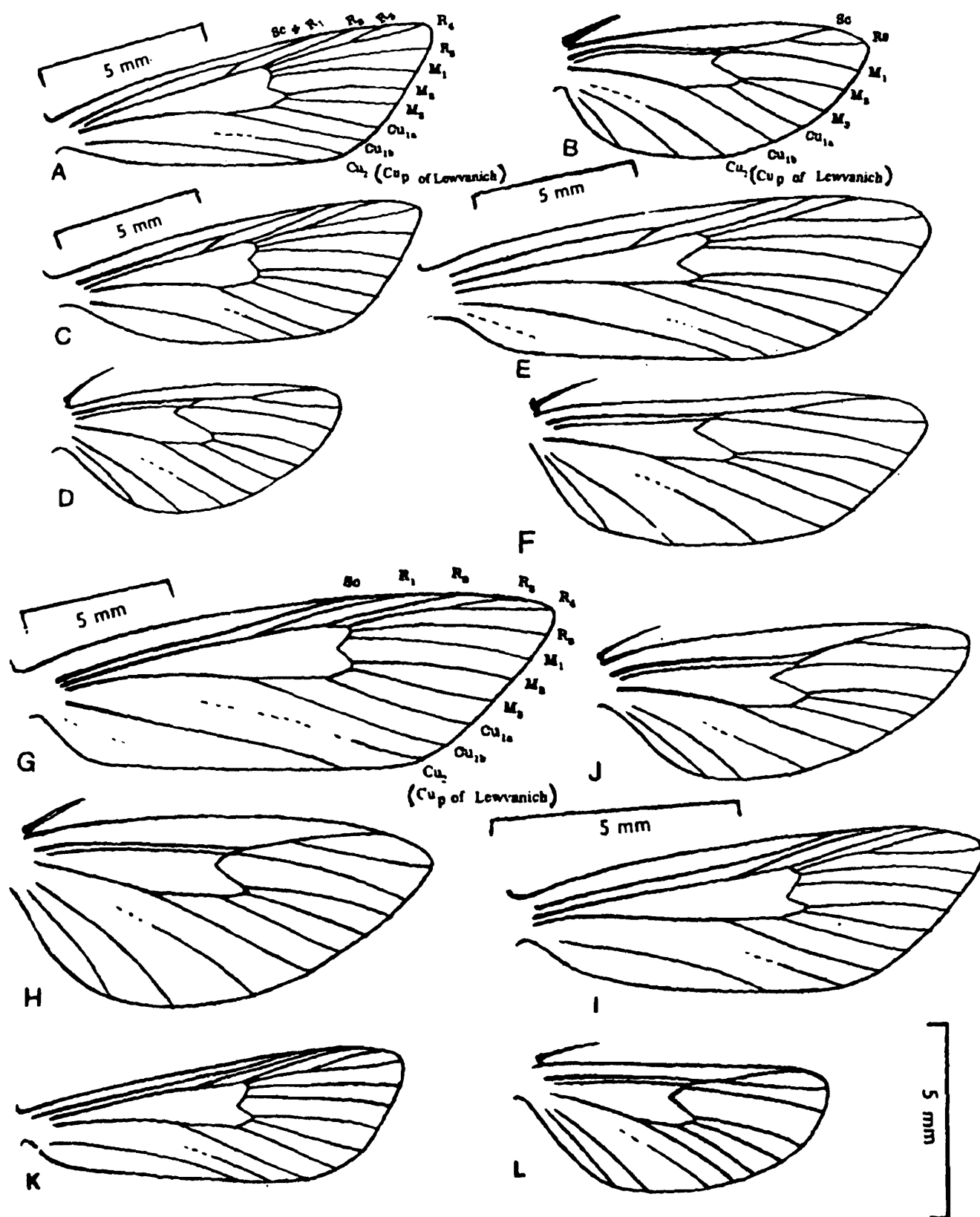


Fig. 9. *Scirpophaga whalleyi* Lewvanich ♀ : (A) Fore - and (B) hindwing venation (♀ from Trincomalee, i.1906. E.E. Green coll.); *Scirpophaga xanthogastrella* (Walker) ♂ : (C) Fore - and (D) hindwing venation (♂ from Peradeniya, .iii.1900, E.E. Green coll.); *Scirpophaga excerptalis* (Walker) ♀ : (E) Fore - and (F) hindwing venation; *Scirpophaga nivella* (Fabr.) ♀ : (G) Fore - and (H) hindwing venation (♀ from Trincomalee, -.xi.1906, E.E. Green coll.); *Scirpophaga gilviberbis* Zeller ♂ : (I) Fore - and (J) hindwing venation (♂ from Cuttack, 11.xi.1995, G.S. Arora coll.); *Scirpophaga fusciflua* Hampson ♂ : (K) Fore - and (L) hindwing venation (Magnification of B, D, F, H, J and K same as of A, C, E, G, I and L, respectively).

free, but close to each other at the origin; Cu_{1a} from before the lower angle, almost in line with the origin of R_2 above; Cu_{1b} from before, nearly in line or slightly before the origin of R_1 above; Cu_2 developed at about terminal one third of wing; 1A present. *Hindwing*: Sc free, from base to a little beyond the upper angle, beyond which it anastomoses with Rs for some distance but again diverges and terminates at costa; Rs minutely stalked with M_1 at base, and after anastomosing with Sc ends at costa before apex; M_2 - M_3 close, from lower angle of cell; Cu_{1a} and Cu_{1b} from before lower angle, the former being closer to M_3 than to Cu_{1b} ; Cu_2 indistinct, developed at terminal end; 1A + 2A and 3A present.

Genitalia : Vide Lewvanich (1981: p.251)

Material examined : SRI LANKA : Trincomalee, 1 ♀, -i-1906; Galagawa, 1 ♀, - viii. 1902 (Both *E.E. Green* Colln.) (In ZSI, Calcutta)

Wing expanse : ♂, 19-21 mm; ♀, 22 mm. (♀, 21-27, Recorded)

Distribution: India; Sri Lanka.

Biology : Unknown.

Host : Unknown in India. Lewvanich (1981) records the species from the rice fields in India and apparently it seems to be a pest, but in the absence of any definite evidence of its being pest on rice, its status can not be ascertained presently.

Status : Unknown.

Remarks : Both the sexes of this species are similar to females of *Scirpophaga incertulas* (Walker) except that the dark fuscous spot on forewing, as present in the latter, is absent in *whalleyi*. Besides, R_1 is completely anastomosed here, compared to that in *incertulas* where it is usually free and the frenulum spines being double but fused in females in *whalleyi* unlike in *incertulas* where these are double but free spines.

The specimens available for study, have been redetermined from material labelled as *Scirpophaga chrysorrhoea* Zeller, in ZSI. As *chrysorrhoea* stands synonymised to *Scirpophaga nivella* (Fabr.) (vide Lewvanich, 1981), the material was compared to the *nivella*. As mentioned above, the species *whalleyi* Lewvanich is different from *nivella* in the vein R_1 being anastomosed (vs free in *nivella*); frenulum spine being double fused in female (vs two free spines in *nivella*) and forewings being ochreous yellow in both sexes and without spots (vs ochreous yellow in male and white with spots in female, in *nivella*). Hence, the material from Sri Lanka, is redetermined as *Scirpophaga whalleyi* Lewvanich.

II. EXCERPTALIS Group

Lewvanich (1981) has treated ten species under this group, all with the common character of vein R_1 fully anastomosed with Sc in forewing and the frenulum spine single in

both sexes. Out of these, only eight species viz., *excerptalis* (Walker), *magnella* de Joannis *xanthogastrella* (Walker), *khasis* Lewvanich, *flavidorsalis* (Hampson), *melanostigma* (Turner), *brunnealis* (Hampson) and *tongyaii* Lewv., are known to occur in Indian region. Further, out of these, only the first three are recorded pests of sugarcane. The biology and host records of other species are not known. Also *flavidorsalis* and *melanostigma* are known by females and males, respectively. Lewvanich (1981) is of the opinion that they are, perhaps, opposite sexes of one and the same species since these are identical to each other externally. The material of these other pests is neither available for study, nor these are known to be of any economic importance, hence these have been excluded from this work. The present study, therefore, deals with only three species.

***Scirpophaga xanthogastrella* (Walker)**

(TOP BORER)

(Plate II, fig. 2; Text-figs. 9C-D)

1863. *Apurima xanthogastrella* Walker, *List Lep. Ins. Br. Mus.*, 27 : 194.

Diagnosis : Head with the frons smooth; labial palpi 2.5 times the diameter of eye; antennae filiform, gradually narrowing towards distal end, about half the length of forewing costa. Tibial spurs unequal, with the outer ones being half of the inner spurs. Frenulum spine single in both the sexes.

Head, thorax and forewings pale ochreous; abdomen darker; labial palpi dark above, underneath and the third segment whitish. Forewing upperside shining, with a spot at lower angle of cell; underside with fuscous suffusion nearly upto postmedial area, beyond which is paler. Hindwings whitish, with a shine, cilia whitish; underside fuscous in the costal area.

Venation : *Forewing* : Vein R_1 confluent with Sc; R_2 free, close to angle; R_{3+4} stalked for nearly one-third the distance from cell angle, R_{3+4} ending at costa before apex; R_5 and M_1 from below the upper angle, R_5 closer to cell angle than to M_1 ; M_2 - M_3 closer to each other, than to Cu_{1a} , which is almost in line with the origin of R_2 above; Cu_{1b} from much before the cell angle, in line with the origin of R_1 above. Other features as given in generic description. *Hindwing* : Sc anastomosed with Rs beyond cell angle, ending at costa before apex; Rs shortly stalked with M_1 , and ending at apex; M_1 ending below apex; M_2 - M_3 close at angle; Cu_{1a} , Cu_{1b} from before the angle. Other features as given for the genus.

Genitalia : Vide Lewvanich (1981).

Material examined : INDIA: UTTAR PRADESH: Lucknow, 1 ♂, 19.ix.1957, no coll.
[In I.I.S.R., Lucknow]

INDIA: ASSAM: Cachar, without data. BIHAR: Champaran, 1 ex on sugarcane. PUNJAB: Ludhiana, 1 ♂, -i.64 Ramzan (Reared). SIKKIM: 2 ♂, without more data.

BHUTAN: 1 ♂, 8.v.1894, 1 ♂ 17.vi.1895, 19.-vii.1896, 1 ♀ vi.1899. G.C. Dudgeon coll.

SRI LANKA: 1 ♂ iv.1892, 2 ♂, iv. 1895; Peradeniya, 1 ♂, - iii. 1900; Pundaluoya, 1 ♂, - v. 1903. [All in Z.S.I., Calcutta]

Wing expanse : ♂ 22-32 mm.; ♀, 27-36 mm.

Distribution: INDIA: Assam; Bihar; Kerala; Punjab; Sikkim; and Uttar Pradesh. *Elsewhere*: Bhutan; Nepal; Philippines; Sri Lanka; and Taiwan.

Host: Sugarcane

Status: Moderate

Remarks: The species is very close to *Scirpophaga excerptalis* (Walker), particularly in the wings being whitish in both the sexes, the frenulum single in both sexes and in the confluence of vein R_1 with Sc. However, the labial palpi are slightly longer, being about 2.5 times the diameter of eye (vs 1.5 to 2 times the diameter of eye in *excerptalis*), in the underside fore and hind wings with fuscous suffusion (vs whitish in *excerptalis*) and in the anal tufts in female being ochreous yellow (vs orange-red in *excerptalis*). Both the species are pests of sugarcane, but *excerptalis* is more serious pest compared to *xanthogastrella* which is reported to be of moderate status.

Scirpophaga excerptalis (Walker)

(TOP BORER)

(Plate II, fig. 3, Plate V, figs. 1-2; Text figs. 9E-F)

1863. *Chilo excerptalis* Walker, *List Lep. Ins. Br. Mus.* 27 : 142.

Diagnosis: Head with the frons smooth; labial palpi porrect, about 1.5 times the diameter of compound eye, sometimes slightly longer but never more than twice the diameter of eye; ocelli present, small; antennae simple in both sexes, profusely ciliated in male, sparsely in female, about half the length of forewing-costa in male and two-fifths the length in female i.e. shorter in female. Hindwing with frenulum spine single in both sexes.

Male : Head with the frons white; labial palpi white, sometimes suffused with fuscous; antennae generally dark. Thorax upperside white, underside pale ochreous, suffused with fuscous; legs generally white on innerside, fuscous on outside generally throughout upto claws, particularly in forelegs, fuscous suffusion sometimes reduced in tibiae of mid- and hind legs. Abdomen white on upperside, pale ochreous on underside. Wings slightly shining white on upperside, pale ochreous on underside, sometimes suffused with fuscous, without or with a dark prominent spot at lower angle of cell in forewing. *Female*. As in male except that these are more shining white, with less of fuscous suffusion on underside. Anal tufts brilliant orange-red.

Venation : Forewing : Vein R_1 anastomosed fully with Sc, arising almost in line with Cu_{1b} below; R_2 a little before upper angle of cell; R_3+R_4 stalked, the stalk generally shorter than R_4 which is longer than R_3 ; R_5 from below the upper angle of cell; M_1 below R_5 ; M_2-M_3 very close to each other but not connate; Cu_{1a} slightly before lower cell-angle, close to M_3 and in line with the origin of R_2 above; Cu_{1b} from before the cell angle and Cu_{1a} . *Hindwing :* Sc free till about cell angle, beyond which it is anastomosed with Rs for half-way towards margin; M_1 from cell angle; M_2-M_3 , Cu_{1a} , Cu_{1b} as in forewing.

Genitalia Vide Lewvanich (1981).

Material examined: INDIA: BIHAR: Pusa, 1 ♂, 19.viii. 1908, *G M C* coll., U.P.. Haridwar dist.: Mohammadpur, 1 ♀, 14.iv. 1931, *R.N. Mathur* coll., ex. sugarcane. Dehra Dun Dist., Dehra Dun, 1 ex., on sugarcane, 25.viii. 1915; New Forest, 1 ♂ 21.iv. 1931 1 ♂, 21.xi. 1931, *R.N. Mathur* coll.; Dehra Dun, 1 ♂ 2 ♀, i.iii. 1937, *J.C.M. Gardner* coll.; Dehra Dun, Malhan, 1 ♀, 23.iv. 1940, on grass, *Balwant Singh* coll, 1 ♀, 23.iii.1942, on sugarcane *P.N. Chatterjee* coll. (Labelled as *Scirpophaga nivella* Fb.)

(All in F.R.I., Dehra Dun)

INDIA: ASSAM: Thaji, 1 ♀, 4.x.1928, *Bose* coll.; Jorhat, 3 ♂, 3 ♀, - vii. 1918, *S.R. Gupta* coll.; BIHAR: Saran, 1 ♂, no date, 3 ♂, 2 ♀ - ii. 1904 *M. Mackenzie* coll.; Muzzaffarpur, 1 ex., 16.xi. 1904, *T.V.R.* coll.; Pusa, 1 ex., 4.iii. 1906, 1 ♂, 25.ii. 1914, on Kanra, *Saccharum spontaneum* stem, *CBS* coll.; 1 ♂, 13.iii. 1906, *D.P.S.* coll.; 1 ♂, 9.ii. 1914, 2 ♂, 4, 10.v. 1914, *Boy* coll.; 1 ♂, 3.ii. 1914, 1 ♂, 2.v. 1914, 2 ♀, 7, 9.v. 1914, 1 ♂, 1 ♀, 15.v. 1914, 2 ♀, 24.vii. 1914, 1 ♀, 26.x. 1914, 1 ♂, 9.xi. 1914, 2 ♂, 3.iii. 1915, 1 ♂, 1 ♀, 11, 12.iii. 1915, 1 ♂, 1 ♀, 13, 14.vi. 1915, 1 ♂, 3.vii. 1915, 1 ♀, 7.x. 1915, 2 ♂ 3, 15.iii. 1917, 1 ♂ 12.iii. 1931, all on sugarcane, 1 ♀, 16.iii. 1915, on jowar, *D.P.S.* coll., 1 ♂, 1.ii. 1914, 2 ♀ 2.v.1914, 1 ♀ 6.v. 1914, 1 ♀, 2.i. 1915, 1 ♀, 13.ix. 1915, 2 ♂, 10, 12.ii.1917, 2 ♂, 2, 10.v. 1917, all on sugarcane, *R.S.* coll.; 1 ♂, 25.ii. 1914, 1 ♀, 16.ii. 1915, 3 ♂, 4.iii. 1916, 2.vii. 1915, 16.ii.1927, all *Fletcher* coll., 1 ♂, 16.iii. 1915, 2 ♂, -.xii. 1926, on sugarcane, *Dwarka Prasad* coll.; 1 ♂, 1 ♀, 8.iii. 1928, on sugarcane top shoot, *Haq* coll.; 1 ♂, 25.x. 1914, 1 ♀, 12.xi.1914, 1 ♂, 21.xi. 1914, 1 ♂, 4.iii. 1916, 2 ♂, 10, 12.iii. 1917, on sugarcane, 1 ♂, 16.iv. 1932, 1 ♀, 28.ii. 1932, on sugarcane, no. coll.; 1 ♀ 8.vii. 1915, 1 ♀, 8.ix. 1918, on Batri, *T. Ram* coll.; 1 ♀, 11.iii.1916, *U. Bahadur* coll., on sugarcane; 1 ♂, 15.iii.1926, on Kanra, *Chatterjee* coll.; 1 ♀, 9. viii. 1926, *Pillai* coll, at light; 5 ♂, 9, 10, 13, 16, 18.v. 1918, 1 ♀, 12.iii. 1921, 1 ♂, 16.iii.1921, 1 ♀, 28.ii. 1931, on top of sugarcane shoot, *Rangi* coll; 1 ♂, 8.iii.1920, on sugarcane *Ghosh* coll.; 1 ♂, 8.iii. 1929, *K. Singh* coll.; 1 ♀ 29.vi.1929, 1 ♀, 30.vii. 1928, 2 ♂ 23.ii. 1931, 3 ♀, 14, 17, 25.ii.1931, 1 ♂, 1 ♀ 2.v.1931, jhilli cane, *E. Hassan* coll.; 1 ♀, 15.iii. 1926, 1 ♂, 6.iii. 1926, *Ojha* coll.; 1 ♂, 1 ♀ 4.iii. 1926, *Bose* coll.; 1 ♀, 11.iii.1930, *Gupta* coll.; 1 ♀, 4.v.1933, *Nigam* coll., Dharbhanga: Madhupur, 1 ♂, 2 ♀, 10.viii. 1925, on sugarcane, 2 ♀, 15.iii. 1926, on

sugarcane, no coll.; Chapra; 1 ♂, on cane, -.- 1904, 1 ♀, no date, *M. Mackenzie* coll, Betliah, 4 ♀, 2.iii. 1928, *A.C. Hasan* coll., boring shoots of sugarcane.

Doling Sarai (No more data): 1 ♂, 1.iii. 1920, 1 ♀, 3.iii. 1920, *Ojha* coll.

Ryam Factory (No more data), 3 ♂, 24.ii. 1922, boring stem of sugarcane, *D.P.S.* coll.; Chakiya Factory (No more data), 1 ♂, 24.ii. 1922, boring stem of sugarcane, *D.P.S.* coll.

Lohat Factory (No more data), 1 ♀, 11.iv.1933, 2 ♀, 3.viii. 1933, on sugarcane, *D.P.S.* coll.

Barachallia Factory (No more data), 1 ♀, 27.vii. 1932, 1 ♀, 6.v. 1934, *D.P.S.* coll.

Harsingpur Factory (No more data), 2 ♂, 1 ♀, 27. vii. 1933, 1 ♂, 1 ♀ 4.viii. 1933, 1 ♂, 25.viii. 1934, all on sugarcane, *D.P.S.* coll.

DELHI: 1 ♂ 18.iii. 1938, *Nigam* coll.; MADHYA PRADESH: (C.P.): Sindwali, 1 ♂, 26.vii, 1914, *Chanda* coll.; MAHARASHTRA: Bombay: Poona, A Farm, 1 ♂, 21 vii. 1914, on lamp, 2 ♂, 28.vii. 1914, 1 ♂, 1.viii. 1914, on sugarcane, 3 exs badly damaged, no coll.; SIKKIM: Kurseong, 5000, 1 ♂, 1 ♀, 18-30.iv. 1922, on sugarcane, *Fletcher* coll.; UTTAR PRADESH: Gorakhpur, Sardar Nagar, Saraya Factory, 3 ♂, 1 ♀, 5, 7, 8, 9, i. 1926, 2 ♀, 22, 26.i. 1926, all boring sugarcane, *Bose* coll.; 1 ♀, 25.ii.1920, on sugarcane; Harra, 2 ♂, 2 ♀, 8.iii. 1920, *Ghosh* coll.; WEST BENGAL: Calcutta: Dumdum, 1 ex., 26.iv. 1907 on sugarcane; Chinsura, 1 ♀, 8.iii. 1920, boring sugarcane, *Ghosh* coll.; 1 ♀, on sugarcane no more data.
[All in I.A.R.1., New Delhi]

INDIA: UTTAR PRADESH: Lucknow, 1 ♀, 30.xii. 1956, 1 ♀, 26.v. 1957, 1 ♀, 26.i. 1958, 1 ♀ 18.vii. 1958, all on sugarcane, no coll.; 1 ♀, 4.vii. 1958, *K.S.S.* coll.; lex, 2.iii. 1963, 1 ♀, 27.iii. 1963, on sugarcane, 1 ♀, 7.viii. 1963, at light, 1 ♀, 25.ii. 1965, all on sugarcane, *T.N.S.* coll.; 1 ♀, 1.x. 1974, *H.P.P.* coll.; Lab. bred 6 ♂, 35 ♀, without date, I.I.S.R. colln. on sugarcane.
[All in I.I.S.R., Lucknow]

INDIA: KARNATAKA: Mandya, 2 ♂, 2exs, 19.xi.1961, 2 ♂, 1 ♀, -xi. 1962, no coll.

PAPUA NEW GUINEA: Gusap Downs, 1 ♀, on sugarcane leaf, no date & coll.
(All in P.D.B.C., Bangalore)

INDIA: HARYANA: Karnal: Uchani, 8 ♂, 3 ♀, -iv. 1996, no coll.
(In Sugarcane Res. Stn., Uchani)

INDIA: TAMIL NADU: Coimbatore, lex. on sugarcane, -.-. 1936, *C.K.S.* coll.; 2exs., no other data.
(In T.N. Ag. Univ., Coimbatore)

INDIA: KARNATAKA: Bangalore, 1 ♂, 10.x. 1982, on sugarcane, no coll.; Kathalagere, 2 ♀, -.-. 1995, *Chinnamade Gowda* coll.;
(In Univ. Ag. Sci., GKVK, Bangalore)

INDIA: ARUNACHAL PRADESH: Subansiri Dist.; Chukru, 112 m., 1 ♀, 22.v. 1966, A.N.T. Joseph coll.; HIMACHAL PRADESH: Kangra Valley, 4500, 1 ♂, -.viii. 1894, G.C. Dudgeon coll.; SIKKIM: 3 ♀, all without data; 1800, 1 ♂, -.iv. 1897, 1 ♂, -.ix. 1897, all G.C. Dudgeon coll.; TAMIL NADU: Coimbatore, 10 ♂, 11 ♀, 3-17.i. 1996, (all bred from larvae & pupae collected from sugarcane at Coimbatore, on 29.xii.1995) all coll. G.S. Arora.

BHUTAN: 1 ♂, 1 ♀, -.vii. 1894, 1 ♀, 18.v. 1895, 1 ♀, -.viii. 1895, all G.C. Dudgeon coll., (All these examples from Bhutan are labelled as *Scirpophaga monostigma*, and agree with that of *Scirpophaga excerptalis*, particularly in the vein R_1 being anastomosed with Sc and the frenulum being single in both the sexes.)

SRI LANKA: 1 ♀, -ii. 1905, E.E. Green colln.

[All in Z.S.L., Calcutta]

Wing expanse ♂, 21-31 mm.; ♀, 20-42 mm

Distribution: INDIA: Arunachal Pradesh; Assam; Bihar; Delhi; Haryana; Himachal Pradesh; Karnataka; Madhya Pradesh; Maharashtra; Orissa; Punjab; Sikkim; Tamil Nadu; Uttar Pradesh; and West Bengal. *Elsewhere*: Ambon; Andora Is.; Australia; Bangladesh; Bhutan; Buru Is.; China; Indonesia; Japan; Nepal; New Britain; New Guinea; New Hannover; New Ireland; Pakistan; Philippines; Singapore; Solomon Is.; Sri Lanka; Sumba; Taiwan; Thailand; Timor; Vietnam; W. Malaysia.

Host : Mainly sugarcane. *Alternative Hosts*: *Andropogon sorghum*; *Chloris barbata*; *Echinocloa colona*, *Erianthus arundinaceum*; *E. munja*; *E. ravennae*; *Naranga prophyrocoma*; *Panicum* sp., *Pennisetum purpureum*; *Saccharum spontaneum*; *Sclerostachya fusca*; *Sorghum halepense* (vide Mukunthan, 1986): Also *Oryza sativa* in Japan (vide Jepson, 1954).

Status: Serious.

Remarks: Popularly known as "The Top Borer", the species is characterised by both the wings being shining white in both sexes, on both upper as well as undersides. Its females have a characteristic orange-red anal tufts not found in any species, besides the vein R_1 being anastomosed with Sc in forewings and the frenulum spine being single in females. The species, being a serious pest of sugarcane, is distributed widely in all the sugarcane-growing areas in India. The common symptoms of infestation being the parallel rows of "shot-holes" on leaves, a red streak caused by mining inside the mid-rib, deadhearts and the bunchy top caused by the sprouting of top buds of the stalk.

The perusal of literature as well as the examination of hundreds of specimens during the course of this study has shown that the species has mostly been referred to as "*nivella*", which is, actually, quite different from "*excerptalis*" Narayanan & Venkatraman (1951) discussed the identity of *Scirpophaga* species associated with sugarcane in India, and referred to the opinion given by Mr. W.H.T. Tams from the then Imperial Institute of Entomology, London, that the material from Coimbatore, [sent for identification], spotted and non-spotted, belongs to *S. rhodoproctalis*. Further, they also refer to the opinion expressed by the Director, I.I.E., London, to Mr. Cherian, that *auriflua* and *rhodoproctalis* are distinct species. However,

they feel that both *nivella* and *monostigma* are one and the same species. The authors (*loc. cit.*) also claim to have bred the species in laboratory and even crossed males of *monostigma* from Coimbatore with females of *nivella* from Delhi. Narayanan & Venkatraman (*loc. cit.*) further presented the photomicrographs of genitalic preparations of both, the *nivella* from Delhi and *monostigma* from Coimbatore about which they claim, are identical and are referable to the only *S. nivella*, in India.

Unfortunately, the confusion in identity of the species continued in the literature as well as in the major repositories, till Lewvanich (1981) clearly differentiated *excerptalis* from *nivella*. His differentiation is almost in conformity with what the Director, I.I.E., London had communicated to Mr. M.C. Cherian (quoted Narayanan & Venkatraman, 1951) that "*S. auriflua* and *S. rhodoproctalis* are quite distinct.", as both have been treated by Lewvanich (1981) separately, though as synonyms, under *S. nivella* and *S. excerptalis*, respectively.

A large series of specimens in this species has been examined at major repositories, like FRI, Dehra Dun, I.A.R.I., New Delhi, I.I.S.R., Lucknow and P.D.B.C., Bangalore. Invariably the collections were found to be labelled as "*S. nivella*" Lewvanich (1981) has differentiated the species on the basis of characters like:

- (i) Labial palpi; about 1.5 to twice the diameter of eye. (vs. 1.3 times the diameter of eye in *nivella*)
- (ii) Vein R₁ anastomosed with Sc in forewing (vs. free in *nivella*)
- (iii) frenulum spine single in female (vs. double in *nivella*)
- (iv) anal tufts orange-red in female (vs. ochreous in *nivella*)
- (v) and the both wings being white in both sexes (vs. white only in female; the male forewing ochreous and with an oblique band of spots from apex, as in *incertulas* and *gilviberbis*).

Following the above parameters, the collections were examined and were found to be an assemblage of both the species, viz. *S. excerptalis* and *S. nivella*. It is also pertinent to mention here that those which were redetermined from the lot labelled as *nivella*, as *excerptalis* invariably had the host record, if given, as "Sugarcane", particularly at F.R.I., I.A.R.I., and P.D.B.C. It was only at I.I.S.R. Lucknow, that out of about 115 examples studied and labelled as "Top Borer", on sugarcane, had both the species, viz., *S. excerptalis* and *S. nivella*, conforming to above mentioned characters. Although Lewvanich (1981) has clearly stated that *nivella* does not occur on sugarcane, the availability of material, referable to true "*S. nivella*", on sugarcane, at I.I.S.R. Lucknow, is of great significance. All the examples are with the dates of collection between 1955 and 1972 and clearly suggest its occurrence on sugarcane along with *excerptalis*, at least then, at Lucknow. Does it suggest that the species no longer exists now on sugarcane as advocated by Lewvanich (1981) and Mukunthan (1986)?

From genitalic point of view also, the species are quite different from each other, particularly in the subteguminal process being a long spine (vs. large, flattened and with sinuous margin in *nivella*); and aedeagus slender, with coarse spines (vs. slightly swollen distally, with coarse spines in addition to one slender and two unequal long cornuti in *nivella*).

Avasthy (1969) and Mukunthan (1986) have listed several hosts of the species, but Lewvanich (1981) is of the view that all other host-records need to be critically checked and confirmed.

Scirpophaga magnella de Joannis

1929. *Scirpophaga magnella* de Joannis, *Annls. Soc. ent. Fr.*, **98**: 608.

Remarks: Material of this species was not available for study at Z.S.I, or any of the repositories. Perusal of the literature particularly of Lewvanich (1981) indicates that the species is very close to that of *S. excerptalis* in all respects, including the features of labial palpi, except in the anal tufts in the female being ochreous yellow, unlike orange-red in *S. excerptalis*. However, in respect of male genitalia, the species differs in the subtegumen process being short and stout spine unlike being slender and long in *excerptalis*.

Wing expanse : ♂ 25-40 mm; ♀ 32-49 mm

Distribution: INDIA: Assam; Bihar; Himachal Pradesh; Punjab; and Uttar Pradesh. **Elsewhere:** Afghanistan; Bangladesh; China; Hongkong; Iran; Myanmar; Nepal; Pakistan; Thailand; and Vietnam.

Host: Sugarcane.

Status: Minor.

III. INCERTULAS Group

Two species, viz., *Scirpophaga incertulas* (Walker) and *S. innotata* (Walker) have been included in this group. Although Lewvanich (1981) did not record *innotata* from India, Banerjee & Pramanik (1967), Grist & Lever (1969), Ghai *et al.* (1979) and Seshagiri Rao & Kulshreshtha (1985) record the species from India. The latter has particularly recorded the species from Bihar, Gujarat, Karnataka, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh. Ghai *et al.* also record the species from Orissa and Tamil Nadu. During the course of present study, the material from Punjab was also available which constitutes the first ever record of the species from this state, besides Orissa.

Scirpophaga incertulas (Walker)

(THE YELLOW STEM BORER; PADDY STEM BORER)

(Plate II, figs. 4-6, Plate V, fig. 3; Text figs. 10A-D)

1863. *Chilo incertulas* Walker, *List Lep. Ins. Br. Mus.*, **27**: 143, ♂

Diagnosis: Head with the frons smooth; labial palpi porrect, about three to three and a half times the diameter of eye; antennae minutely serrate and profusely ciliated in male, simple and sparsely ciliated in female, about half the length of forewing costa in male and one-third in female. Outer tubial spurs about half the length of inner spurs. Frenulum spine

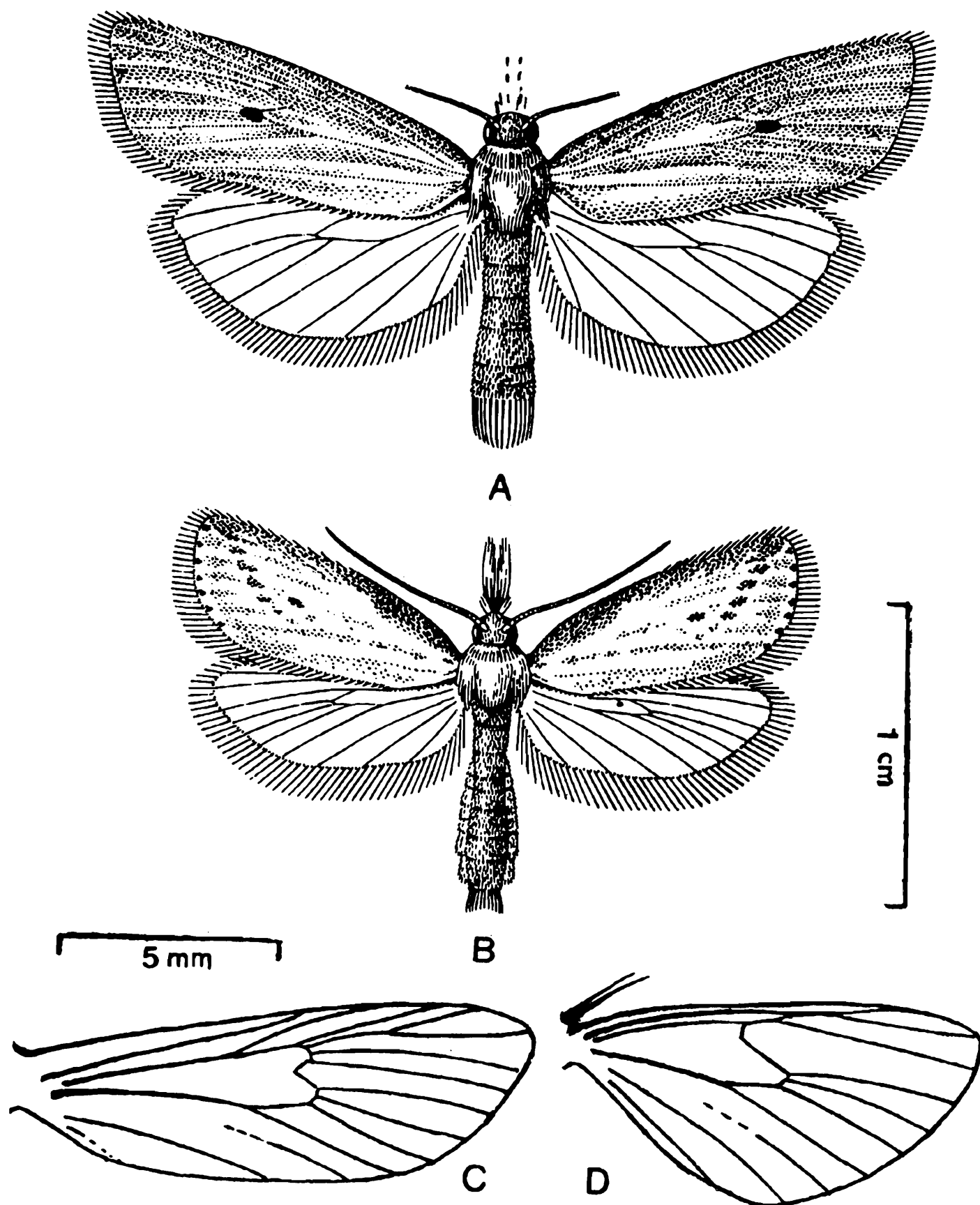


Fig. 10. *Scirpophaga incertulas* (Walker) : Adult ♀ (A) and ♂ (B), with wings spread, showing wing pattern and other features (♂ from Muzaffarpur, ♀ from Champaran, Bihar). (C) Fore - and (D) hindwing venation (Magnification of A and D same as of B and C, respectively).

single in male, held by a retinaculum bar; spines two in female and held by a cluster of bristles.

Male: Head and thorax pale ochreous; labial palpi darker. Forewing upperside ochreous; four fuscous spots, three on the submedian fold and the fourth at lower angle of cell, often faintly marked; an oblique series of fuscous spots extending from costa, near apex, to third fuscous spot on the submedian fold; a series of small but prominent neural dots present along termen; underside fuscous, without fuscous spots and the oblique series but with the terminal neural dots prominently present; cilia pale ochreous. Hindwing upperside whitish to pale ochreous; underside with costal suffusion. **Female:** Ochreous. Forewing upperside ochreous, without fuscous spots on the submedian fold, oblique series and terminal neural dots; a black spot present at lower angle of cell; underside ochreous and without spot at lower angle. Hind wing upperside as well underside whitish to pale ochreous. Legs fuscous, particularly in the basal joints. Anal tufts pale ochreous.

Venation: Forewing: Vein R_1 curved towards Sc and closely approximated to the latter but sometimes touching or shortly anastomosing with it; R_2 free; R_{3+4} stalked; R_5 , M_1 free, from below the upper angle of cell; M_2 - M_3 close to each other, from lower angle of cell; Cu_{1a} close to the lower angle, nearer to M_3 than to Cu_{1b} , the three veins, i.e. M_2 , M_3 and Cu_{1a} equidistantly placed; Cu_{1b} much before the cell angle, about thrice as far from Cu_{1a} as the latter from M_3 , and nearly in line with origin of R_1 above. Other features as given for genus. **Hindwing** venation as given for the genus; M_2 , M_3 close to each other.

Genitalia: Vide Martin (1958), Kapur (1967) and Lewvanich (1981).

Material examined: INDIA: ANDHRA PRADESH, Hyderabad, Rajendra Nagar, 3 ♀, no date.

(In: A.P. Ag. Univ. Hyderabad)

INDIA: KERALA: Trivandrum, C. Farm, 1 ♀, 23.ix.1952, 1 ♂, 1 ♀, 10, 11.xi.1952, 1 ♀, 20.viii. 1954, 1 ♀, 11.xi.1954, all C.J.S., coll.; on paddy.

(In Coll. Ag. Sci., K. Ag. Univ. Vellayani)

INDIA: MAHARASHTRA: Bombay, Bassein Fort, 1 ♀, - ix. 1909, no coll.

(In: F.R.I., Dehra Dun)

INDIA: ASSAM:, Jhajhi, 1 ♀, 5.x. 1928, Bose coll.; Tinsukhia, 1 ♀, 12.x. 1928; Sarbhog, 1 ♂, 17.x. 1911, C.C.G. coll.; BIHAR: Chakradharpur, 1 ♀ -ix. 1907, A.M. coll.; Pusa, 1 ♂, 14.iii. 1910, 1 ♀, 23.x. 1914, 2 ♂, 1 ♀, 12, 14, 28.iii. 1918, 1 ♀, 28.iii. 1923, all Bose coll.; on rice stubbles, 1 ♂, 11.v.1910, D.N.P. coll.; 1 ♂, 14.x. 1910, 1 ♂, 13.x. 1911, 1 ♂, 12.x. 1911, 2 ♂, 8, 10. iii. 1912, 2 ♂, 11, 12.iii. 1915, 1 ♂, 8.ix 1915, 4 ♂, 2, 4, 9.x. 1915, 1 ♂, 7.iii. 1916, all T.B.F. coll.; 1 ♂, 3.iii. 1911, 2 ♂, iv. 1911, G.R.D. coll.; 1 ♀, 14.ix. 1915, Boy coll.; 1 ♂, 20.ix. 1923, 1 ♂, 4.x. 1923, 2 ♂, 30.x. 1923, 1 ♂, 5.iii. 1924, all Peries coll.; 1 ♂, 1.iv. 1924, Pillai coll.; Katihar, 1 ♀, 16.x. 1911, C.C.G. coll.; Bhaumuhani, 4 ♂, 3 ♀, 29.x. 1911, C.C.G. coll.; Laksamju, 1 ♀, 28.x. 1911

(All in IARI, New Delhi)

UTTAR PRADESH: Lucknow, 1 ♂, at light, 19.ix. 1957. (In I.I.S.R. Luckinow)

INDIA: ASSAM: Dispur, 1 ♀, -.iii. 1963, resting on *Scirpus* sp.; Titabar, Jorhat, 1 ♀, on paddy, - iv. 1963. PUNJAB: Kapurthala, 1 ♀, resting on paddy, -viii. 1962.

THAILAND: Nura Taback, 1 ♀, at light, -xii. 1961. (In P.D.B.C., Bangalore)

INDIA: HARYANA: Kaithal: Kaul, 6 ♂, 12 ♀, -.. 1994, on paddy, *K.S. Kushwaha* coll. (In R.R. Stn., Kaul)

INDIA: ANDHRA PRADESH: Samalkot, 1 ♀, 14.xii. 1922, 1 ♂, 4 ♀, 10.xi. 1926, 1 ♀, -.xii. 1926, on paddy, all *A.G.R.* coll.; 2 ♀, -.i. 1923, 1 ♀, -.xi. 1923, on paddy, *C.V.C.* coll.; 1 ♂, 2 ♀, -.i. 1923, on paddy, *C.V.S. Rao* coll.; N. MALABAR: Taliparamba; 1 ♂, 10-30.ix. 1929, *A.G.R.* coll.; TAMIL NADU: Coimbatore, 1 ♀, 3.xi. 1913, *C.N.* coll.; 1 ♀, 5.ii. 1915, *P.S. Nathan* coll.; 1 ex; 16.xii. 1917, 1 ♀, 1.iii. 1920, *T.K.V.* coll.; 1 ♀, 17.xii. 1925, 2 ♀, 14, 17. ii. 1930, 1 ♀, 18.xi.1930, all *K.C.M.* coll.; 1 ♂, -.v. 1924, *M.C.C.* coll.; 2 exs., 12, 26.xi. 1932, 7 exs., 17, 19, 21, 22, 23, 29, 31. xii. 1932, 1 ex. 20.i.1932, 2 exs., 1.x. 1935, all at light; Madumalai Hills, 1 ♀, 23.i.1925, at light, no coll.

(All in T.N. Ag. Univ. Coimbatore)

INDIA, ASSAM: Seeks, 1 ♀, no other data; Silghat, 1 ♀, 6.x. 1961, Mikkir Hills, 1 ♀, 6.x. 1961, Kaziranga, 1 ♀, 7.x. 1961, all *R.N. Katiyar* coll.; N. Lakhimpur, Army officers' Mess, 14 ♀, 3.vi. 1966, *S.K. Tandon & G.S. Arora* coll.; BIHAR: Champaran, 1 ♀, -.viii 1901, no coll.; ORISSA: Cuttack, 5 ♀ -. 1965, 4 ♂, 17 ♀, 7-11.xi. 1995 all *G.S. Arora* coll., at light from paddy fields. PUNJAB: Kapurthala, 1 ♂, 1 ♀, 18. vi. 1963, an paddy, 1 ♀, 31. viii. 1963, no coll.; SIKKIM: 1800', 1 ♂, -.x. 1897, *G.C. Dudgeon* coll.; UTTAR PRADESH: Mazaffarpur, 1 ♂, -.iii. 1901, 2 ♂, -.vi. 1901, *G.C. Dudgeon* coll.; WEST BENGAL: Calcutta, 1 ♀, 16.x. 1961, *ZSI Party* coll.: 1 ♂, 11 ♀, 24.x. 1962, *S.K. Ghosh* coll.; Canning, 1 ♀, 18.xi. 1965, *G.S. Arora* coll from paddy fields; Dum Dum, 1 ♂, 1 ♀, 10.ii. 1959, *A.K. Bhounik* coll.; Victoria Memorial, 20.ii. 1960; Chinsura, Rice fields, 4 ♂, 5 ♀, 4.xi. 1996, 2 ♂, 18 ♀ 23. iv. 1997, all *G.S. Arora* coll.

BHUTAN: 1 ♀, -.vii. 1895, *G.C. Dudgeon* coll.

PAKISTAN: Tali, 1 ♂, 1 ♀, 2.i. 1963; Sidiquibad, 1 ♀, 13. ii. 1963; Khanpur, 1 ♀, 26. iii. 1963; Sukkar, 2 ♂, 29. iii. 1963.

SRI LANKA: Peradeniya, 1 ♂, -.i. 1900, 1 ♀, -.iii. 1900, 1 ♀, -.ii. 1901, 1 ♀, -.iii. 1900, 2 ♀, - iii. 1911, 1 ♀ -ii. 1912. all *E.E. Green* coll.

(All in Z.S.I., Calcutta)

Wing expanse: ♂ 16-24 mm; ♀ 22-25 mm

Distribution: INDIA: Andhra Pradesh; Assam; Bihar; Delhi; Haryana; Karnataka; Kerala; Maharashtra; Orissa; Punjab; Sikkim; Tamil Nadu; Uttar Pradesh; and W. Bengal. *Elsewhere:* Afghanistan; Bangladesh; Bhutan; Cambodia; China; Hongkong; Indonesia;

Japan; W. Malaysia; Myanmar; Nepal; Pakistan; Philippines; Singapore; Sri Lanka; Sulawesi; Taiwan; Thailand; and Vietnam.

Host : Paddy

Status: Serious

Remarks: It is a serious stem borer pest of paddy all over paddy growing areas in India and other regions as given above. All other records of its occurrence on any other host are unconfirmed, as all the earlier attempts to rear this species on alternative hosts have failed (Shiraki, 1917, Fletcher & Ghosh, 1920, Ayyar, 1940, Jepson, 1954, Banerjee & Pramanik, 1967, Kapur 1967; Grist & Lever, 1969; Pruthi, 1969 and Lewvanich, 1981).

The damage by the borer starts from the young seedling stage in the plant and lasts to its maturity and causes "deadhearts" and "white earheads", particularly the leaves become yellow and wither, and as a result immature grains fail to develop.

The caterpillars, on hatching, move downwards, wander about for sometime on the plant surface or simply hang themselves by silken thread and get blown to adjoining plants. They enter the leaf-sheath and feed upon the green matter for a few days before boring into the stem near the nodal region. In a normal course, only single borer is found in the infested stem, but more than one borer larvae in a single infested stem is not unusual where they pupate there. Before pupation, the larvae made an exit hole which is covered with thin webbing and later a silken cocoon is formed for pupation. (Nayar *et al.*, 1976).

The species is dimorphic in its adult stage, i.e., while the general colouration of forewing is characteristically ochreous, the pattern of spots and dots differentiate the male from uniformly coloured forewing in female. In fact, the two sexes were named and described as two species viz., *Schoenobius bipunctifer* Walker, for the female and *S. incertellus* Walker, for the male (*vide* Hampson, 1896: 48-49). Shiraki (1917) synonymised *S. bipunctifer* to *incertellus* (now *incertulas*) and has since been followed. Later, *Tryporyza* was created by Common (1960), with the type as *Tipanaea innotata* Walker, and *incertulas* was included as one of its species. Lewvanich (1981) in his revision of old world species of the genus *Scirpophaga*, synonymised *Tryporyza* to the latter genus and transferred *incertulas* for the first time as a new combination as *Scirpophaga incertulas* (Walker) and has been followed here.

The males of *Scirpophaga incertulas* (Walker) are characterised by the presence of submedian spots, a spot at the lower angle of cell, an oblique series of spots from apex to sub-median spot and a terminal series of neural dots, and come very close to males of *Scirpophaga nivella* (Fb.) and *S. gilviberbis* Zeller. In fact at several repositories, the males of *nivella* and *gilviberbis* have often been found to be mis-identified as "*incertulas*", but the careful examination of the labial palpi clearly segregate these species, even externally, i.e. the labial palpi in *incertulas* are extremely long, about three to 3½ times the diameter of eye, projected much beyond face and can be made out by naked eye, unlike in *nivella* where these are only 1.3 times the diameter of eye and in *gilviberbis*, 1.5 times the diameter of eye. Again, the females in all the three species are quite different i.e. the females in *incertulas* are ochreous, with a single large black spot at the lower angle but without neural dots on

upper as well as underside of forewing, unlike in *nivella*, and *gilviberbis*, where the females are white, shining and without spots. The two latter species, however, differ from each other by the venation in forewing where R_1 runs straight to costa and the frenulum spine double in *nivella* unlike in *gilviberbis* where the vein R_1 runs closely approximated to Sc shortly and the frenulum spine is single in female. Compared to *incertulas* where the anal tuft in female is ochreous, in the other two species, the anal tuft is either pale ochreous or whitish grey to dark grey.

With the help of these external characters, *S. incertulas*, during the course of present study, could be easily identified and separated from the other two related species, particularly, in their males. Further, if genitalic features are utilized, these further help in segregating these species. It is hoped that, in future, agricultural entomologists will make use of external characters more to identify these species.

***Scirpophaga innotata* (Walker)**

(WHITE RICE BORER)

(Plate II, figs. 7-8; Text figs. 11A-D)

1863. *Tipanaea innotata* Walker, *List Lep. Ins. Br. Mus.*, 28: 523 (Sarawak).

Diagnosis: Head with the frons smooth, rounded; labial palpi long, porrect, about twice the diameter of compound eye; antennae about half the length of forewing costa in male, slightly shorter in female, simple in both sexes, ciliation dense in male but sparse in female. Hindwing with the frenulum spine double in female. Anal tufts whitish.

Male: Pale ochreous, Forewing upperside pale ochreous to whitish, without any markings; underside darker than that of upperside. Hindwing upperside whitish, underside slightly darker. **Female:** Colouration as in male except that the suffusion as on forewings underside, is absent.

Venation: Forewing: Vein R_1 running close to Vein Sc but free and not anastomosing with the latter; R_2 free, from a little before upper angle; R_{3+4} stalked; R_5 and M_1 free, from below the upper angle of cell; M_2 - M_3 free, close to lower angle; Cu_{1a} close to lower angle but not equidistantly placed with those of M_2 - M_3 ; Cu_{1b} much before the origin of Cu_{1a} , about twice as far from Cu_{1a} as the latter from M_3 , Cu_2 incomplete and ending abruptly, close to the margin. **Hindwing:** Very similar to that in *incertulas* except veins M_2 - M_3 being close at each other at lower angle of cell than to vein Cu_{1a} .

Genitalia: Vide Lewvanich (1981)

Material examined: INDIA: ORISSA: Cuttack, CRRI Fields, 1 ♀ -x. 1965, 1 ♀, 11.xi. 1995, all G.S. Arora coll.; PUNJAB: Kapurthala, 1 ♂, 18.vi. 1963 B.S. Bains coll., on rice. [In Z.S.I. Calcutta]

Wing expanse: ♂, 18-22 mm; ♀, 22-32 mm

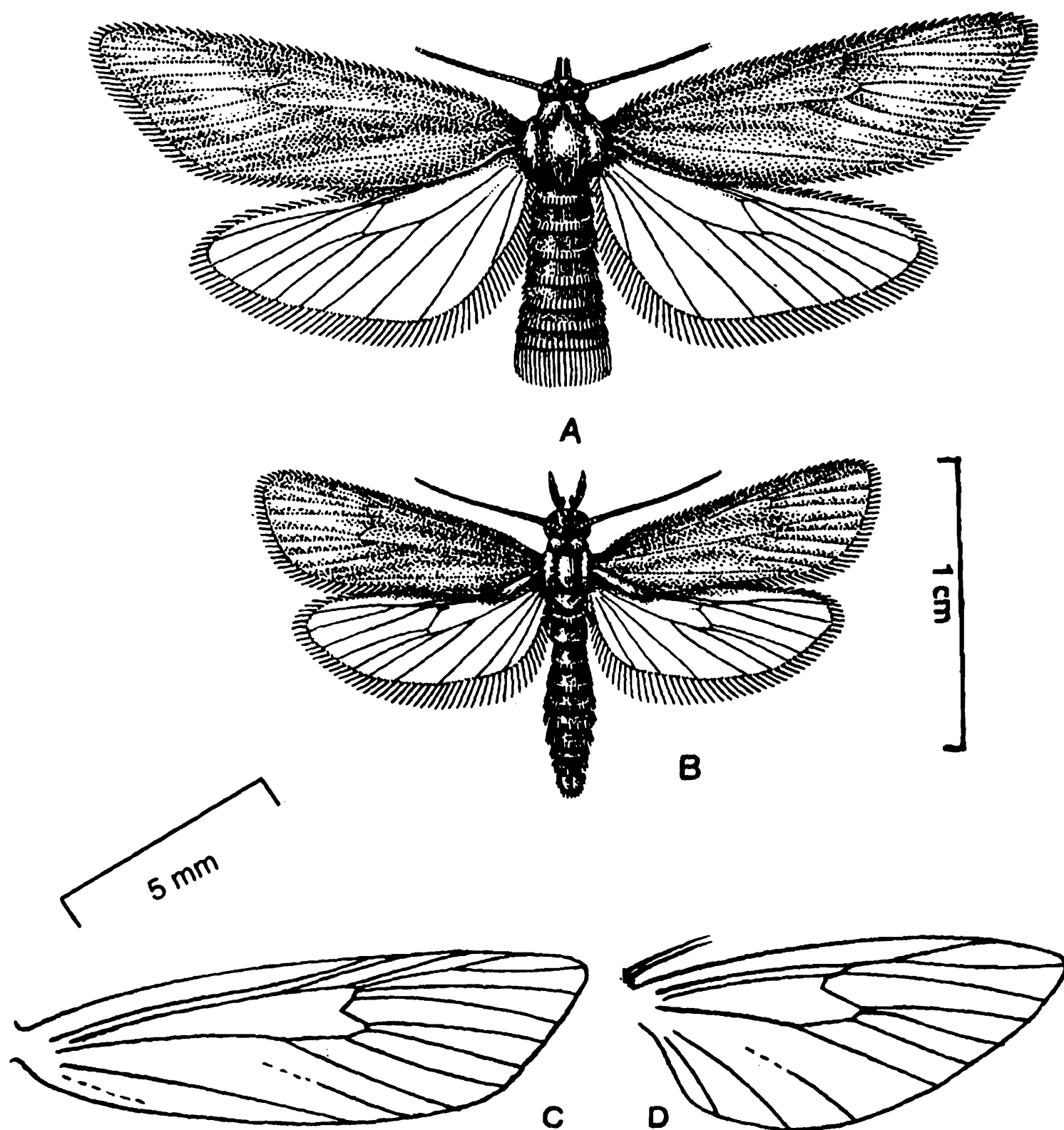


Fig. 11. *Scirpophaga innotata* (Walker) : Adult ♀ (A) and ♂ (B) with wings spread, showing wing pattern and other features, (C) Fore - and (D) hindwing venation (♀ from Cuttack) (Magnification of A and D same as of B and C, respectively).

Distribution: INDIA: Bihar, Gujarat; Karnataka; Orissa; Punjab; Rajasthan; T.N.; and U.P. **Elsewhere:** Australia; Indonesia; Flores; New Guinea; Pakistan; Philippines; Sulawesi; Sumba; Sunbowa; and Timor.

Hosts: Rice (*Oryza sativa*); Wild rice (*O. australiensis*)

Status: Serious.

Remarks: Lewvanich (1981) has clubbed this species with *S. incertulas* (Walker) in *Incertulas* Group on the basis of external as well as genitalic characters. He has studied the genitalia of both the sexes, and is of the view that the two species differ very little, particularly from genitalic characters. Externally, colouration, however, offers a very good differentiating character, which is ochreous yellow in both sexes, with considerable markings in male in *incertulas* unlike in *innotata* which is predominantly white in both sexes. Besides, labial palpi are longer, 3-4 times the diameter of compound eye in *incertulas*, but only twice the diameter of eye in *innotata*.

Kapur (1967: p. 26), who made genitalic studies of both sexes from the material collected by the author from Orissa, was of the opinion that this species differs from that of Philippines material. Though studies made by Kapur (1967) and Lewvanich (1981) agree in similarity of structure, the latter is of view that this occurs from "Eastern Asia to Australia", thus not reported to occur in Indian region. However, the material present before the author for study once again confirms its availability in the Indian region, as given by Kapur (1967), Grist & Lever (1969), Ghai *et al.* (1979) and more recently by Seshagiri Rao & Kulshreshtha (1985).

The species is being recorded from Punjab for the first time.

IV PRAELATA Group

Lewvanich (1981) recorded ten species under this group, with only two known from the Indian region. Both these species, viz., *S. nivella* (Fabr.) and *S. gilviberbis* Zeller are mainly rice pests of economic importance. The group has been characterised by the vein R₁ in forewing being free but curved toward Sc to lie close to it or run straight to costa, and further by the frenulum spine being either double in female, as in *nivella*, or single in *gilviberbis*. Besides, the two species differ from each other externally, by the length of labial palpi which are about 1.3 times the diameter of compound eye in *nivella* and 1.5 times in *gilviberbis* and by the anal tufts in females being ochreous in former and greyish in latter.

S. nivella (Fabr.) is a very serious pest of rice, occurring widely in southern India, Central India, eastern coastal areas, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Haryana, Meghalaya, Punjab and West Bengal in India, besides in Australia, Bangladesh, China, Fiji Is., Hongkong, Indonesia, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Singapore, Thailand, Taiwan, Timor and Vietnam. Obviously, the areas recorded are under rich cultivation of rice and hence the wide occurrence of this species. The other species, *S. gilviberbis* is also a rice pest but of moderate importance and is confined to Assam, Bihar, Himachal Pradesh, Karnataka, Meghalaya, Orissa, Tamil Nadu and U.P. in India and also occurring in Java, Myanmar, Singapore, Sulawesi, Thailand and Vietnam.

A large collection of the two species has been studied at the major repositories, viz., FRI, IARI, PBDC, (UAS) GKVK and T.N.A.U. and have been described as under.

***Scirpophaga nivella* (Fabr.)**

(RICE STEM BORER)

(Plate II, figs. 9-10, Plate V, fig. 4; Text figs. 9G-H)

1794. *Tinea nivella* Fabricius. *Ent. Syst.* 3 (2): 296.

Diagnosis: Head with the frons smooth; labial palpi, porrect, short and about 1.3 times the diameter of eye; antennae minutely serrate and profusely ciliated in male and simple and sparsely ciliated in female, about half the length of forewing costa in male and one-third in female. Outer tibial spurs half the length of inner ones. Frenulum spine single in male and held by a retinaculum bar; spines two in female, held by a cluster of bristles.

Male: Head, thorax and abdomen pale ochreous. Forewing ochreous to dark-greyish ochreous; with three fuscous spots on submedian fold, the fourth spot at lower angle of cell; an oblique series of fuscous spots from costa, near apex, to near third spot; a series of very small fuscous neural dots along termen, sometimes quite reduced. Underside: labial palpi dark. legs dark, particularly the basal joints; forewings fuscous; hindwings semi-hyaline white, paler in basal half. **Female:** Head, thorax, abdomen, wings and legs whitish on upper as well as underside. Wings unmarked on both sides. Anal tufts ochreous yellow.

Venation: Forewing: Vein R_1 free, running straight to costa; R_2 free, from a little before the upper angle of cell; R_{3+4} on a long stalk; R_5 , M_1 from below the upper angle of cell, nearly equidistant to R_{3+4} ; M_2 , M_3 close to each other from lower angle; Cu_{1a} from before the angle, about twice as far from M_3 as the latter from M_2 ; Cu_{1b} also about twice as far from Cu_{1a} as the latter from M_3 , and arising in line with R_1 above. **Hindwing:** Vein Sc anastomosing with Rs, after the latter's origin from cell angle, for about basal one-third; M_1 from cell angle and connate with Rs; M_2 , M_3 close to each other at lower angle and, along with Cu_{1a} , placed as in forewing. Other features as given for the genus.

Genitalia: Vide Lewvanich (1981).

Material examined: ASSAM: Gauhati, 1 ♀, -v. 1920, *Fletcher* coll.; Margherita, 1 ♀, 15.v.1914, 1 ♀ -v. 1920, *Fletcher* coll.; Tinsukhia, 1 ♀, 14.x. 1928, *Bose* coll.; BIHAR: Pusa 3 ♀, 13.xii. 1926, on leaves of *Heliocharis* plant genus (no more data) 2 ♀, 10.vi. 1915, at light; Lohat Factory, 1 ♀ 10.viii. 1933 (no more data); Laksam, 1 ♀, 27.x. 1911, at light, *C.C.G.* coll.; Pusa, 1 ♀ -x. 1909, *CWM* coll.; 2 ♀, 29. iv. 1918, 2 ♀, 19. iv. 1921, 2.v. 1921 boring stems of chikori, *Rangi* coll., 1 ♀, 29.x. 1919. *Ram Saran* coll., 4 ♀, 3, 7, 9.x. 1926, *Pillai* coll., 1 ♀, 29. vi. 1929, *E. Hassan* coll., 1 ♀, 29. viii. 1930, 1 ♀, 3.ix. 1930, 2 ♀, 9.xi. 1930, *Gupta* coll., 3 ♀ 24.x.1932, 1 ♀, 2.xi.1932, all *W.K. Wesley* coll., 1 ♀, 5.vii.1933, 1 ♀, 17.x. 1933, resting on rice (at light), *H.N. Batra* coll.; MEGHALAYA: Shillong, 2 ♀, -viii-ix. 1919, 1 ♂, -vi. 1920, *Fletcher* coll.; UTTAR PRADESH: Kathgodam, 1 ex., 1.ix.1930, *Samuel* coll.

(All I.A.R.I., New Delhi)

INDIA: UTTAR PRADESH: Lucknow, 2 ♀, 1, 20.vii, 1955, *J.P.K.* coll.; 1 ♀, 5.v. 1956, 1 ♀, 4.x. 1956, 4 ♀, 6.x. 1956, all on sugarcane, no coll.; 1 ♀, 26.ix. 1956, *M.C.G.* coll.; 1 ♀, 18.x. 1956, 1 ♀, 17.vii. 1957, 2 ♀, 1.viii. 1957, 2 ♀, 20.viii. 1957, 1 ♀ 9.vi. 1958, 1 ♀, 11.vii. 1958, 1 ♀ 1.viii, 1959, all on sugarcane, *K.S.S.* coll.; 2 ♀, 10, 20, vii. 1961, 4 ♀, 9.viii. 1961, 5, 10. viii 1961, 1 ♀, 24.ix. 1964, ♀, 1 ♀, 20 viii 1966, all on sugarcane, *T.N.S.* coll.; 1 ♀, 19. iii. 1971, *A.N. Kalra* coll.; 1 ♀, 3.vi. 1971, 1 ♀, 17.vii. 1971, 1 ♀, 25.ii. 1972, 1 ♂, 16 iii. 1972, all on sugarcane, *Beena* coll.

(All in I.I.S.R. Lucknow)

INDIA: ASSAM: Jorhat; Bengal Pokhuri, 3 ♀, 1 ex., on wing, paddy fields, -. viii. 1962; Titabar, 2 ♀, 1 ex., -x. 1962; Sishupal, 6 ♀, -.xi. 1963, no more data except labelled as "*Scripus*" borer moth" KARNATAKA: Mandya, 1 ♀ -.xi. 1962, no coll.; PUNJAB: Kapurthala, 2 ♂, 6 ♀, on *Oryza sativa*, -.viii. 1962.; WEST BENGAL: Plassey, 2 ♀, -.vii. 1962, no coll.

(In P.D.B.C., Bangalore)

INDIA: HARYANA: Kaithal; Kaul, 6 ♀, -- 1994, all on paddy *K.S. Kushwaha* coll.

(In R.R. Stn., Kaul)

INDIA: ANDHRA PRADESH: Samalkot, 1 ♀, at light, -.xii. 1925, *N.K.M.* coll.; 1 ♀, 20.x. 1927, *A.S. Naidu* coll.; KERALA: Cannanore, 2 ♀, -iv-vi. 1925, *N.K. Menon* coll.

(All in T.N. Ag. Univ., Coimbatore)

INDIA: KARNATAKA: Mandya, 1 ♀, --. 1982, at light, no coll.

(In Univ. Ag. Sci. GKV, Bangalore)

INDIA: ARUNACHAL PRADESH: Subansiri Dist.; Majgan, 79m., 1 ♂, 30.x. 1966, *A.N.T. Joseph* coll. ORISSA: Cuttack 1 ♀, 7.xi. 1995, 1 ♀, 10.xi. 1995, 2 ♂, 6 ♀, 11.xi. 1995, all *G.S. Arora* coll., on paddy-field light trap. WEST BENGAL: Chinsura, 1 ♂, 18.x. 1996, 4 ♀, 4.xi. 1996, 3 ♀, 23.iv. 1997, all *G.S. Arora* coll. on paddy-field light trap.

SRI LANKA: Trincomalee, 3 ♀, -.xi. 1906, *E.E. Green* coll.

(In Z.S.I., Calcutta)

Wing expanse: ♂ 21-23 mm; ♀ 25-30 mm

Distribution: INDIA: Andhra Pradesh; Arunachal Pradesh; Assam; Bihar; Haryana; Karnataka; Kerala; Madhya Pradesh; Orissa; Punjab; Uttar Pradesh; and West Bengal *Elsewhere:* Australia; Bangladesh; Borneo, Fiji; Hongkong; New Guinea; Malaysia; Myanmar; Philippines; Singapore; Sri Lanka; Sumatra; Taiwan, Thailand; Timor; and Vietnam.

Hosts: Mainly paddy; Sugarcane ?

Status: Serious pest.

Remarks: A large number of specimens, of *nivella*, has been examined at the various research institutes/universities and other repositories. Often it was found that the specimens labelled at various places, as "*nivella*", turned out to be those of *Scirpophaga excerptalis*

(Walker). Since both sexes of the latter species and the females of *nivella* are predominantly white, the latter species was confused and the material of *excerptalis*, which is mainly sugarcane pest, identified as *nivella*. It was Lewvanich (1981) who, for the first time, stated that *excerptalis* is a sugarcane pest and *nivella* is a paddy pest, differentiating the two on the basis of vein R_1 being free in *nivella* (confluent in *excerptalis*), labial palpi about 1.3 times the dia. of eye in *nivella* (1.5 to twice the dia. of eye in *excerptalis*) and frenulum spine being double in *nivella* (single in *excerptalis*). Besides, the male in both the species are considerably different. While those in *excerptalis* are pure white, the males in *nivella* are with ochreous forewings, spotted on submedian fold with an oblique series from apex and a series of neural dots, almost like those of the males of *incertulas* and *gilviberbis*. Further, the genitalic differences between both the species are quite significant and sufficient to differentiate.

Lewvanich (1981) has clearly stated that *nivella* is paddy pest and all the hitherto record of its occurrence on sugarcane, particularly in literature, are due to misidentity. The detailed examination of each and every specimen present in various repositories proved almost to what Lewvanich (1981) had stated that past record of *nivella* on sugarcane were due to misidentity. However, about 35 examples of males and females present at Indian Institute of Sugarcane Research, Lucknow, mostly with the host as "Sugarcane", with the identity label as "*nivella*", are true *S. nivella*, based on the differentiating characters as mentioned above. Nearly 26 years have passed since collection of the last of this series, i.e., on 28. iii. 1972, and since then no further record of this species on sugarcane either at I.I.S.R., Lucknow, or from elsewhere, has ever been made. It seems that the species' occurrence at least presently, on paddy is relevant. Nevertheless, the availability of specimens with clear indication of "sugarcane" as host for *nivella*, at least till 1972, can not be completely ignored. It will be worthwhile surveying extensively the pest in sugarcane-crops at Lucknow, and even monitoring the emergence of all lab-bred moths of these two species consecutively for several seasons.

Scirpophaga gilviberbis Zeller

(YELLOW STEM BORER)

(Plate II, fig. 11; Text figs. 9 I-J)

1863. *Scirpophaga gilviberbis* Zeller, *Chilonidarum et Crambidarum genera et species*: 2

Diagnosis: Head with the frons smooth; labial palpi porrect, about 1.5 times the diameter of eye; antennae very minutely serrate and profusely ciliated in male, simple and sparsely ciliated in female, about half the length of forewing costa. Frenulum spine single in both the sexes; held in male by retinaculum bar and the cubital bristles in female. Outer tibial spurs about half the length of inner spurs.

Male: Dark ochreous. Head, thorax and abdomen dark ochreous. Forewings upperside dark ochreous to fuscous; with three dark fuscous spots on submedian fold at subbasal, medial and three-fourths of inner area below cell and a spot at lower angle of cell; an oblique series of fuscous marks extends inwards from apex to submedian fold near 3rd spot on inner area;

a series of small terminal neural dots present; underside fuscous. Hindwings semihyaline and whitish; costal area and apex ochreous; underside with costal area darker compared to upperside. Labial palpi, antennae and legs darker. *Female*: Whitish. Fore-and hindwings whitish or suffused with ochreous. Anal tufts whitish grey to dark grey.

Venation: Forewing : Vein R_1 curved towards Sc but free and not anastomosing with latter; R_2 from a little before upper angle of cell; R_3 - R_4 stalked, from angle of cell; R_5 - M_1 equidistantly placed, arising from below the upper angle; M_2 - M_3 from lower angle of cell, close the each other; Cu_{1a} from a little before angle; Cu_{1b} twice as far from Cu_{1a} as the latter from M_3 ; Cu_2 only traces in the inner area. *Hindwing* : Sc+ R_1 free till about the angle, beyond which it anastomoses with Rs to nearly halfway to apex; M_1 from angle; M_2 - M_3 connate to each other; Cu_{1a} closer to M_3 than Cu_{1b} .

Genitalia: Vide Lewvanich (1981)

Material examined: INDIA: U.P: Dehra Dun, 1 ♂, 1 ♀, 26, 27. viii. 1915, N.C. Chatterjee coll.

(In FRI, Dehra Dun)

ASSAM: Sibsagar, 1 ♀, 1.x.1928, Bose coll.; Tinsukhia, 1 ♀, 12.x. 1928, Bose coll.; Dibrugarh, 3 ♀, 16.x. 1928, Bose coll.; BIHAR: Puss, 1 ♀ 20.vii. 1914, 1 ♀, 9.viii. 1914, Boy coll., 1 ♀, 12.vi. 1914, 1 ♀, 11.viii. 1915, 1 ex., 29.11.1916, 1 ♂, 23.vi. 1916, 1 ex., 19.viii. 1916, 1 ex. 20.ix. 1916, 1 ♀, 16.v. 1917, 1 ♀, 20.ii.1927, all Fletcher coll.; 1 ♀, 4.x. 1923, Peries coll., 1 ♀, 15.iii. 1926, Pillai coll., 1 ♂ 9.v. 1927 Dwarka Prasad coll., 1 ♀, 23.v. 1929., 1 ♀, 29.xi. 1933, E. Hassan coll., 2 ♂, 8 ♀, 1.vi. 1932, 1 ♂ 2.vi. 1932, all on sugarcane, no more data, 1 ♂, 26.x. 1932, 1 ♀, 30.v. 1933. Bose coll, 1 ex., 2.viii. 1933, R.B. Misra coll., 1 ♂, 1 ♀, 13.iii.1935, N. Ayyar coll.; Champaran, on paddy, 2 ♂, 10.x. 1931, no more data. MEGHALAYA: Cherrapunji, 19 exs., no more data Native coll.; TAMIL NADU: Palnis, Kodai Kanal 7000, 1 ♂, 22.viii. 1921, 3 ♂, 28.x.1921, Fletcher coll.

MYANMAR: Rangoon, 1 ♂, 1 ♀, 18-30.ix.1914 Fletcher coll.

(All in I.A.R.I., New Delhi)

INDIA: ORISSA: Sambalpur, 1 ex. 5.vii. 1962; Bhubaneswar, 1 ex., 25.vii. 1962, no more data

(All in P.D.B.C., Bangalore)

KARNATAKA: Bangalore, 1 ♂, 10.viii. 1979, at light, 1 ♂, 16.vi.1932, Srinivasa coll., GKVK, 1 ♀, 26.xii. 1974, M. Thippaiah coll.

(In Univ. Ag. Sci. GKVK, Bangalore)

INDIA: HIMACHAL PRADESH: Kangra Valley, 4500, 1 ♂, -iii. 1899, G.C. Dudgeon coll.; ORISSA: Cuttack, CRRF Fields Light Trap, 2 ♂, 7, 11.xi. 1995, G.S. Arora coll.; WEST BENGAL: Chinsura, Rice Field Light Trap, 1 ♂, 8.x.1996, 1 ♂, 4.xi. 1996, G.S. Arora coll.

SRI LANKA: Eppawala, 1 ♂, -ix. 1905; Hakgala, 1 ♀, -iii. 1907, *E.E. Green* coll.
(All in Z.S.I., Calcutta)

Wing expanse: ♂ 14-20 mm; ♀ 18-25 mm.

Distribution: INDIA: Assam; Bihar; Himachal Pradesh; Karnataka; Meghalaya; Orissa; Tamil Nadu; Uttar Pradesh; and West Bengal. *Elsewhere:* Java; Myanmar; Singapore; Sri Lanka; Sulawesi; Thailand; and Vietnam.

Hosts: Paddy; Sugarcane (?)

Stauts: Moderate.

Remarks: The species is grouped under *Praelata* along with *nivella*, the males of which closely resemble each other. As mentioned above, the males of both these species closely resemble with those of *incertulas* which is under *Incertulas* group. All the three species are paddy pests and can easily be differentiated externally.

Common (1960) transferred this species under his genus *Niphadoses*, but Lewvanich (1981) opined that this species did not belong to the genus *Niphadoses* Common and revived the earlier combination and placed it back to the genus *Scirpophaga*.

Except for a few examples from Bihar, present in I.A.R.I., New Delhi, which had the label of the host as "sugarcane", no other material in any repository had shown the record of the host as sugarcane. The records needs further survey and investigation by monitoring of the pest.

V OCCIDENTELLA Group

Lewvanich (1981) recorded eight species under this group, with only two as Asian species, viz., *S. fusciflua* Hampson and *S. virginia* Schultze. While *fusciflua* is known to occur in Afghanistan, India, Nepal, Sri Lanka, Thailand and Taiwan, *virginia* occurs in Bangladesh, Borneo, China, Japan, Philippines, Singapore, Sri Lanka, Sumatra, Taiwan, Thailand, West Malaysia and Vietnam. Thus, the countries where both the species are available are only Sri Lanka, Taiwan and Thailand, and both the species are rice pests. Although, the material present for study does not indicate any host-record except one collected by the author from rice fields of CRRI, Cuttack, the material can be conveniently placed into this group, particularly the one from Sri Lanka on the basis of external characters, i.e. the vein R_1 in forewing though free, curves towards Sc and the frenulum spine is single in both the sexes. Lewvanich (1981) is of the view that both these species are inseparable externally except in size which is smaller in *virginia*. He has also studied the genitalia which has considerable difference in subtegumenal process which is rounded in *virginia* but bifid in *fusciflua*.

The studies on the basis of material available, presently, have been made to give the differences in external characters in the two species so as to give an identity to these species. These taxonomic details are as follows.

***Scirpophaga fusciflua* Hampson**

(Plate II, figs. 12-13; Text figs. 9K-L)

1893. *Scirpophaga fusciflua* Hampson, *Ill. Lep. Het. Br. Mus.*, 9: 167, pl. 172, figs. 29. 30.

Diagnosis: Head with the labial palpi very short, nearly equal to the diameter of eye; antennae simple in both sexes, ciliated, the ciliation profuse in male, sparse in female; about three-fifths the length of forewing costa in male and two-fifths in female. Hindwing with the frenulum spine single in both sexes. Outer tibial spurs about half the length of inner ones.

Male: Pale ochreous white. Head with the labial palpi and antennae, thorax with legs and abdomen whitish to ochreous white. Forewing upperside white to ochreous white, suffused with pale fuscous in the costal area. **Female:** As in male; anal tufts greyish to ochreous yellow.

Venation: Forewing: Vein R_1 free, curved to lie close to vein Sc, without touching or anastomosing with it; R_2 free, from a little before angle; R_{3+4} stalked; R_5 , M_1 from below the upper angle, nearly equidistantly placed from angle; M_2 , M_3 close to each other but not connate; Cu_{1a} from a little before lower angle; Cu_{1b} about $2\frac{1}{2}$ times as far from Cu_{1a} as the latter from M_3 . **Hindwing:** Vein Sc free till about cell angle, beyond which it anastomoses for a short distance with Rs, which arises from angle and slightly stalked with M_1 at origin; M_2 - M_3 close to each other; Cu_{1a-1b} as in forewing.

Genitalia: Vide Lewvanich (1981)

Material examined: INDIA : TAMIL NADU : Madras (now Chennai), Needamanglam, 1 ♀, 30.x. 1962, no coll.; UTTAR PRADESH: Lucknow, 1 ♀, -.xii. 1968.

[In P.D.B.C. Bangalore]

INDIA: HARYANA: Kaithal Dist.; Kaul, 31 ♀, -.-. 1978, K.S. Kushwaha coll. on paddy.

[In R. Res. Stn., Kaul]

INDIA: HARYANA: Kaithal Dist.; Kaul, 5 ♀, -.-. 1978, K.S. Kushwaha coll on paddy. HIMACHAL PRADESH: Kangra Valley, 4500, 2 ♀, -.viii.x. 1899, G.C. Dudgeon coll.; ORISSA : Cuttack, CRR1, Rice Fields, 1 ♀, -.11.xi. 1995, G.S. Arora coll.

SRI LANKA: Hakgala, 1 ♂, 1 ♀, -.iii. 1907, E.E. Green coll.

[All in Z.S.I., Calcutta]

Wing expanse: ♂ 16-22 mm; ♀ 21-27 mm

Distribution: INDIA: Assam; Haryana; Himachal Pradesh; Orissa; Tamil Nadu; Uttar Pradesh; and W.B. *Elsewhere:* Afghanistan; Nepal; Sri Lanka; Taiwan; and Thailand.

Host: Paddy.

Status: Minor.

Remarks: Lewvanich (1981) recorded the species from Assam and Uttar Pradesh, based on the actual study of the material from these areas. The present study extends the distribution of the species to state of Orissa, Himachal Pradesh, Haryana, Tamil Nadu and W.B. In fact during the visits to Rice Research Station, Chinsure (W.B.), several examples of *fusciflua* were examined which were erroneously identified, in the monitoring of pest-species on paddy fields at the Farm, as *S. nivella*, being whitish in colour. When the specimens were examined, the females were found to contain single frenulum spines (vs two in *nivella*), smaller labial palpi i.e. about the length of diameter of eye (vs. 1.3 times in *nivella*) and R_1 curved in forewing towards Sc (vs running straight in *nivella*). The material from Kangra Valley by G.C. Dudgeon, in August-October 1899, also had the identity label of *S. auriflua* (now a synonym of *S. nivella*). These specimens have also been presently redetermined as *Scirpophaga fusciflua* Hampson.

It seems that the species is abundantly available in rice-growing areas and is not being actively monitored for its pest status and the damage it is causing to the rice crop. It is hoped that the entomologists will, henceforth, start looking for this species also as pest and monitor its occurrence in nature.

Scirpophaga virginia Schultze

(Plate II, fig. 14)

1908. *Scirpophaga virginia* Schultze, *Philipp. J. Sci.* (A) 3 : 34.

Diagnosis: Smaller than *S. fusciflua* Hampson. Head with the labial palpi porrect, nearly equal to the diameter of eye; antennae simple in both sexes, ciliated, ciliation profuse in male, sparse in female, nearly three-fourths the length of forewing costa in both sexes. Hindwing with frenulum spine single in both sexes.

Male: Head with the labial palpi and thorax with the legs white to pale ochreous white. Forewings upperside shining, pale ochreous white; underside pale fuscous, with a little shine. Hindwings upper and underside shining white, with costal area suffused with pale fuscous, particularly near the basal area. Abdomen upper and underside shining, white to pale ochreous. *Female:* As in male but more inclined to ochreous tinge.

Venation: Forewing : Vein R_1 free, or curved towards Sc, sometimes touching it or slightly anastomosing for a short distance; R_2 from a little before angle; R_{3+4} stalked; R_5 from a little below upper angle; M_1 much below R_5 and the two veins not equidistantly placed from cell angle (unlike in *fusciflua*); M_2 - M_3 close to each other; Cu_{1a} , from before cell angle; Cu_{1b} about twice as far from Cu_{1a} as the latter from M_3 . Other features as given for the genus. *Hindwing:* As in *fusciflua* except that veins M_2 - M_3 connate and Cu_{1b} about thrice as far from Cu_{1a} as the latter from M_3 .

Genitalia: Vide Lewvanich (1981).

Material examined: SRI LANKA: Eppawala, 2 ♂, -.ix. 1905; Hakgala, 1 ♂, -.iii. 1907, E.E. Green coll.

PAKISTAN : Liaquatpur, 1 ♂, 25.xii. 1962; Gujrawala, 1 ♂, 31.ii.1963, 1 ♂, 3.i.1963; Kalashahkoku, 1 ♀, 18.ii. 1962 all collected as larvae from rice stubbles.

[All in Z.S.I., Calcutta]

Wing expanse: ♂ 13-19 mm; ♀ 17-22 mm

Distribution: Bangladesh; Borneo; China; Japan; Pakistan (New record); Philippines; Sri Lanka; Taiwan; Thailand; W. Malaysia; and Vietnam.

Host: Paddy

Status: Minor

Remarks: The species has no specific record from India, and is also being recorded from Pakistan for the first time.

Lewvanich (1981) mentioned that this is very close to *fusciflua* except that *S. virginia* is comparatively smaller in size. Presently, attempts were made to look for some significant external differences between the two species. It was found that vein R_1 which is free in *fusciflua*, was found to touch or partly anastomose with Sc in *virginia*; the antennae being slightly longer than in *fusciflua* though the moths are smaller in size and vein M_1 in forewing not equidistantly placed to R_5 from cell angle but slightly lower. Besides, the wings show more shine in *virginia*.

While *S. fusciflua* Hampson is distributed in Assam, Haryana, H.P., Orissa, Tamil Nadu, Uttar Pradesh and W.B. in India, this species is hitherto unreported from India. Sri Lanka being the common country where both the species have been reported to occur. The present study add Pakistan as a new record of distribution for this species. It is quite probable that this species also occurs in rice growing areas, and an extensive survey might reveal its occurrence in India, particularly in areas closer to (i) Sri Lanka i.e. Tamil Nadu on one hand, and (ii) Pakistan i.e. Punjab, on the other hand.

C. Subfamily NYMPHULINAE

The subfamily comprises small to medium sized and often delicately built moths. Body slender. Colour often pale, with the wings usually having definite and complicated pattern of transverse bands. Some species have a row of shining metallic spots, along termen of each hindwing, which are raised and displayed when the moths are at rest.

The Nymphulinae are of special interest and have attracted considerable attention as their larvae are aquatic in some species.

In respect of the Indian species, particularly in relevance to the present study, only two species viz., *fluctuosalis* (Zeller) and *stagnalis* (Zeller) under the genus *Parapoynx* Hübner, are included. Both the species are among the major rice pests, popularly known as

"The Rice Case Worms", and are distributed throughout India, particularly in paddy-growing areas.

The general diagnosis of the sub-family is as follows.

Head with the frons smoothly rounded and not prominent; proboscis moderately to well developed; labial palpi upturned, the third segment reaching vertex of the head; eyes large; ocelli well developed, or small in some and absent in others; chaetosema present antennae thickened in male, slender in females. Venation variable, with the vein R_2 in forewing free, or stalked with R_{3+4} ; hindwing with the termen strongly or weakly excavated behind apex. Praecinctorium simple and ending in a tuft of scales. Legs with the spurs unequal. Frenulum spine single in male and two or more in female.

Munroe (1972) has given generalised genitalic features of Nymphulinae, in both male and female, and are quoted below. "The male genitalia have a simple uncus, most often long and slender, and a long, slender gnathos, basally articulating at the base of the tegumen, and distally usually with a dorsal row of teeth. The juxta is simple. The valves are usually simple and distally rounded. In a number of genera they have long, strongly bent, scale-like setae extending dorsally beyond the costa. These setae are usually few in number and arise from different parts of valve in different genera. Their function has not been determined. The female genitalia vary considerably in different genera. The bursa often, but by no means always, has a strong elaborate armature of spine."

Following Munroe (1972), the genus *Parapoynx* Hübner, falls into the Tribe *Nymphulini* which is characterised by the cell in the forewing about two thirds to three-fifths the length of wing, the latter not strongly incised behind vein M_1 and the male without any glandular swelling behind costa. Munroe (*loc cit.*) has considered two more tribes viz., *Argyractini* (where M_2 is absent in hind wings) and *Ambiini* (which has M_2 present as in *Nymphulini* but with the other characteristic features of the latter not as given above, for *Ambiini*). The genus *Parapoynx* is dealt with here as under.

Genus *Parapoynx* Hübner

1825. *Parapoynx* Hübner. *Verz. bek. Schmett* : 362.

Type species: Phalaena stratiotata Linn.

Diagnosis: Male. Head with the frons rounded, smoothly scaled; labial palpi upturned, the 3rd joint short and acuminate, reaching vertex of the head; maxillary palpi prominent, moderate to strongly dilated with scales; proboscis well developed; eyes large; ocelli present, reduced; antennae annulated and thickened. Wings long and narrow; cell about two thirds to three-fifths the length of wing; hindwing-cell half the length of wings. Legs long and smooth; spurs unequal. Frenulum spine single in male, held by a narrow and weak retinaculum bar from subcostal vein in forewing. Abdomen long and narrow. Praecinctorium simple and ending in a tuft of scales. **Female.** Similar to male except that the antennae are

slender and the frenulum spines are three, held at the cubital vein underside forewing by a cluster of bristles.

Venation: Forewing: Vein R_2 free, or stalked with R_{3+4} ; 1st A missing; 2nd A present, well developed; 3A short and straight, or absent. **Hindwing:** Sc anastomosed with Rs, on a long stalk, and both ending at costa; all the three anal veins present.

Genitalia: Male: Uncus and gnathos stout; the latter with some dorsal spines, or spines missing; aedeagus small and without large cornuti; valvae simple. **Female:** Ductus bursae elongated; ostium bursae sclerotised; ductus bursae unsclerotised and leads to an unsclerotised unarmed bursa, or may be with bands of small denticles (*vide* Munroe, 1972).

Distribution: World-wide.

Remarks: Only two species viz. *P. fluctuosalis* (Zeller) and *P. stagnalis* (Zeller), which were earlier known as *Nymphula fluctuosalis* Zeller and *N. depunctalis* (Guenee) (*Vide* Hampson, 1986), are dealt with here.

***Parapoynx fluctuosalis* (Zeller)**

(Plate III, figs. 1-2; Text figs. 12A-B)

(THE RICE CASE WORM)

1852. *Nymphula fluctuosalis* Zeller, *Lep. Microptera. Caffer.* : 27.

Diagnosis: Labial palpi unturned; antennae annulated and thickened in male, slender in female, about two-thirds the length of forewing costa; outer tibial spurs less than or nearly half the length of inner spurs. Frenulum spines three in female. Forewing apex narrow and produced; cell long and narrow.

Head and thorax white, irrorated with black; abdomen white, with broad black-edged fulvous bands. Forewing white; the costal area tinged with fulvous and irrorated with black; oblique subbasal and antemedial black bands present, tinged with fulvous from cell to the inner margin; an indistinct fulvous spot in cell and a black spot at upper angle of cell; an oblique fulvous-tinged black band extending from the costa near apex to lower angle of cell, beyond which it runs straight. Hindwing with an oblique subbasal line from cell to the inner margin, where it is joined by an oblique line from costa. Both wings with a slightly curved oblique black-edged fulvous post-medial band, a black line near the termen, a fulvous marginal band and a black line at base of cilia, present.

Venation: Forewing: Vein R_1 arising free from close to upper angle of cell; R_2 free from upper angle and closely approximated at base to R_{3+4} ; R_{3+4} on a long stalk and ending at costa, before narrowed and produced apex; R_5 , M_1 from below the upper angle, R_5 closer to base of R_{3+4} than to M_1 ; M_2 , M_3 connate at the origin, from lower angle of cell; Cu_{1a} , from before the lower angle, closer to M_3 than Cu_{1b} which is arising before the origin of R_1 above. **Hindwing:** Vein Sc free upto a little beyond cell angle, beyond which it anastomoses

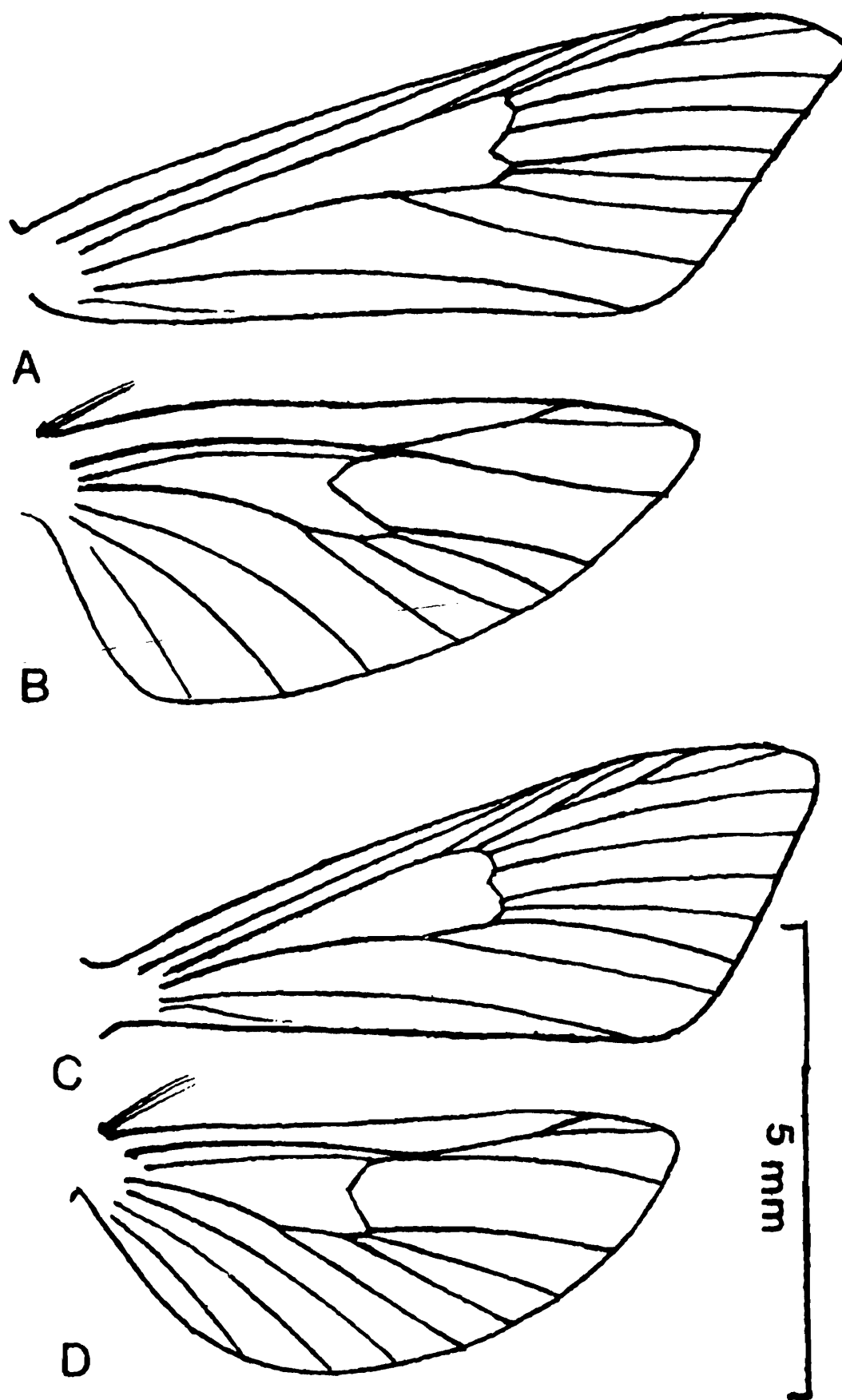


Fig. 12. *Parapoynx fluctuosalis* (Zeller) ♀ : (A) Fore - and (B) hindwing venation (♀ from Wellawaya, -xi.1905, E.E. Green coll.); *Parapoynx stagnalis* (Zeller) ♀ : (C) Fore- and (D) hindwing venation (♀ from Kandy, .ii.1902, E.E. Green coll.) (Magnification of A-C same as of D)

with Rs on a long stalk, nearly upto the costal margin, both the veins ending at costal margin; M₁ slightly stalked with Rs before latter's anastomoses with Sc and ends at termen below the narrowed and produced apex; M₂, M₃ close at lower angle; Cu_{1a}, Cu_{1b} from before angle.

Material examined: S. ANDAMANS: 1 ♀, -.viii. 1927, *Ferrar* coll.; ASSAM : Sibsagar, 1 ♀, 26.x. 1921, at light, *C.C.G.* coll.; BIHAR: Patonganj, 2 ♀, 15.viii. 1905, *C.S.M.* coll.; Palamau, 3 ♂, 1 ♀, -.ix. 1906, 1 ♂, -.x. 1906, all *A.M.* coll.; Daltonganj, 1 ex., 1 ♀, 28.viii. 1925, *Haq* coll.; Katihar, 1 ♀, 16.x. 1911, at light, *C.C.G.* coll.; Pusa, 1 ex., 1 ♂, 27, 30.vii. 1906, *A.M.* coll.; 1 ♀, 31.vii. 1908, *R.D.D.* coll.; 1 ♂, 8.viii. 1914, 1 ♂, 27.x. 1914, on weeds, *R.S.* coll.; 1 ♂, 9.xii. 1914, 1 ♂, 9. iii. 1915, lex., 21.iv. 1915, 1 ♀, 5.v. 1915, 2 exs., 4.ix. 1915, 1 ♀, 20.ix. 1915, 1 ♂, 27.xi. 1915, all *Boy* coll.; 1 ♀, 12.vii. 1911, 2 ♂, 15, 16.iii. 1915, *T.B.F.* coll.; 1 ♀, 1.vii. 1915, *D. Nandan* coll.; 3 ♀, 1.ix. 1915, 2 ♂, 7, 24.ix. 1915, *U. Bahadur* coll.; 1 ♀, 4.viii. 1916, on grass, *H. Singh* coll., 2 ♀, 16, 30.vii. 1924, 1 ♂, 2.viii. 1924, *Mukherjee* coll.; 2 ♀, 21, 28.vii. 1926, lex., 6.ix. 1926, 1 ♂, 1 ♀, 7.ix. 1926, 2 ♀, 1 ex., 14, 15, 16.ix. 1926, all *Pillai* coll.; 1 ex., 30.x. 1923, *Peries* coll.; 1 ♀, 30.iii. 1927, 1 ♀, 22.viii. 1928, 1 ♂, 28.iv. 1930, all *E. Hassan* coll.; 1 ♂, 30.i. 1932, *S.C. Mukherjee* coll.; MADHYA PRADESH: Katni, 2 ♀ -.ii. 1907, 1 ♂, -.iii. 1907, *A.M.* coll.; MEGHALAYA: Shillong, 5000, 3 ♂, 8, 26, 27.vi. 1928, 2 ♀, 28.vi. 1928, *A.G.R.* coll.; Cherrapunji, 1 ♂, 1 ♀, no other data. ORISSA: Cuttack, 1 ♂, -.viii. 1906, 1 ♀, -.x. 1906, 1 ♂, -.iii. 1907, *A.M.* coll.; 1 ♀, 6.iii. 1945, at light, *Bose* coll.; Bhadrak, 1 ♂, 23.x. 1906, 1 ♀, -.x. 1906, *A.M.* Coll.; TAMIL NADU: Coimbatore, 1 ♀, 12.iii. 1913, 1 ex., 20.ix. 1913, *A.G.R.* coll.; at light; Palnis, Kodaikanal, 7000, 1 ♀, -.viii. 1921, 2 ♂, 19, 27.viii. 1929, 1 ♂, 13.x. 1929, all *Fletcher* coll.; WEST BENGAL: Kalimpong, 2 exs., 2 ♀, no other data, *O. Lindgren* coll.; Darjiling, 1 ex., no other data, *Mackenzie* coll.; Purulia, 1 ♂, -.ix. 1907, *A.M.* coll.; Calcutta, 2 ♂, 12.xi. 1924, *S. Mukherjee* coll.

BANGLADESH: Dacca, lex. 15.i. 1906, *C.S.M.* coll.; Bagherhat, 3 ♂, -.iv. 1908, *A.M.* coll.

MYANMAR: Moulmein, 2 ♀, 19.vi. 1911, 1 ♀, -.vii. 1911, *W.H.C. Pope* coll.; Minbu, 1 ♂, 6-8.viii. 1914, *Fletcher* coll., 1 ex. 15.xi. 1917, no coll.

PAKISTAN: PESHAWAR Dt.; Taru, 1 ♀, 16-19.v. 1915, *Fletcher* coll.; PUNJAB: Lyalpur, 1 ♀, 10, vii. 1906, *C.S.M.* coll.

(All in I.A.R.I., New Delhi)

INDIA: SIKKIM: 1 ♀, 15.vii. 1890, 1 ♀, 9.vii. 1891, 1 ♀, -.vi. 1896, all *G.C. Dudgeon* coll.

BHUTAN: 1 ♀, -.xi. 1894, *G.C. Dudgeon* coll.

SRI LANKA: 1 ♀, -.xii. 1894, no data; Diyatalawa, 1 ♀, -.x. 1901; Peradeniya, 1 ♀, -.v. 1902, 1 ♂, -.vii. 1902, 1 ♀, -.x. 1905; Eppawala, 1 ♀, -.ix. 1905; Wellawaya, 1 ♀, -.xi. 1905; Heputala, 1 ♀, -.xii. 1903; Trincomalee, 1 ♂, 1 ♀, -.xi. 1906, all *E.E. Green* coll.

(All in Z.S.I., Calcutta)

Wing expanse: ♂, 10-19 mm; ♀, 14-22 mm

Distribution: INDIA: Andamans; Assam; Bihar; Madhya Pradesh; Meghalaya; Orissa; Sikkim; Tamil Nadu; and West Bengal; *Elsewhere:* Africa; Australia; Bangladesh; Bhutan; China; Formosa; Hawaii, Indonesia; Japan; Myanmar; Pakistan; Sri Lanka; and Tonkin.

Host: Paddy.

Status: Major.

Remarks: Popularly known as the RICE CASE WORM, because of the case made by the larvae in which these live, the species is reportedly distributed throughout India and the tropical and subtropical zones to Australia.

The species differs from the other "Case Worm" externally in venation, i.e. the vein R_2 is free in forewing, unlike R_2 being stalked with R_{3+4} . For further differences and other remarks see *stagnalis* below.

***Parapoynx stagnalis* (Zeller)**

(PADDY CASE WORM)

(Plate III, figs. 3-4; Text figs. 12C-D)

1852. *Nymphula stagnalis* Zeller, *Lepid. Microptera* : 26.

Diagnosis: Head with the labial palpi upturned, reaching vertex of the head; antennae in male thickened, annulated and about two-thirds the length of forewing costa; slender in female; outer tibial spurs about half the length of inner spurs.

Head, thorax, wings and abdomen pure white. Forewings with the costa darker; a dark speck on a fulvous spot below middle of cell in inner area; a fulvous spot below the origin of Cu_{1b} ; two black discocellular specks; an oblique fulvous band beyond the cell from costa to vein M_2 ; a submarginal fulvous band, narrowing below vein M_2 , or often reduced to specks and obsolescent. Hindwing with dark discocellular specks; medial and post-medial fulvous bands sinuous and usually broken into spots. Both wings with a fine crenulate fulvous or dark brown line just inside the margin and more or less developed series of marginal specks. Underside thorax and abdomen darker; forewings irregularly irrorated with fuscous from base to just before margin; hindwing as on upperside, but without conspicuous band; both wing with discocellular spot and an irregular dark band just before margin.

Venation: As in *P. fluctuosalis* except that the vein R_2 in forewing is stalked with R_{3+4} , all these veins are ending at costa before apex and R_1 close to angle of cell.

Material examined: INDIA: WEST BENGAL: Purulia, 1 ex., (without abdomen) ix. 1907, A.M. Coll. (In F.R.I., Dehradun)

INDIA : ANDAMANS : 1 ex., -vii. 1927, *Ferrar* coll.; ASSAM : Gauhati, 1 ♂, -iv. 1908, at light, *A.M.* coll.; Naokhali, 1 ♀, 29.x. 1911, *C.C.G.* coll at light; Lumding, 1 ♀, 24.x. 1911, *C.C.G.* coll., at light; Dibrugarh, 1 ex. 1 ♀, 16.x. 1928, *Bose* coll.; at light. BIHAR : Pusa, 1 ♀, -x. 1907, *A. Mujtaba* coll.; 1 ♂, 12.ix. 1910, 1 ♀, 8.viii. 1912, 1 ex., 29.x. 1927, all *Fletcher* coll; 1 ex, 1 ♀, 23.ix. 1914, 1 ex, 1 ♀, 25.ix. 1914, 1 ♂, 2.x. 1914, all without coll.; 1 ♀, 3. xi. 1914, *Boy* coll.; KARNATAKA : S. Canara, Mangalore, 1 ♂, 1 ex., 18, 22.iv.1915, *C.R. Dutt* coll.; KERALA : MALABAR: Hurumbranad, 1 ex, 23.xi. 1908, *Y.R.* coll on paddy. MAHARASHTRA : Bombay, Bassein Fort, 1 ♂, -x. 1909, *A.M.* coll.; MEGHALAYA : Cherrapunji, 1 ex., 1 ♀, -x. 1916, *Native* coll.; TAMIL NADU : Coimbatore, 1 ex., 16.xi. 1908, on paddy, *T.V.R.* coll.; 1 ♂, 1 ♀, 15.i. 1913, *A.G.R* coll.; WEST BENGAL : Chakradharpur, 2 exs., 1 ♀, -ix. 1907, *A.M.* coll.; Purulia, 10 ♂, 2 ♀, -ix. 1907, *A.M.* coll.; Calcutta, 2 ♂, 1-7.xi. 1921, *Fletcher* coll.

MYANMAR: Moulmein, 1 ♀, -vi. 1911, 1 ♀, -vii. 1911, 1 ex. -viii. 1911, all *W.H.C. Pope* coll.; Rangoon, 2 ♀, 18-30. ix. 1914, *Fletcher* coll.; Lashio, 3000, 1 ♀, 22-24.viii. 1914, *Fletcher* coll.; 1 ex, 15.xi.1913, no other data.

PAKISTAN Abbottabad, 1 ♀, -.viii. 1917, *Mujtaba* coll.

(All in I.A.R.I., New Delhi)

INDIA : WEST BENGAL : Chinsura, 3 ♂, 3 ♀, 11.xi. 1996, paddy field Light Trap., *G.S. Arora* coll.

BHUTAN : 1 ♀, -.xi. 1894, *G.C. Dudgeon* coll.

SRI LANKA : Kandy, 1 ♀, -.ii. 1902; Peradeniya, 1 ♀, -.v. 1902, 2 ♂, 1 ♀, -.x. 1905, 1 ♀, -.x. 1910, 2 exs. without data, all *E.E. Green* coll.

(All in ZSI, Calcutta)

Wing expanse: ♂ 12-15 mm; ♀ 14-17 mm

Distribution: INDIA: Andamans; Andhra Pradesh; Assam; Bihar; Karnataka; Kerala; Madhya Pradesh; Maharashtra; Meghalaya; Orissa; Punjab; Tamil Nadu; U.P.; and West Bengal. *Elsewhere.* Australia; Bhutan; Java; Myanmar; Pakistan; and Sri Lanka.

Host: Paddy.

Status: Major, at times a serious pest.

Remarks: The species, like the preceding one is popularly known as “Paddy Case Worm”, and is distributed throughout India, particularly in paddy growing areas, and is also semi-aquatic. On hatching, the caterpillars cut the leaf-sheath into short longitudinal pieces and join these into a tubular case inside of which the larvae pass their larval period. These continue to feed on the undersurface on the leaf-tissue by scrapping it in patches. As a result, the upper surface remain intact and appears white. The larvae carry their case as they move from one place of the surface to another and form another “white patch” on the leaf. In fact

TABLE 4. Distribution of Schoenobiinae and Nymphulinae in States of India and some adjacent countries.

Names of States Names of Species	Andaman & Nicobar Is.	Andhra Pradesh	Arunachal Pradesh	Assam	Bihar	Delhi	Gujarat	Haryana	Himachal Pradesh	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Meghalaya	Orissa	Punjab	Rajasthan	Sikkim	Tamil Nadu	Uttar Pradesh	West Bengal	Bhutan	Myanmar	Sri Lanka	Papua New Guinea	Pakistan	Nepal	Bangladesh
SCHOENOBIINAE																												
Scirpophaga whalleyi Lewvanich																			+		+			±				
Scirpophaga xanthogastrella (Walker)				±	±						+					±		±		±		±		±			+	
Scirpophaga excerptalis (Walker)			±	±	±	±		±	±	±		±	±		+	+		±	±	±	±	±		±	±	+	+	+
Scirpophaga magnella de Joannis				+	+				+							+				+			+			+	+	+
Scirpophaga incertulas (Walker)		±		±	±	+		±		+	±		±		±	±		±	±	±	±	±	±	+	±		±	+
Scirpophaga innotata (Walker)					+		+			+					±	±	+		+	+						+		
Scirpophaga nivella (Fab.)		±	±	±	±			±		±	+	+		±	±	±				±	±		+	±				+
Scirpophaga gilviberbis Zeller				±	±				±	±				±	±				±	±	±		±	±				
Scirpophaga fusciflua Hampson				+				±	±						±				±	±	+			±			+	
Scirpophaga virginia Schultze																								±		±		+
NYMPHULINAE																												
Parapoynx fluctuosalis (Zeller) Rice Case Worm	±			±	±							±		±	±			±	±		±	±	±	±		±		±
Parapoynx stagnalis (Zeller) Rice Case Worm	±	+		±	±					±	±	+	±	±	+	+			±	+	±	±	±	±		±		

± = Based on material examined

+ = Based on literature.

TABLE 5: Occurrence of Schoenobiinae and Nymphulinae in Nature.

[illegible]

the infestation by the species can be detected very easily by the hanging tubular cases on the undersurface of the leaf and by the white patches." When the infestation is heavy, the growth of plant gets stunted and ultimately the plant gets killed. The infestation and the resultant damage is usually severe in the early stages of transplanted crop.

The pest is reported to be serious in swampy areas of U.P., Assam, Bihar, Bengal, Karnataka, Orissa and Tamil Nadu.

This species differs from the other species by the vein R_2 being stalked in forewing unlike free in *fluctuosalis*, and by the abdomen being white unlike in *fluctuosalis* where the abdomen is with broad black-edged bands. Besides in *fluctuosalis*, both the wings are with well-marked black bands tinged with fulvous in sub-basal area and beyond cell from apex to inner margin, unlike in *stagnalis* where these bands are irregular or reduced to spots.

D. Subfamily PHYCITINAE

The subfamily Phycitinae, comprising small and delicate to moderately sized moths, is distributed all over the world. It includes some very economically important and serious pests as borers, webbers, leaf-rollers, and defoliators, or in stores infesting grains, cereals, dried fruits or other stored products. While *Cadra cautella* (Walker) and *Plodia interpunctella* Hübner, infest store-grains/products, the remaining species are pests of vegetables, fruits, sugarcane, paddy, sorghum and millets, cotton and tobacco, and even oilseeds. and cause extensive damage to plants.

The subfamily Phycitinae deals here with fifteen pest-species in thirteen genera under four tribes viz., Anerastiini (1 genus, 1 species); Peoriini (2 genera, 2 species); Cryptoblabini (1 genus, 1 species); and Phycitini (9 genera, 11 species). While the bulk of species of economic importance belongs to the tribe Phycitini, the species belonging to other tribes are no less important and deserve an equal attention for their study.

Although Hampson (1896), and later Whalley (1970), treated Anerastiinae as a subfamily independent of Phycitinae, due mainly to the proboscis being absent, Shaffer (1968) was of the opinion that the definition of Anerastiinae has not generally been regarded as very satisfactory. He further points out (*loc. cit.*) that, though most of the species have a distinctive habitus, this and the reduced proboscis, in absence of other substantial correlated characters, are not sufficient enough to define the group. Both the subfamilies (*sensu* Hampson, 1896) show a close similarity in wing-venation, particularly of the loss of vein R_5 in forewing, identical palpi, single frenulum spine in both the sexes and the presence of pecten on median nervure, on upperside, on hindwings.

Following Hulst (1890), who had first proposed the subfamily Peoriinae, Shaffer (1968) treated eight genera, including the genus *Anerastia* Hübner, under Phycitinae, and the remaining seven genera including *Emmalocera* Ragonot and *Saluria* Ragonot, under Peoriinae. He (*loc. cit.*) also states that Peoriinae are similar to Phycitinae, mainly differentiated by the genitalic characteristic features, opines that "A better understanding of

the problem will require examination of the genitalic structure of all the species....” Obviously, because of the lack of substantial external differences, these genera have, recently, been treated under four tribes, viz., Anerastiini, Cryptoblabini, Peoriini and Phycitini under the subfamily Phycitinae (*vide* Heppner & Inoue, 1992).

The present studies, due to some limitations, mainly utilized external characteristic features for providing an easy identification. Nevertheless, it is advisable to study the genitalic structures of a particular pest, if desired, for further study and confirmation.

The main diagnostic features of the subfamily Phycitinae and the key to identification of various genera involved in the present studies, have been dealt with as under.

Diagnosis: Head with the labial palpi small to moderate or well developed; maxillary palpi moderate, or very small, often reduced to brush-like and concealed in hollowed labial palpi; proboscis well developed, rudimentary or absent; ocelli usually well developed; antennae in male thickened, with basal segments variously fused, with or without sinus, or with a tuft of scales at base or shortly pectinate; antennae in female usually simple or very shortly serrate. Forewings with vein 3A separate from 1A + 2A; R_5 always absent; hindwings with the median nervure always pectinated on upperside. Frenulum spine single in both sexes. Praecinctorium simple; tympanic bullae separate or approximated.

Key to identification of *Phycitinae* genera

1. Proboscis weakly developed or absent. 2
 Proboscis well developed 4
2. Frons with long and flattened corneous plate, with toothed protuberance; maxillary palpi rudimentary. Only three veins arising from lower angle in both the wings
 *Raphimetopus* Hampson
 ((i) Tribe ANERASTIINI)
- Frons without corneous plate or toothed protuberance; maxillary palpi well developed but lie in hollowed out 2nd segment of labial palpi 3
 ((ii) Tribe PEORIINI)
3. Hindwings with four veins arising at lower angle of cell *Emmalocera* Ragonot
- Hindwings with three veins arising at lower angle of cell *Saluria* Ragonot
4. Hindwings with four veins arising from lower angle of cell 5
- Hindwings with three veins arising from lower angle of cell 11
5. Veins M_2 - M_3 in both wings closely approximated at base, from lower angle of cell; labial palpi upturned and reaching vertex of head; antennae with a slight tooth at base
 *Cryptoblabes* Zeller
 ((iii) Tribe CRYPTOBLABINI)

- Veins M_2 - M_3 not as above. Labial palpi upturned or porrect; antennae thickened in male, with or without tufts of scales, or sinus 6

((iv) Tribe **PHYCITINAE**)

6. Labial palpi very long and porrect. Veins M_2 - M_3 separate at lower angle of cell in forewing *Etiella* Zeller
- Labial palpi small to moderate, upturned. Veins M_2 - M_3 closely approximated, connate or slightly stalked, at lower angle of cell in forewings, and stalked in hindwings ... 7
7. Vein Cu_{1a} in both wings closely approximated to lower angle of cell at base 8
- Vein Cu_{1a} close to lower angle, connate or stalked with M_2 - M_3 in forewings, separate in hindwings. 9
8. Antennae in male with a large tuft of scales at extremity of basal joints; labial palpi with the 2nd joint dilated and hollowed to receive brush-like maxillary palpi. Hindwing with corneous ridges on upper and underside and inner margin enclosing deep furrows. Hind tibiae with long hairs *Thylacoptila* Meyrick
- Antennae without tufts at base; labial palpi normal and not hollowed; Hindwings without corneous ridges or plate. Hind tibiae normal and with a few tufts
..... *Nephopterix* Hübner.
9. Antennae pectinated nearly upto basal 2/3rd in male, simple and minutely serrate in female. Veins M_2 - M_3 stalked in both wings *Myelois* Hübner.
- Antennae without pectination in male but thickened, with or without sinus; M_2 - M_3 closely approximated in forewings and stalked in hindwings, at lower angle of cell
..... 10
10. Frontal tufts prominent and conical; antennae with sinus at base in male
..... *Elasmopalpus* Blanchard
- Frons with or without conical tufts; antennae with or without sinus at base
..... *Phycita* Curtis
11. Forewings with four veins arising from lower angle of cell; Vein R_3 present at upper angle and stalked with R_4 *Euzophera* Zeller
- Forewings with three veins arising from lower angle of cell; vein R_3 absent, i.e. all the veins free 12
12. Labial palpi distinctly upturned, thickly scaled. Underside forewings with a fold and scales at base and middle of costa well developed in male; veins at lower angle separate in forewings, connate in hind wings *Cadra* Walker

- Labial palpi obliquely upturned. Underside forewings with a small fold containing dark scales only in male; veins at lower angle connate in forewings and stalked in hindwings
 *Plodia* Guenee.

(i) Tribe ANERASTIINI

Genus *Raphimetopus* Hampson

1918. *Raphimetopus* Hampson, *Proc. zool. Soc. Lond.*, 1918 : 57 (key), 78.

Type species : *Anerastia spinifrontella* Ragonot

Diagnosis : Head with the frons with long and flattened corneous plate, somewhat trifid in front and produced to short lateral processes, a corneous plate below the frons; labial palpi porrect extending about thrice the length of head and thickly scaled; maxillary palpi minute and filiform; proboscis reduced; antennae thickened, ciliated and laminate in male, simple and filiform in female. Forewings narrow; the apex rounded, the termen obliquely curved.

Venation : *Forewing*. Veins R_1 and R_2 free, from cell; R_{3+4} stalked; M_1 from close to upper angle; M_2 absent; M_3 from above the lower angle; $1A + 2A$ well developed, $3A$ short and free. *Hindwings* : Vein R_s closely approximated to, or anastomosed with Sc ; R_s-M_1 stalked; M_3-Cu_{1a} stalked; M_2 absent.

Distribution : India. *Elsewhere*. Bangladesh; Myanmar; Pakistan and Sri Lanka.

Remarks: Only one species, *Raphimetopus ablutella* (Zeller) is included here which is of minor economic importance.

Raphimetopus ablutella (Zeller)

(THE GREEN BORER)

(Plate III, fig. 5; Text figs. 13A-B)

1839. *Anerastia ablutella* Zeller, *Isis* : 17.

Diagnosis. Head thorax and forewing ochreous. Forewings with a small discocellular spot at the lower angle of cell. Hindwing whitish.

Venation: *Forewing*: Veins R_1 , R_2 free; R_{3+4} stalked; M_1 from slightly below the upper angle; M_3 connate with Cu_{1a} and arising from lower angle; Cu_{1b} slightly before angle. *Hindwing*: Vein Sc anastomosed with R_s beyond the cell angle; M_1 from angle or stalked with R_s ; M_3 stalked with Cu_{1a} ; Cu_{1b} from angle.

Material examined: INDIA: BIHAR: Pusa, 1 ♂, 7.iii 1924, at light, *Peries* coll.; 2 exs, no other data.

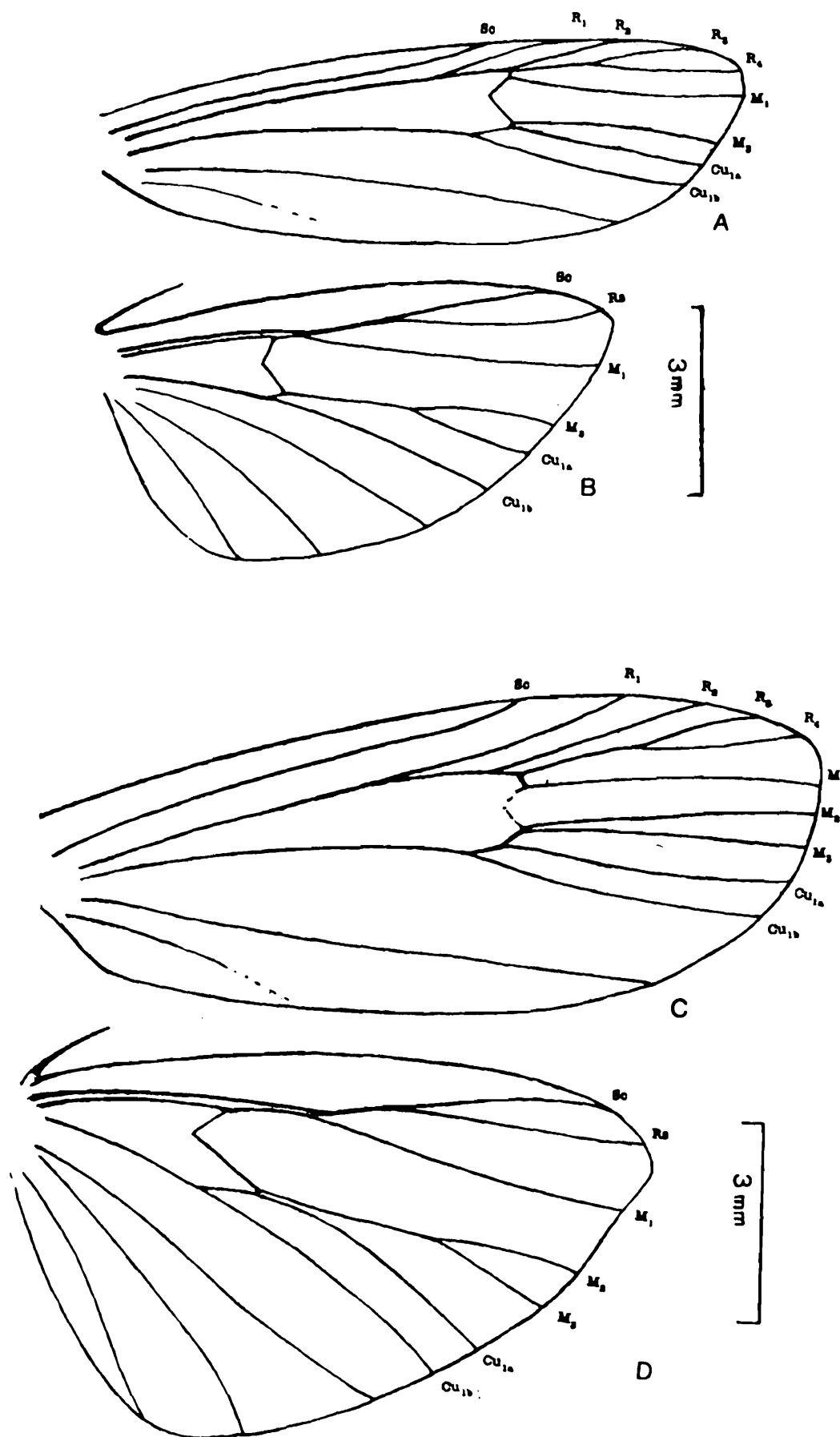


Fig. 13. *Raphimetopus ablutella* (Zeller) : (A) Fore - and (B) hindwing venation; *Emmalocera depressella* (Swinhoe) : (C) Fore - and (D) hindwing venation (Magnification of A and C same as of B and D, respectively).

MYANMAR: Mandalaya, 2 ♀, 13, 19.v. 1922, *Rani* coll.

(In I.A.R.I., New Delhi)

SRI LANKA: Eppawala, 2 exs., -ix. 1905; Puttalam, 1 ♀, -iii. 1910, *E.E. Green* coll.

(In Z.S.I. Calcutta)

Wing expanse : ♂ ♀ ; 14-23 mm.

Distribution: INDIA: Bihar; H.P.; Punjab; and U.P. *Elsewhere*: Myanmar, Pakistan and Sri Lanka.

Hosts: Maize, Sugarcane. *Alternative hosts*: *Erianthus munja* and *Saccharum spontaneum*.

Status: Minor.

Remarks: Commonly known as the “Green Borer”; (*Vide* Gupta 1957), because of the predominant green colour of the larvae and in the early pupae, the species is of minor economic importance. It attacks shoots when young and the infestation causes drying-up of the leaves and the “dead hearts”

The “dead hearts” caused by this species can be pulled out easily and emit offensive smell unlike those caused by the “Root Borer”

Avasthy and Tiwari (1986b) report that the species has three generation in a year, being active only from February to June each year, when the mature larvae enter into a diapause in the stubbles of dead shoot. The larvae revive only in February when these pupate. The pupation takes place in earthen cells which are very tough and do not dissolve in the earthen or ground moisture due to the water present in subsoil.

(ii) Tribe PEORIINI

Genus *Emmalocera* Ragonot

1888. *Emmalocera* Ragonot, *Nouv. Genres Especies* : 38.

Type species : *Emmalocera crenatella* Ragonot

Diagnosis : Head with frontal tuft of scales; labial palpi porrect or upturned, the 2nd joint hollowed out to receive the brush-like maxillary palpi; antennae serrate in male, with a large tuft of scales in a sinus at base. Legs with a fringe of hair on outer side of middle and hind tibiae. Forewings long and narrow, the apex rounded, the termen evenly curved.

Venation: Forewing with four veins arising from the upper angle i.e. R, absent. Both wings with four veins arising from the lower angle of cell; M₁-M, free in forewing and stalked in hind wing.

Remarks : Only one species, *Emmalocera depressella* (Swinhoe) is being treated here, being root borer in sugarcane.

***Emmalocera depressella* (Swinhoe)**

(ROOT BORER)

(Plate III, figs. 6-7; Text figs. 13C-D)

1885. *Melissoblaptes depressellus* Swinhoe, *Proc. zool. Soc. Lond.*: 876, Pl. 57, fig. 5

Diagnosis : Head with the frons rounded and slightly protruded; the labial palpi porrect, hollowed out to receive maxillary palpi, ocelli well developed; antennae serrate, with a sinus at base in male, simple in female; about three-fourths the length of costa in male and about a little over half the costal length in female. Legs with mid. and hind tibiae fringed with scales on outside; frenulum spine single in both sexes.

Head pale-pink; forewings straw-brown, with a pale costal fasciae suffused with pink, narrowing and not reaching the base and apex, the area below the costal fascia suffused with brown and the veins' outer margin streaked with dark brown. Hindwing whitish, semi-hyaline. Abdomen ochreous.

Venation : *Forewings*: R_1 - R_2 free, from cell; R_{3+4} stalked upto halfway between the angle of cell and apex; R_5 absent; M_1 well below the upper angle; M_2 present, connate with M_3 ; Cu_{1a} from a little before lower angle. *Hindwings*: Sc closely anatomosed beyond the upper angle with vein Rs; Rs- M_1 from upper angle; M_2 - M_3 on long stalk; Cu_{1a} close to the common stalk of M_2 - M_3 ; Cu_{1b} from before the upper angle.

Material examined : BIHAR (ORIGINAL LABEL "BENGAL" in several examples): Pusa, 1 ♀, 2.ix.1914, (no. coll.) on sugarcane; 1 ♂, 17.iii.1914, CBS; 1 ex., 19.iii.1914, Fletcher coll.; 1 ♀, 26.iii.1914, 2 ♀, 30,31.iii.1914, C.B.S. coll.; 1 ♂, 9.iv.1914 Fletcher coll.; 1 ♀, 11.vii.1914, 1 ♀, 14.ix.1914, R.S. coll.; 1 ♂, 1 ♀, 3.viii.1914, on sugarcane, no coll.; 1 ♀, 4.viii.1914, 1 ♀, 14.ix.1914; 1 ♂, 1 ♀, 8,14.vi.1915, D.P.S. coll.; 1 ♀, 30.iii.1916, no coll.; 1 ♀, 13.iv.1916, R.S. Coll.; 1 ♂, - v.1916, 3 ♂, 21.v.1916, 1 ♂, -23.v.1916, 1 ♀, 25.v.1916, 2 ♂ ♂, 1 ♀, 27.v.1916, 1 ex., 4 vi.1916, 1 ♂, 10.vi.1916, 1 ♀, 12.vi.1916, 2 ♀, 3,4, vii.1916, 1 ♀, 27.vii.1916, all on sugarcane, Haq coll.; 1 ♀, 30.iii.1916, no coll.; 1 ♂, 6.v.1917., 1 ♂, 26.v.1917, 1 ♂, 30.iii.1918, 1 ♂, 6.v.1918; 1 ♂, 30.viii.1926, 1 ♂, 2.ix.1926, Haq coll.; 1 ♂, 6.vi.1922, 3 ♀, 18,22.v.1918, 2 ♂ ♂, 1 ex. 9,10,15.viii.1927, all Rangi coll.; 1 ♀, 21.v.1926, Dwarka Prasad coll.; 1 ♂, 1 ♀, 15.vi.1932, 1 ♂, -vi.1932 all on sugarcane, no coll.; 2 ♀, 18.iii.1933, on sugarcane roots, R. M. Batra coll.; 2 ♀, 15.vi.1933, 1 ♂, 8.ix.1933, 1 ♂, 25.x.1933, 2 ♀, 21,23.vi.1934, all on sugarcane, H. Sareen coll.; 2 ♂, 6,10.vii.1935, on sugarcane, H. Ayyar coll.; 1 ♂, 27.iii.1935, S. Khan coll.; BENGAL : Jehanabad, 1 ♂, 2.vi.1907, no coll.; HARYANA ; Karnal, boring sugarcane, 2 ♀,

21.25.vi.1927, 1 ♀, 30.vi.1927. UTTAR PRADESH : Kheri, 2 ♀, 13.vi.1916, on sugarcane.; Gorakhpur, boring stem, 1 ♀, 6.vi.1917, 1 ♀, 23.vi.1917.

(In IARI, New Delhi)

INDIA: U.P.: Lucknow, 1 ♂, 20.viii.1956, 2 ♀, 3.x.1967, all *T.N.S.* coll., on sugarcane
(In I.I.S.R., Lucknow)

INDIA: PUNJAB: Ludhiana, 1 ♀, without data and coll.

(In Pb. Ag. Univ Ludhiana)

INDIA : HARYANA : Dist. Karnal : Uchani, 1 ♂, 3 ♀, all on sugarcane, iv.1996, no coll.
(In R.R. Stn. Uchani)

INDIA : BIHAR : Pusa, 19, 16.vi.1934, *D.P. Singh* coll.

(In T.N. Ag. Univ, Coimbatore)

Wing expanse : ♂ 22-31 mm; ♀ 25-34 mm.

Distribution : INDIA : Andhra Pradesh; Bihar; Delhi; Gujarat; Haryana; Karnataka; Madhya Pradesh; Maharashtra; Orissa; Punjab; Tamil Nadu; and Uttar Pradesh. *Elsewhere* : Bangladesh; Malaysia; and Pakistan.

Nature of damage and status : The species is of moderate status, economically, particularly in terms of losses in cane-weight and sucrose amount. The root borer generally infests the young shoots, though its infestation in grown-up cane is not unknown. When the infestation occurs in young stages of growth, "deadhearts" are formed, but in grown-up canes no external symptoms are visible except yellowing of leaves, and to detect its attack, the plants have often to be pulled out. Characteristically, the "deadhearts" caused by this species can not be pulled out easily and often the whole plant gets pulled out in the process, compared to "deadhearts" caused by others borers. Further, the entry hole in this species is only one, nearer to the base of shoot (Agarwal, 1975 and Avasthy & Tiwari, 1986b).

Hosts : Sorghum; Bulrush; Millet; Maize; and Sugarcane. Besides, Avasthy & Tiwari (1986b) have recorded alternative hosts, viz., Rarhi (*Erianthus munja* Roxb.); Sarkanda (*Saccharum spontaneum* L.), Ikri (*Sclerostachya fusca* Roxb.), Baru (*Sorghum halepense* Pers.) and Napier grass (*Pennisetum purpureum* Schum.).

Remarks : The species can be easily distinguished from other economically important species, viz., *Saluria inficita* (Walker), dealt with here in Peoriini, by the presence of four veins arising from the lower angle in both wings (vs. three in hindwings in *Saluria inficita*). Besides, this species is a root borer unlike others which are stem/shoot borers. Cheema mentioned (1948) about the symptoms of attack, i.e. the tunnels made by this pest are of irregular nature and are filled with powdery frass unlike those caused by stem borer *Argyria sticticrasis* now *Chilotraea infuscatellus* (Snellen) where the tunnels are straight throughout the stem and hollow, and later Cheema worked out its biology (1950).

The root borer is distributed all over the cane growing tracts of India but is more serious in light-sand regions. Sengupta & Behura (1957) are of the view that the soil in which the

borers were found in Banki (Cuttack: Orissa) was of the poor type of sandy soil. Besides cane, it also feeds and breeds on wild *Saccharum*.

The caterpillars, on hatching, crawl upto the base of stem and make a single entry-hole at or just below the ground level and bore downwards in an irregular manner (Pruthi, 1969, Avasthy & Tiwari, 1986b). Before pupation the caterpillars cut an opening on the shoot and construct a silken tube upto the surface of soil and often pupate in this tube for emergence of moth.

Genus *Saluria* Ragonot

1887. *Saluria* Ragonot, *Annls. Soc. ent. Fr.*, (6) 7 : 258

Type species : *Saluria maculivittella* Ragonot

Diagnosis : Head with frontal tuft of scales; labial palpi obliquely upturned, with the 2nd joint followed out to receive brush like maxillary palpi, and projecting beyond head; antennae serrate, with a sinus at base in male, containing ridge of scale. Legs with fringe of hair on mid and hind tibiae.

Venation: Fore wing with four veins from the upper angle, i.e. R_5 absent; lower angle also with four veins, vein M_2 stalked with M_3 . Hindwing with only three veins from the lower angle of cell, Cu_{1a} stalked with M_3 , M_2 absent.

Remarks : Only one species *Saluria inficita* (Walker) is being included here as under.

Saluria inficita (Walker)

(RAGI WHITE BORER)

(Plate III, figs. 8-9; Text figs. 14A-B)

1863. *Acrobasis inficita* Walker, *List Lep. Ins. Brit. Mus.*, 27 : 30

Diagnosis : Head with the palpi obliquely upturned, over twice as long as head, hollowed out to receive the maxillary palpi; frons subrounded, with a tuft of scale; antennae with a sinus at base, nearly upto basal four segments in male, simple in female; ocelli well developed. Middle and hind tibiae with a fringe of scale on outside. Wing with frenulum spine single in both sexes.

Head and thorax black brown; abdomen ochreous; forewings brown, with a narrow costal fascia, narrowing to apex and the base. Hindwings paler or ochreous, with a slight fuscous tinge.

Venation : Forewing : Veins R_1 and R_2 free, rarely R_2 stalked with R_{3-4} , the latter on a long stalk; M_1 from slightly below the upper angle; M_2 - M_3 on a long stalk; the common stalk arising from above the lower angle; Cu_{1a} from angle; Cu_{1b} from before the angle

Hindwing : Vein Sc anastomosed with Rs beyond the angle, the latter stalked with M_1 ; M_2 absent; M_3 stalked with Cu_{1a} , from the lower angle of cell; Cu_{1b} before the angle.

Material examined : BIHAR : Pusa; 1 ♀, 30.ix.1908, 2 ♀, 5.x.1908, all on grasses, I.N.J. coll. (labelled as "Pusa, Bengal"); 1 ♂, 2.iv.1910, 3 ♀, 15,16,20.vii.1910, 2 ♀, 14,27-vii.1910, 2 ♀, 24, 26.viii.1910 all T.B.F. coll. (labelled as "Pusa, Bengal"); 1 ♀, 17.ix.1923 Peries coll.; 1 ♀, 3.vii.1924, Mackenzie coll.; 4 ♀, 2,7.ix. 1926, 3 ♂ 6,7,9.ix.1926, Pillai coll.; 1 ♂, 30.vi.1927, E. Hassan coll (In I.A.R.I., New Delhi)

INDIA : KARNATAKA : Motipur, 1 ♀ -vii. 1970, larva boring *E. Coracana* (In P.D.B.C., Bangalore)

SRI LANKA : Madulsima, 1 ♂, -.x.1905; Wellawaya, 2 ♀, - viii. 1905, 1 ♀, - xi. 1905; Peradeniya, 1 ♀, - viii 1902, 1 ♀ -ix. 1910 all E. E. Green colln. (In Z.S.I. Calcutta)

Wing expanse : ♂ 13-22 mm.; ♀ 15-20 mm

Status : Moderate.

Distribution : INDIA : Bihar; Karnataka; M.P.; Orissa; and Tamil Nadu. Also Sri Lanka.

Hosts : Paddy; Finger and Italian Millet; Sorghum; Maize.

Remarks : Commonly known as "Ragi White Borer", the species is easily distinguished by the presence of a costal fascia and other characters as given above. Ayyar (1940) and Sengupta & Behura (1957) record this as a specific pest on ragi, *Eleusine coracana*, in southern India, especially in Coimbatore and Orissa, respectively.

The species at its caterpillar stage is confined to lower portion of the plant, closer to soil, and the larvae pupate in the stem itself.

(iii) Tribe CRYPTOBLABINI

Genus *Cryptoblabes* Zeller

1848 *Cryptoblabes* Zeller, *Isis Oken. Leipzig.* : 644

Type species : *Cryptoblabes bistriga* Haworth

Diagnosis : Head with the frons smoothly curved; labial palpi upturned, reaching above vertex of head; maxillary palpi filiform; antennae with the basal segment large, with a slight tooth of scales at the base of shaft. Tibial spurs unequal. Forewings with veins M_2 - M_3 at lower angle of cell, closely approximated, connate or slightly stalked; hindwings with four veins at lower angle of cell.

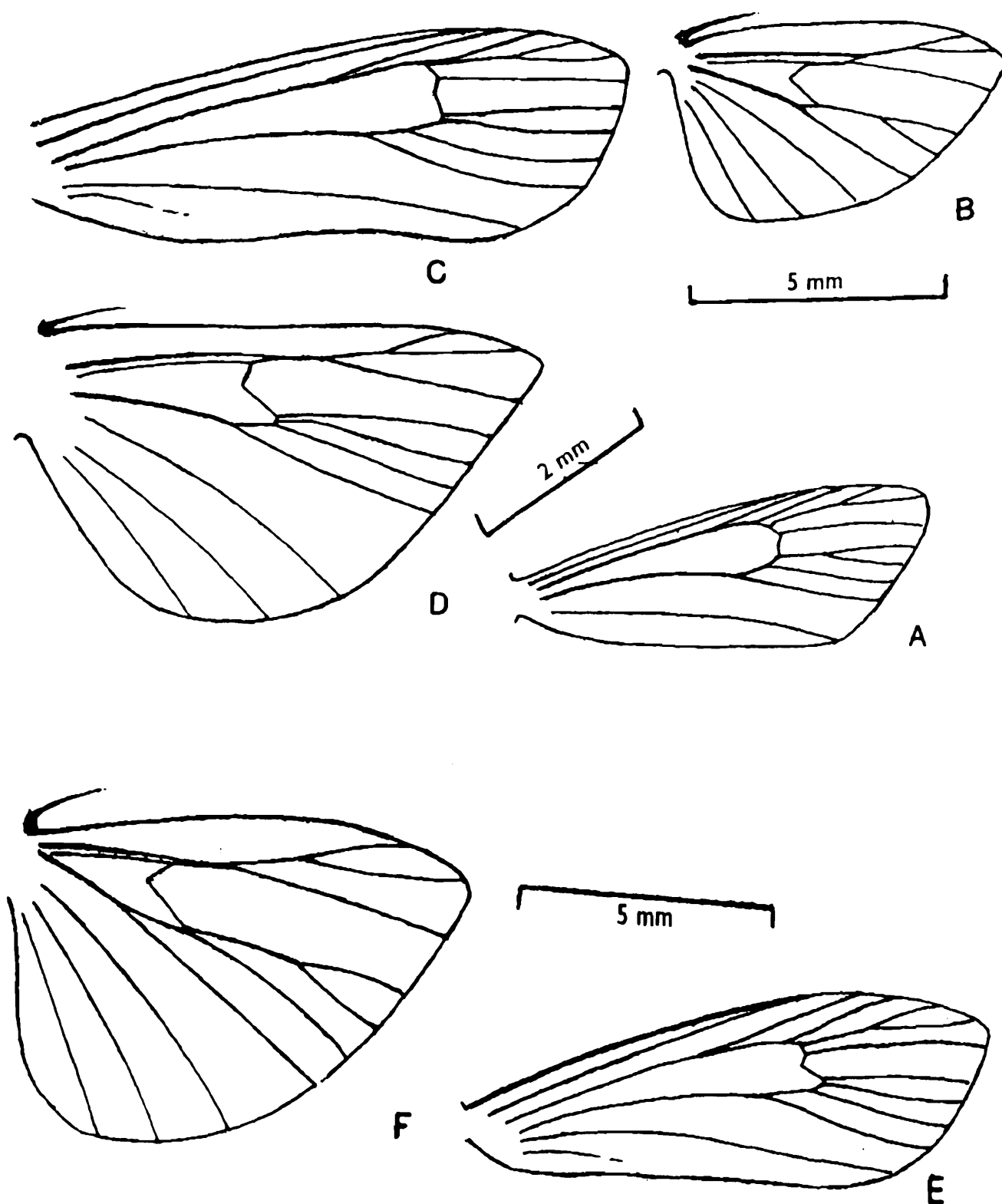


Fig. 14. *Saluria inficita* (Walker) ♀ : (A) Fore - and (B) hindwing venation; *Cryptoblabes angustipennella* Ragonot ♀ : (C) Fore - and (D) hindwing venation; *Etiella zinckenella* (Treitschke) ♂ : (E) Fore - and (F) hindwing venation (Magnification of A, C and F same as of B, D and E, respectively).

Distribution : India. *Elsewhere* : Sri Lanka.

Remarks: Only one species, viz., *Cryptoblabes angustipennella* Ragonot, a minor pest, is being dealt with here.

***Cryptoblabes angustipennella* Ragonot**

(THE WEB WORM)

(Plate III, fig. 10; Text figs. 14C-D)

1888. *Cryptoblabes angustipennella* Ragonot, *Nouv. Genres. Espèces* : 6.

Diagnosis: Labial palpi upturned, the 2nd joint reaching vertex of head, 3rd well developed and reaching above vertex of head; maxillary palpi filiform; antennae with the basal segment large, with a slight tooth of scales at base of shaft, about 2/3rd the length of forewing costa. Outer tibial spurs about half the length of inner spurs. Forewing narrow; cell nearly two-thirds the length of wing; hindwing cell about half its length.

Grey, thickly irrorated with fuscous. Forewing with a few crimson scales at base of the costal and inner margin; an oblique pale antemedial line with fuscous band on its outer edge; dark specks present at both, the upper and the lower angles of cell; an oblique pale minutely dentate submarginal line present, incurved at vein M_2 , with its inner edge defined by fuscous; a marginal series of dark specks present. Hindwing pale, semihyaline; the submarginal area tinged with fuscous. Underside forewing pale greyish-lemon, without any marking; hindwings semihyaline white. Abdomen paler.

Venation : *Forewing* : Vein R_1 free, arising from the distal one-fourth of the cell; R_2 free, from upper angle, closely approximated to the stalked R_{3+4} , the latter both the veins ending at costa before apex; M_1 from below the upper angle; M_2 - M_3 closely approximated at base, from lower angle of cell; Cu_{1a} , Cu_{1b} from before the lower angle, the latter vein more towards lower angle and not in line with R_1 above. *Hindwing*: vein Sc anastomosed with Rs and ending at costal margin; Rs- M_1 also strongly anastomosed from upper angle; M_2 - M_3 closely approximated at base, from lower angle; Cu_{1a} from angle and Cu_{1b} from before the angle.

Material examined: SRI LANKA : 1 ♂, 2 ♀, -.ix.- ; Pundaluoya, 1 ♀ -i. 1899, E.E. Green coll. (In Z.S.I., Calcutta)

Wing expanse: ♂ 19 mm.; ♀ 15-20 mm.

Distribution: INDIA: Himachal Pradesh and Karnataka. *Elsewhere* : Sri Lanka.

Hosts : *Eleusine coracana* (Finger Millet); *Pennisetum typhoideum* (Bulrush Millet); *Ricinus communis* (castor); *Sorghum vulgare* (Sorghum).

Status: Minor

Remarks: Popularly known as "The Web Worm", the caterpillars on hatching, infest the ears of sorghum or the panicles of castor, web together the adjacent grains and feed on them. The caterpillars live inside this thin web.

The earlier recorded wing expanse (*vide* Hampson 1896) was 20 mm., but the present lowest record, however, gives the expanse as 15 mm for the females.

(iv) Tribe PHYCITINI

Genus *Etiella* Zeller

1839 *Etiella* Zeller, *Isis Oken. Leipzig* : 179.

Type species: Phycis zinckenella Treitschke.

Diagnosis: Head with the frons smoothly rounded, conical tuft prominent, labial palpi long and porrect, the 2nd joint hollowed out to receive brush like maxillary palpi; antennae with sinus containing a tuft of scales, in male. Forewing long and narrow; four veins arising from the lower angle of cell in both wings. Tibial spurs unequal.

Distribution : Cosmopolitan.

Remarks: Only one species, viz. *Etiella zinckenella* (Treitschke), a serious pest of economic importance, is included here.

Etiella zinckenella (Treitschke)

(PEA-POD BORER)

(Plate III, fig. 11; Text figs. 14E-F)

1832. *Phycis zinckenella* Treitschke, In Ochsenheimer: *Schmett. Eur.*, 9 (1) : 201.

Diagnosis : Frontal tufts prominent and conical; labial palpi very long, about three and a half times the diameter of eye, the 2nd joint hollowed out to receive the brush-like maxillary palpi; antennae with moderate sinus containing a tuft of scales at base in male, simple in female, about three-fourths the length of forewing costa. Forewing long and narrow, over three times as long as wide, cell extending to about two-thirds the length of wing; hindwing with the inner margin enlarged, thus very wide at middle, the cell about one-third the length of wing. Outer tubial spurs about half the length of inner spurs.

Head with the labial palpi, thorax and abdomen pale rufous or purplish brown. Forewing with a whitish costal fascia, with a grey-brown streak on costa from before middle to near apex; the rest of the wing grey-brown, usually suffused with rufous, especially at base and below the costal fascia; an antemedial yellowish brown band with a ridge of raised

scales on its inner edge and a greyish patch before it; traces of a minutely dentate sub-marginal line and a marginal series of specks present. Hindwing semi-hyaline whitish; the veins, apical area, a marginal line and a line through the cilia brown. Underside pale, greyish-brown; forewing paler, veins brown, and without markings or the raised scales; hindwings paler, the costa and the apex greyish-brown.

Venation : Forewing : Vein R_1 free, arising from about distal one third of the cell; R_2 free, from close to upper angle; R_{3+4} stalked, both ending at costa before apex; M_1 from below the upper angle and ending just below the apex; M_2 , M_3 separate, Cu_{1a} close to lower angle; Cu_{1b} from before the lower angle and after the origin of vein R_1 above. *Hindwing:* Vein Sc anastomosed with Rs beyond the angle; Rs- M_1 stalked, from angle of cell; M_2 - M_3 on a long stalk, Cu_{1a} from angle, closely approximated at base to M_2 - M_3 ; Cu_{1b} from before angle.

Material examined : INDIA : BIHAR : Namkum, 1 ♂, 2 ♀, 21.ii. 1950, Jheri Pod borer, K.C.C. coll.; 3 ♂, 17.iii. 1950, pest on Boga Medalore, K.C.C. coll.; MADHYA PRADESH : Nagpur, 1 ♂, -. xi.1907, A.M. coll.; UTTAR PRADESH: Mohammadpur, 1 ♂, 25.xi. 1930, R.N. Mathur coll.; Dehra Dun, New Forest, 1 ♀, 17.iv. 1936, J.C. Gardner coll., 1 ♂, 4.v. 1946, Forest Entomologist coll., 1 ♀, 7.v. 1946, eating green leaves of Pea pod, Forest Entomologist coll. (In F.R.I., Dehra Dun)

INDIA: BIHAR: Barauni, 2 ♀, 13.iv. 1922, at light, Bose coll.; Pusa, 1 ♂, 24.iii. 1906, P. Sircar coll.; 2 ♂, 15, 16.iv. 1906, 2 ♂, 2 ♀, 17.iv. 1906, 1 ♀, 18.iv. 1906, all A.H. coll.; on Khesari pod; 1 ♀, 23.iv. 1906, on *Acacia arabica*, 1 ♀, 12. iv. 1907, on pea pods, A.H. coll.; 1 ♂, 15.ii. 1907, 1 ♂, 17.iii. 1907, on Sann, B.S. coll.; 1 ♀, 9.iii. 1908, on Kurbhi seeds within pods, no coll.; 1 ♂, 1 ♀, 14.iii. 1908, boring Sunnhemp pods, no coll.; 1 ♀, 9. iv. 1908, on Khesari pods, no coll.; 1 ♂, 25.ii. 1908, 1 ♂, 14.i. 1915, 1 ♂, 1 ♀, 27.i. 1915, 1 ♀, 1.ii. 1915, 2 ♂, 19.ii. 1915, 1 ♀, 3.iv. 1915, all on Sunnhemp, no coll.; 2 ♂, -.i.1909, 1 ♂, 17.iv.1914, all on pea pod, no coll.; 1 ♀, 10.iii. 1909, A.M. coll.; 1 ♀, 20.ii. 1915, 1 ♀, 29.iii. 1915, 1 ♂, 30.iii.1915, 1 ♂, 1.iv.1915, 1 ♂, 1 ♀, 2.iv. 1915, 3 ♂, 2 ♀, 3.iv. 1915, 3 ♂, 3 ♀, 5.iv. 1915, all on *Lathyrus sativa* pod, no coll.; 1 ♀, 19.xii. 1915, Fletcher coll.; 2 ♀, 9, 21.iii. 1915, 1 ♀, 1.iv. 1915, all Boy coll.; 1 ♀, 6.i. 1920; 1 ♂, 9.i. 1920, boring *Crotalaria mujussi*, Haq coll.; 3 ♂, 2 ♀, 6.ii. 1920, boring pod of *Crotalaria mujussi*, D.P.S. coll.; 1 ♀, 12.xi. 1923; 1 ♀, 4.ii. 1924, 1 ♂, 15.iii. 1924, Peries coll.; 1 ♀, without date, Peries coll., on *Crotalaria* sp.; 1 ♀, 7.xii. 1925, boring sunnhemp pod, 1 ♀, 17.iii. 1927, on seeds in pods of *Pisum sativum*, Rangi coll.; 1 ♂, 27.i. 1926, feeding on sunnhemp pod, R. Saran coll.; 1 ♂, 2 ♀, 6.iv. 1926, 1 ♀, 10. iv. 1926, all on seeds inside khesari pod, R. Saran coll., 1 ♀, 6.i. 1927, boring *Crotalaria juncea* pods, R. Saran coll.; 1 ♀, 29.ii. 1928, K. Singh coll.; 1 ♂, 18.iii. 1932, 1 ♀, 1.xi. 1932, at light, Bose coll.; Namkum, 4 ♂, -.iii. 1938, on green pea seeds, S.N. Gupta coll.; DELHI: 1 ♀, 8.i.1937, on wild Indigo, R.S. coll.; 2 ♂, 1 ♀, 11.iv. 1937, boring *Pisum sativum*, R. Saran coll.; 1 ♀, 14.i. 1937, 1 ♀, 13.iv. 1937, 1 ♂, 4.xi. 1938, 2 ♂, 10.xi.1938, all boring pods of Sunnhemp, R. Saran coll.; 1 ♂, 22.iv. 1937, 1 ♀, 8.v. 1937, on *Lathyrus sativa*, R.S. coll.; 1 ♂, 20.xii.1937, on *Crotalaria*

juncea, R.S. coll.; 2 ♂ 3 ♀, 1.iv. 1938, 1 ♀, 11.iv. 1938, feeding on *Pisum sativum* pod, H. Ullah coll.; HARYANA: Hansi, 1 ♂, 3.iv. 1941, A. Singh coll.; MADHYA PRADESH: Babughat, 1 ♀, -.iii. 1907, A.M. coll.; Chindwara, 1 ♂, -.ii. 1907, G.R.D. coll.; Katni, 1 ♂, 1 ♀, -.ii. 1907, A.M. coll.; Nagpur, 1 ♂, -.ii. 1907, G.R.D. coll.; 1 ♀, -.ii. 1907, A.M. coll.; Nainpur, 1 ♂, 25.ii. 1907, 1 ♂ -.iii. 1907, A.M. coll.; MAHARASHTRA: Bombay; Jalalpur, 1 ♀, 22.v. 1904, H.M.L. coll.; Virat, 1 ♂, 16.iii. 1904, on Lab Lab; Mirpur Khas, 1 ♂, 1 ♀, 14.ix. 1906, on Saidi Beans no coll.; SIKKIM: Kurseong, 5000, 1 ♀ 18-30.iv 1922, Fletcher coll.; TAMILNADU: Coimbatore, 2 ♀, 6, 9.iii. 1907, boring into Horse Gram. V.R. coll.; UTTAR PRADESH: Saharanpur, 2 ♀, 8-9.v. 1911, on pea pod, no coll.; Kumaon, 7000, Muktisar, 1 ♀, 24.iv. 15.v. 1923, Fletcher coll.; WEST BENGAL: Kalimpong, 1 ♂, 3 ♀, no date, O. Lindgren coll.; Bankura, 1 ♂, 19.iii. 1906, 1 ♀, 23.iii. 1906, 1 ♂, 4 ♀, 10.iv. 1906, P. Sircar coll., on Khesari pod.

(All in A.R.I., New Delhi)

SRI LANKA: Peradeniya, 1 ♂, 1 ♀, -.vii. 1903, no coll.

(All in I.A.R.I., New Delhi)

INDIA: TAMIL NADU: Coimbatore, 1 ♂, 1 ♀, on pods of *Sesbania aegyptica*, no other data.

(In IFG & T.B., Coimbatore)

INDIA: U.P.: Lucknow, 3 ♂, 1 ♀, 23.1.1958, no other data.

(In I.I.S.R., Lucknow)

INDIA: TAMIL NADU: Coimbatore, 1 ex, 21.ii. 1913, on Horse Gram, A.G.R. coll.; 1 ex., 27.iii. 1914, 1 ex. -.iv. 1914, on Gram, Y.R. coll.; 1 ex., 26.iii. 1932, boring into Lab Lab pods, A.G.R. coll.

(In. T.N. Ag. Univ., Coimbatore)

INDIA: BIHAR: Muzzaffarpur, 3 exs., -.iii. 1901, no coll.; SIKKIM: 1800, 2 ♂, 1 ♀, -.v.- 1896, 1 ♂, -.ii. 1897, 1 ♀, -.iv. 1896, all G.C. Dudgeon coll.

SRI LANKA: 1 ♂, -.iv. 1892, without other data; Peradeniya, 2 ♂, 2 ♀, -.vii. 1903; Pundaluoya, 1 ♂, -.iii. 1899, all E.E. Green coll.

(All in ZSI, Calcutta)

Wing expanse: ♂ 18-26 mm; ♀ 16-26 mm.

Distribution: Widely distributed. INDIA: Bihar; Delhi; Haryana; Madhya Pradesh; Maharashtra; Punjab; Sikkim; Tamil Nadu; Uttar Pradesh, and West Bengal. *Elsewhere*: Afghanistan; Australia; South America; Egypt; Indonesia; Japan; Sri Lanka; and U.S.A.

Hosts: *Acacia arabica*; *Cajanus cajan* (Redgram); *Crotalaria juncea*, *C. mujussi*; *Dolichos biflorus* (Horsegram); *Lathyrus sativa*; Khesari pods; *Pisum sativum* (Pea); *Sesbania aegyptica*; *Tephrosia candida*, *T. nocilora*, and *T. purpurea*; *Vigna sinensis* (cowpea).

Status: Serious pest on pea pod, horsegram, redgram and other pulses.

Remarks : The larvae, on hatching, bore into the pods of pea and feed on the growing seed. Often more than one larvae are found feeding inside a single pod. After devouring the seed, in one pod, the larvae move on to another pod, thus resulting in the reduction in grain yield. The full-grown caterpillars, however, pupate in an earthen cocoon, in the soil, or in the debris.

Genus *Thylacoptila* Meyrick

1885. *Thylacoptila* Meyrick, *Ent. Mon. Mag.*, **22** : 105.

Type species : *Thylacoptila paurosema* Meyrick

Diagnosis : Head with the frons roughly scaled; labial palpi obliquely upturned, the 2nd joint dilated and hollowed out to receive brush like maxillary palpi; antennae thickened in male, with a large tufts of scales at extremity of basal joints, and about three-fourths the length of forewing-costa. Forewings long and narrow, the apex rounded; cell about or less than two-thirds the length of wing. Hindwing with the inner margin enlarged; cell about one-fourth the length of wing; inner area in male with corneous ridge on the upper and underside, enclosing deep furrows with a tuft of scales. Mid. and hind tibiae fringed with long hair, those on hind tibiae present at the base as well as the extremity; outer tibial spurs about half or less than half the length of inner spurs. Abdomen in male, with tufts of scales laterally on 8th segment.

Female: Antennae not thickened. Hindwings without corneous ridge.

Distribution : India. *Elsewhere:* Africa, Pakistan and Sri Lanka.

Remarks: Only one species, *Thylacoptila paurosema* Meyrick, is included here, and is of moderate economic importance.

***Thylacoptila paurosema* Meyrick**

(AMALTAS DEFOLIATOR)

(Plate III, fig. 12; Text figs. 15A-B)

1885. *Thylacoptila paurosema* Meyrick, *Ent. Mon. Mag.*, **22** : 106

Diagnosis: Head and thorax ochreous-grey; labial palpi darker. Abdomen darker. Forewings greyish, irrorated with fuscous; the basal two-thirds of costa pale; a large blackish antemedial oval patch not reaching costa and becoming brown near inner margin; two minute discocellular dark specks; an indistinct postmedial whitish line, excurved and minutely dentate between veins M_3 and Cu_{1b} , then incurved; a series of dark specks present on the inner margin. Hindwings iridescent, semihyaline white, the apex tinged with fuscous; the ridges on the inner area ochreous in male, absent in female. Underside forewings with tufts of scales

at costa near base. Legs fuscous grey, interrupted at extremity of each tarsal joint, giving an appearance of segmental band.

Venation : Forewing : Vein R_1 free, from distal one-third of cell; R_2 free from close to upper angle and closely approximated to R_{3+4} , all the three veins ending at costa before apex; M_1 from below the upper angle; M_2 - M_3 closely approximated at base, from lower angle; Cu_{1a} close to M_2 - M_3 ; Cu_{1b} from before the lower angle, but close to Cu_{1a} . *Hindwing*: Vein Sc strongly anastomosed with Rs and M_1 from beyond the cell angle and ending at costal margin before apex, or vein Rs ending just at apex; M_2 - M_3 strongly anastomosed; Cu_{1a} very closely approximated to stalked M_2 - M_3 for about half the distance from angle to margin; Cu_{1b} from before the angle.

Material examined: INDIA: UTTAR PRADESH: Dehra Dun, 1 ♂, 25.vi. 1928, S.N. Chatterjee coll., defoliating flowers of *Cassia fistula*; New Forest, Dehra Dun, 1 ♂, 31.vii. 1941, 1 ♀, 1.viii. 1941, defoliating *Cassia tora*, Gauri Dutt coll.; 1 ♂, 2 ♀, 1.x. 1949, 1 ♀, 9.viii. 1950, defoliating *Cassia tora*, R.N. Mathur coll.

(In F.R.I. Dehra Dun)

INDIA: BIHAR: Pusa, 1 ♀, 19.ii. 1905, 3 ♂, 13, 15.v. 1907, boring *Cassia*, no coll.; 1 ♀, 10.xii. 1905, 1 ♂, 19.ii. 1906, all on *Cassia* (Chakaur), C.H.A. coll.; 2 exs., 26.iv. 1906, on *Acacia arabica*, no coll.; 1 ♂, 2.ix. 1908, chakor leaf roller, S. Kar coll.; 1 ♀, 29.x. 1908, G.R.D. coll.; 1 ♀, 25.v. 1913, 1 ♂, 18.xii. 1915, 1 ♂, 5.xii. 1917, on Amaltas leaves, all Fletcher coll.; 1 ♂, 9.i. 1920, 1 ♀, 15.i. 1920, rolling *Cassia tora* leaves, 1 ♀, 17.vi. 1920, 2 ♂, 2 ♀, 18.vi. 1920, in flowers of *Cassia fistula*, 1 ♂, 31.xi. 1920, 3 ♂, 10, 11, 14.xii. 1920, boring pods of *Cassia longifolia*, all Rangi coll.; 1 ♂, 1 ♀, 20.xi. 1926, 1 ♀, 30.xi. 1926, 2 ♀, 11, 14.viii. 1928, 2 ♂, 12, 15.viii. 1928, feeding on *Cassia tora*, all Rangi coll.; 3 ♀, 3, 4.ix. 1927, on *Cassia tora*, Haq coll.; MADHYA PRADESH: Balaghat, 1 ♀, - .ii. 1907, A.M. coll.; ORISSA : Cuttack, 1 ♂, - .x. 1906, A.M. coll.; TAMIL NADU : Coimbatore, 1 ♂, 15.vii. 1930, Webbing *Cassia* leaves, T.S.R. coll.

PAKISTAN: N.W.F.P. : 1 ♀, 12.x. 1941, H.N. Batra coll.

(In I.A.R.I., New Delhi)

INDIA: BIHAR: Pusa, lex. 11.ii. 1908, on chakori pod, no coll.; TAMIL NADU: Coimbatore, lex. 1.iv. 1914, on *Cassia auriculata* pod, A.C.R. coll.

(In T.N. Ag. Univ., Coimbatore)

SRI LANKA: Eppawala, 1 ♀ - .ix. 1905; Kandy, 2 ♂, - .vii. 1909; Peradeniya, 1 ♀, - .x. 1905, 1 ♀, - .vii. 1906, 1 ♂, 2 ♀, - .v. 1911, 1 ♂, 2 ♀, - .vi. 1911; Wellawaya, 1 ♀, - .xi. 1905, all E.E. Green coll.

(In Z.S.I., Calcutta)

Wing expanse : ♂ 16-21 mm; ♀ 17-21 mm

Distribution: INDIA: Assam; Bihar; Madhya Pradesh; Orissa; Tamil Nadu; Uttar Pradesh; and West Bengal. *Elsewhere*: Afghanistan; Pakistan; and Sri Lanka.

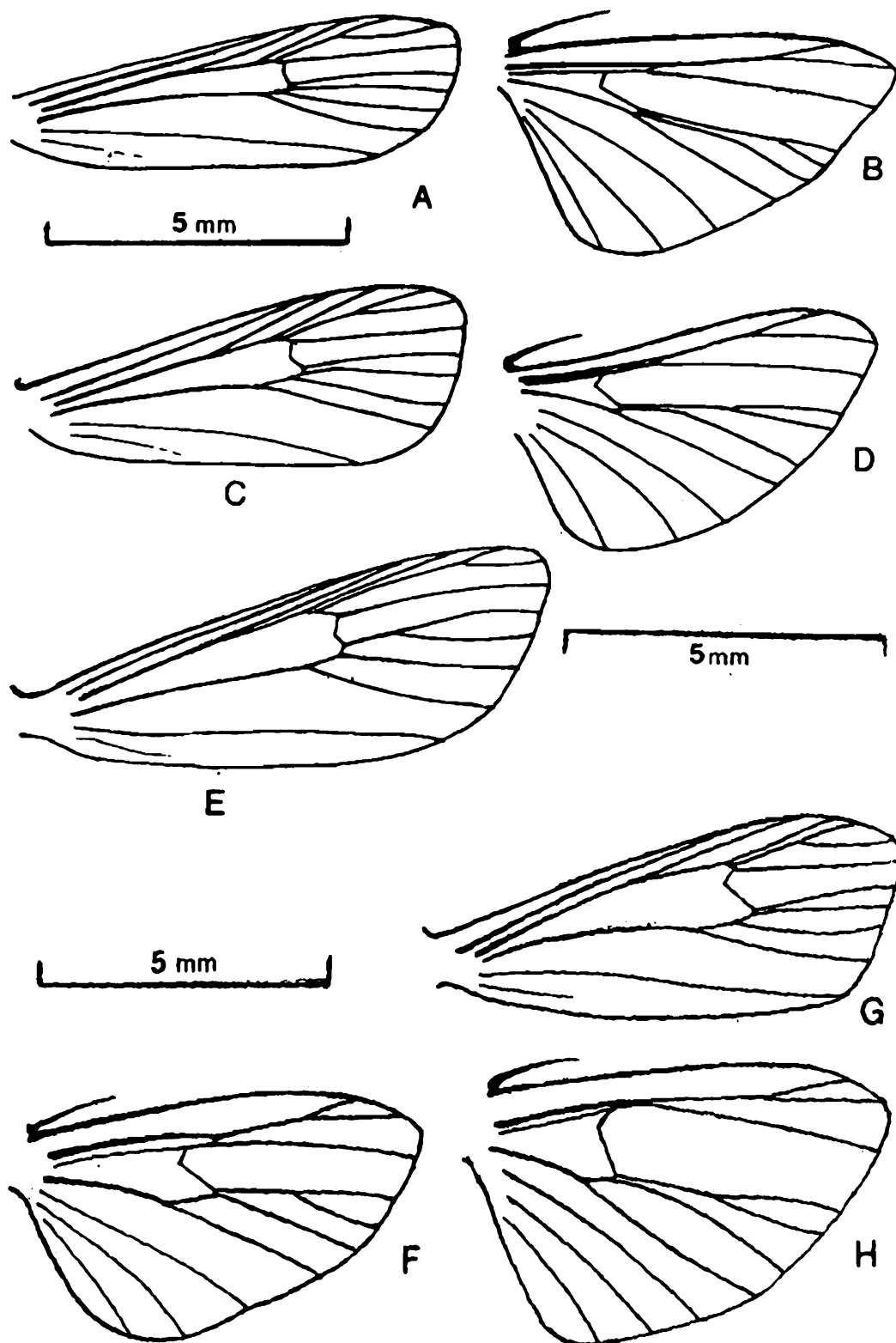


Fig. 15. *Thylacoptila paurosema* Meyrick : (A) Fore and (B) hindwing venation; *Nephopterix eugraphella* Ragonot : (C) Fore and (D) hindwing venation; *Myelois pectinicornella* Hampson : (E) Fore - and (F) hindwing venation; *Elasmopalpus jasminophaga* (Hampson) ♀ : (G) Fore and (H) hindwing venation (Magnification of B to D, F and H same as of A, E and G, respectively).

Hosts: Acacia arabica; Cassia auriculata; C. fistula (Amaltas); *C. longifolia*; and *C. tora*.

Status: Moderate.

Remarks : The species is hitherto not known by any common name. Since, it is mainly a pest of well known plant of medicinal importance, viz., *Cassia fistula* (Amaltas), it is being given the name of AMALTAS DEFOLIATOR. The species mainly feeds on pods, flowers and also rolls the leaves of *Cassia* spp.

Hitherto mostly known under the genus *Nephopterix* Hübner, it is nevertheless quite different from *N. eugraphella* Ragonot (see below).

Genus *Nephopterix* Hübner

1825. *Nephopterix* Hübner, *Verz., bek. Schmett.* : 370

Type species: Phycis rhenella Zincken

Diagnosis: Head with the frons smoothly curved, covered with rough scales; labial palpi upturned; closely appressed to face; maxillary palpi filiform; antennae thickened in male, simple in female, about two-thirds the length of forewing-costa. Outer tibial spurs about half the length of inner ones.

Distribution : Cosmopolitan.

Remarks: Only one species, viz., *Nephopterix eugraphella* Ragonot, a serious pest of sapota, is included here as under.

Nephopterix eugraphella Ragonot

(THE SAPOTA LEAF WEBBER)

(Plate IV, figs. 1-2; Text figs. 15C-D)

1888 *Nephoptyx eugraphella* Ragonot, *Nouv. Genres Especies*: 16

Diagnosis: Head with the frons smoothly curved, covered with rough scales, labial palpi upturned, closely appressed to head, the 2nd joint normal and not hollowed; maxillary palpi filiform; antennae thickened in male, simple in female, more than two-thirds the length of forewing costa. Tibial spurs unequal, the outer ones about half the length of inner ones, and some tufts at extremity; tarsi irrorated with fuscous above, interrupted at distal end of each joint, giving an appearance of pale bands. Forewing with the apex rounded; cell about two-thirds the length of wings in forewing and 1/4th in hindwing.

Forewing slightly suffused with brown and irrorated with black; some raised black scales at base in the cell; an antemedian band present, edged by black lines, the inner of which is with a ridge of raised scales, the band transversed by a fuscous line; two black discocellular specks present; postmedial line black, obliquely incurved from costa to vein M_2 and then bent outwards upto vein Cu_{1b} , with flXa brown line beyond it; a marginal black

line present, with some specks on the cilia. Hindwings whitish, semi-hyaline; the apical area, a marginal line and a line through the cilia fuscous. Underside forewing greyish fuscous, without bands and lines, except in postmedial area which has an indistinct line; hindwing semi-hyaline, costa pale fuscous. Abdomen and legs paler.

Venation : Forewing : Vein R_1 free, arising from basal two thirds of the cell; R_2 free, from before the angle, close to R_{3+4} ; R_{3+4} stalked, ending at costa before apex; M_1 from below the angle; M_2 - M_3 connate, at base, from the lower angle of cell; Cu_{1a} , Cu_{1b} from before the angle. **Hindwing:** Vein Sc strongly anastomosed with Rs and ending at costa; Rs stalked, at base, with M_1 , from angle and ending at apex; M_2 - M_3 strongly stalked at base, from the lower angle; Cu_{1a} very closely approximated to stalk of M_2 - M_3 at base; Cu_{1b} close to lower angle.

Material examined: INDIA: NEW DELHI: 1 ♂, 20.viii. 1935, 1 ♂, 1 ♀ 11.ix. 1935, 1 ♂, 14.ix. 1935, 1 ♀, 20.ix. 1935, all Ram Saran coll.; UTTAR PRADESH: Mohammadpur, 1 ♀, 17.xi. 1930, R.N. Mathur coll.; Kanpur (Cawnpur on label), 1 ♀, 17.x. 1946, on Sapota, R.L. Gupta coll. (In F.R.I., Dehra Dun)

INDIA: BIHAR: Pusa, 1 ♀, 12.vi. 1911, A.H. coll.; lex. 10.ii. 1914, 1 ♂ 25.v. 1914, 1 ♂, 1 ♀, 28.v. 1914, 4 ♂, 8, 10, 14, 16.vii.1914, on Sapota, all D.P.S. coll.; 1 ♂ 10.vii.1915, U.B.M. coll.; on Sapota; 1 ♂, 1 ♀, 7.ix. 1915, 1 ♀, 23.ix. 1915, on Sapota, U. Bahadur coll.; 1 ex., 2.ix. 1913, 1 ♀, 31.vii. 1916, 1 ♂, 14.viii. 1918, 3 ♀, 18, 21.viii. 1921, 2 ♂, 22.viii. 1916, 1 ♀, 2.ix. 1916, jointing leaves of *Achras sapota*, all R. Saran coll.; 1 ♂, 2.vii.1920, 4 ♂, 2 ♀, 3.vii. 1920, 3 ♂, 4.vii. 1920, 1 ♂, 4 ♀, 5.vii. 1920, 1 ♂ 6.vii. 1920, 1 ♀, 8.vii. 1920, Webbing *Mimusops* leaves, all Rangi coll.; 1 ♀, 7.vi. 1916, on sapota, H. Singh coll.; 1 ♀, 13.viii. 1923, on *Achras sapota*, Peries coll.; 1 ♀, 27.vii. 1926, 1 ex., 29.vii. 1926, 1 ♀, 9.viii. 1926, 2 ♂, 4, 25.viii. 1926, Webbing *Mimusops* leaves, all Shaffi coll.

(In I.A.R.I., New Delhi)

INDIA: PUNJAB: Ludhiana, 1 ♂, 30.x. 1974, 1 ♀, 4.xi. 1974, on sapota, all G.S. Mann coll.; 1 ♂, 1 ♀, 2.xi. 1976, reared in Lab on sapota, Amrik Singh coll.

(In P. Ag. Univ., Ludhiana)

INDIA: TAMIL NADU: Coimbatore, lex., vi. 1912, A.V.R. coll., lex., -ix. 1912, 3 exs. 28.v.1938, D.K.P. coll., 1 ex., -ix. 1912, 3 exs., 28.v.1938, D.K.P. coll.; 1 ex. 14.iv. 1959, on sapota, E.V. Abraham coll. (In T.N. Ag. Univ., Coimbatore)

INDIA: WEST BENGAL: Calcutta, 2 exs., 1 ♂, 2 ♀, no other data; 1 ♀ 30.vii.1891, on Bokool Tree *Mimusops clengi*; 1 ex, 1 ♂, 25.ix. 1907, 2 ♂, 1 ♀, 1 ex., -x. 1907, on Bokool tree, Phaku Ram coll. (In Z.S.I., Calcutta)

Wing expanse: ♂ 18-20 mm; ♀ 19-22 mm.

Distribution: INDIA: Bihar; New Delhi; Punjab; Tamil Nadu; Uttar Pradesh; and West Bengal.

Hosts: Mainly *Achras sapota* (Sapota). *Alternative Hosts:* *Mimusops clengi* (Bokool Tree); *Nicotiana tabacum* (Tobacco).

Status: Moderate to serious pest on sapota.

Remarks: Commonly known as "The Sapota Leaf Webber", the species is mainly a pest of Sapota, constructs a tunnel of web and frass, and feeds on the green matter of leaf-buds, flower-buds, tender leaves, fruits, and curved tobacco leaves. The larvae pupate in the tunnel itself. Often, more than two larvae are found in a single tunnel.

The species is characterised by the presence of raised tuft of scales on the antemedial band, the antennae are without sinus in male and the labial palpi normal, *i.e.* without a hollow to receive maxillary palpi. The species can be very easily differentiated from *Thylacoptila paurosema* by the characters as given in key.

Genus *Myelois* Hübner

1825 *Myelois* Hübner, *Verz. bek. Schmett.* : 371

Type species: *Tinea cribrella* Hübner

Diagnosis: Head with the frons smoothly curved, thickly scaled; labial palpi upturned, closely appressed to face and reaching beyond vertex of head; antennae thickened, ciliated or pectinated in male, simple in female. Forewings long and narrow, the apex rounded; cell about a little over half the length of wings in forewings and about half the length in hindwings. Tibial spurs unequal.

Distribution : Universally distributed.

Remarks The genus is represented by single species, *viz.*, *Myelois pectinicornella* Hampson, from India and Bhutan, as a pest on oilseeds. Hampson (1896) recorded this species as male only from Bhutan. The present study is recording both sexes of the species from Bihar and Tamil Nadu in India besides from Sri Lanka, thus extending its range from Sri Lanka, through Tamil Nadu and Bihar in India, to Bhutan.

Myelois pectinicornella Hampson

(TOONA CATERPILLAR)

(Text figs. 15E-F)

1896. *Myelois pectinicornella* Hampson, *Fauna Br. India* (Moths), 4: 88-89.

Diagnosis: Head with the antennae about two-thirds the length of forewing costa, bipectinate nearly upto basal two-thirds of its length, the apical part minutely serrate, with

the pectination maximum being about the length of two antennal segments; antennae very minutely serrate and ciliate in female. Outer tibial spurs about half the length of inner spurs; hind tibiae with tufts of scales at extremity.

Head, thorax and abdomen grey, irrorated with fuscous. Forewings greyish-brown, with the veins streaked with fuscous; antemedial line irregularly dentate, grey and dark edged; discocellular band present; a submarginal line present, minutely dentate, grey and dark edged; prominent marginal series of specks present. Hindwings semi-hyaline, tinged with fuscous; a marginal line present. Underside forewing greyish-brown, without any markings; hindwings semi-hyaline white, with the costal area brownish. Legs greyish known above, paler beneath; abdomen paler beneath.

Venation : Forewing : Vein R_1 free, arising from distal one-third of the cell; R_2 free from angle and closely approximated to base of R_{3+4} ; R_{3+4} on a long stalk, with the vein R_3 ending at costa and R_4 at apex; M_1 from below the upper angle; M_2 - M_3 stalked from lower angle; Cu_{1a} , Cu_{1b} from before the angle. *Hindwing*: Vein Sc anastomosed with Rs, and ending at costa; Rs stalked at base with M_1 , or only connate, from angle; M_2 - M_3 stalked for nearly halfway from base to the margin; Cu_{1a} close to lower angle; Cu_{1b} from before.

Material examined: INDIA: BIHAR: Pusa, 1 ♀, 13.ix. 1923, boring top shoots of *Cedrela toona*, Haq coll.; 1 ♂, 22.iii. 1927, 3 ♂, 8, 20, 21.iv. 1927, 3 ♀, 9, 20, 29.iv. 1927, 1 ♂, 6.ii. 1928, all feeding in seeds of *Pogamia glabra*, Rangi coll.; 1 ♂, 20.i. 1928, boring into seeds of *Pogamia glabra*, Haq coll.; Ranchi, Namkum, 2 ♀, 6, 9.v. 1940, 1 ♂, 10.v. 1940, on *Pogamia glabra* seeds, S.N. Gupta coll.; TAMIL NADU: Chennai ('Madras' on label); 2 ♀, 1 exs., 26.ii. 1907, boring into seeds of *Pogamia glabra*, T.V.R. coll.

(All in I.A.R.I., New Delhi)

SRI LANKA: Peradeniya, 1 ♂, 1 ♀, -.viii. 1910; Kandy, 1 ♀, -.ix.-, 1 ♀, -.x. 1911; all E.E. Green coll.

(In Z.S.I., Calcutta)

Wing expanse: ♂ 24-30 mm; ♀ 27-30 mm

Distribution: INDIA: Bihar and Tamil Nadu. *Elsewhere*: Bhutan and Sri Lanka.

Hosts: Oilseeds : *Cedrela toona* and *Pogamia glabra*.

Status: Serious pest in oilseeds.

Remarks: Hampson (1896) described the species, based on male, from Bhutan only. The material available from the National Pusa Collections, New Delhi, and National Zoological Collections, Calcutta, have several examples of females, from Bihar, Tamil Nadu and Sri Lanka. The study makes a report as first ever record of the females in the species and of new areas of occurrence in India and Sri Lanka.

The species is an important pest, infesting oilseeds and causing serious damage to the seeds by boring into them.

Genus *Elasmopalpus* Blanchard

1852. *Elasmopalpus* Blanchard, In: Gay's *Hist. Chile* (Zool.), 7: 104.

Type species: Elasmopalpus angustella Blanchard

Diagnosis: Head with the frons smoothly curved, flat, frontal tufts prominent and conical; labial palpi upturned, reaching above vertex of head, 2nd joint hollowed out to receive brush-like maxillary palpi; antennae in male with a sinus at base of shaft. Tibial spurs unequal.

Distribution : India; Bhutan; and Sri Lanka.

Remarks: Only one species, viz., *Elasmopalpus jasminophaga* Hampson, is being dealt with here.

Elasmopalpus jasminophaga (Hampson)

(BUD AND SHOOTWORM)

(Plate IV, figs. 3-4; Text figs. 15G-H)

1896. *Phycita* (*Elasmopalpus*) *jasminophaga* Hampson, *Fauna Br. India* (Moths), 4 : 96-97.

Diagnosis: Labial palpi upturned, the 2nd dilated and hollowed out to receive the maxillary palpi which are brush-like; antennae in male with a sinus at base, containing a large ridge of scales, simple in female, about three-fourths the length of forewing-costa. Outer tibial spurs half the length of inner spurs. Forewings narrow, the costa arched, the apex and the outer margin rectangular; cell about two-thirds the length of wings in forewing and one-third in hindwings; M_2 - M_3 closely approximated at base in forewing, and stalked in hindwing.

Head with the labial palpi, antennae, and thorax grey, irrorated with brown. Abdomen brown above, paler beneath. Forewings grey, irrorated with brown; an oblique waved antemedial line present, defined outwardly by brown; two brown discocellular specks present; a submarginal grey line outlined by brown, slightly excurved and minutely dentate between veins M_3 and Cu_{1a} ; a series of dark specks present on the margin. Hindwings semi-hyaline, with a light brown tinge; a brown marginal line and a line through the cilia present. Legs grey, irrorated with dark brown above, interrupted at apical end of tarsal joint by paler tinge, giving an appearance of band; paler beneath. Underside forewing and the costal area in hindwing grey-brown, without any markings on forewings.

Venation : Forewing : Vein R_1 free, arising from about distal one third of the cell; R_2 from angle, closely approximated to the stalked R_{3+4} , both ending at the costal margin; M_1 from below the upper angle; M_2 - M_3 closely approximated at base, from lower angle; Cu_{1a} , Cu_{1b} from before the lower angle, the latter closer to Cu_{1a} and not in line with R_1 above. **Hindwing :** Veins Sc and Rs strongly anastomosed, Sc ending at the costal margin; Rs slightly above the apex; M_1 stalked with Sc-Rs and ending at margin below the apex; M_2 - M_3 on a long stalk; Cu_{1a} closely approximated at base to M_2 - M_3 ; Cu_{1b} close to lower angle.

Material examined: INDIA: TAMIL NADU: Coimbatore, 2 ♀, 14, 27.vii. 1956, S.K. David coll., on Jasmine.

SRI LANKA: Peradeniya, lex., 1 ♀, -x. 1901, 3 ♂, 3 ♀, -x.1910, E.E. Green coll.
(In Z.S.I., Calcutta)

Wing expanse: ♂ 15-16 mm; ♀ 13-20 mm

Distribution : INDIA: Tamil Nadu. *Elsewhere :* Bhutan and Sri Lanka.

Host : *Jasminum sambae* (Jasmine).

Status : Moderate.

Remarks : The species is, hitherto, known to occur in Bhutan and Sri Lanka, (*Vide* Hampson, 1896), thus leaving a large gap in distribution between the two areas. The present record of the species from Tamil Nadu (Coimbatore), based on the collection made about four decades ago and present in the Forest Research Institute, Dehra Dun, fills this gap and makes an interesting link in the distribution of this species from Sri Lanka, through Indian mainland, to Bhutan.

Further, Hampson (1896) based his new species on the basis of males only. Thus, the record of females both from Sri Lanka and Coimbatore constitutes a first ever record of the unrecorded females of the species.

The species is popularly known. as “BUD AND SHOOTWORM”, and is very close to other species under the genus *Phycita*, but differs as given in the key.

Genus *Phycita* Curtis

1828 (1824-39). *Phycita* Curtis, *Brit. Ent.* 5: 233.

Type species: *Tinea spiciella* Fabr. (*vide* Clarke, J.F.G., 1986)

Diagnosis: Head with the frons with prominent tufts, or smoothly curved; labial palpi upturned, the 2nd joint reaching vertex of head; antennae thickened in male, with or without sinus; tibial thickly scaled. Forewing rather narrow; the costa arched; the apex rectangular; cell about two-thirds the length in forewing and one-fourth the length in hind wing.

Distribution: Universally distributed.

Remarks: Only two species, viz., *clientella* (Zeller) and *infusella* Meyrick, are being dealt with here, as pests of brinjal and cotton, respectively. These are differentiated externally by the streaks of black scales on the underside of forewings and hindwings in *infusella*, in males, unlike in *clientella* where these black scales are absent. Besides, the colour markings also separate them considerably and these are pests on different hosts.

Phycita clientella (Zeller)

(BRINJAL LEAF ROLLER)

(Plate IV, fig. 5; Text figs. 16A-B)

1867. *Nephoteryx clientella* Zeller, *Stett. ent. Zeit.* : 396.

Diagnosis : Head with the frons smoothly curved; labial palpi upturned, reaching vertex of the head, about one-and-a-half times the diameter of eye; antennae thickened, at base, with a sinus in male, simple in female, about two-thirds the length of forewing costa. Outer tibial spurs two-thirds the length of inner spurs.

Head, thorax and abdomen pale reddish-brown, the collar grey. Forewing pale red-brown suffused with grey and slightly irrorated with black; a sinuous grey medial line outlined with brown, and with a triangular red-brown patch on its inner edge, not reaching the costa; a discocellular lunule present, better developed in male than in female; a black speck at lower angle of cell and short black streaks on vein Cu_{1b} , M_1 , M_2 and M_3 , just beyond the angle; a submarginal brown line present, outlined by grey line, excurved between veins Cu_{1a} and M_2 , and expanding at costa; a marginal series of black specks prominent. Hindwings iridescent semi-hyaline, with an ochreous tinge. Legs darker on upperside, interrupted at the end of each tarsal joint by paler tinge, giving an appearance of tarsal bands. Underside forewings without bands; costa with pale-ochreous scales at base; inner area pale ochreous.

Venation : Forewing : Vein R_1 free, from basal two-thirds of the cell; R_2 from before the upper angle, closely approximated to base of R_{3+4} at origin; R_{3+4} stalked upto the half way from angle, and ending at costa before apex; M_1 from below the upper angle; M_2 - M_3 closely approximated, at base, from lower angle; Cu_{1a} , Cu_{1b} both before the lower angle, but closer to the latter; Cu_{1b} almost in line with the origin of R_2 above. **Hindwing:** Vein Sc anastomosed with Rs beyond the angle, both ending at costa before apex; M_1 stalked with Rs, arising from angle; M_2 - M_3 on a long stalk; Cu_{1a} close to the base of M_2 - M_3 , arising from angle; Cu_{1b} from before.

Material examined : INDIA: BIHAR: Pusa, 2♂, 15.vii. 1903, ber leaf roller, *G.D.O.* coll.; 2♀, 9, 14.xii. 1905, 2♂, 1.i. 1906, 2♀, 7.i. 1906, 2♂, 3, 7.ix. 1912, 1♀, 6.ix. 1912, 2♂, 12, 16.ix. 1912, all brinjal leaf roller, *A.H.* coll.; 2♀, 9.ix. 1906, 1♂, 22.ix. 1906, on brinjal leaves; 1♂, 7.vi. 1908, 1♀, 14.vii. 1908, on *Chrozophora plicata*, no coll.; 2♀, 11, 15.iv. 1911, 2♂, 11, 13.iv. 1911, on mango bud, *A.H.* coll.; 1♀, 2.vi. 1915, on castor fruit, *D.P.S.* coll.; 2♂, 7, 9.viii. 1915, 2♀, 11, 16.viii. 1915, 1♀, 30.viii. 1915, on brinjal leaves, *U. Bahadur* coll.; 1♂, 1.ii. 1916, *T.B. Fletcher* coll.; 1♂, 19.v. 1921, boring fruits and seeds of Bhant plant, *D.P.S.* coll.; 1♂, 14.xi. 1921, feeding on brinjal leaves, *Rangi* coll.; 1♀, 17.vii. 1923, 1♂, 20.ix. 1923, *Peries* coll.; 1♀, 4.viii. 1924, *Mukherjee* coll.;

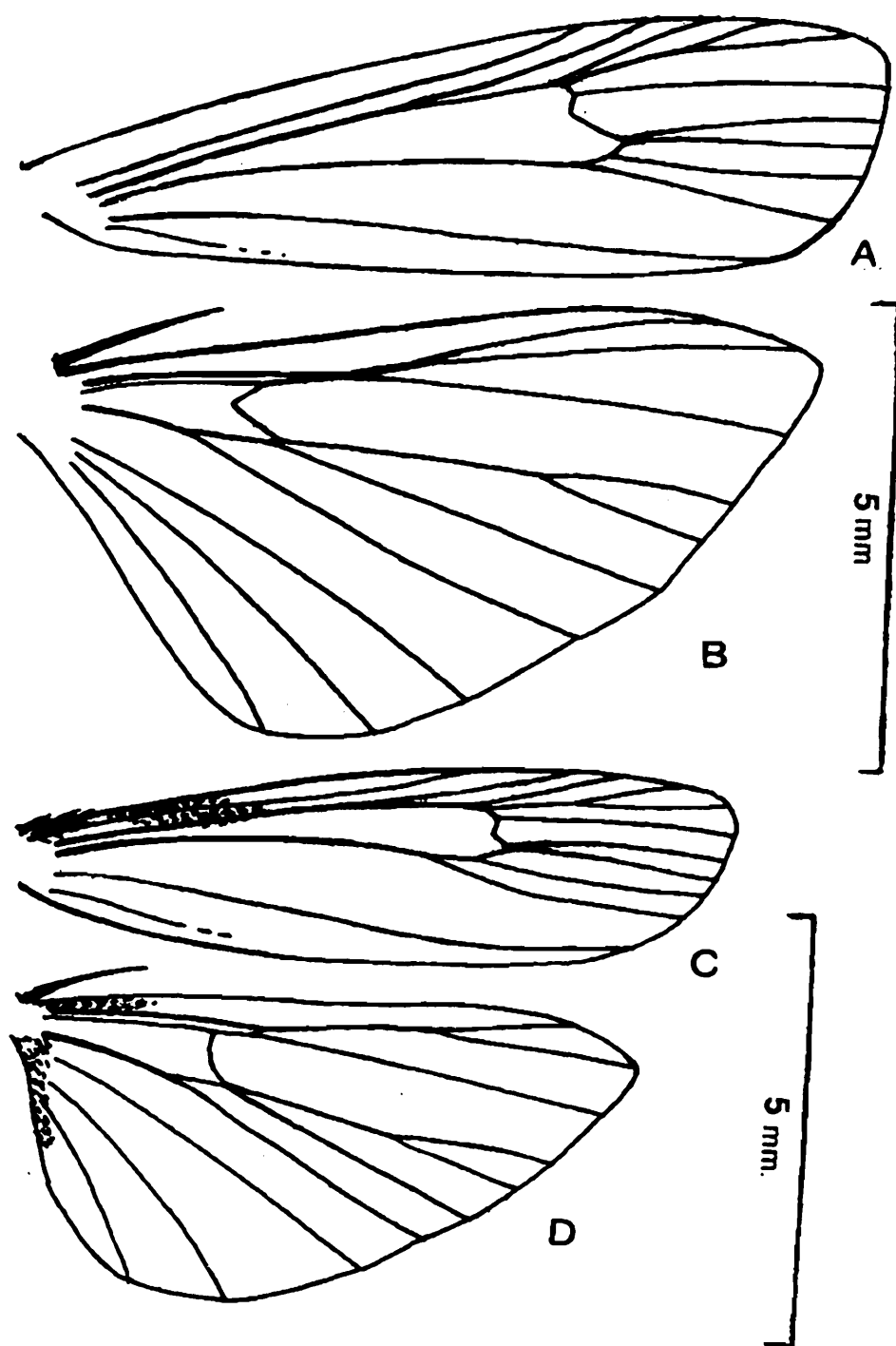


Fig. 16. *Phycita clientella* (Zeller) : (A) Fore - and (B) hindwing venation; *Phycita infusella* (Meyrick) : (C) Fore - and (D) hindwing venation (Magnification of A and C same as of B and D, respectively).

1 ♂, 23.x. 1925, 1 ♂ 11.xi. 1925, 1 ♂, 9.xii. 1925, all rolling brinjal leaves, *R. Saran* coll.; 1 ♂, 14.x. 1927, feeding on leaves of *Solanum melongea*, *Insectory Mali* coll.; 1 ♂, 22.iii. 1931, 1 ♀, 29.iii. 1931, 2 ♂, 2, 10.iv. 1931, 1 ♀, 20.iv. 1931, all flower feeders, *Haq* coll.; 1 ♀, 28.iv. 1933, leaf folder on *Solanum melongea*, *Rangi* coll.; DELHI: 1 ♀, 30.x. 1936, feeding on castor leaves, *R. Saran* coll., GUJARAT: Navasarai, 1 ♀, -.ii. 1904, on castor, *P.C.P.* coll.; Surat, 1 ♂, 13.vi. 1904, on castor, *P.C.P.* coll.; TAMIL NADU: MADRAS: Attur, 1 ♂, 17.vi. 1907, Webbing castor capsule; Hagari, 1 ♀, 11.v. 1907, 1 ♀, 25.v. 1908, Webbing castor leaves, *Y.R.* coll.

CHINA: Kwangsi, 1 ♀, 26.viii. 1942, on egg plant, no coll.

(In I.A.R.I., New Delhi)

INDIA: UTTAR PRADESH: Lucknow, 2 ♀, 4.v. 1908, no coll.

(In I.I.S.R., Lucknow)

CHINA: Kwangsi, 1 ♂, 26.viii. 1942, on egg plant, no coll.

(In Z.S.I., Calcutta)

Wing expanse: ♂ 15-20 mm; ♀ 17-22 mm

Distribution: INDIA: Bihar, Delhi; Gujarat; Maharashtra; Tamil Nadu; Uttar Pradesh and West Bengal. *Elsewhere*: China; Sri Lanka.

Hosts: Ber; Brinjal; Castor; and Mango.

Status: Serious on brinjal and castor.

Remarks: Popularly known as "The Brinjal Leaf Roller", the species also causes extensive damage to castor seeds, leaves and fruits (capsules) by webbing them. Habitually, the pest rolls the leaves of brinjal plant and feeds on the leaves. Its other alternative hosts are Ber (*Zizaphus jujuba*) and Mango (*Mangifera indica*), particularly the buds and flowers in the latter case.

Hampson (1896) mentioned about the males of the species as "Unknown" The present study records a large number of males from various localities, as given above, and differ from the females in the antennae being thickened and with a sinus at base.

In both the sexes, the hindwings are very much enlarged at the inner margin. The species differs from *P. infusella* by the absence of tufts of scale and ridge of black scales on underside of both wings.

Phycita infusella (Meyrick)

(COTTON BUD CATERPILLAR)

(Plate IV, fig. 6; Text figs. 16C-D)

1879. *Nephoteryx infusella* Meyrick, *Proc. Linn. Soc. N.S.W.*, 4: 218-219.

Diagnosis: Head with the frons smoothly curved; labial palpi upturned, reaching beyond vertex of head, and about a little over twice the diameter of eye; antennae thickened at base, with a sinus and a small tuft of scales in male, about two-thirds the length of forewing costa. Forewings long and narrow, about thrice as long as wide; hindwings with the inner margin enlarged. Outer tibial spurs about two-thirds the length of inner ones.

Head and thorax pale-reddish brown. Abdomen greyish brown. Forewing pale-reddish brown, irrorated with slightly iridescent dark fuscous scales in sub-basal and submarginal areas; basal area pale-red brown; antemedial band red-brown, diffused at costa; medial band broader than that of antemedial band and irrorated with fuscous scales, diffused at costa and not reaching the margin; discocellular lunule indistinct; postmedial and submarginal bands indistinct and diffused; a series of black specks, often seven, prominent at the margin: Hindwings semi-hyaline white, slightly iridescent. Underside: Thorax dark, intermixed with pale-reddish brown scales, with a large tuft of dark fuscous hair at base between fore- and mid legs; tarsi dark fuscous, interrupted at the distal end of each segment. Abdomen dark, as on upperside. Forewings pale-reddish brown but without any marking or bands; a tuft of scale at the basal area of sub-costal vein; the costal and the sub-costal area, from near the base to middle of cell, also streaked with black scales in male. Hindwings also with black scales in costal and the anal margin in male. Females with the antennae simple and without sinus, and without tufts and black scales on both the wings.

Venation : Forewings : Vein R_1 free, from basal two thirds of cell; R_2 close to upper angle; R_{3+4} stalked to nearly half-way from angle to margin; M_1 from below the upper angle; M_2 - M_3 closely approximated at base; Cu_{1a} , Cu_{1b} from before the angle. **Hindwings:** Sc anastomosed with Rs from beyond the angle; Rs- M_1 shortly stalked; M_2 - M_3 stalked to nearly halfway from cell angle to the margin; Cu_{1a} close to M_2 - M_3 ; Cu_{1b} from before the angle.

Material examined: INDIA: BIHAR: Pusa, 1 ♂, 5.v. 1905, *D.N.P.* coll.; 1 ♂ 2.vi. 1906, 1 ♀ 16.vii. 1906, *A.M.* coll.; 1 ♂, 23.viii. 1906, on cotton shoot, 1 ♀, 20.ix. 1906, 1 ♂ 24.ix. 1906, cotton top leaf roller, 1 ♂, ix. 1906, on cotton balls, all *C.S.M.* coll.; 1 ex., 9.iii.1907, *H.M.L.* coll.; 1 ♂ 1 ♀, -.viii. 1907, *A.M.* coll., on cotton top shoot; 1 ♂ -.ix.1912, on cotton leaves, no coll.; 1 ♂, 1 ♀, 17.ii. 1914, *G.D.O.* coll.; 2 ♂, 2, 5.v. 1915, 1 ♀ 6.v.1915, 1 ♂ 1 ♀ 12.vi. 1915, on cotton, all *R. Saran* coll.; 1 ♀, 28.vii. 1915, 1 ♂ 1 ex., 12, 14, viii. 1915, 1 ♀ 20.viii. 1905, 1 ♂, 3.ix. 1915, 1 ♀, 1.x. 1915, 1 ♂, 1 ♀ 7.iii. 1916, 1 ♂, 9.iii. 1916, 1 ♀ 28.ix. 1916, on cotton buds, all *U. Bahadur* coll.; 1 ♀ 27.vii. 1916, *D. Nandan* coll.; 1 ♂ 28.vii. 1923, rolling top tender leaves of cotton, *Bose* coll.; 1 ♀ 4.iii.

1924, boring top shoot of cotton, *Rangi* coll.; 1 ♀, 2.ix. 1927, feeding on leaves of cotton, *Insectory Mali* coll.; GUJARAT: Surat, 1 ♀, no date, on cotton, *R.R.K.* coll.; 2 ♀, 12, 13.ix. 1904, on cotton, *T.V.R.A.* coll.

(All in I.A.R.J., New Delhi)

Wing expanse : ♂ 15-18 mm; ♀ 14-18 mm.

Distribution: INDIA: Bihar; Gujarat; Punjab; and Tamil Nadu.

Host: Cotton.

Status: Often serious.

Remarks : Popularly known as "The Cotton Bud Caterpillar", the species does not appear to confine itself to cotton buds only. The perusal of the material examined clearly shows that the species infests top cotton shoots, feeds on cotton leaves, and even rolls the cotton leaves. While Ayyar (1940) records that the species attacks cotton plants when about a month or two old, and as a result the top shoots show the peculiar fading, Pruthi (1969) is of the view that the species webs the leaves of top shoot into small compact masses which turn dark brown and become conspicuous, called "knots", rendering plants being bushy and stunted in growth.

Genus *Euzophera* Zeller

1867. *Euzophera* Zeller. *Trans. ent. Soc. Lond.*, (3) 5 : 456.

Type species : *Myelois cinerosella* Zeller

Diagnosis: Head with the frons smoothly curved; labial palpi upturned reaching beyond frons, the 2nd joint well scaled at extremity, 3rd well developed and acuminate; maxillary palpi triangularly scaled and flattened against frons or filiform; antennae thickened in male, simple and slender in female, about three-fourths the length of forewing-costa. Forewings long and narrow; the apex rounded; four veins arising from lower angle. Hindwings with three veins arising from lower angle. Tibial spurs unequal.

Distribution : India. *Elsewhere*: African, Palearctic and Neotropical regions. Also Pakistan and Sri Lanka.

Remarks: Only two species, viz., *E. perticella* Ragonot and *E. plumbeifasciella* Hampson, have been included here as pests, mainly on brinjal and wood apple.

The two species are differentiated by the following key based on external characters.

Key to identification of *Euzophera* Zeller species

1. Maxillary palpi triangularly scaled and flattened against frons. Forewings without costal fascia; M_2 stalked with M_3 in forewings; M_3 stalked with Cu_{1a} in hindwings. Mid. and hind tibiae fringed with hair on outside *Euzophera perticella* Ragonot

- Maxillary palpi filiform. Forewing with costal fascia; M_2 free in forewings; M_3 free in hindwings. Mid. and hind tibiae smoothly scaled and without fringe.....
 *Euzophera plumbeifasciella* Hampson

***Euzophera perticella* Ragonot**

(BRINJAL STEM BORER)

(Text figs. 17A-B)

1888. *Euzophera perticella* Ragonot, *Nouv. Genres Espèces* : 32.

Diagnosis: Head with the frons smoothly curved and flat; labial palpi upturned, closely appressed to face, reaching beyond frons; antennae thickened in male, simple in female, about three-fourths the length of forewing-costa; ocelli small. Legs with the mid and hind tibiae fringed with hair on outside; outer tibial spurs about half the length of inner ones. Forewing cell long, about two-thirds the length in forewing and about half the length in hindwing.

Head with the frons dark fuscous; labial palpi with the 2nd joint at extremity and the 3rd joint entirely dark fuscous; thorax pale rufous and grey; Abdomen pale. Forewing pale rufous; the costal area to beyond middle and the apical area suffused with grey; a black line from middle of costa very strongly dentate, being retracted along subcostal and median nervures almost to base of wing, bent outwards in and below the cell to beyond middle of wing and terminating on inner margin before middle; a slight pale discocellular mark present; postmedian line minutely dentate, very slightly bent outwards at vein M_3 and defined on outside by ochreous; beyond this fuscous suffusion, streaks present on the veins and in the interspaces; a series of large marginal specks present. Hindwings whitish; the marginal area tinged with fuscous. Underside forewings fuscous, without markings; hindwings and abdomen paler.

Venation : Forewing : Vein R_1 free, arising from distal part of the cell; R_2 from close to upper angle; R_{3+4} stalked, R_3 ending before apex and R_4 at the apex; M_1 from below the angle; M_2 - M_3 shortly stalked; Cu_{1a} from before the angle bent close to M_2 - M_3 ; Cu_{1b} from before the lower angle. **Hindwing:** Sc stalked with Rs to near costal margin, both the veins end at costal margin; Rs stalked with M_1 before its anastomosis with Sc and end at outer margin below apex; M_3 - Cu_{1a} stalked; M_2 absent; Cu_{1b} before the lower angle.

Material examined: INDIA: KERALA: Kavuraneru, 1 ♀, boring into brinjal stem, 12.iii. 1933, Venkatasubban coll.

(In Coll. Ag. Sci., K. Ag. Univ. Vellayani, Trivandrum)

INDIA: BIHAR: Pusa, 1 ♀, 15.v. 1905, 1 ex., 30.ix. 1905, 1 ex., -.ix. 1908, 1 ♂, 24.iii.1912, all on sunnhemp, no coll.; 1 ♀, 7.ix. 1907, 1 ♀, -.iii. 1909, on brinjal, no coll.; 1 ♀, 23.ix. 1937, larva boring brinjal, no coll.; GUJARAT: Surat, 1 ♀, 11.vii. 1903, 1 ♀, 29.v. 1904, C.V.P. coll.; Baroda, Kalol, 1 ♀, 12.viii. 1905, no coll.; MAHARASHTRA: Poona, 1 ♀, 22.ii. 1904, on brinjal, no coll.; ORISSA: Cuttack, 1 ♀, 21.v. 1941, on brinjal, Panda coll.; UTTAR PRADESH: Shikohpur, K.V.K., 3 ♂, 6 ♀, 22, 27.vii. 1986, all on brinjal, B.N. Bose coll.

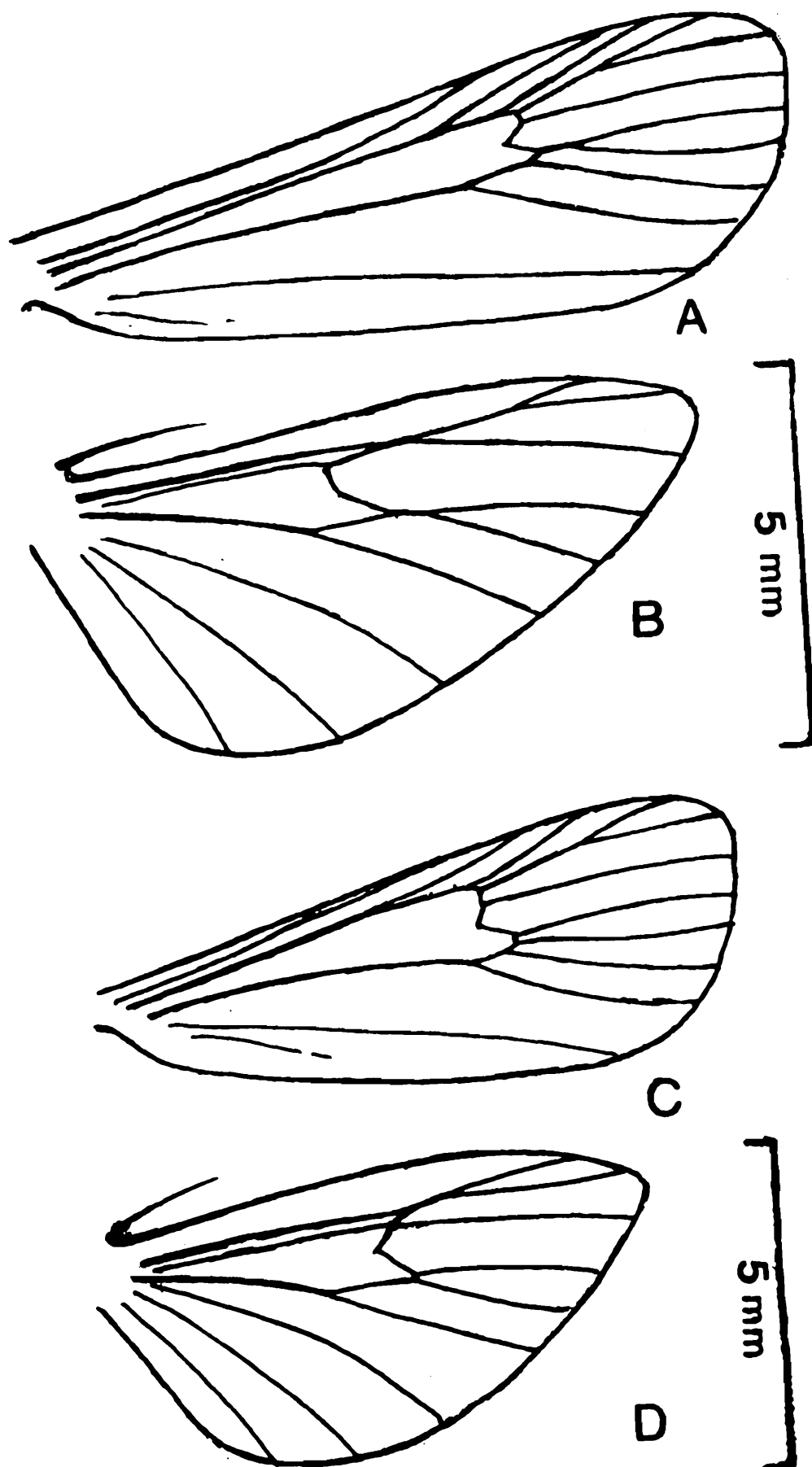


Fig. 17. *Euzophera perticella* Ragonot : (A) Fore - and (B) hindwing venation: *Euzophera plumbeifasciella* Hampson : (C) Fore - and (D) hindwing venation (Magnification of A and C same as of B and D, respectively).

PAKISTAN: Quetta, 1 ♀, 6.vii. 1937, on Kandhari apple, no coll.

(All in I.A.R.I., New Delhi)

INDIA: PUNJAB: Ludhiana, 2 ♀, 2.vi. 1977 on Potato, *M. Ramzan* coll.

(In Pb. Ag. Univ., Ludhiana)

INDIA: TAMIL NADU: Coimbatore, 1 ex., 15.viii. 1908, from brinjal stem, *T.V.R.* coll., 1 ex., 28.viii.1916, from brinjal stem, *Ramakrishna* coll.

(In T.N. Ag. Univ., Coimbatore)

INDIA: ANDHRA PRADESH: Bapatla, 1 ♀, 15.ix. 1957, on brinjal, no coll.

SRI LANKA: Kandy, 1 ♂, 1 ♀, -.ix. 1902, *E.E. Green* coll.

(In Z.S.I., Calcutta)

Wing expanse : ♂ 20-24 mm; ♀ 18-32 mm.

Distribution : INDIA: Andhra Pradesh; Bihar; Gujarat; Kerala; Maharashtra; Orissa; Punjab; Tamil Nadu; Uttar Pradesh; and West Bengal. *Elsewhere*: Pakistan and Sri Lanka.

Hosts: *Abelmoschus esculentus* (Bhindi); *Capsicum annum* (Chilli); *Crotalaria juncea* (Sunnhemp); *Solanum aviculare*; *Solanum melongena* (Brinjal); *Solanum tuberosum* (Potato);

Status: Serious.

Remarks: Popularly known as the "Brinjal Stem Borer", the caterpillars on hatching bore into the leaf axil, closing the entry hole with excreta and frass and reach the stem, which is the main site of pest's infestation. The larvae feed throughout their life span mainly in the stem and pupate there. The pupation takes place inside the tunnelled stem in a thin silken cocoon.

The species is characterised by the presence of four veins at lower angle in forewing, and three in hindwing, which differentiates this species from the other species dealt with here under this genus, beside the colouration and wing pattern.

The species is a very serious pest, particularly on brinjal, but it also has other hosts as given above, particularly vegetables, spices etc.

Euzophera plumbeifasciella Hampson

(WOOD APPLE BORER)

(Plate IV, fig. 7; Text figs. 17C-D)

1896. *Euzophera plumbeifasciella* Hampson, *Fauna Brit. India*, Moths, 4 : 73.

Diagnosis: Frons smoothly curved, flat; labial upturned, the 3rd joint reaching beyond frons; maxillary palpi filiform; antennae thickened in male, simple in female, about two thirds the length of forewing-costa. Legs with the tibial spurs unequal, outer spurs about half the

length of inner ones; the tibiae without fringe of scales. Forewing long and narrow, about thrice as long as wide at the middle; cell about two-thirds of the wing length in forewing and about half the wing-length in hind wings; only three veins arising from the lower angle in hind wings.

Head and thorax brown, abdomen pale-brown. Forewings deep-brown, with the antemedial, medial, postmedial, submarginal and marginal bands of diffused leaden colour scales; the antemedial and postmedial bands broadened at costa, the postmedial and the marginal band being the broadest; costal fascia from beyond base to a little before apex along costa, and extending into the cell; marginal dots prominent. Hindwing whitish, semi-hyaline. Underside forewings dark in the postmedial area than in the basal half, with a patch of paler scales at subapical area; hindwings paler.

Venation: *Forewings:* Vein R_1 free, from distal one-fourth of the cell; R_2 free, close to the origin of stalked R_{3+4} ; R_3 ending at costa before apex, and R_4 at the apex; M_1 from below the upper angle; M_2 - M_3 close to the lower angle but separate; Cu_{1a} from a little before angle; Cu_{1b} also close to Cu_{1a} . *Hindwings:* Sc anastomosing, beyond the angle, with Rs which is arising from angle; M_1 free, from angle; M_3 and Cu_{1a} connate or slightly stalked, from the lower angle.

Material examined: INDIA: BIHAR: Pusa, 1 ♂, 1.vi. 1905, 3 ♀, 7.vi. 1905, 1 ♀, 30.vi. 1905, all K.D.S. coll., on bel fruit; 2 ♀, 1, 2.xii. 1905, 2 ♀, 4.iii. 1914, 1 ♀, 11.i. 1915, on bel fruit, no coll.; 1 ♂, 5 ♀, 10.xii. 1914, 1 ♀, 11.xii. 1914, 2 ♀, 12.xii. 1914, all on bel fruit, D.P.S. coll.; 2 ♂, 14 ♀, 12.iv. 1914, all on bel, A.M. coll.; TAMIL NADU : Coimbatore, 2 ♀, 22, 27.v. 1915, on wood apple, A.G.R. coll.

(All in I.A.R.I., New Delhi)

INDIA: TAMIL NADU: Coimbatore, 4 exs., 19.iv. 1915, 1 ex., 21.iv. 1915, 2 exs., 22.iv. 1915, 2 ex., 26.iv. 1915, all on wood apple, A.G.R. coll.

(In T.N. Ag. Univ., Coimbatore)

Wing expanse: ♂ 19-20 mm.; ♀ 16-25 mm

Distribution: INDIA: Bihar; Tamil Nadu and West Bengal.

Host: Bel Fruit (Wood Apple) (*Feronia elephantum*)

Status : Serious

Remarks : Popularly known as the "Wood Apple Borer", the species attacks its fruits and causes extensive damage. This species differs from the other species under this genus by the forewing pattern, particularly the costal fascia which is absent in *perticella*, and by the absence of fringe of scales on hind tibiae (present in *perticella*). Besides, in venation this species differs from *perticella* in the placement of veins M_1 and M_3 - Cu_{1a} in hindwings.

Hampson (1896) described the species from Calcutta (W.B.) on the basis of female. The present study reports the species from hitherto unknown areas of Bihar and Tamil Nadu, and also report the male sex, which is of interest.

Genus *Cadra* Walker

1864. *Cadra* Walker, *List Lep. Ins. Br. Mus.*, 30 : 961.

Type species: Cadra defectella Walker

Diagnosis: Body slender. Head with the frons simple and smooth; labial palpi stout, upturned, reaching just above the vertex of head; maxillary palpi filiform; ocelli present antennae thickened in male, simple and slender in female. Forewing long and narrow; male with a fold at the base on underside of forewing and containing a fringe of long hair; some fringe of scales at middle of costa on underside of forewing, in both sexes. Legs slender; Abdomen extending beyond the hind wings.

Venation: Forewing: Veins R_3 and R_5 absent at upper angle, as a result all the Radial veins arise free from the cell; the lower angle also with only three veins i.e. M_2 absent. **Hindwing:** Only three veins arising from the lower angle i.e. M_2 absent.

Distribution : Cosmopolitan.

Remarks: Only one species, viz., *Cadra cautella* (Walker), a well known economically important species, is dealt with as under.

Cadra cautella (Walker)

(FIG. MOTH/RICE MOTH)

(Plate IV, fig. 8; Text figs. 18A-B)

1863. *Pempelia cautella* Walker, *List Lep. Ins. Br. Mus.*, 27 : 73

Diagnosis: Labial palpi upturned, appressed to face, reaching above the vertex of head and about thrice the diameter of eye; antennae thickened in male, simple in female, about two-thirds the length of forewing-costa. Forewings long and narrow, about four times the width at middle; cell about two-thirds the length of wings; male with a fold at base of costa on underside, containing a fringe of long hair and hair scales along costa to beyond the cell; the tuft of scales on upperside only confined to the base at costa; female without tufts at base on upperside but with a few at base on underside. Hindwing cell less than half the length of wing. Outer hind tibial spurs, about half the length of inner ones; hind tibiae with some tufts of scales.

Head, thorax and forewing fuscous grey-brown; forewing with an indistinct erect antemedial brown band; traces of minutely dentate submarginal line present and slightly bent outwards at vein Cu_{1b} . Hindwings semi-hyaline white; the veins and margin tinged with fuscous. Underside fuscous grey-brown, without markings; hindwings as on upperside.

Venation: Forewing: Vein R_1 free, arising from about distal one-fourth of the cell; R_2 free and close to the origin of R_4 ; Veins R_3 , R_5 absent; M_1 from below the angle of cell; M_3 from slightly above the lower angle; M_2 absent; Cu_{1a} from angle and almost in line with the origin of R_2 above; Cu_{1b} slightly before the angle. **Hindwing :** Vein Sc anastomosed with Rs

from beyond the cell angle to near costal margin before apex, both veins ending at the costal margin; M_1 stalked with R_s at base and arising from angle; M_3 and Cu_{1a} connate at lower angle; M_2 absent; Cu_{1b} from before the angle.

Material examined: INDIA : BIHAR : Pusa, 2 exs., 2.xi. 1985, 2 exs., 16, 20.iv. 1986, *F.R.I. President* coll. RAJASTHAN : Jaipur, 2 exs., 10.viii. 1964, 9 exs., 13.x. 1964, 2 exs., 1.ix. 1965, *F.R.I. President* coll.; 2 exs., 19.vi. 1965, 2 exs., 24.vi. 1965, 4 exs., 23.vii. 1965, all *H. Singh* coll.

(In *F.R.I.*, Dehra Dún)

INDIA: BIHAR: Pusa, 1 ♀, 28.vi. 1905, on wheat flour, *K.D.S.* coll.; 1 ♂, 29.vi. 1906, 1 ♀, 27.vii. 1906, 1 ex., 17.viii. 1906, 2 ♀, 22.viii. 1906, 1 ex., 1 ♂, 27.viii. 1906, 1 ♂, 6.ix. 1906, 2 ♀, 25.x.1906, 1 ♂, 1.xii.1906, all on Tamarind, *A.H.* coll.; 1 ♀, 12.iii. 1907, on Gauva leaves, *C.S.M.* coll.; 1 ♀, 9.viii. 1907, on beewax; 1 ♀, 7.ix. 1908, on ripe Plaintain; 1 ♀, 3.iii. 1909, on comb of *Apis flora*; 3 ♂, 5 ♀, 5.iv. 1909, on honey comb; 2 ♀, 20, 21.ix. 1910, on rice grain in store; 1 ♂, 1 ♀, 7.x. 1910; 2 ♂, 4 ♀, 24.iv. 1911, 1 ♀, 2.v.1911, all emerged in Lab. on bee wax and comb; 1 ♂, 8.v. 1911, on whole meal flour, *Fletcher* coll.; 4 ♀, 24.viii. 1914, on Pistachio in store, *C.C.G.* coll.; 2 ♀, 23, 24.i.1924, boring almond kernels in store, *C.D. Shah* coll.; 1 ♂, 3.iii. 1926, 2 ♂, 6.iii. 1926, 1 ♀, 9.iii.1926, 3 ♂, 2 ♀, 22.iii. 1926, 1 ♂, 1 ♀, 26.iii. 1926, all on Pistachio in store, *A. Husain* coll.; 2 ♂, 23.iv. 1928, 1 ♂, 1 ♀, 28.iv. 1928, 3 ♂, 5 ♀, 30.v. 1928, all on whole meal flour, *Fletcher* coll.; Patna, 2 ♀, 21.v.1911, 1 ♂, 1.vi. 1911, 1 ♂, 26.vi. 1911, 2 ♀, 28, 29.vi. 1911, 3 ♀, 1, 2.vii. 1911, 2 ♂, 3.vii.1911, 2 ♀, 5.vii. 1911, 3 ♂, 3 ♀, 6.vii. 1911, 1 ♂, 10.vii.1911, 1 ♀, 15.vii. 1911, all emerged in Lab. in dry poppy petals; Gaya, 1 ♂, 1 ♀, wheat in store in Gaya Jail, 18.iii. 1915; Namkum, 1 ♂, 11.v.1938, 2 ♀, 20, 21.v. 1938, 1 ♂, 3 ♀, 23.v.1938, all on Mohua. KARNATAKA: Dharwar, 1 ♀, 16.iii. 1913, on almond in store. MAHARASHTRA: Bombay, Bassein Fort, 1 ♀, -.x.1909. TAMIL NADU: Madras, 2 ♀, 8.ii.1907, 1 ♂, 4.iii. 1907, all on wheat in store; Palur, 1 ♀, 12.iii. 1914, 1 ♂, 28.iii. 1916, 1 ♂, 3.iv. 1916, all on groundnut, no coll.; Coimbatore, 1 ♀, 11.ii.1915, on lab lab beans (*Insectory colln.*); Pondicherry, 1 ♀, 3.iii. 1941, on groundnut Kernels, *M. Basheer* coll.; Cuddalore, 1 ♀, -.viii.1944, *E.R.G.* coll.; UTTAR PRADESH: Gazipur, 2 ♂, 4 ♀, -.iv. 1929, all emerged in lab. on pressed poppy petals.

(All In *I.A.R.I.*, New Delhi)

INDIA: WEST BENGAL: Kalimpong, 7 exs., -.x. 1962, on grain.

(In *P.D.B.C.*, Bangalore)

INDIA: PUNJAB: Ludhiana, 2 ♂, 2 ♀, 1 ex., -.iv.1975, on stored cashewnut, 1 ex., 1 ♂, 10.viii. 1975, on stored chilli, all *O.S. Bindra* coll.

(In *PbAg. Univ.*, Ludhiana)

INDIA: TAMIL NADU: Coimbatore, 1 ex., on Garlic, 9.xi. 1932, *M.S.K.* coll.; Pondicherry, 1 ex., 3.ii. 1941, boring groundnut, *M. Basheer* coll.

(In *T.N. Ag. Univ.*, Coimbatore)

INDIA: WEST BENGAL: Calcutta, 1 ♀, -.vii.1907, N.A. coll., 1 ♂, 1 ♀ -.ix. 1939, on rice, Roy Choudhary, coll., 2 exs., 23.iii. 1968, on wheat imported from U.S.A to India, 1 ex., 26.xii. 1973, bred on red chillies, G. Joshi coll.; Kalyani, 2 ♂, 3 ♀, -.v. 1976, S. Chakravarti coll.

SRI LANKA : Pundaluoya, 1 ♂, 1 ♀ no more data; Peradeniya, 1 ♀, -.vii.1900; Diyatalawa, 1 ♀, -.x. 1901; 1 ♂, 1 ♀, 3 exs., without data, all E.E. Green coll.

(All in Z.S.I., Calcutta)

Wing expanse: ♂ 12-16 mm; ♀ 13-19 mm

Distribution: Widely distributed in Indian region.

Hosts: Mainly pest in stores, on wheat, flour, rice, almond, groundnuts, pista, and grains. Also on bee-wax, honey combs, dry poppy seeds and petals; spices like garlic, tamarind; fruits like plaintain, guava, dried apple; tobacco leaves; and cotton seeds.

Status: Serious.

Remarks: Popularly known as the FIG MOTH, or simply the RICE MOTH, the species is mainly a pest on stored products, including cereals, grains, dry fruits, condiments, chocolates, cotton and tobacco etc.

The species is characterised by the presence of only three veins from the lower angle of cell in both wings and by the absence of R_3 , R_5 in forewing. Besides, the forewings are fuscous grey-brown and have an indistinct transverse band in the antemedial area, and a minutely dentate submarginal band; the forewings have basal scales on upperside and a fold with a fringe of long scale on underside in male.

Genus *Plodia* Guenee

1845. *Plodia* Guenee, *Annls. Soc. Ent. Fr.*, (2) 3 : 318

Type species: *Tinea interpunctella* Hübner

Diagnosis: Head with the frons smoothly curved, flat; labial palpi obliquely upturned; antennae simple in both sexes, slightly thickened in male. Tibial spurs unequal; outer spurs shorter than those of inner spurs. Forewings long and narrow; cell about two-thirds the length in forewing and less than half the length in hindwings; underside with costal fold on forewings. Both wings with only three veins at lower angle i.e. M_2 absent; forewings with the veins R_3 and R_5 absent.

Distribution : Cosmopolitan.

Remarks: Only one species viz. *Plodia interpunctella* popularly known as “The Indian Meal Moth”, a pest in stored grains, cereals and fruits, is being dealtwith here.

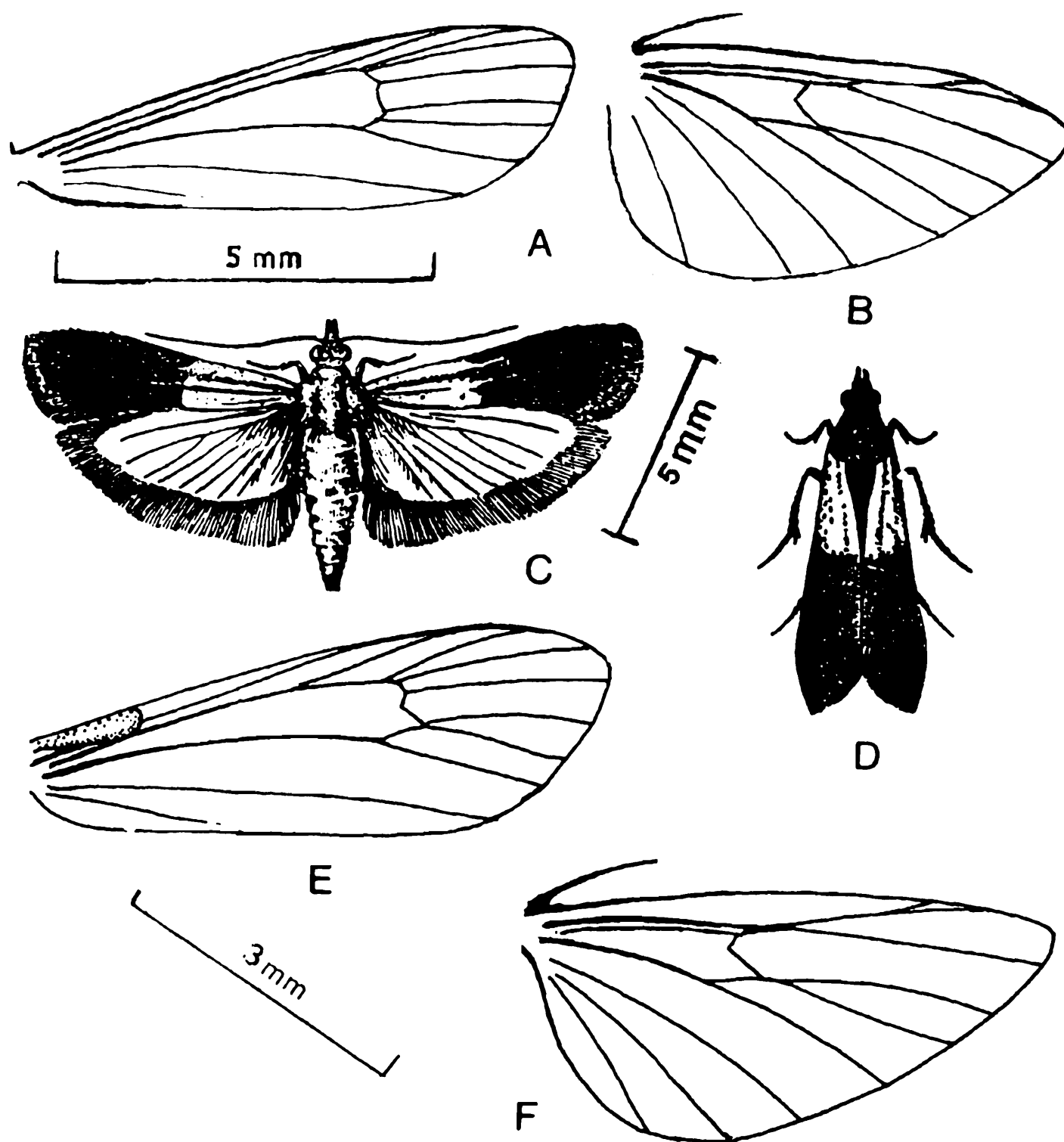


Fig. 18. *Cadra cautella* (Walker) : (A) Fore - and (B) hindwing venation; *Plodia interpunctella* (Hübner) : Adult moth (C) with wings spread, showing wing pattern and other features, Adult moth (D) in a normal resting position (Figures adopted from Metcalf & Flint, 1979), (E) Fore - and (F) hindwing venation (Magnification of B and F same as of A and E, respectively).

***Plodia interpunctella* (Hübner)**

(INDIAN MEAL MOTH)

(Text figs. 18C-F)

1813. *Tinea interpunctella* Hübner, *Samml. eur. Schmelt* : 8 : Pl. 45, fig. 310.

Diagnosis: Head with the labial palpi obliquely upturned, the 3rd joint not reaching frons; antennae thickened in male; simple in female; ciliated in both sexes and about two-thirds the length of forewing costa. Forewing long and narrow; male on the underside, with a fold containing a fringe of long hair; a tuft of scales at middle on costa, also present on underside.

Head, thorax reddish brown; abdomen paler. Forewings pale whitish buff at the basal area, the distal nearly two-thirds dark reddish-brown, tinged with coppery luster. Hindwings paler. Underside forewing with the distal two-thirds dark as on upperside.

Venation : Forewing : All the veins free; vein R_1 from distal a little over one third of the cell; R_2 from close to upper angle; veins R_3 , R_5 absent; R_4 from angle; M_3 and Cu_{1a} connate, from lower angle; Cu_{1b} from before angle. **Hindwing:** Vein Rs-Sc stalked to nearly costal margin and ending at costa; vein M_1 stalked at base of Rs; $M_3 - Cu_{1a}$ slightly stalked at base, from lower angle; Cu_{1b} from before the angle.

Material examined : PAKISTAN: N.W.F.P.; 1 ♂, 1 ♀; 14.x. 1933, 1 ♀, 31.x. 1933, all H.N. Batra coll., reared on Pistachio; Quetta, 1 ♂, 22.ix. 1933, boring Pistachio, Samuel coll. (In I.A.R.I., New Delhi)

Wing expanse: ♂ 15 mm; ♀ 16 mm

Distribution: Cosmopolitan. It is fairly common in India, Myanmar, Pakistan and Sri Lanka.

Hosts: Maize; Wheat; Pistachio; Fig.; Cotton; dried fruit; herbs; dead insects; dried animal material and museum specimens; powdered milk, pollen in beehive etc.

Status. Serious pest.

Remarks. Popularly known as "The Indian Meal Moth", or merely the "Meal Moth", the species is a very serious pest in stored dried fruits, including Pistachio, Figs., etc. and stored grains like wheat and maize, and cotton. In fact it is reported (*vide* Corbet & Tams, 1943, Pruthi, 1969 and Metcalf & Flint, 1979) to feed on a variety of foods, grains, in store, and the foods get covered by an extensive sheet of silken material spun by caterpillars, thus making the same unfit for human consumption.

The species is very close to *Cadra cautella* (Walker), both being very serious pests, by the presence of a fold on underside forewing and in the absence of veins R_3 , R_5 in forewings and M_2 in both wings, so that only three veins arise at lower angle in both wings. The two, however, differ by the wing colouration, which is deep brown with coppery luster, in the distal two-thirds in *Plodia interpunctella*, unlike being uniform grey-brown in *cautella*; and by placement of veins M_3 and Cu_{1a} in both wings as given in venation.

TABLE 6. Distribution of Phycitinae in States of India and some adjacent countries.

Names of States Names of Species	Andhra Pradesh	Arunachal Pradesh	Assam	Bihar	Delhi	Gujarat	Haryana	Himachal Pradesh	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Sikkim	Tamil Nadu	Uttar Pradesh	West Bengal	Bangladesh	Bhutan	Myanmar	Pakistan	Srilanka
<i>Raphimetopus ablutella</i> (Zeller)				±				+						+				+				±	+	±
<i>Emmalocera depressella</i> (Swinhoe)	+			±	+	+	±		+		+	+	+	±			+	±		+			+	
<i>Saluria inficita</i> (Walker)				±					±		+		+				+							±
<i>Cryptoblates angustipennella</i> Ragonot								+	+															±
<i>Etiella zinckenella</i> (Treitschke)				±	±		±				±	±		+		±	±	±	±					±
<i>Thylacoptila paurosema</i> Meyrick			+	±							±		±				±	±	+				±	±
<i>Nephoterix eugraphella</i> Hampson				±	±									±			±	±	±					
<i>Myelois pectinicornella</i> Hampson				±													±				+			±
<i>Elasmopalpus jasminophaga</i> (Hampson)																	±				+			±
<i>Phycita clientella</i> (Zeller)				±	±	±						+					±	±	+					+
<i>Phycita infusella</i> (Meyrick)				±		±								+			+							
<i>Euzophera perticella</i> Ragonot	±			±		±				±		±	±	±			±	±	+				±	±
<i>Euzophera plumbeifasciella</i> Hampson				±													±		+					
<i>Cadra cautella</i> (Walker)*				±					±			±		±	±		±	±	±					±
<i>Plodia interpunctella</i> (Hübner)*																						+	±	+

(*Widely distributed in India
as pest in stored grain/products)

± = Based on material examined
+ = Based on literature.

TABLE 7 : Occurrence of Phycitinae in Nature

SCHOENOBIIINAE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	REMARKS
<i>Raphimetopus ablutella</i>													
(Zeller)													
<i>Emmalocera depressella</i>													
(Swinhoe)													
<i>Saluria inficita</i> (Walker)													
<i>Cryptoblabes</i>													
<i>angustipennella</i> (Ragonot)													
<i>Etiella zinckenella</i> (Treit.)													
<i>Thylacoptila paurosema</i>													
Meyrick													
<i>Nephoterix eugraphella</i>													
Hampson													
<i>Myelois pectinicomella</i>													
Hampson													
<i>Elasmopolpus</i>													
<i>jasminophaga</i> (Hampson)													
<i>Phycita clientella</i> (Zeller)													
<i>Phycita infusella</i> (Meyrick)													
<i>Euzophera perticella</i> Ragonot													
<i>Euzophera plumbeifasciella</i>													
Hampson													
<i>Cadra cautella</i>													
(Walker)													
<i>Plodia interpunctella</i> (Hüb.)													

Based on the material examined

E. Subfamily GALLERIINAE

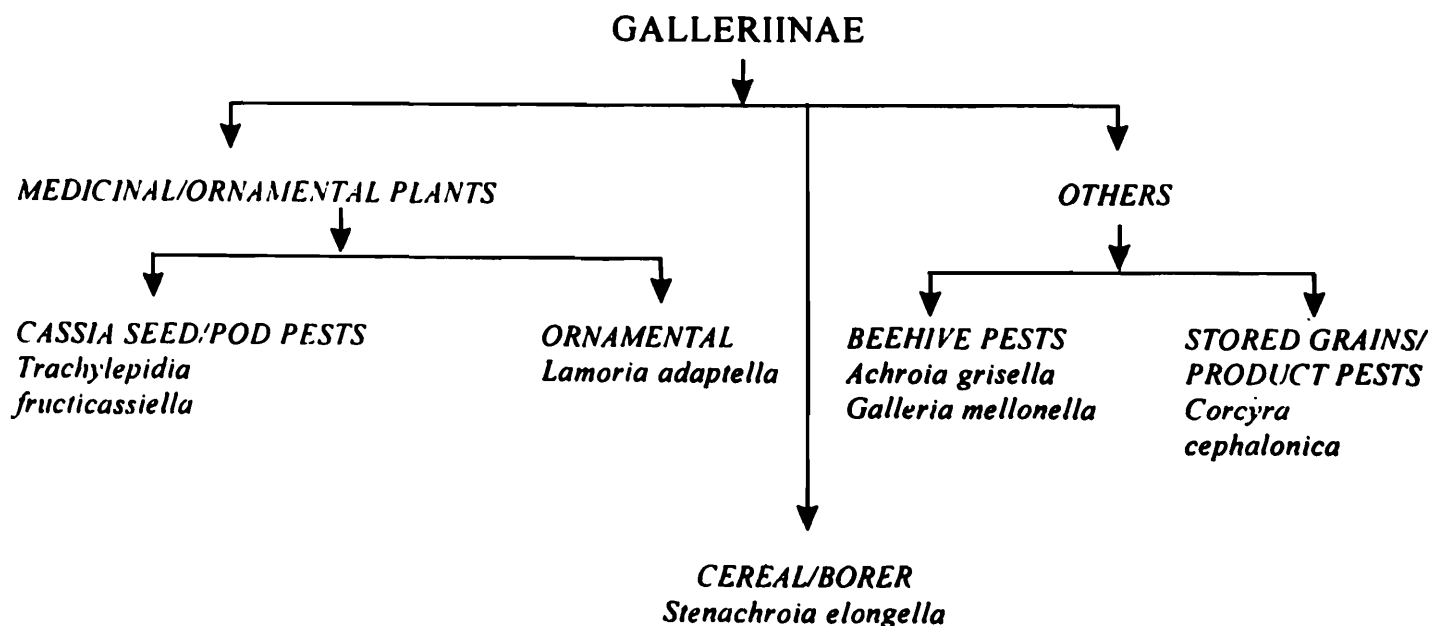
The subfamily is small but widely distributed and represents notoriously known Wax-Moth, *Galleria mellonella* Linnaeus, which destroys the combs of honey-bees and is recorded to occur all over the world. Other species of this subfamily feed on dried food, stored grains/products, pods, nests of wasps and sometimes on roots and under the bark of the tree. Species like *Corcyra cephalonica* (Stainton) is a serious and major pest in stored grains/products, dried fruits and is cosmopolitan in distribution.

Whalley (1964) is of the view that because of its peculiar characteristics, the subfamily Galleriinae can be considered as of an equal status to the family Pyralidae, but himself desists from doing so obviously because of several issues involved. He has considered this to be a subfamily under Pyralidae and is being followed, comprising only six genera with as many species, of economic importance.

Diagnosis: Head without proboscis and ocelli. Forewings with vein R_3 free or R_{3-5} usually stalked; 3A free or ending at 1A + 2A. Hindwings with pecten, i.e. a fringe of long hair, on upperside of cubital vein. Chaetosema absent; tympanal organ simple.

The genitalia relatively simple, without gnathos, valvae simple in male; without signum and variable ovipositor in female.

Remarks : Only six genera and all under the tribe Galleriini (vide Whalley, 1964), with a species each of economic importance, have been included here, whose larvae are known to feed on dried fruits, beehive-wax, wasp-nests, roots and beneath the bark. Of these, three species, viz., *Achroia grisella* (Fabr), *Galleria mellonella* (Linn.) and *Corcyra cephalonica* (Stainton) have attained major status as pests and are nearly cosmopolitan in distribution. While the latter is mainly a stored grains & products' pest, the other two species are serious pests of beehive-wax. The remaining three species, viz., *Lamoria adaptella* (Walker), *Stenachroia elongella* Hampson and *Trachylepidia fructicassella* Ragonot are of minor-pest status and feed, respectively, on *Cassia fistula*, sorghum and fallen leaves of indigo plant. (See below).



Key to identification of *Gallerniiae* genera

1. Hindwing with three veins arising from the lower angle of cell. 2
 - Hindwing with four veins from the lower angle 5
2. Forewing underside with the costal fold well developed in both sexes; R_1 free, R_2 absent, R_3 free or stalked with R_{4-5} . Hindwing cell open or closed; Sc anastomosing with Rs to near apex; frenulum spine single in male, three in female. 3
 - Forewing underside with the costal fold present only in male, if present; R_1 free, R_2 free or stalked with R_{3-5} ; Hindwing cell open; frenulum single in male, two or more spines in female 4
3. Forewing with veins M_2 - M_3 connate or on a short stalk. Hindwing cell closed; M_1 close to or stalked with Rs at angle; M_3 stalked with Cu_{1a} *Achroia* Hübner
 - Forewing with veins M_2 - M_3 on a long stalk; Hindwing cell open; M_1 from below the angle; M_3 connate with Cu_{1a} *Stenachroia* Hampson
4. Forewing with the vein R_1 free; R_{2-5} stalked; M_2 present; underside cell covered with long hairs in male, short and sparse in female. Hindwing with the Sc stalked with Rs upto halfway between the cell angle and the apex. *Trachylepidia* Ragonot
 - Forewing with the vein R_1 free, rarely connate with R_2 ; R_{3-5} stalked; M_2 absent; underside cell with normal scales. Hindwing with the Sc stalked with Rs to near apex.. *Corcyra* Ragonot
5. Forewing in male highly excised below apex to termen; R_3 free, or when stalked with R_{4-5} , nearer to cell angle. Hindwing with the cell closed..... *Galleria* Fabr.
 - Forewing with terminal margin in both sexes normal; R_3 stalked with R_{4-5} , R_3 nearer to apex than to origin of R_5 . Hindwing with the cell open *Lamoria* Walker

Genus *Achroia* Hübner

1819. *Achroia* Hübner, *Verz. bek. Schmett.*: 163

Type species: Bombyx cinereola Hübner

Diagnosis : Head with the frons rounded; labial palpi minute, porrect; maxillary palpi minute; antennae minutely serrate. Legs with the tibiae strongly scaled. Forewings short, the apex rounded; a glandular fold fringed with hair at base of costa on underside, well developed in male; vein R_2 absent. Hindwing with the apex acute; the lower angle of cell with only three veins arising from it.

Distribution : Australian, Oriental and Palaearctic Regions.

Remarks Only one species, as given below, is being dealt with here.

Achroia grisella (Fabr.)

(LESSER WAX MOTH)

(Plate IV, fig. 9; Text figs. 19A-B)

1794. *Tinea grisella* Fabricius. *Ent. Syst.*, 3(2):289.

Diagnosis : Pale brown. Head small; frons simple, smooth, rounded and not raised above the level of eyes' margin; palpi minute in male, projecting about half the length of head in female; antennae simple, very slightly serrate in male, particularly in their distal half, about three-fourths the length of costa in male and about half the length in female. Forewings oblong; about thrice as long as broad; a glandular fold present upto nearly basal 1/3rd of wing, between costal margin and subcostal vein; a tuft of scales from median nervure directed towards cell and reaching as far as the glandular fold. Hindwing with frenulum spine single in male and three in female. Tibial spurs unequal, the outer spurs being half of the inner in middle leg and two-thirds in the hind legs. Abdomen much shorter than the length of hindwings.

Venation : Forewing : Sc curved inwards to accommodate the glandular fold but not touching the Radial vein; R_1 free, from much before the cell angle; R_2 absent; R_3 stalked with R_{4+5} ; cell closed, less than two-thirds the length of wing; M_1 free, from the upper angle of cell; M_2 - M_3 very slightly stalked or connate; Cu_{1a} - Cu_{1b} from before the angle, with Cu_{1a} slightly close to origin of M_2 - M_3 than to Cu_{1b} ; Cu_{1b} almost in line with the origin of vein R_1 above; anal veins present. **Hindwing:** Cell closed, less than half the length of wing; Sc free nearly throughout except beyond cell angle when it anastomoses with Rs nearly upto the apical margin; Rs stalked with M_1 at its base; M_2 absent; M_3 stalked with Cu_{1a} ; Cu_{1b} from before the angle, anal veins present; anal margin with marginal hair tufts.

Genitalia : Vide Clarke (1986).

Material examined. : INDIA : HIMACHAL PRADESH; Simla , 1 ♀, 29.ix.1943, A.E. John coll.; U.P., Dehra Dun, 1 ♀ 21.viii.1923, S.K. Pillai coll.; New Forest, Dehra Dun, 1 ex, 8.viii.1933, damaging beehive, 2 ♀, 22,23.iii.1935, 11 exs. 24.iii.1935, damaging beehive, all R.N. Mathur coll.

(In FRI, Dehra Dun)

INDIA : BIHAR; Pusa, 1 ♂, 1.x.1918, 3 ♂, 4.x.1918, 1 ♂, 5.x.1918, 3 ♂, 1 ♀, 6.x.1918, 2 ♂, 8.x.1918, 1 ♂, 1 ♀, 10.x.1918, 2 ♂, 1 ♀, 12.x.1918, 2 ♂, 13.x.1918, 1 ♂, 1 ♀, 14,15.x.1918, 1 ♂; 1 ♀, 19,21.x.1918, 1 ♂, 1 ♀, 25.x.1918, 2 ♂, 1 ♀, 27.x.1918, 1 ♂, 1 ♀, 28.x.1918, 3 ♀, 17,27.i.1919, 2 ♀, 21,24.i.1919, 1 ♂, 1 ♀, 28.i.1919, 1 ♀, 1.ii.1919, 2 ♀, 3,8.ii.1919, 2 ♀ ♀, 15,17.ii.1919, 1 ♂, 1 ♀, 18.ii.1919, 1 ♀, 22.ii.1919, 2 ♂, 1 ♂, 24.ii.1919, 1 ♂, 1.iii.1919, 1 ♂, 1 ♀, 7, 9.iii.1919, 1 ♀, 11.iii.1919, 2 ♀, 18.iii.1919, 4 ♂, 21,22,24,26. iii.1919, 1 ♂, 2 ♀, 27.iii.1919, 1 ♂, 1 ♀, 28,29.iii.1919, 1 ♂, 1 ♀, 31.iii.1919, 2 ♂, 1 ♀, 4.iv.1919, 1 ♂, 1 ♀, 7.iv.1919, 2 ♂, 9.iv.1919, all Ghosh coll., found nibbling Blanket; 2 ♂, 13 ♀, 22.ix. 1919, 2 ♂, 6 ♀, 24.ix.1919, all coll. in old comb of honey-beehive in store; 4 ♀, 27.iii.1915 2 ♂, 3 ♀, 23.vii.1919, on beecomb, no

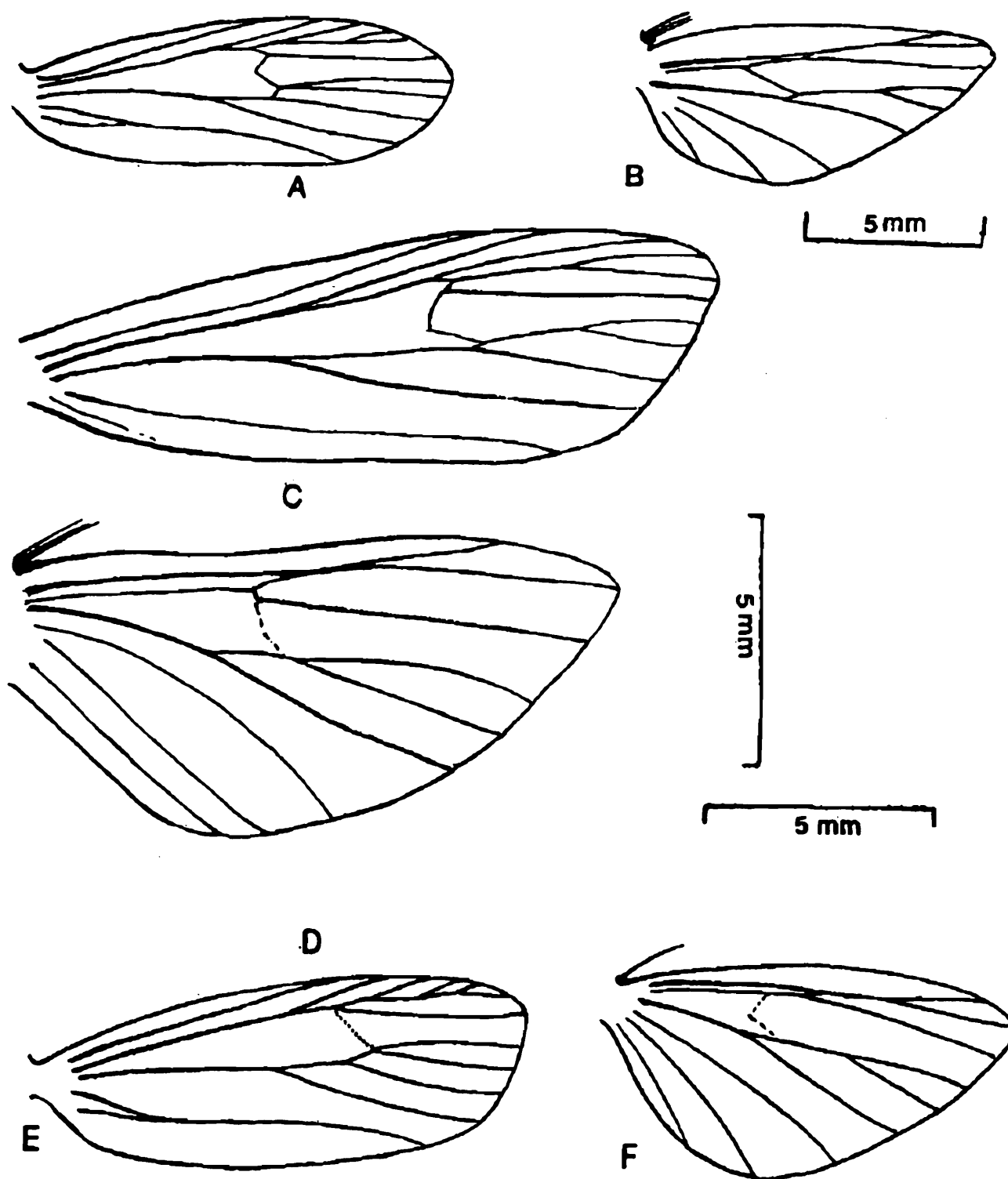


Fig. 19. *Achroia grisella* (Fabr.) ♀ : (A) Fore - and (B) hindwing venation; *Stenachroia elongella* Hampson ♀ : (C) Fore - and (D) hindwing venation; *Trachylepidia fructicassiella* Ragonot ♂ : (E) Fore - (F) hindwing venation (Magnification of A, C and E same as of B, D and F, respectively).

coll.: 3 ♀ ♀ 1 ♂ 23.vii.1919, 1 ♂, 30.vii.1919, 1 ♀, 5.viii.1919, 1 ♂, 8.viii.1919, 2 ♀ 15.viii.1919, 2 ♂ 22.ix.1919, 3 ♂ 6 ♀ 24.ix.1919, 2 ♂ 2.x.1919 all on *Propolis*, no coll.
(In I.A.R.I. New Delhi)

INDIA: TAMIL NADU: Coimbatore, Attacking honeybee comb, 1 ♀ 29.vi.1936.
S.R. Coll.

(In T.N. Ag. Univ. Coimbatore)

INDIA : WEST BENGAL : Calcutta, 11 ♂, 9 ♀, bred on *Apis mellifera*, 18.vi.1890.
Lord Walsingham Coll.

BHUTAN : 1 ♂ -viii. 1894, G.C. Dudgeon coll.

SRI LANKA : Colombo, 1 ♀, 1 ex, iii. 1905; Peradeniya, 1 ♀, -xii. 1904, 2 ♂, 1 ♀ -i.1905, 1 ♀ -xii.1907 E.E. Green coll.

(In Z.S.I., Calcutta)

Wing expanse : ♂, 7-21 mm; ♀, 12-25 mm.

Distribution: INDIA : Bihar; Himachal Pradesh; Punjab; Sikkim; Tamil Nadu; Uttar Pradesh; and West Bengal. *Elsewhere* : Australia; Bhutan; France; Germany; Japan; Madagascar; Sri Lanka; and N. America.

Hosts: Beehive wax and combs; dried fruits and dead insects. Also found beneath tree barks, roots etc. The collections examined at IARI, New Delhi show the species record as "nibbling Blanket" in Bihar. The record points towards its versatility as far as its choice of host is concerned, which may be due to some compulsion rather than choice.

Status : Serious.

Remarks: Sexual dimorphism is not pronounced except that the antennae in male are slightly serrate unlike simple in female.

The species is clubbed with the group containing other two Galleriinae genera, viz., *Trachylepidia* and *Corcyra* because of the hindwings having three veins arising from the lower angle, but differs from both these genera by the hindwing cell being closed and the vein R_{1+2} of forewing being absent. In size, the species is smaller than *Trachylepidia* but bigger than or as big *Corcyra*.

Genus *Stenachroia* Hampson

1898. *Stenachroia* Hampson. *J. Bombay nat. Hist. Soc.*, 12 : 93-94.

Type species: *Stenachroia elongella* Hampson.

Diagnosis: Head with the frontal tuft large, truncate and hollowed out below; labial palpi in male small and tufted with hair; maxillary palpi minute; antennae short and simple, the basal joints with tuft of hair. Forewing long and narrow; costa nearly straight to near the apex which is rounded; the outer margin short; cell rather long; veins R_1 free;

R_2 absent, R_3 free; R_{4-5} stalked; M_1 from below the upper angle; M_2 - M_3 on a long stalk. *Hindwing* : M_2 absent; M_3 - Cu_{1a} connate, cell open.

Distribution : India.

Remarks : Only one species is being dealt with here as follows.

***Stenachroia elongella* Hampson**

(Text figs. 19C-D)

1898. *Stenachroia elongella* Hampson, *J. Bombay nat. Hist. Soc.*, 12 : 93

Diagnosis : Head with the frontal tuft large; labial palpi small, the 2nd segment obliquely upturned, the 3rd porrect; maxillary palpi minute; antennae simple, the basal joints tufted with hair. Forewing long and narrow; the costa nearly straight upto apex which is rounded; the outer margin short, the cell long; a glandular swelling at base in both sexes; a fringe of upturned scales in middle of cell above the median nervure. Hindwing cell open.

Head, thorax, abdomen and forewing yellowish white. Forewings irrorated with a few black scales; a diffused whitish streak in cell, a point of black scales in middle of cell and another on discocellular; a faint oblique fuscous postmedian band; a marginal series of black specks. Hindwings semihyaline whitish; the veins and a marginal line fuscous.

Venation : *Forewing* : Sc nearly straight; R_1 free, from much before the cell angle; R_2 absent; R_3 free, from a little before cell angle; R_{4-5} stalked; cell closed; M_1 from below the upper angle; M_2 - M_3 on long stalk; Cu_{1a} close to lower angle or to common stalk of M_2 - M_3 ; Cu_{1b} from nearly middle of cell and before the origin of R_1 above. *Hindwing* : Sc free upto a little beyond cell angle, thereafter it anastomoses only slightly with Rs; M_1 free and from below the upper angle; M_3 connate with Cu_{1a} at angle; Cu_{1b} from before; frenulum spine single in male, three in female. Anal veins present.

Material examined: INDIA : KERALA (COCHIN STATE); Trivandrum, C. Farm, 1 ex. 17.xii.1933, boring cholam, Neelakandhan coll.

(In Coll. Ag. Sci. K. Ag. Univ. Vellayani, Trivandrum)

INDIA : BIHAR: Pusa, on *Marua* earhead; 2 ♀, 18,25.ix, 1907, 3 exs., 20,23.ix.1907. *M. Singh* coll., 1 ♂, 7.x.1907, 1 ♀, 14.x.1907, on Sorghum earheads, 1 ♀ 1.ix.1906, 1 ♀, 23.x.1907, on Maize, all D.P.S. coll. TAMIL NADU: Coimbatore, 1 ♂, 29.vii.1912, on Cholan earheads: Haqri Bellery, 1 ♂, 26.vi.1916 from Cholan earheads, V.R. Rao coll.

(In IARI, New Delhi)

INDIA . WEST BENGAL; Kalimpong, 2 ♂, 4 ♀, on Maize, 14.ix.1963.

(In P.D.B.C. Bangalore)

INDIA : TAMIL NADU : Coimbatore 1 ex., 23.vi.1916, 1 ♀, 5.vii.1916, 2 exs., 8.vii.1916, all Y.R. coll. from cholam earhead.

(In T.N. Ag. Univ.. Coimbatore)

Wing expanse: ♂ 24 mm; ♀, 29-32 mm.

Distribution: INDIA : Assam; Bihar; Kerala; Tamil Nadu; and West Bengal.

Hosts: Ear-heads of Sorghum, *Sorghum vulgare*, Maize, Marua, *Eleusine coracana*, and grains.

Status: Minor pest.

Remarks: The species is close to the preceding species by the presence of a fold on underside of forewing, and a tuft of scales, but differs due to the cell being open in hindwing, and other characters as given in the key.

Genus *Trachylepidia* Ragonot

1887. *Trachylepidia* Ragonot. *Ann. Soc. Ent. Fr.*, (6) 7 : 260.

Type species: *Trachylepidia fructicassiella* Ragonot.

Diagnosis: Head with the frons having a conical tuft; labial palpi minute in male, larger in female, projecting about the length of head; maxillary palpi filiform; antennae simple in both sexes, with a tuft on basal joint in male. Legs with spurs unequal. Forewings with the vein R_2 stalked with R_{3-5} . Hindwing with the cell open; lower angle with only three veins arising from it.

Distribution : India; Egypt; Papua New Guinea; Sri Lanka and Syria

Trachylepidia fructicassiella Ragonot

(POD BORER)

(Plate IV, figs. 10-11; Text figs. 19E-F)

1887. *Trachylepidia fructicassiella* Ragonot. *Ann. Soc. Ent. Fr.*, (6) 7 : 260.

Diagnosis: Head large; frons simple, rounded and smoothly curved; labial palpi minute in male, large in female, projecting about twice the diameter of eye; antennae about half to less than half the length of costa, simple in both sexes. Forewings about three times as long as wide; underside with a well developed costal fold, with tuft of scales in male, female without fold but with a tuft of long hair-like scales on costal area corresponding to the fold in male; tufts also present in discocellular cell area almost upto the discocellulars. Hindwings with frenulum spine single in male, three or more in female. Tibial spurs unequal, outer spurs half the length of inner in middle legs and three fourths in hindlegs.

Head, thorax, forewings and abdomen dark greyish brown. Forewings irrorated with dark brown patches, angled inwards in antemedial and postmedial areas; a series of terminal black dots present. Hindwing pale brown, particularly in female.

Venation: Forewing : R_1 free; R_2 - R_5 stalked, R_2 close to angle of cell or mid-way between cell angle and R_3 ; R_{4-5} from nearer to the apex; M_1 from upper angle; M_2 - M_3 connate or stalked, from the lower angle which is produced; Cu_{1a} from before angle, but in line with upper angle, Cu_{1b} from before Cu_{1a} and the origin of R_1 , above. **Hindwing:** Sc anastomosing with Rs to beyond origin of M_1 ; M_3 - Cu_{1a} on a long stalk; Cu_{1b} from before; cell open, without any trace of discocellulars.

Material examined: INDIA : U.P. : Dehra Dun, 1 ♂, 1 ♀, 4.v.1911, ex. *Cassia fistula*; Chandbag, 2 ♀, 3.ix.1915, 2 ♀, 15.iii.1924, 1 ♂, 1 ♀, 12.iv.1924, 1 ♀ 20. v.1924, all J.C.M. Gardner coll.; New Forest, 1 ♂, 30.iv.1940, B.S. Gusain coll., 1 ♀, 14.iv.1951, 2 ♀, 16.iii.1953, Forest Entomologist coll.

(In FRI, Dehra Dun)

INDIA : BIHAR : Pusa; 1 ♀, 19.iii.1914, 3 ♀, 28, 31.iii.1914, 1 ♂, 4 ♀, 1,2,3.iv.1914, 2 ♀, 6,9.iv.1914, 2 ♀, 22.v.1914, 1 ♀, 14.vi.1914, all from *Amaltas* Pod; 3 ♀, 15,23,28.vi.1915, U.B.M. coll.; 1 ♀, 14.iv.1915, inside dry *Cassia* pod, T.B.F. coll.; 1 ♀, 15.iv.1915, 1 ♂ 2 ♀ 29.ii.1916, 1 ♀, 3.iii.1916, inside *Cassia fistula* pod, Haq coll.; 1, ♂ 1 ♀, 19.vi.1915, 2 ♀ 24.vi.1915, 2 ♂, 24,27.vii.1915, 3 ♀, 4,14.viii.1915, 2 ♀, 24,28.ix.1915, from *Cassia fistula* pods, T. Ram coll.; 5 ♀, 13, 17, 18, 20. iv. 1916, Ram Saran coll.; 2 ♂ 22.i.1927, boring pods of *Cassia fistula*, Rangi coll. DELHI : 7 ♀ 3,5,7, 12,16, 24.iii.1938, all boring pods of *Cassia fistula*, Bhatia coll. KARNATAKA : Coorg; Sidapur, 4 ♀, 11,14.iv.1917, 5 ♀, 15,17,18.iv.1917, 1 ♂, 19.iv.1917, 27.iv.1917, 1 ♀, 1.v.1917, boring pods of *Cassia fistula* V.R. coll

(In IARI, New Delhi)

INDIA : TAMIL NADU : Coimbatore, 6 ♀, on *Cassia fistula*, no other data, Forest Entomologist coll

(In I.F.G. & T.B. Coimbatore)

INDIA : KARNATAKA : Bangalore, 3 ♀, -v.1961.

PAPUA NEW GUINEA : GUSAP, Lanu Ramu site, 1 ex., -iv. 1961

(In PDBC, Bangalore)

INDIA : BIHAR : Pusa, 1 ♀, 26.iii.1908, from pods of *Cassia fistula*, no coll.

(In T.N. Ag. univ. Coimbatore)

INDIA : TAMIL NADU; Coimbatore, 1 ♀, - 1978, F.R.C., J.C. Bosuchoudhary coll.

WEST BENGAL : Hooghly Dist., 4 ♂, 7 ♀, 2.i.1895, emerged, 4.i.1895, Baboo Girish Chander coll. on fruits of *Cassia fistula*.

SRI LANKA : Habarane, 1 ♂, 18.vi.1906, 1 ♀, 11.vii.1906, E.E. Green coll.

(In Z.S.I. Calcutta)

Wing expanse : ♂, 20-30 mm; ♀, 24-34 mm

Distribution : INDIA : Bihar; Delhi; Karnataka; Punjab; Tamil Nadu; Uttar Pradesh; and W. Bengal; Elsewhere : Egypt; Papua New Guinea; and Sri Lanka.

Status : Serious pest on pods of *Cassia fistula*.

Remarks : The species, as in *Achroia grisella* and *Stenachroia elongella*, is characterised by the presence of costal fold on underside forewings but only in male. The species differs from both the above-mentioned species by the cell being open in both wings (vs. closed in both wings in *Achroia grisella* and open in hindwing and closed in forewing in *Stenachroia elongella*).

The species *Trachylepidia fructicassiella*, has been grouped here with the genus *Corcyra* and, along with *Achroia* and *Stenachroia*, has only three veins arising from the lower angle of cell in hindwing, but has been clearly differentiated in the key. While *Corcyra cephalonica* (Stainton) is a serious pest of stored grains/fruits/products/spices, this species is mainly confined to only seed-pods of *Cassia fistula* which is mainly of medicinal value.

For more differences from *Corcyra*, see in the latter species.

While Hampson (1896) recorded the species only from Punjab in India, the present study shows its extensive distribution in India, particularly in the states of Bihar, Delhi, Karnataka, Punjab, Tamil Nadu, Uttar Pradesh and W.B. The pattern of distribution only indicates that it is well distributed in India, obviously related to the areas where *Cassia fistula* is available.

Genus *Corcyra* Ragonot

1885. *Corcyra* Ragonot. *Ent. mon. Mag.*, **22** : 23.

Type species: *Melissoblaptēs cephalonica* Stainton.

Diagnosis: Head with the frons smooth; labial palpi short in male, longer in female, antennae annulated in male, simple in female, with the basal segment i.e. scape nearly as long as five antennal segments. M_2 absent in both wings; cell open in hind wings.

Distribution : Cosmopolitan.

Remarks: Only one species, *Corcyra cephalonica* (Stainton) is being dealt with here. The species is a serious pest, the larvae of which infest a large variety of agricultural produce including cereals, millets, pulses, oilseeds, spices, dry fruits etc. The larvae either feed directly on the food material, or bind the food material by silken web and their own faecal matter and form galleries through which the larvae move about. Thus, the food material is rendered unfit for human consumption.

Corcyra cephalonica (Stainton)

(RICE MOTH)

(Text figs. 20A-C)

1866. *Melissoblaptēs cephalonica* Stainton. *Ent. mon. Mag.*, **2** : 171-172

Diagnosis: Head small, with the frons smooth, with anteriorly directed tufts; labial palpi short in male, less than the diameter of the eye but longer in female and about twice

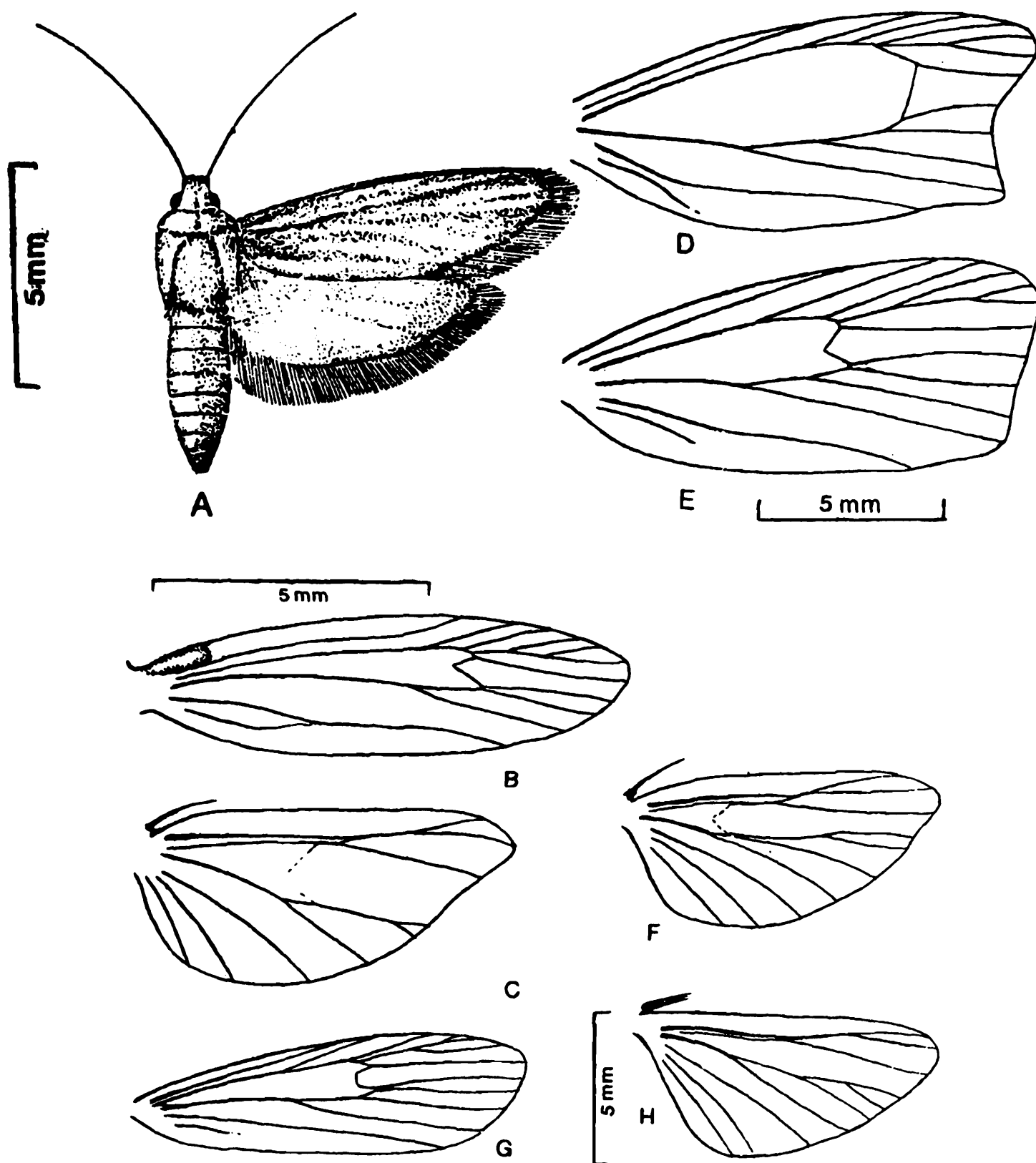


Fig. 20. *Corcyra cephalonica* (Stainton) : Adult moth (A) with one side wings spread (adopted from Pruthi, 1969). (B) Fore - and (C) hindwing venation: *Galleria mellonella* (Linn.). (D) ♂ Fore -. (E) ♀ Fore - and (F) hindwing venation; *Lamoria adaptella* (Walker) ♀ : (G) Fore- and (H) hindwing venation (Magnification of C, D & F, and G same as of B. E and H, respectively).

the diameter of eye: antennae minutely annulated in male, simple in female, about two thirds the length of forewing costa; scape very long, flattened and about the length of 5-6 antennal segments. Tibial spurs unequal, with the outer spurs about half of inner spurs. Forewings long and narrow, oblong, about three-and-in-a-half to four times as long as broad, with the apical margin rounded. Hindwing with apex narrowed and produced, about twice as long as broad; frenulum spine single and stout in male, held by well developed retinaculum: three spines in female. Underside forewing with an oblong fold at base, in costal region, due to which the vein Sc bends towards the radial vein but does not touch the same. Underside with a tuft of scales along subcostal vein and in the space below median nervure, both directed towards cell.

Head and thorax pale brown; antennae pale brown, with segmental fuscous bands; abdomen darker; forewing dark brown, irrorated with black scales throughout the upper portion of the forewing, nearly forming streaks along veins, the lower portion, from below cubito-median vein and vein Cu_{1b} , paler; hindwings semi-hyaline and dark-brown.

Venation : Forewings: Vein R_1 generally free, rarely stalked with R_2 , the latter from before the upper angle of cell; R_3 stalked with R_{4+5} , nearly from the middle of the stalk of R_{4+5} or slightly nearer to angle, R_4 ending at costa; M_1 from below the upper angle; M_2 absent; $M_3 - Cu_{1a}$ connate, rarely stalked from angle; Cu_{1b} from much before angle and the origin of R_1 above. *Hindwings :* Sc free, anastomosing with Rs after latter's origin to nearly half the distance between its anastomosis and costal margin; discocellulars weak, making the cell being open; M_1 anastomosed with Rs at base; M_2 absent; $M_3 - Cu_{1a}$ on a very long stalk; Cu_{1b} from angle.

Material examined : INDIA : KERALA : Quillon, stored cashewnut, 3 exs., 16.ii.1979, Oomen V. Oomen coll. TAMIL NADU : Coimbatore, 3 exs. from stored grain, 10.iv.1933, 3 exs., 17.iv.1933, 1 ex., 24.iii.1933, all A.M. coll.

(In Coll. Ag. Sci. K. Ag. Univ, Vellayani, Trivandrum)

INDIA : U.P.; Saharanpur, 1 ♀, ex. *Butea frondosa*, 5.xii.1918, C.F.C. Beeson coll.
(In FRI Dehra Dun).

INDIA : BIHAR : Pusa, 9 exs. on jowar, - iv.1905, 10 exs., 7.vi.1905, all C.P. coll.; 1 ♀, on suji, 8.i.1926, Rangi coll.; 1 ♀, on suji, 4.iii.1926, Ram Saran coll.; 1 ♂, 12.xii.1930 from wheat, L. Nigam coll.; 1 ex. 16.ix.1933 from wheat, 2 ♂, 3.x.1933, 11 ♂, 11.x.1933, 2 ♀, 14.x.1933, all from stored maize flour, H.N. Batra, coll. MADHYA PRADESH : Gwalior, 2 ♀, in stored Jowar, 1.xi.1944, H.L. Rattan coll. MAHARASHTRA : Bombay, from cork and rice grain, 3 ♀, 30.v.1909. TAMIL NADU (Labelled "South India") : Coimbatore, 4 ♂, 10, 11, 12, 14.ii.1914, in stored rice, 1 ♀, 17.i.1916, from cotton seed, all E.B. coll; 1 ♂ 1 ♀, 18.iii.1914 from flour, T.V.R. coll., 1 ♂, 18.ii.1916, Ponniah coll. UTTAR PRADESH : Gaya jail, wheat in store, 3 ♂, 3 ♀, 28.v.1915. 2 ♂, 5 ♀, 4.vi.1915, 2 ♀ 11.vi.1915, 1 ♀, 2.vii.1915, 3 ♀, 8.viii.1915, no other data. WEST BENGAL : Calcutta, Alipore Jail, 8 exs., 4, 6, 29, 31.iii.1907, 7, 11. iv.1907, 3.v.1907 all from imported Flax seeds, 1 ♂, 2 ♀, 24.iv.1907, 4 ♀, 29.viii.1907, from wheat flour.

MYANMAR : Mandela, on ground nut, 3 exs.8.vi.1930: on salad seeds, 6 exs, 23.i.1906, 3 exs., 12.v.1909, all *K.D.S.* coll.

PAKISTAN : Sind [no more data] : on jowar grain, 4 ♂, 2 ♀, 29.xi.1919, *G.S. Kulkarni* coll.

SRI LANKA : Suduganga, 1 ♂, 1.vii.1918, *S.R. White* coll.

(All in I.A.R.I., New Delhi)

INDIA : PUNJAB : Ludhiana, 1 ex.; 7.vi.1982, 2 ♂, 2 ♀, 20.vii.1982, all on cotton seed, *Joginder Singh* coll., 1 ex., 1 ♀, 26.viii.1983, on Turnip seed, *Darshan Singh* coll.

(In Pb. Ag. Univ. Ludhiana)

INDIA : ANDHRA PRADESH : Hyderabad : 3 ♂, attacking stored groundnuts, 11.i.1996, *G.S. Arora* coll. (from Dept. of Oilseed Research Hyderabad); Hyderabad, several larvae (from A.P. Ag. Univ. Bio. Control Lab.) 12.i.1996 (11 ♂, 12 ♀ emerged in Z.S.I. Lab. in March, 1996) all *G.S. Arora* coll. on maize grain. KERALA : Vellayani, 1 ex., 2.vi.1956, on grass. W. BENGAL : Burdwan, 2 ♂, -.1986; Calcutta, 6 exs., bred in Z.S.I. Lab., *G. Joshi* coll.

SRI LANKA : Bandarawella, 2 ♂, -.iii, iv.1905; Peradeniya, 1 ♂, -.ii.1904, 1 ♂, -.iii.1905, 2 ♀, 1 ex., -.xi.1907, 1 ♂, -.xii.1907.

(All in Z.S.I., Calcutta)

Wing expanse : ♂ 12-22 mm; ♀ 17-28 mm

Distribution: Cosmopolitan. In India, material from Andhra Pradesh; Bihar; Delhi; Kerala; M.P.; Maharashtra; Tamil Nadu; U.P.; and West Bengal.

Hosts: Dried fruits, cashew and groundnuts, spices, rice and cereals in stores, lac, cork and bark of tree.

Remarks: It is a very serious pest in store and ware-houses, attacking almost every edible material in store and rendering it unsuitable for human consumption due to webbing of stored material. Pruthi (1969) states that the larvae in fact spoil food material more than it actually feeds upon. Malhotra and Katiyar (1970) reported it to feed on live lac insects and even their own moths. Joshi (1976) reported it to feed even on the plastic cap of the bottles in which these were being bred. The larvae live in tubes made up of silk re-enforced with powdery matter and broken grain into a mess, thus making it unfit for human consumption.

Like the preceding species, *Trachylepidia fructicassiella* with which *Corcyra cephalonica* has been grouped due to the presence of only three veins arising from the lower angle of cell in hindwings, the two differ by the character of vein R_2 in forewing which in *cephalonica* is not anastomosing with R_{3+5} (vs stalked in *fructicassiella*) and by the absence of vein M_2 in hindwing in *cephalonica*, (unlike present in *fructicassiella*) i.e. there are only three veins arising from the lower angle of cell in both wings in *cephalonica*.

Whereas *Corcyra cephalonica* is a very serious pest in stored products/grains/cereals/ rice/foods including biscuits/spices, and economically very important due to huge losses it causes, *Trachylepidia fructicassiella* is of minor status, compared to losses it causes, and is restricted to seed pods of *Cassia fistula*, the pods of which are used for medicinal purposes in Ayurvedic system.

When alive, the adult moths rest in a sloping manner, with their frontal one third part of body raised, supported by legs, and not touching the ground with the wings folded over backwards, on the abdomen, with their antennae directed posteriorly dorso-laterally on wings, whereas the palpi lie close to each other pointing anteriorly giving an appearance of a closed beak. The mature larvae pupate without any pupal case, i.e. the pupae are naked.

Genus *Galleria* Fabricius

1798 *Galleria* Fabricius. *Ent. Syst. (Suppl.)* : 419. 462

Type species : *Phalaena cereana* Blom. (= *mellonella* L.)

Diagnosis : Head with the frons smooth, frontal tuft sharp; labial palpi short in male, long in female and projecting beyond the frontal tuft, maxillary palpi short and filiform; antennae simple in both sexes. Forewing with the costa highly arched; deeply incurved in male at outer margin between apex and vein Cu_{1a} , simple in female; cell large, about three-fourths of wing in male, but a little over half in female; vein R_3 free or connate with R_{4+5} in male, stalked in female.

Distribution : India, Europe, Syria; West Indies.

Remarks: Only one species, *G. mellonella* (Linn.) is being dealt with as under.

Galleria mellonella (Linn.)

(THE HONEYCOMB MOTH)

(Plate IV, figs. 12-13; Text figs. 20D-F)

1758. *Phalaena (Tinea) mellonella* Linn., *Syst. Nat.* 10th ed, 1 : 537.

Diagnosis : Head with the frons smooth, rounded; labial palpi porrect, short in male but long in female; antennae simple in both sexes, about three-fifths the length of costa in male, slightly longer in female. Forewing highly excised below apex to termen which is angled in male, but the same is normal in female; cell extremely large in male; about three-fourths of the total length, but normal and about a little over half in female; frenulum spine single in male, held by retinaculum, three in female. Legs with the outer tibial spurs about half the length of inner. Underside forewing with tufts of scales at base in both sexes in subcostal area.

Head and thorax ochreous brown; underside paler, with tufts of ochreous brown shining scales. Forewing upperside greyish brown at base, and brownish beyond upto

termen; the inner area paler, with raised tufts of rough scales, below the cell, more pronounced in male; hindwing upperside pale ochreous brown to nearly postmedial area, beyond which is fuscous brown. Undersides paler, forewings cell uniformly laden with grey scales in male, the inner area paler from base to tornal area, but the outer and costal area darker; underside hindwings paler, irrorated with black scales and three subapical streaks. Abdomen dark brown dorsally, with segmental tufts laterally; underside paler.

Venation : Forewing : R_1 and R_2 free; R_3 free or connate with R_{4+5} in male but stalked in female, due to shifting of discocellulars, thus enlarging cell in male; M_1 from a point corresponding to upper angle of cell, almost in line with the origin of R_2 ; M_2 - M_3 connate from lower angle of cell in male, connate or stalked in female; Cu_{1a} - Cu_{1b} from before the angle. *Hindwing*: Vein Sc anastomosed with Rs to beyond the origin of M_1 ; M_2 - M_3 stalked, from lower angle of cell; discocellulars weak, but the cell closed, Cu_{1a} closely approximated to base of M_2 - M_3 .

Material examined : INDIA : TAMIL NADU : Coimbatore, 1 ♂, 10.iv.1933, 4 ♂, 3 ♀, 12.iv.1933

(In Coll. Ag. Sci. K. Ag. Univ., Vellayani, Trivandrum)

INDIA : BIHAR : Pusa, 1 ♂, 17.iii.1910, on beewax. UTTAR PRADESH Dehra Dun, 4 ♀, 4.iv.1923, ex beehive, *N.C. Chatterjee*, 2 ♀, 17.vii.1933, 1 ♂, 2 ♀ 18.vii.1933, predacious on beehive, all *J.C.M. Gardner* coll.

(In F.R.I., Dehra Dun)

INDIA : BIHAR : Muzaffarpur, 1 ♀, 3.iv.1905, 1 ♀, 21.iii.1906, 3 ♀, 25, 26.iii.1906 all *T.V.R.* coll. on *Cassia* pods; Pusa, 1 ♂, 3.v.1906, 1 ♂, 1 ♀, 1 ex., 12.v.1906, *H.M.L.* coll.; 1 ♀, 25.vi.1909, 1 ♂, 7.vii.1909, 1 ex, 9.viii.1909, 1 ♂, 21.iii.1910, no coll; 1 ♀, 30.vii.1906, 1 ♀, 6.viii.1906, 2 ♀, 14.ix.1906, 1 ♀, 2.xi.1906, all *A.H.* coll; 1 ♂, 3 ♀, 11.vi.1906 1 ♀, 12.vi.1906, 1 ♂, 21.iii.1910, 1 ♀, 9.x.1914, 1 ♀, 8.iii.1915, ex beewax, all *Y.R.C.* coll.; 1 ♂, 2 ♀, 18,19.iii.1913, *N.C.* coll; 1 ex., 2.x.1920 on wax of bees, *S.C. Sarkar* coll; 1 ♂, 5 ♀, 23,24.viii.1916, *Fletcher* coll; 2 ♂, 27.ii.1928, 1 ♀, 1.iii.1928, *Bose* coll.; 2 ♂, 23.iii.1923, *Isaac* coll. from combs of *Apis indica*. MADHYA PRADESH : Nagpur 1 ♀ in honeycomb, 29.iv.1911, 2 ♀, 3,6.vii.1945; Maharaj Bag, 1 ♀, 26.iv.1911. TAMIL NADU : Madras Mus.; 1 ♀, 16.ix.1941.

SRI LANKA : Colombo, 2 ♂, 1 ♀, -vii.1906, destructive to beewax either in comb or prepared, no coll.

(all in I.A.R.I., New Delhi).

INDIA : KARNATAKA : South Coorg, 1 ♀, no date, *Entomologist F.R.C.* coll.

(In I.F.G. & T.B., Coimbatore)

INDIA : BIHAR Pusa, 1 ♂, 16.vi.1911, no coll. TAMIL NADU Coimbatore, attacking honeycomb, 1 ♂, 21.v.1929, 3 ♂, 1 ♀, 16.xii.1930, 2 ♀, 27.xii.1930, *M.C.C.* coll; 1 ♀, 21.v.1929, 1 ♂, 25.x.1935, 5 ♂, 1 ♀, 29.x.1935, 2 ♂, 10.vi.1937, 1 ♂ 15.vi.1937,

2♂, 2♀, 2.ix.1938, all attacking honeycomb, S.R. coll; 1♀, 10.vi.1937, Cherian coll.; Kovilpatha, 2♂, no date, A.V.R. Rajah coll..

(In T.N. Ag. Univ., Coimbatore, T.N.)

INDIA : SIKKIM, 1♀, -.vi.1897, G.C. Dudgeon coll.

SRI LANKA : Kandy, 1♀, -.vi.1906; Colombo, 1♂, 2♀, -.viii.1906; Peradeniya, 1♂, 1♀, -.vii.1911, 2♂, 3ex, -.x.1911, 1♀, no date, all E.E. Green coll.

(In Z.S.I., Calcutta)

Wing expanse: ♂ 20-30 mm; ♀ 19-32 mm

Distribution: Cosmopolitan. In India : Bihar; Karnataka; Madhya Pradesh; Sikkim; Tamil Nadu; and U.P. Also Sri Lanka.

Hosts: Mainly honeycombs in beehive or stored wax of *Apis indica*, *Apis florea* and pods of *Cassia fistula*.

Status: Serious pest.

Remarks: The species is a very serious pest of bee-wax and honeycomb in beehives and causes huge losses.

The species is quite different externally as well as on the basis of other characters from all the preceding species, particularly by the presence of four veins from the lower angle of cell in both wings. Due to this character, it has been grouped with the following species viz., *Lamoria adaptella* (Walker). Besides, forewings in male are highly excised which is characteristic feature in this species. The two species, viz., *G. mellonella* and *L. adaptella* differ from each other by the hindwing cell being closed in the former and open in the latter, and by the R_3 in forewings always stalked with R_{4+5} and being nearer to apex than to R_5 in *Lamoria adaptella*, unlike in this species where it is either free or if stalked, it is closer to angle and not to apex.

While *Galleria mellonella* is a major serious pest of beehive wax, the *Lamoria adaptella* is of minor status economically, and is restricted to Indigo plants, or fallen fruits of gullar and banyan trees. Rarely, it attacks onions in stores.

Genus *Lamoria* Walker

1863. *Lamoria* Walker. *List Lep. Ins. Br. Mus.* 27:87

Type species : *Lamoria planalis* Walker (= *adaptella* Walker)

Diagnosis : Head with the frons smooth, frontal tuft conical; labial palpi minute in male, large in female, projecting beyond the head; maxillary palpi short and filiform; antennae simple in both sexes, stout at base. Forewings long and narrow, with a glandular swelling well developed in male on underside, weakly developed in female; vein R_{3+5} stalked, R_3 nearer to the apex; lower cell angle much produced in male than in female. Hindwing with the cell open. Legs stout; spurs long and unequal.

Distribution : Throughout India, Myanmar and Sri Lanka. Also Afghanistan; S. Africa; and Europe.

***Lamoria adaptella* (Walker)**

(INDIGO MOTH)

(Plate IV, fig. 14; Text figs. 20 G-H)

1863 *Pempelia adaptella* Walker, *List Lep. Ins. Br. Mus.*, 27 : 74

Diagnosis : Head with the frons simple, smoothly curved; labial palpi minute in male, longer in female, projecting about twice the diameter of eye, downwardly curved at extremity; antennae simple in both sexes, about a little over half the length of forewing costa; the scape large and flattened, about the length of five antennal segments. Tibial spurs unequal, outer spurs about half the length of inner. Forewings with glandular swelling at base of costa, large in male but smaller in female. Hindwings longer than abdomen; frenulum spine single in male, three in female.

Head, thorax, abdomen and forewings grey-brown, the latter suffused with dark fuscous; indistinct, dentate antemedial and postmedial lines present, with more or less developed fuscous specks in cell and a marginal series. Hindwings pale, semi-hyaline, more so in female, suffused with fuscous towards margin.

Venation : *Forewing* : views R_1 and R_2 free; R_3 on a long stalk with R_{4+5} , arising from far beyond the origin R_5 and nearer to the apex; M_1 from below the upper angle; M_2 - M_3 slightly stalked or connate; Cu_{1a} - Cu_{1b} from before the angle. *Hindwing* : cell open; four veins arising from the lower angle of cell and at regular interval.

Material examined : INDIA : U.P. : Ram Nagar Div., Milani R., 1 ♂, 29.iv.1919, 1 ♂, 28.vii.1919, 1 ♂, 30.vii.1919, 2 ♂, 1 ♂, 31.vii.1919, 3 ♂, 1 ♀, 3.viii.1919, 1 ♂, 1 ♀, 12.viii.1919, 1 ♀, 29.viii.1919

(In FRI, Dehra Dun)

INDIA : BIHAR : Pusa, 3 ♀, 5,6.iii.1906, on dry Indigo leaves, no. coll.; 1 ♂, 11.ii.1907, *B.S.* coll; 1 ♀, 15.vi.1908, 3 exs., 25,26.vi.1908, 1 ♀, 1.vii.1908, all on Onion in store, no coll; 1 ♀, -.vii.1908, *C.W.M.* coll; 1 ♀, 11.ix.1908, *T.N.J.* coll., 1 ♀, -i.1908, 1 ex, 27.iv.1916, *U.Babadur* coll.; 1 ex, 16.i.1917, 1 ♀, - v,1918, all *D.P. Singh* coll; 2 ♂, 23,24.ii.1910, 1 ♀, 10.ii.1916, no coll.; 1 ♂, 11.ii.1914, sitting on wall, 1 ex, 20.iv.1910, 7 ♀, 17.viii.1914, 1 ♂, 3 ♀, 19.viii.1914, 1 ♂, 3 ♀, 20.viii.1914, 3 ♀, 21.viii.1914, 1 ♀, 22.viii.1914, 1 ♂, 1 ♀, 12,13.ii. 1915, 1 ♀, 15.ii.1915, 6 ♀, 22.ii.1915, 3 ♀ 27.ii.1915 1 ♂, 10.ii.1916, 2 ♂, 1 ex 15.iii.1916, 1 ♀, 7.iii.1928, all on ripe fallen gullar fruits, *T.B.F.* coll.; 3 ♀, 25.iii.1918, all in silken tube in soil among guinea grass, *Boy* coll; 1 ♀, 28.iv.1928, 1 ♀, 3.v.1928, *Bose* coll. MEGHALAYA : Cherrapunjee, 1 ♂, *Native* coll.

(In IARI, New Delhi)

INDIA : BIHAR; Pusa, 1 ♀, 11.vi.1910, *T.B.F.* coll.; TAMIL NADU : Coimbatore 1 ♀, -.1994 student coll.

(In T.N. Ag. Univ., Coimbatore)

SRI LANKA : Kandy, 1 ♂, -.iv.1904, 1 ♀, -.vi.1907; Maskeliya, 1 ♂, -ii.1905, 2 ♂, -.iv.1905, *E.E. Green* coll.

(In Z.S.I., Calcutta)

Wing expanse: ♂ 18-31 mm; ♀ 24-44 mm

Distribution : INDIA : Bihar : Maharashtra. Meghalaya, Tamil Nadu and Uttar Pradesh. Also Sri Lanka; Afghanistan; Africa and Europe.

Hosts : Indigo leaves ; Ripe fallen gullar fruits; Ripe banyan fruits; and onion in store.

Status : Minor.

Remarks : Like *G. mellonella* Linn., this species has also been characterised by the presence of four veins arising from lower angle of cell in hindwing, due to which it has been clubbed in the key with this species. However, this is different due to an open cell in hindwing unlike closed in *mellonella* and the vein R_3 though stalked with R_{4-5} as in *mellonella*, it arises from nearer to the apex of forewing unlike in the latter where it is closer to the cell angle.

TABLE 8. Distribution of Galleriinae in States of India and some adjacent countries.

Names of States Names of Species																			
	Andhra Pradesh	Assam	Bihar	Delhi	Himachal Pradesh	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Meghalaya	Punjab	Sikkim	Tamil Nadu	Uttar Pradesh	West Bengal	Bhutan	Myanmar	Pakistan	Srilanka
Achroia grisella (Fabr.)			±		±						+	+	±	±	±	±			±
Stenachroia elongella Hampson		+	±				±						±		±				
Trachylepidia fructicassella Ragonot			±	±		±					+		±	±	±				±
Corcyra cephalonica (Stainton)	±		±	+			±	±	±		±		±	±	±		±	±	±
Galleria mellonella (Linn.)			±			±		±				±	±	±					±
Lamoria adaptella (Walker)			±						+	±			±	±					±

± = Based on material examined

+ = Based on literature.

TABLE 9 : Occurrence of Galleriinae in Nature

[illegible]

SUMMARY

The study deals with the identity of Pyralid moths of economic importance, mainly based on external characteristic features. As many as forty-four species represented by about 3800 examples were examined, in five subfamilies, viz., (i) Crambinae, Schoenobiinae, Nymphulinae, Phycitinae and Galleriinae. The material was studied at various important repositories, including Agricultural Universities, Zoology/Entomological Departments in Universities, Research Institutes/Stations, National Pusa Collections at I.A.R.I., New Delhi, Forest Research Institute, Dehra Dun, and National Zoological Collections, at Z.S.I., Calcutta (vide Table I).

(i) The subfamily Crambinae deals with eleven species in six genera, viz., *Ancylolomia* Hübner (1 species), *Chilo* Zincken (3 species), *Chilotraea* Kapur (4 species), *Girdharia* Kapur (1 species) *Bissetia* Kapur (1 species) and *Borer* Guenee (1 species).

The genus *Ancylolomia* Hübner includes only one species, viz., *A. chrysographella* (Kollar) which is a root-caterpillar infesting mainly paddy.

The genus *Chilo* Zincken, includes only three economically important pests, viz., *suppressalis* (Walker), *partellus* (Swinhoe) and *tumidicostalis* (Hampson). *C. partellus* is mainly sorghum and maize pest and does not appear to infest other crops like sugarcane or paddy where sorghum and maize are widely grown. In their absence it becomes a serious pest on paddy; *suppressalis* attacks maize, jowar, paddy, and is also recorded on paddy. This species is also being recorded from newer areas of Kerala, Rajasthan and U.P. The third species, *tumidicostalis* is mainly a sugarcane pest.

The genus *Chilotraea* Kapur, till recently treated as a synonym of *Chilo* Zincken has been revived again, and deals with four important pests, viz., *infuscatellus* (Snellen), *ceylonicus* (Hampson), *auricilia* (Dudgeon) and *polychrysa* Meyrick. All these are serious pests of paddy or sugarcane, or both. *C. auricilia* is a serious pest on paddy in eastern India, Orissa, M.P., T.N., Kerala and J.K., but serious pest on sugarcane from Bihar westwards through U.P., Punjab, Haryana, H.P., Gujarat and Rajasthan. It does not seem to attack sugarcane in paddy-growing areas like Assam, W.B., Sikkim, Bihar, Orissa, M.P., J.K., T.N. and Kerala, and paddy in sugarcane-growing areas like U.P., Punjab, Haryana, H.P., Gujarat and Rajasthan. *C. infuscatellus* (Snellen) is a serious pest on sugarcane and is fast spreading to newer sugarcane-growing areas, where the temperature is high with low humidity. *C. ceylonicus*, mainly known from Sri Lanka and Tongkin, is being recorded from Indian mainland areas like Assam, Bihar, Kerala, Maharashtra, Southern India and W.B., being a major pest on paddy.

The genus *Girdharia* Kapur, dealing with only one pest here, viz., *tauromma* Kapur, had hitherto been known by males only. The present study brings to light several females of the species and also report the species from Bihar for the first time.

Bissetia steniellus Hampson, also hitherto known from Assam and Punjab, is being reported to occur in areas of Haryana, H.P., Maharashtra, Rajasthan and U.P.

The genus *Borer* Guenee has been included here for an important sugarcane pest, "The Internode-Borer", hitherto known as *Chilo sacchariphagus indicus* (Kapur) (*Vide* Bleszynski, 1970), or *Proceras indicus* Kapur (*Vide* Kapur, 1950). In fact Fletcher & Nye (1984) stated that *Proceras* Bojer is not a Pyralid genus, due to incorrect type species designation of *sacchariphagus* Bojer to *Proceras* Bojer. Following Tams (1942) and Fletcher & Nye (1984), the genus *Borer* is being included to place as a new combination, the Indian Internode Borer, as *Borer sacchariphagus indicus* (Kapur).

(ii) The subfamily Schoenobiinae deals with ten species under single genus *Scirpophaga* Treitschke. Following Lewvanich (1981), the pest-species have been kept under five different groups, viz., *Whalleyi* (1 species), *Excerptalis* (3 species), *Incertulas* (2 species), *Praelata* (2 species) and *Occidentella* (2 species).

All the species are pests mainly of sugarcane, or paddy, or both, besides on some other alternative hosts. While *Scirpophaga xanthogastrella* (Walker), *S. excerptalis* (Walker) and *S. magnella* deJ. are pests exclusively on sugarcane, all the other species, except *S. whalleyi* Lewvanich whose status is not known, viz., *S. incertulas* (Walker), *S. innotata* (Walker), *S. nivella* (Fabr.), *S. gilviberbis* Zeller, *S. fusciflua* Hampson and *S. virginia* Schultze are mainly paddy pests in the Indian region. Of these, *excerptalis* and *xanthogastrella* on sugarcane, and *incertulas*, *innotata* and *nivella* on paddy are serious pests. Although *S. nivella* (Fabr.) has often been considered as a serious pest on sugarcane, the recent findings, however, suggest that this species does not occur on sugarcane but occurs only on paddy. This has also been confused with sugarcane top-borer, *S. excerptalis*, but the two differ considerably from each other, even externally, and both the species have been clearly separated.

Similarly, the males of the paddy pests, *S. gilviberbis* Zeller and *S. nivella* (Fabr.) have often been confused with those of *S. incertulas* (Walker). However, all the three species are quite different externally and can very easily be separated, if carefully examined. The keys and the text help segregate these species easily.

Based on the availability of material, the species *S. innotata* (Walker) is being recorded for the first time from Punjab; *S. fusciflua* Hampson from Orissa, H.P., Haryana, T.N. and W.B., and *S. virginia* Schultze from Pakistan.

(iii) The subfamily Nymphulinae includes only two well known "Rice-Case-Worms" species under the genus *Parapoynx* Hübner.

(iv) The subfamily Phycitinae includes fifteen pest-species in thirteen genera under four tribes, viz., *Anerastiini* (1 species, 1 genus), *Peoriini* (2 species, 2 genera), *Cryptoblabini* (1 species, 1 genus) and *Phycitini* (11 species, 9 genera). While two species, *Cadra cautella* (Walker) and *Plodia interpunctella* (Hübner), of *Phycitini*, are pests on stored-products, grains, cereals, dried fruits, stored tobacco and a variety of hosts, the remaining thirteen species infest as Stem-borers, Root-borers, Pod-borers, Pod-webbers, Leaf-webbers, Leaf-defoliators on a variety of host-plants, like sugarcane, paddy, vegetables, fruits, cotton, tobacco, oilseeds, etc. Only two species, *Raphimetopus ablutella* (Zeller) and *Cryptoblabes angustipennella* Ragonot are of minor status, whereas all the other are more or less serious pests and cause extensive damage to their hosts.

Several new records, both in respect of newer areas and unknown sexes are being reported here. Particular mention may be made of the following species : *Myelois pectinicornella* Hampson was hitherto known by males from Bhutan. Presently recorded from Tamil Nadu and Bihar in India, and Sri Lanka, and reporting “females” of the species for the first time; *Elasmopalpus jasminophaga* (Hampson), hitherto are known by males from Bhutan and Sri Lanka, the species is being reported from India, with both the sexes, for the first time; *Phycita clientella* (Zeller), hitherto known by females, is being represented by both the sexes from various localities of India; *Euzophera plumbeifasciella* Hampson, hitherto known by females, is being represented by both the sexes from India, with Bihar and Tamil Nadu as first report from these states.

(v) The subfamily Galleriinae comprises six species in six genera, which are very serious pests on honey-comb/wax, stored-grains/cereals, and products, *Cassia fistula* pods and indigo plants.

All the species and genera under various subfamilies have been provided with identification keys based on external characters, and illustrations of wing-venation, both fore and hindwings, provided to help identify the pests easily.

The study also records lower wing expanse in several species.

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- | | | | |
|----|--|---|--|
| 1. | Aligarh Muslim University
Department of Zoology
Aligarh (U.P.) | : | Professor M.S. Jairajpuri

Professor Saifuddin. |
| 2. | Andhra Pradesh Agric.
Univ., Hyderabad (A.P.) | : | Dr. D.N. Reddy,
Principal
:
Dr. Ganeswara Rao
Head, Dept. of Biological Control. |
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Hisar (Haryana) | : | Professor J.S. Naresh
Dr. Sucheta Singh
Asstt. Professor |
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Dept. of Entomology,
Cuttack (Orissa) | : | Dr. Y.R.Y.S. Rao,
Head |
| 6. | Directorate of Oilseed Research,
Entomology Division,
Hyderabad (A.P.) | : | Dr. Vijay Singh
Head. |

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Director
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Head, Dept. of Entomology
Dr. N.V Krishmaiah,
Entomologist |
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Dr. R.K. Thakur,
Scientist SD, Entomologist |
| 9. | G.K.V.K., University
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Dr. Usha Ramakrishnan
Principle Scientist |
| | : | : | Dr. V V. Ramamurthy
Senior Scientist |
| | : | : | Dr. S.L. Gupta
Senior Scientist |
| 11. | Institute of Forest Genetics
& Tree Breeding,
Coimbatore (Tamil Nadu) | : | Dr. Madhavan Pillai,
Entomologist |
| 12. | Indian Institute of Sugarcane
Research, Dept. of Entomology,
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Dr. Jagdish Chander
Entomologist |
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Dr. D. Muralidharan,
Professor |

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| 16. | National Research Institute
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Kozikode (Kerala) | : | Dr. S. Devasahayam, Head. |
| 17. | Department of Oilseed Research,
Division of Entomology
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Dept. of Entomology,
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| | | : | Dr. G.S. Mavi |
| | | : | Dr. K.S. Brar |
| 20. | Punjabi University,
Dept. of Zoology, Patiala | : | Dr. H.S. Rose
Reader |
| 21. | Rice Research Station,
Chinsure (W.B.) | : | Entomologist |
| 22. | Rice Research Station,
CCS HAU, Kaul
Dist. Kaithal | : | Dr. Roshan Lal
Entomologist |
| | | : | Dr. Lekhi Ram |
| 23. | St. John's College
Agra (U.P.) | : | Dr. Ipe M. Ipe
Principal |
| | | : | Dr. (Mrs.) A. Ipe
Prof. & Entomologist |
| 24. | Sugarcane Breeding
Institute, Coimbatore | : | Dr. Easwaramoorthy, Head
Div. of Entomology |
| 25. | Sugarcane & Cotton Research
Station, Jullundhur (Punjab) | : | Dr. M.S. Dhoor
Entomologist |
| 26. | Sugarcane Research Station
CCS HAU, Uchani,
Karnal (Haryana) | : | Dr. Y.R. Madan
Entomologist |

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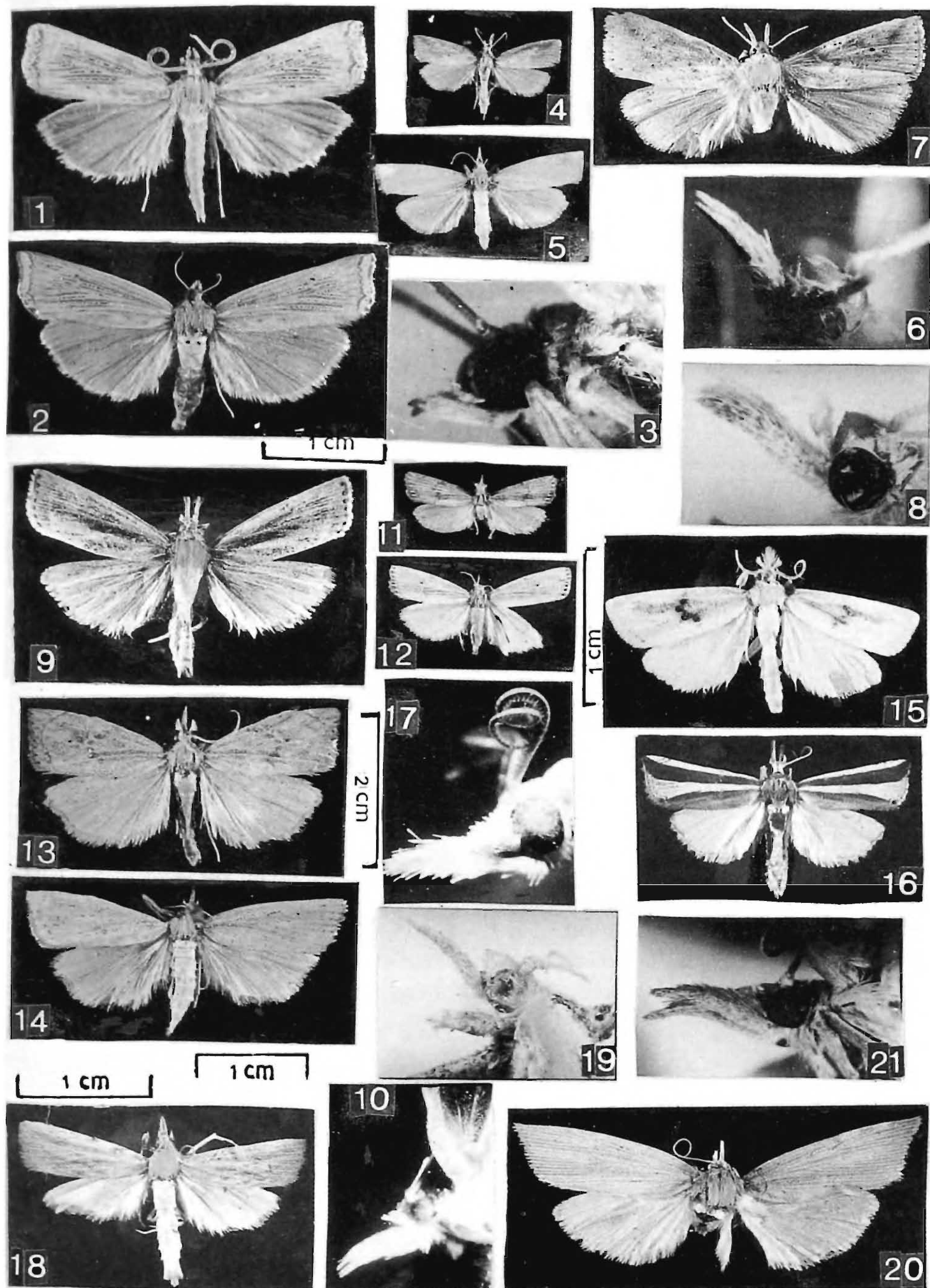
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1. *Ancylolomia chrysographella* (Kollar) ♂ up.
2. - do - ♀ up.
3. - do - : Head enlarged, lat. view for labial palpi.
4. *Chilo suppressalis* (Walker) ♂ up.
5. - do ♀ up.
6. - do - : Head enlarged, lat. view for labial palpi.
7. *Chilo partellus* (Swinhoe) ♂ up.
8. - do - : Head enlarged, lat. view for labial palpi.
9. *Chilo tumidicostalis* (Hampson) ♂ up.
10. - do - : Head enlarged, lat. view for labial palpi.
11. *Chilotraea ceylonicus* (Hampson) ♂ up.
12. - do - ♀ up.
13. *Chilotraea auricilia* (Dudgeon) ♂ up.
14. - do - ♀ up.
15. *Chilotraea polychrysa* (Meyrick) ♂ up.
16. *Girdharia tauromma* Kapur ♂ up.
17. - do - : Head enlarged, lat. view for labial palpi.
18. *Bissetia steniellus* Hampson ♂ up.
19. - do - : Head enlarged lat. view for labial palpi.
20. *Borer sacchariphagus indicus* (Kapur) ♂ up.
21. - do - : Head enlarged, lat. view for labial palpi.

up = upper view

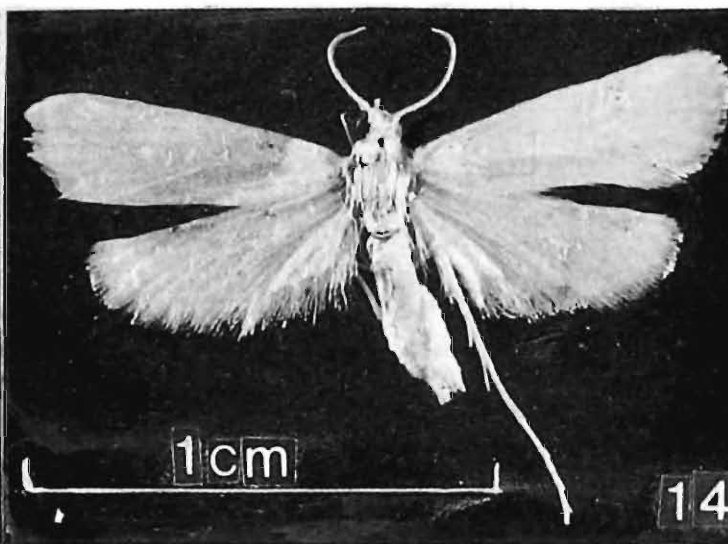
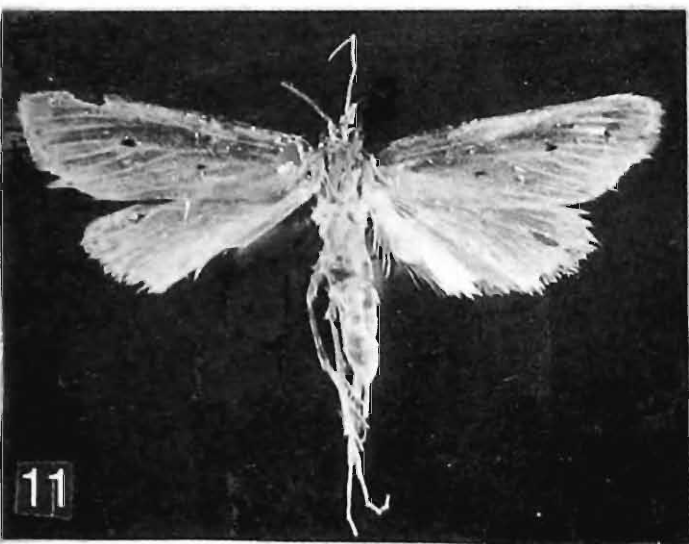
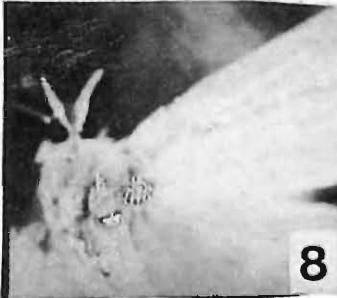
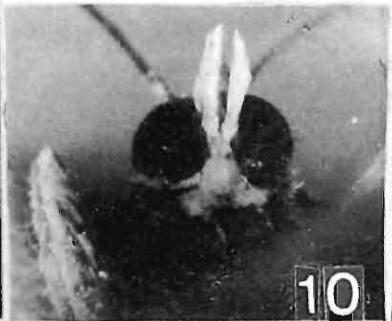
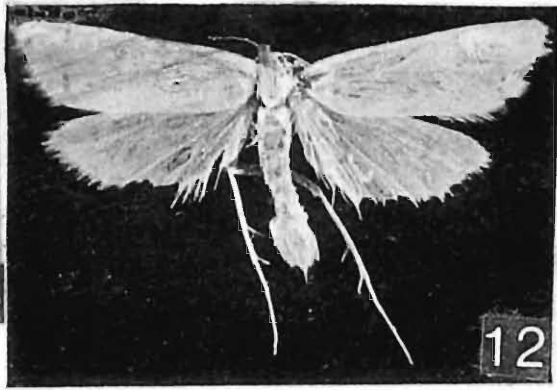
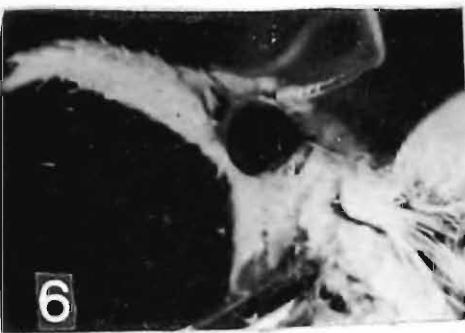
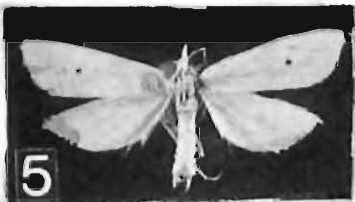
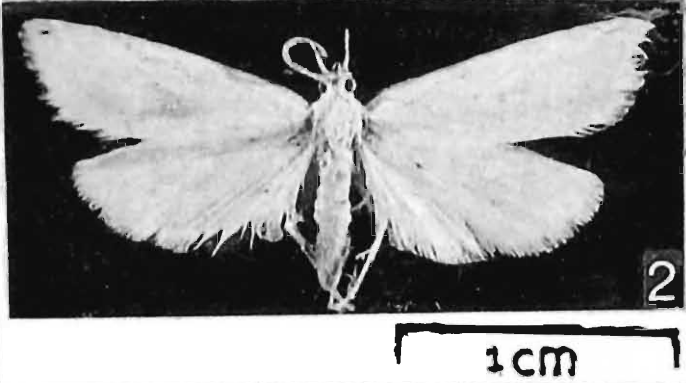
(Magnifications : 1, 7 as of 15; 4, 5, 11, 12 as of 13; 9, 16, as of 14; 20, as of 18)



1. *Scirpophaga whalleyi* Lewvanich ♀ up.
2. *Scirpophaga xanthogastrella* (Walker) ♀ up.
3. *Scirpophaga excerptalis* (Walker) ♂ : Head enlarged, lat. view for labial palpi.
4. *Scirpophaga incertulas* (Walker) ♂ up.
5. - do - ♀ up.
6. - do - ♀ up.
7. *Scirpophaga innotata* (Walker) ♀ up.
8. - do - : underside part view for labial palpi.
9. *Scirpophaga nivella* (Fabr.) ♀ up.
10. - do - : Head underside view for labial palpi.
11. *Scirpophaga gilviberbis* Zeller ♀ up.
12. *Scirpophaga fusciflua* Hampson ♀ up.
13. - do - : Underside part view for labial palpi.
14. *Scirpophaga virginia* Schultze.

(up = upper view)

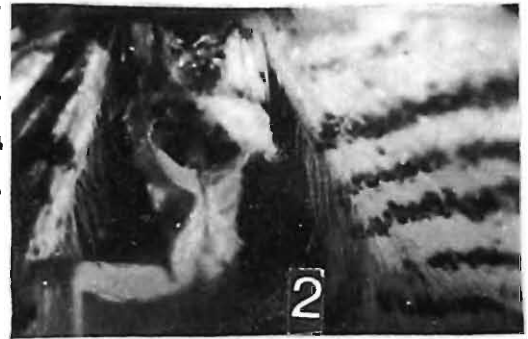
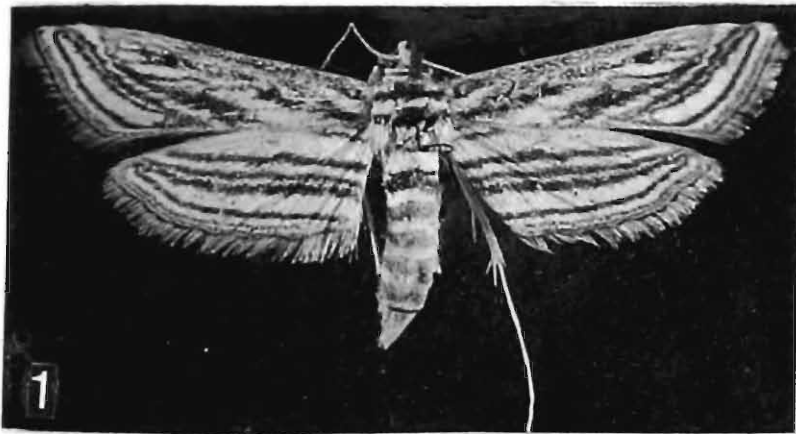
(Magnifications: 1 as of 7; 2, 11 as of 12; 4 as of 5)



1. *Parapoynx fluctuosalis* (Zeller) ♂ up.
2. - do - : Praecinctorium.
3. *Parapoynx stagnalis* (Zeller) ♂ up.
4. - do - ♂ Head enlarged for antennal segments.
5. *Raphimetopus ablutella* (Zeller) ♂ up.
6. *Emmalocera depressella* (Swinhoe) ♂ up.
7. - do - ♂ Head enlarged, dor. view for antennal sinus.
8. *Saluria inficita* (Walker) ♂ up.
9. - do ♀ up.
10. *Cryptoblabes angustipennella* Ragonot ♂ up.
11. *Etiella zinckenella* Treitschke ♂ up.
12. *Thylacoptila paurosema* Meyrick ♀ up.

(up = upper view)

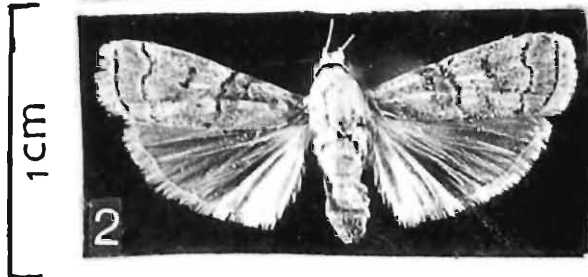
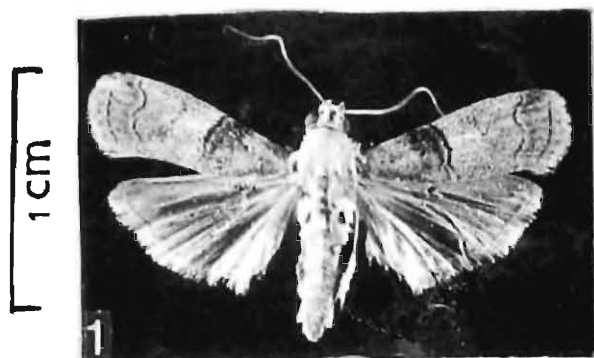
(Magnifications of 5 as of 6; of 8 as of 9)



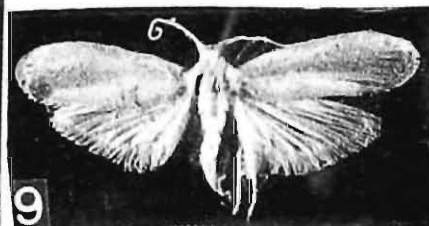
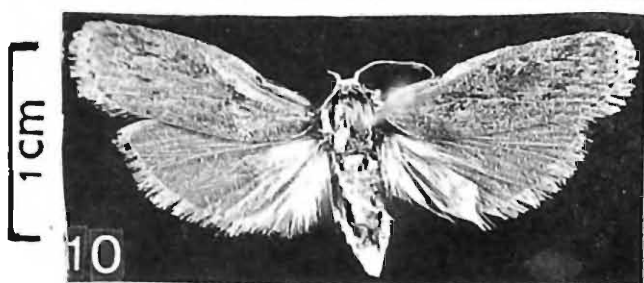
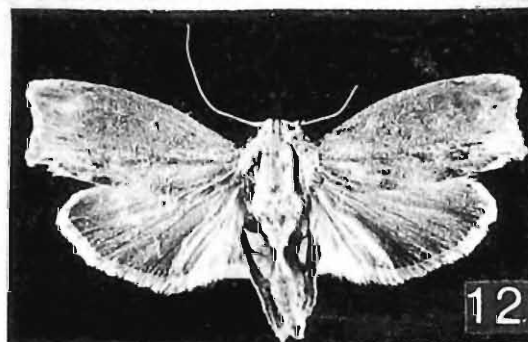
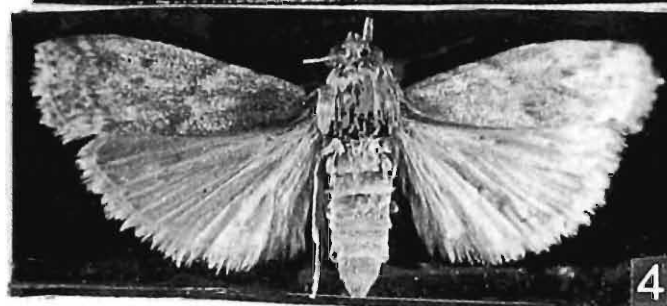
1. *Nephopterix eugraphella* Ragonot ♂ up.
2. - do - ♀ up.
3. *Elasmopalpus jasminophaga* Hampson ♂ up.
4. - do - ♀ up.
5. *Phycita clientella* (Zeller)
6. *Phycita infusella* (Meyrick)
7. *Euzophera plumbeifasciella* Hampson.
8. *Cadra cautella* (Walker)
9. *Achroia grisella* (Fabr.)
10. *Trachylepidia fructicassiella* Ragonot ♂ up.
11. - do - ♀ up.
12. *Galleria mellonella* (Linn.) ♂ up.
13. - do - ♀ up.
14. *Lamoria adaptella* (Walker)

up = upper view

(Magnifications: 9 as of 5, 7; 12, 14 as of 13)



1 cm



1 cm

2 cm



ARORA, G.S.

PLATE-V

1. *Scirpophaga excerptalis* (Walker) ♂ up.
2. - do - ♀ up.
3. *Scirpophaga incertulas* (Walker) ♂ up.
4. *Scirpophaga nivella* (Fabr.) ♀ up.

(up = Upper view)

(Magnifications: Normal size)

ARORA, G.S.

PLATE V



1



2



3



4