

Biological notes on eye-frequenting moths from N. Thailand

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Biological Notes on Eye-frequenting Moths from N. Thailand *

by

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c/o Ciba Ltd., Basle, Switzerland

(with 10 Figures)

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Synopsis

Some detailed records on the occurrence and distribution in N. Thailand of 25 eye-frequenting lepidoptera are given. The prevalence of the two main species (*Lobocraspis griseifusa* and *Arcyophora sylvatica*) was investigated over a period of one year. Records of eye-frequenting habits have been compiled from Chiangmai, Fang and Hot Districts, and new host records are included in this present paper. The observations on the day- and night-time resting places are summarized; and a short description of the natural habitats is given. One specimen of *Mermis* sp., an endoparasitic nematode, was obtained from a *L. griseifusa* female.

* This article is dedicated to Prof. J. SEILER, formerly Director of the Zoological Institute, Federal Institute of Technology (E.T.H.), Zürich, on the occasion of his 80th anniversary.

1. Introduction

Eye-frequenting lepidoptera were first known from Africa (REID 1954, LEWIS 1960). This particular behaviour of adult noctuids was discovered in Asia much later, i.e. on the occasion of entomological investigations carried out in Cambodia during 1958 (BÜTTIKER 1959, 1962 a, 1962 b). The African and S.E. Asian records have been summarized chronologically in a map (Fig. 1). On account of the interesting field and laboratory results obtained from Cambodia it was possible to carry out an expedition to North Thailand in 1963, which yielded further data on the biology, feeding habits etc. of eye-frequenting moths from S.E. Asia.*

Two papers have been published so far and referred mainly to the host specificity of the noctuids, pyralids and geometrids found during that particular survey (BÜTTIKER 1964, 1965).

The area visited during the entomological expedition in 1963 covers mainly the neighbourhood of Chiangmai ($18^{\circ} 48' \text{ N.}$; $98^{\circ} 59' \text{ E.}$; 307 m. o. sea level), Chiang Dao ($19^{\circ} 22' \text{ N.}$; $98^{\circ} 59' \text{ E.}$), Fang ($19^{\circ} 56' \text{ N.}$; $99^{\circ} 14' \text{ E.}$) and Hot ($18^{\circ} 05' \text{ N.}$; $98^{\circ} 34' \text{ E.}$). (Fig. 2).

The mean monthly rainfall figures in millimetres for Chiangmai are the following :

TABLE 1

	mm		mm		mm		mm
January	10	April	31	July	150	October	126
February	2	May	154	August	218	November	56
March	18	June	129	September	271	December	11

thus totalling 1181 mm. per annum. (See also BRAAK 1931).

Description of the main collecting sites

LIVESTOCK BREEDING STATION, CHIENGMAI — L.B.S.C. (altitude approx. 340 m.) situated at the foot hills of Doi Sutep, very close to a large area of dry Dipterocarp forest, and at the edge of the rice growing plains of Chiangmai.

* This expedition was financed by the Swiss National Fund for the Advancement of Science, Grant Nr. 2669.



Fig. 1. — Records of Eye-frequenting Lepidoptera from Africa and S.E. Asia 1915–1964

Number of record on map	Year of observation	Author *, country, species of moth and host
1	1915	NEAVE, Nyasaland, <i>Arcyophora elegantula</i> , dead bullock
2	1915	NEAVE, South Africa, species unknown on "wounded buck"
3	1915	POULTON (and TAMS), Tanganyika, <i>Arcyophora patricula</i> and <i>A. longivalvis</i> on mules and horses
4	1929	BRAIN, S. Africa, <i>Arcyophora longivalvis</i> on cattle
5	1941	CHORLEY/TAYLOR, Uganda, <i>Arcyophora patricula</i> on cattle
6	1941	LEWIS, Sudan (Heiban), <i>Arcyophora patricula</i> on horse
7	1953	REID, Sudan (Wau), <i>Arcyophora patricula</i> , <i>A. longivalvis</i> , <i>A. zanderi</i> on cattle, horse, donkey
8	1953	REID, Sudan (Aweil), <i>Arcyophora patricula</i> , <i>A. zanderi</i> on cattle
9	1953	REID, Sudan (Malek), <i>Arcyophora patricula</i> , <i>A. zanderi</i> on cattle
10	1954	REID, S. Rhodesia, <i>Arcyophora longivalvis</i> on cattle
11	1955/56	DU TOIT, S. Africa (Cape Province), <i>Arcyophora longivalvis</i> and <i>Semiothisa inaequilinea</i> on sheep
12	1958	BÜTTIKER (1959, 1962 b), Cambodia (Snoul Distr.), <i>Lobocraspis griseifusa</i> on cattle and waterbuffalo
13	1958	BÜTTIKER (1959, 1962 b), Cambodia (Kampot Distr.), <i>Lobocraspis griseifusa</i> and <i>Arcyophora sylvatica</i> on cattle and waterbuffalo
14	1960	BÜTTIKER (1962 a), Thailand (Chiengmai), <i>Lobocraspis griseifusa</i> on waterbuffalo
15	1963	BÜTTIKER (1964), Thailand (Chiengmai Distr.), misc. Noctuidae, Pyralidae, Geometridae on 8 mammalian hosts and 1 uncertain record
16	1964	BÜTTIKER, Burma (Mandalay), <i>Lobocraspis griseifusa</i> on cattle, WHO Doc. (WHO/EBL/29. 64), Geneva 1964
17	1964	BÜTTIKER/WHELLAN (1966) Southern Rhodesia (Gokwe), <i>Arcyophora longivalvis</i> on cattle

* See REID (1954) and BÜTTIKER (1964).

Livestock kept : 20 waterbuffaloes, 76 cattle (several breeds and crosses), 90 pigs (incl. piglets).

Between 27th June and 24th July 1963 a total of 1609 eye-frequenting moths were collected from cattle, 1924 specimens from waterbuffaloes and 497 from domesticated pig at the Station.

Due to the kind cooperation of the Department of Agriculture and Department of Veterinary Services, it was possible to collect specimens for an entire year at weekly intervals at a fixed hour, i.e. from 22.30–23.30 every Thursday. Several lepidopterous species were recorded more or less regularly on *cattle* and *waterbuffaloes* (Table No. 2 and No. 5).

HORSE BREEDING STATION, CHIENGMAI (altitude approx. 340 m.). General situation as for L.B.S.C.

There were 150 horses and 80 mules in semi-open stables. A few heads of cattle were kept under open-air conditions.

The AGRICULTURAL RESEARCH STATION, FANG (altitude approx. 650 m.) is situated in the tropical semi-evergreen forest. The waterbuffaloes and cattle kept on the station were not very numerous, but specimens of eye-frequenting moths were quite common. The same applies to the villages inspected between Muang Fang and the Station.

The ZOOLOGICAL GARDENS and the BOTANICAL GARDENS, CHIENGMAI (altitude approx. 350 m.) are situated on the foot hills of Doi Sutep (W. of Chiangmai) and surrounded completely by the dry Dipterocarp forest. The animals inspected in the Zoo belonged to mammalia, aves and reptilia as listed in the already published papers (BÜTTIKER 1964, 1965).

Thanks to the excursions made by Mr. PICHAI MANICHOTE in the rain forest areas of Mae Chaem District between 23rd and 27th July 1964, it was possible to collect additional information on a number of the lepidoptera from villages situated 600–800 m. o.s.l., i.e. Pang Hin Phon, Kongkak, Amkud and Mae Kae Mook. The results of this supplementary collection trip have been incorporated in the notes on the individual species in the following chapter.

2. Biological Notes

The following notes deal mainly with the biological observations made on the eye-frequenting moths in N. Thailand during June and July 1963. Weekly inspections were conducted at Mae Juak (near Chiangmai) in order to follow up the flight pattern during one year.

According to the observations made so far it would appear that there are *three groups of eye-frequenting moths*, viz. Those

— WITH A VERY STRICT EYE-FREQUENTING BEHAVIOUR. Moths visit no other part than the eye lids and take up lachrymation, pus and, to a

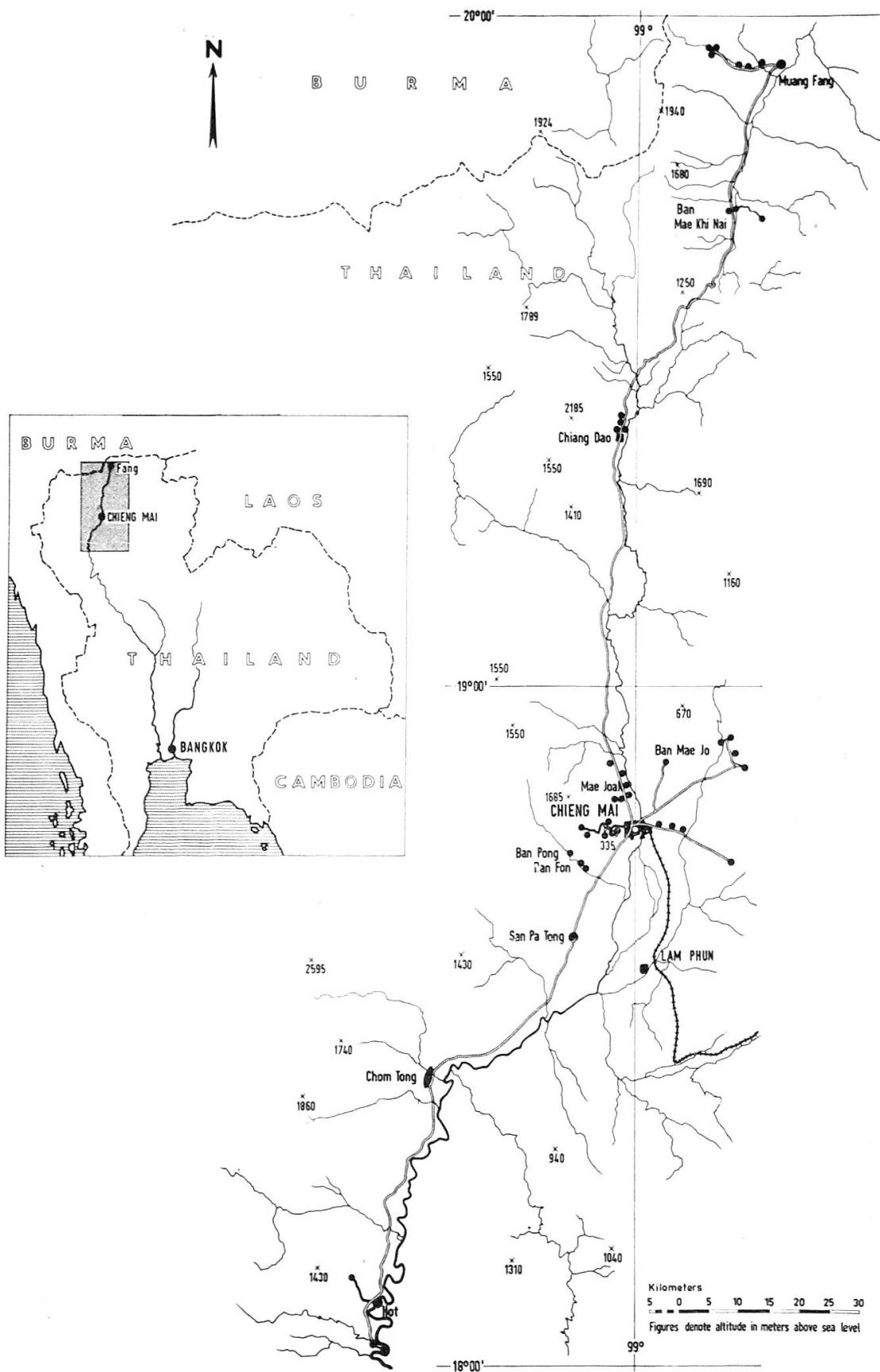


Fig. 2. — Map showing area covered by the expedition to N. Thailand carried out in June/July 1963.

certain degree, blood from conjunctiva or cornea. The species concerned are :

<i>Arcyophora sylvatica</i> BÜTT.	<i>Hypochrosis korndorfferi</i> SNELLEN
<i>Botyodes asialis</i> GUENÉE	<i>Lobocraspis griseifusa</i> HPS.
<i>Botyodes flavibasalis</i> MOORE	<i>Margaronia stolalis</i> GUENÉE
<i>Filodes fulvidorsalis</i> HUEBNER	<i>Pagyda salvalis</i> WALKER
<i>Hypochrosis flavifusata</i> MOORE	<i>Somatina anthrophilata</i> GUENÉE

- WITH A FAIRLY WELL DEVELOPED EYE-FREQUENTING BEHAVIOUR. Moths frequent the eyes and the surrounding area ; they take up lachrymation from conjunctiva, cornea, but also watery fluid running down along cheeks from the eyes of their mammalian hosts, viz.

<i>Pionea aureolalis</i> LEDERER	<i>Semiothisa fasciata</i> FABR.
<i>Pionea damastesalis</i> WALKER	<i>Semiothisa myandaria</i> WALKER

- OCCASIONAL VISITORS ONLY. Moths take up lachrymation irregularly.

<i>Blasticorhinus rivulosa</i> WALKER	<i>Nanaguna breviuscula</i> WALKER
<i>Bradina admixtalis</i> WALKER	<i>Peratophyga</i> sp. nr. <i>tonseae</i>
<i>Hypena conscitalis</i> WALKER	DEBAUCHE
<i>Lampides boeticus</i> L. ; one single record only	<i>Scopula attentata</i> WALKER
<i>Mocis undata</i> FABR.	<i>Typsanodes linealis</i> MOORE

MARTINI (1946) mentions that there are no true parasites among the lepidoptera on human beings or animals. However, there are marginal parasites known as for example the tineid *Tinea vastella* living in the horns of ruminants in Africa, and a second species, *Bradypodicola haneli* belonging to the pyralids, has been recorded from the fur of the sloth in Australia probably feeding on algae and fungi.

NEVEU-LEMAIRE (1938) summarizes the records of Tineidae and Pyralidae ; members of both families have been discovered as intermediate hosts of tape worm (*Hymenolepis diminuta*) known from rodents. The larva of *Aglossa pinguinalis* (Pyralidae) lives in greasy exudates of mammals, and specimens have also been found occasionally in the digestive systems of human beings. No true parasitism by lepidoptera is mentioned by the recent treatise of CAMERON (1964).

The following notes are set out according to the zoological system of the lepidoptera concerned.

2.1 Noctuidae

2.1.1 *Arcyophora sylvatica* BÜTT. 1962 (Westermanniinae) (Fig. 3)

Type locality : Koc Cha Loch (near Kampot, Cambodia) (BÜTTIKER 1959, 1962 a).

Own records : Cambodia (BÜTTIKER 1959).

Thailand : Chiangmai region (BÜTTIKER 1964, 1965) ; a very common moths with strictly nocturnal flight activity.

Arcyophora sylvatica was also found very commonly in or near forested areas throughout N. Thailand incl. Chiangmai, Fang, Chiang Dao, and Hot, particularly during the monsoon season (Table No. 2). There are no other records of this species other than those from Cambodia and Thailand.

It is of interest to note that there are records of related species from other Asiatic countries, but none are known so far to show any eye-frequenting behaviour.

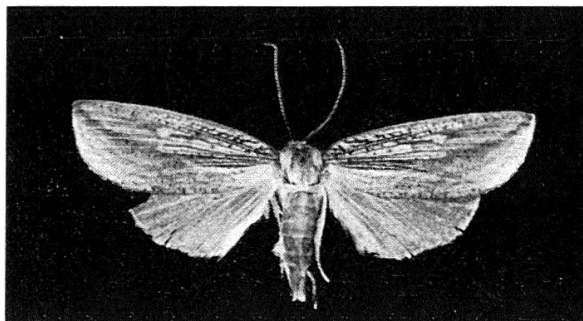


Fig. 3. — *Arcyophora sylvatica* BÜTT., male, expanse 36 mm. Hosts : Waterbuffaloes, cattle and sambar, from Chiangmai, N. Thailand.

A. bothrophora HMPS. 1907, Punjab, Ceylon

A. dentula LEDERER 1869, Syria, Persia, W. Turkestan, Punjab, Bombay

A. icterica SWIN. 1886, Punjab, Bombay, Madras

A. trigramma HMPS. 1912, N.W. India, Rajputana

The following related species are known to occur in Africa :

A. dives BUTLER 1898

A. patricula HMPS. 1902 *

A. elegantula GRÜNB. 1910 *

A. piperitella STRAND 1909

A. ledereri WALLENGR. 1863

A. stalii WALLENGR. 1863

A. longivalvis GUEN. 1852 *

A. Zanderi FELDER 1875 *

Eye-frequenting behaviour : *A. sylvatica* has been commonly found nocturnally on cattle, domestic waterbuffaloes and on the sambar (*Cervus unicolor*).

Development stages : egg larvae and pupa are unknown.

Oviposition : No eggs were obtained despite the continuous attempt to rear this species under laboratory conditions.

Host plants : Many field excursions were carried out with the aim of obtaining larvae of this species and rear them in the insect cages at our improvised laboratory in Chiangmai. However, all these attempts met with no success.

* Species with established eye-frequenting behaviour as mentioned by REID (1954) and FLETCHER (1954).

Males and females show no sexual dimorphism, and the sex can only be determined by dissection. On the basis of specimens collected near Chiangmai the sex ratio was 111 ♂ to 95 ♀ (Table No. 3).

According to the observations made in the laboratory the life span of wild caught adults is up to 8 days for un-fed specimens and up to 14 days for adult fed on sugar water and/or honey. They have strict humidity requirements. The insect cages were sprayed, therefore, daily 2 to 3 times and covered with wet towels in order to keep the atmosphere moist and to enable the moths to take up water and honey ad libitum.

Field observations revealed that *A. sylvatica* is, generally speaking, less common than *L. griseifusa*; nevertheless it has to be regarded as an abundant species, particularly at the beginning of the monsoon season.

TABLE 2

Records on A. sylvatica collected at the Livestock Breeding Station, Mae Juak, Chiangmai, 1963/1964, from every Thursday 22.30–23.30 h

Date 1963	Males + females	Date 1963	Males + females	Date 1964	Males + females	Date 1964	Males + females
27.VI	8	3.X	1	2.I	—	2.IV	—
4.VII	10	10.X	—	9.I	—	9.IV	—
11.VII	14	17.X	4	16.I	2	16.IV	—
18.VII	10	24.X	4	23.I	—	23.IV	2
25.VII	6	31.X	—	30.I	—	30.IV	—
1.VIII	5	7.XI	2	6.II	—	7.V	—
8.VIII	4	14.XI	5	13.II	3	14.V	—
15.VIII	4	21.XI	2	20.II	—		
22.VIII	2	28.XI	2	27.II	—		
29.VIII	1	5.XII	—	5.III	1		
5.IX	2	12.XII	—	12.III	—		
12.IX	4	19.XII	—	19.III	—		
19.IX	6	26.XII	2	26.III	2		
26.IX	5						
Total							113

2.1.2 *Lobocraspis griseifusa* HMPS. 1895 (Westermanniinae) (Fig. 4)

Type locality: The type specimen is from Yaw, Dornat Range, Tennasserim; the description is based on an unique female.

Own records:

Burma: According to Mr. Tha Htoo this species occurs also in jungle areas near Mandalay.

Cambodia: Snoul and Kampot District (BÜTTIKER 1959, 1962 a). The first records of males are from Kbal Trach, Cambodia.

Thailand: 1960 first records of 3 males and 13 females from Chiangmai region (BÜTTIKER 1962 a). 1963 several thousand specimens from a large number of localities, viz. Chiangmai township, Mae Juac, Cattle Breeding Station, Horse Breeding Station, Zoological Gardens Chiangmai, in numerous villages near Chiangmai, Chiang Dao and Fang (Fig. 2).

There are no other records on this species than those from Burma, Cambodia and Thailand. This species is strictly nocturnal.

Eye-frequenting behaviour: This species is closely associated with waterbuffaloes, cattle and sambar.

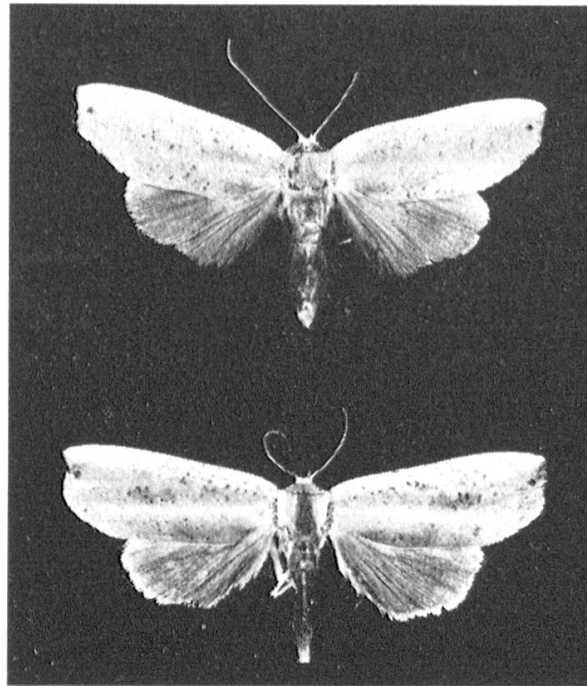


Fig. 4. — *Lobocraspis griseifusa* HMPS., (Noctuidae): (a) male, expanse 37 mm; (b) female, expanse 39 mm.

Hosts: Waterbuffaloes, cattle and sambar from Chiangmai, N. Thailand.

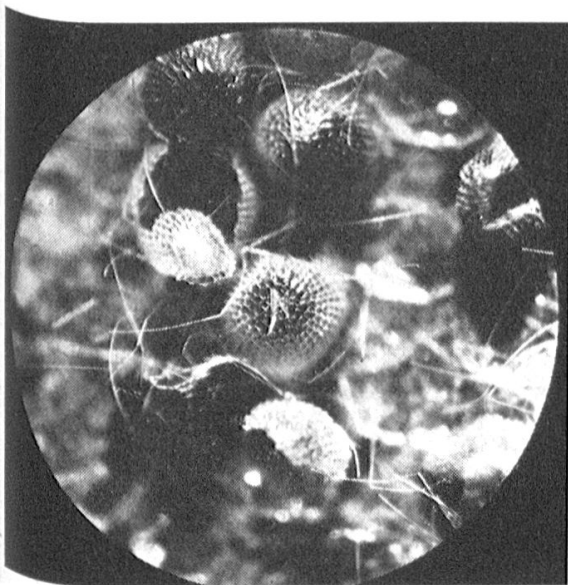


Fig. 5. — Eggs of *Lobocraspis griseifusa* HMPS. reared in the laboratory. Enlarged.

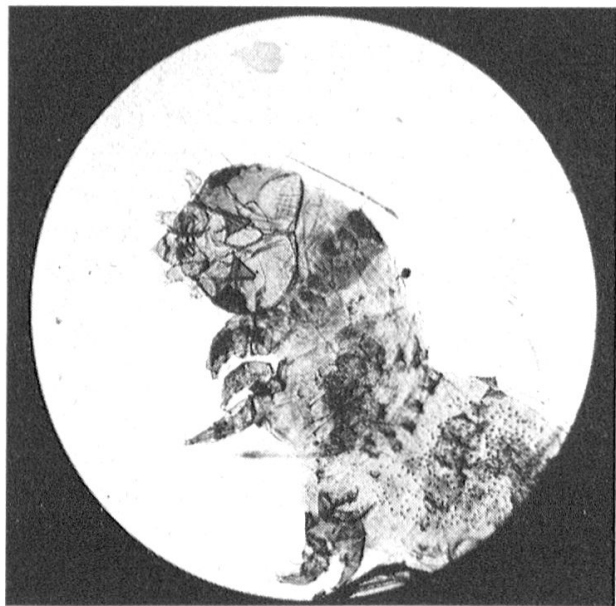


Fig. 6. — Freshly hatched 1st instar larva of *Lobocraspis griseifusa* HMPS. Microphotograph.

TABLE 3

Showing the sex ratio of A. sylvatica, specimens collected from cattle and waterbuffaloes, Chiangmai (L.B.S.C.)

Date 1963	Number of specimens dissected		% females
	♂	♀	
28.VI	2	2	50
30.VI	9	9	50
1.VII	21	14	40
2.VII	4	4	50
4.VII	4	4	50
8.VII	5	3	37,5
10.VII	4	7	64
11.VII	2	3	60
14.VII	5	7	58,3
15.VII	3	3	50
16.VII	6	11	64,7
17.VII	12	8	40
18.VII	9	5	35,7
19.VII	1	7	87,5
23.VII	24	8	25
Total	111	95	mean = 46,1 %

General remarks : This is a very common species notably in/or near forested areas in Cambodia and N. Thailand.

Development stages : Eggs : Two egg batches were reared in the improvised laboratory at Chiangmai. Females kept in captivity were offered numerous plants to be selected for depositing the eggs. From a wide range of woody plants collected in the jungle leaves of *Terminalia chebula* were used by the females for this purpose. The shape of the egg is more or less globular having a diameter of 0.5 mm. approx. They are grooved (Fig. 5), and deposited singly or in groups. The female uses a glue to stick them to the substrate. Eggs are white initially, but gradually attain a darker colour. The development period of the embryo is approx. 3-4 days.

Larva : Viable larvae were reared from the above mentioned egg batches, the size of the freshly hatched specimens being approx. 1.5 mm. (Fig. 6).

Pupa : unknown.

Adults : The dimorphism of males and females is very pronounced. It would appear that the sex ratio varies during the year, but based on records over a whole year males are in the minority (Table No. 4).

TABLE 4

Showing the Sex Ratio of L. griseifusa collected from eyes of cattle and waterbuffaloes ; Chiangmai, 1963

Date 1963	♂	♀	% females
26.VI	4	40	90
28.VI	3	10	76,9
30.VI	14	31	68,9
1.VII	14	36	72
2.VII	7	17	70,8
4.VII	3	7	70
8.VII	12	29	70,7
10.VII	2	14	87,5
11.VII	16	64	80
14.VII	5	35	87,5
15.VII	7	16	69,5
16.VII	13	78	85,7
17.VII	38	93	70,9
18.VII	18	18	50
19.VII	30	86	74,3
20.VII	30	91	75,2
22.VII	18	25	58,1
23.VII	55	104	65,4
Total	289	794	mean = 73,3 %

Collection of adults was carried out over a period of one year, the records being summarized in Table No. 5. It is evident that *L. griseifusa* is more common during the monsoon than during the dry season.

Lifespan: Adults collected in the field, kept in captivity and fed every night with honey, lived for 2 to 15 days. As a rule the males were kept alive for a shorter period than the females. It was very essential to spray the cages daily with water in order to keep a high moisture level in the wire screened cages ; this was achieved by 2 to 3 sprayings per day and by putting wet towels over the top of the cages.

In view of the wish to airmail specimens for microbiological studies to Institutes outside Thailand a preliminary test was undertaken to see how long males and females are able to live under low temperature conditions. On the 25th of June wild caught males and females (age unknown) were put in small glass vials in a refrigerator at +2 to 3°C in which they remained alive for 1 day (♂) and 8 days (♀) respectively.

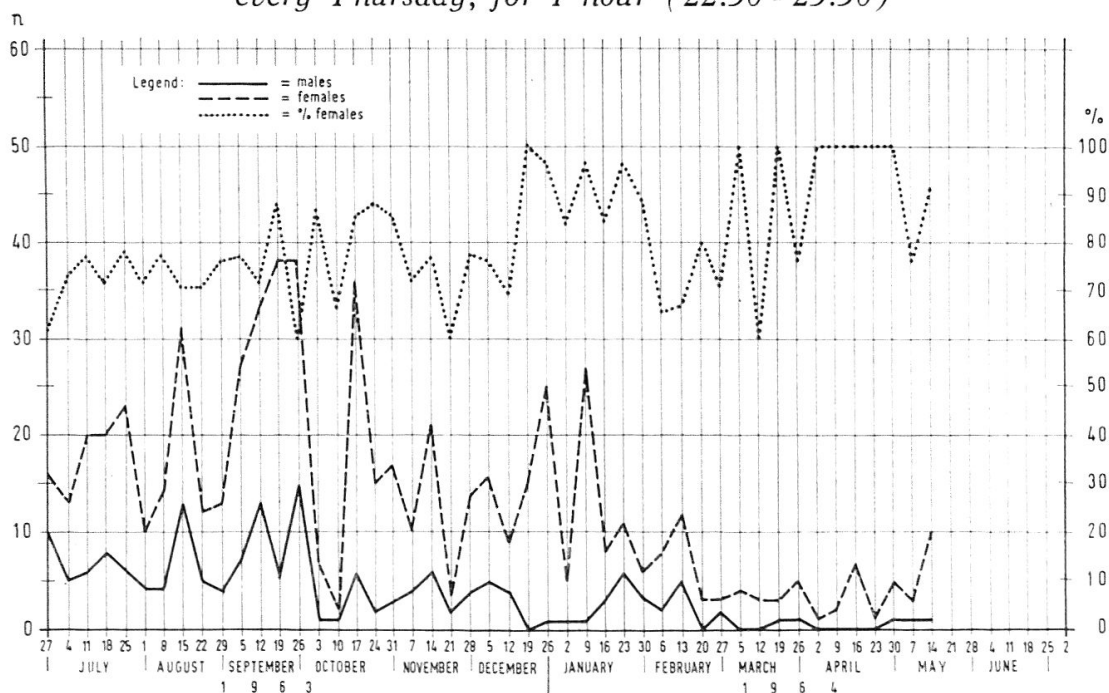
Mating and oviposition: On the occasion of the night excursion at Mae Juac Cattle Breeding Station of 15th July 1963 mating of *L. griseifusa* was observed around the eyes of a waterbuffaloe, kept in the open

air, between 22.00–23.00 h. Several lots of adults were kept in captivity between 27th June and 24th July 1963 in our laboratory in order to gain some information on the mating and on the oviposition. Despite the regular checking, mating was observed only very rarely, e.g. on 17th July between 22.00 and 23.00 hours. The same observation was made during the nights of the 18th to the 20th July 1963.

The number of generations is still unknown but it would appear from *Table No. 5* that two peaks of flight exist during the year, namely a first in September/October (during the monsoon season) and a second one in December/January. The lowest flight activity is encountered prior to the onset of the rainy season.

TABLE 5

Showing number and sex ratio of L. griseifusa collected at Livestock Breeding Station, Chiangmai, at weekly intervals, every Thursday, for 1 hour (22.30 - 23.30)



Observations on migratory habits

According to the observations made in Cambodia during 1958 (BÜTTIKER 1965) this species may exhibit a very pronounced migratory behaviour at least under certain weather conditions. However, no obvious displacement movements have been observed during the field observations in June and July 1963.

2.1.3 *Miscellaneous noctuidae*

Four other noctuids were collected at the L.B.S.C. from the eyes of the domesticated pig, viz.

<i>Blasticorhinus rivulosa</i> Wlk. 1865	<i>Mocis undata</i> Fabr. 1775
record of 23rd July 1963	record of 14th July 1963
<i>Hypena conscitalis</i> Wlk. 1865	<i>Nanaguna breviscula</i> Wlk.
record of 23rd July 1963	1863
	record of 23rd July 1963

However these species are regarded as occasional visitors only.

Distribution :

Blasticorhinus rivulosa : E. India, Formosa, Ceylon, Philippines, Java (NYE 1965)

Hypena conscitalis : W. and C. Africa, Moçambique, Seychelles, Java, Ceylon, Australia, Formosa, Burma, India (NYE 1965)

Mocis undata : Congo, Kenya, Uganda, Rhosedia, S. Africa, Seychelles, Formosa, China, India, Burma, Philippines, Andamans, Java, Assam and Ceylon (NYE 1965)

Nanaguna breviscula : New Guinea, Borneo, S. Australia, Lonisiade Arch., Sarawak (NYE 1965)

According to KALSHOVEN (1951) the caterpillars of *Mocis frugalis* were found on gramineae, such as sugar cane, maize, rice, etc. in Indonesia. The distribution ranges from Australia to W. Africa.

Mocis undata (= syn. *Remigia archsia* CRAM.) feeds on leguminosae, e.g. *Mucuna*, *Tephrosia candida*, *Calopogonium* and *Derris*. Distribution from Africa, S.E. Asia to the Philippines. The same author (KALSHOVEN 1951) gives some information on *Nanaguna breviscula* ; the caterpillars feed on mango and leguminosae in E. Java. Distribution from India to Australia.

The genus *Hypena* has also a very wide distribution. *Hypena proboscidalis* L., for example, is known from Europe, where the caterpillars were recorded feeding on *Urtica dioeca* (WARNECKE 1927).

Calpe minuticornis GUEN. was collected only once in Cambodia during the observations made in 1958 (BÜTTIKER 1962 b). However, no further records on this species have been obtained ever since, either in Thailand or in Cambodia.

2.2 Pyralidae

A large number of pyralidae are known as serious agricultural and horticultural pests in their larval stage (KALSHOVEN 1951, EVANS 1952, SORAUER 1953).

2.2.1 *Botyodes asialis* * GUENÉE, 1854 (Pyraustinae)

Own records : Thailand, L.B.S.C. This species has been collected on the 14th and 15th July 1963 at night from the eyes of the domestic pig, and at the forestry camp at Ban Mae Khi Nai (nr. Fang) on the 7th and 21st July 1963 on elephants.

Distribution : Baluchistan, throughout India, Ceylon, Burma and Borneo (HAMPSON 1896), W. Africa, Uganda, S. Africa, India, Ceylon, Singapore, Sarawak, New Guinea (WHALLEY 1965).

Development stages : Egg and pupa unknown. Larva : short and thick (HAMPSON 1896).

Host plants : *Ficus* sp. (HAMPSON 1896).

2.2.2 *Botyodes flavibasalis* MOORE 1867 (Pyraustinae)

Own records : N. Thailand, L.B.S.C. Collected once only from a domestic cow (22nd July 1963).

Distribution : Sikkhim, Assam, Calcutta, Burma, Sumatra, New Guinea (HAMPSON 1896). *New Guinea*, Philippines, India, Ceylon, Malaya, Sumatra (WHALLEY 1965).

General remarks : This is a rather scarce eye-frequenting species.

Development stages : unknown.

Host plants : unknown.

2.2.3 *Filodes fulvidorsalis* HUEBNER, 1806–1824 (Pyraustinae) (Fig. 7)

Own records : N. Thailand, Zoological Gardens, Chiangmai, on the 18th, 22nd and 24th July in fairly large numbers, but only 1 specimen each in the collection.

Distribution : Réunion, throughout India, Ceylon, Burma, Andamans, Nicobars, The Philippines, Borneo, Java, Sumbava (HAMPSON 1896). East and West Africa, South Africa, India, Ceylon, Malaya, Java, New Guinea, The Philippines (WHALLEY 1965).

Eye-frequenting behaviour : Recorded from the sambar (*Cervus unicolor*), where it seems regularly feeding.

General remarks : This species is a very shy moth and was much disturbed by light. Several specimens escaped very hurriedly so that we obtained only three adults.

Development stages : Eggs : unknown. Larva : olive-green with a subdorsal whitish fascia, each somite with several black warty spots ; head yellowish, legs black (HAMPSON 1896). Pupa : red, with long

* The distribution of the genus is confined mainly to S.E. Asia and Indonesia. MONROE (1960) described a new species, *B. borneensis*, from Borneo.

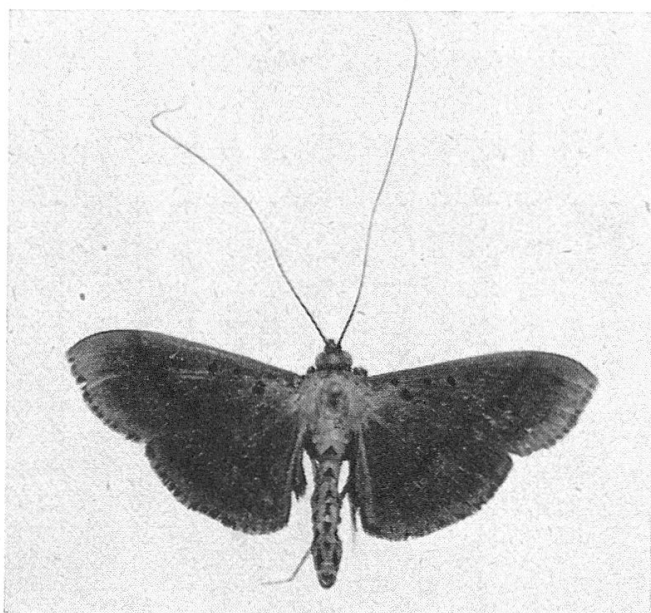


Fig. 7. — *Filodes fulvidorsalis* HUEBN. (Pyrallidae), expanse 36 mm.
Host : Sambar (*Cervus unicolor*) from Chiangmai.

sheaths for antennae and proboscis, the former serrated (HAMPSON 1896).

Food plant : *Thunbergia allata* (HAMPSON 1896).

2.2.4 *Margaronia stolalis* * GUEN. 1854

Margaronia is a genus with numerous species, their larvae preferring *Moraceae* and *Apocynaceae* as food plants. Males have a protruded "genital brush".

Own records : N. Thailand, Chiangmai, almost regularly at small numbers in July 1963.

Distribution : This is a fairly common species in the Chiangmai region. Tropical and warmer temperate zones, Nepal, Sikkhim, Assam, Ceylon, Pulo Laut, Borneo, Australia (HAMPSON 1896). India (Calcutta, Sikkhim), Africa (British East), Borneo, Cameroon, Celebes, Ceram, Ceylon, China (West), Congo, Fiji Islands, Java, Natal, New Guinea (British and Dutch), New Hebrides, The Philippines, Pulo Laut, Seychelles, Sumatra, Tonkin, Uganda (KLIMA 1939). In addition to above : Madagascar, Mauritius, Malaya and Burma (WHALLEY 1965).

Eye-frequenting behaviour : records from waterbuffaloes, cattle, sambar and domestic pig.

* *Margaronia stolalis* = syn. *Diaphania stolalis* GUENÉE.
syn. *Glyphodes stolalis* GUENÉE.
syn. *G. diurnalis* SWINHOE.

Development stages : unknown.

Host plants : *Ficus glomerata*, *F. infectaria*, *Ficus* sp. (MATHUR and SINGH 1963).

KALSHOVEN (1951) mentions several 9 species of *Margaronia* from Indonesia, viz.

<i>Margaronia</i> spp.	On gambir in Indonesia.
<i>Margaronia bivitalis</i>	Recorded from <i>Ficus</i> spp. (Indonesia).
<i>Margaronia caesalis</i>	Caterpillars on <i>Artocarpus</i> spp., distribution from India to New Guinea and The Philippines.
<i>Margaronia indica</i>	Caterpillars feeding on Cucurbitaceae from Mediterranean Sea to S.E. Asia to Australia.
<i>Margaronia itysalis</i>	Recorded from <i>Ficus</i> spp. (Indonesia).
<i>Margaronia laticostalis</i>	On <i>Lansium domesticum</i> (Meliaceae) in Indonesia.
<i>Margaronia marginata</i>	In E. Sumatra, feeding on leaves and flowers of Rubiaceae. Distribution from Sikkhim (India) to Australia and South-West Pacific Islands.
	Noxious on gambir and Gardenia.
<i>Margaronia psittacalis</i>	In Indonesia.
<i>Margaronia pulverulentalis</i>	Recorded from W. Java.
<i>Margaronia unionalis</i>	Distribution from S. Europe, S. and W. Africa to S.E. Asia and Australia.
<i>Margaronia indica</i>	Has been recorded from the mediterranean countries and South Asia to Australia.
<i>Margaronia hyalinata</i> L.	Is an important pest of cucurbits in the W. Indies and Jamaica. Distribution from Canada to S. America.
<i>Margaronia ocellata</i>	Has injured rubber in nurseries in the Gold Coast and inflicted damage to <i>Kickxia elastica</i> in West and East Africa (SORAUER, 1953).

2.2.5 *Pagyda salvalis* Wlk. 1859 (Pyraustinae)

Own records : N. Thailand, Chiangmai region at Ban Pong (25.VI. 1963) on waterbuffaloes and L.B.S.C. (16 July 1963) on pig; Fang region at Ban Mae Khi Nai (21.VII.1963) four specimens on elephant.

Distribution : Japan, Sikkhim, W. and S. India, Ceylon, Burma, Pulo Laut, Borneo (HAMPSON 1896). India, Ceylon, Thailand, Malaya and Borneo (WHALLEY 1965).

Eye-frequenting behaviour : recorded from waterbuffaloes, pig and elephant.

General remarks : This species is rather rarely met with in N. Thailand.

Development stages : unknown.

Host plants : unknown.

2.2.6 *Pionea* * *aureolalis* LEDERER 1863 (Pyraustinae)

Own records : N. Thailand, Chiangmai region at H.B.S. on 2nd July on cattle, at L.B.S.C. on 9th July on pigs, 20th July on water-

* According to SORAUER (1953) *P. traducalis* ZELL. inflicts in Siam damage to *Pithecolobium saman*, the host plant of *Tachardia lacca* KERR.

buffaloes, 22nd July on pigs, at the Zoological Gardens Chiangmai on sambar on 18th July and 23rd July 1963, at Ban Mae Khi Nai (nr. Fang) on 21st July 1963 on elephant.

Distribution : Dharmasala, Sikkhim, Khasis, Ceylon, Andamans (HAMPSON 1896). Seychelles, India, Ceylon, Laos, The Philippines, New Guinea (WHALLEY 1965).

Eye-frequenting behaviour : Recorded from waterbuffalo, cattle, sambar, domestic pig and elephant. At L.B.S.C. also on cattle on 5th December 1963, and in the Mae Chaem District (Hot) 2 specimens between 23rd and 27th July 1964 on cattle.

General remarks : *P. aureolalis* is a fairly scarce species in N. Thailand.

Development stages : unknown.

Host plants : unknown.

2.2.7 *Pionea damastesalis* Wlk. 1859 (Pyrastinae) (Fig. 8)

Own records : N. Thailand, Chiangmai region and near Fang very regularly found at night. With a few exceptions only males were collected from the eyes of the mammalian hosts. Adults were frequently found at night in the jungle particularly on flowering trees of *Terminalia* spp. or in secondary forests near Chiangmai. The species is very common and the first eye-frequenting record was noted in Chiangmai township on the 24th June 1963. There are altogether 39 records with over a 1000 specimens collected between end of June and 24th July 1963. Additional records are for the rest of the one year observation period, viz. from July 1963 – May 1964, 70 specimens on cattle and waterbuffaloes were collected. Also 6 specimens were collected on cattle in Mae Chaem District between 23rd and 27th July 1964.

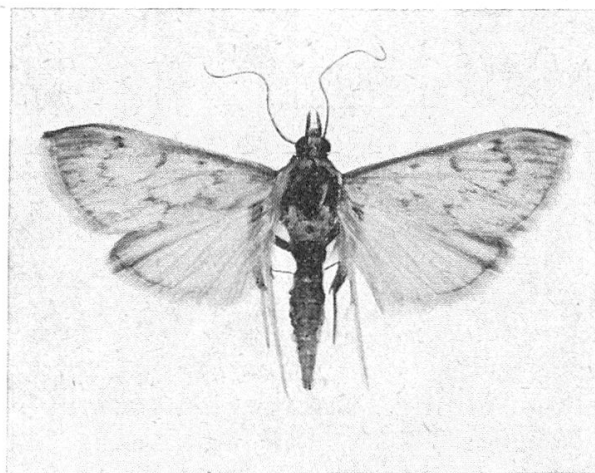


Fig. 8. — *Pionea damastesalis* Wlk. (Pyrastinae), expanse 23 mm. Hosts : Cattle, waterbuffaloes, sambar, pig, elephant, horse and mule, from Chiangmai, N. Thailand.

Distribution : India, Ceylon, Thailand (WHALLEY 1965).

Eye-frequenting behaviour : Very commonly found on pig (the main host species), waterbuffalo, cattle, sambar, elephant, horse and mule.

SORAUER (1953) mentions several *Pionea* species noxious to agricultural crops, e.g. *P. despecta* BUTL. from Hawaii on sweet potatoes ; *P. ferruginalis* HBN. on *Capsicum annum* in green-houses from Japan, the adults being diurnal ; *P. forficalis* from Europe on cruciferous crops, the adults flying at dusk ; *P. rubigalis* GUEN., a nocturnal species, from North America on vegetables, tobacco etc. ; very harmful.



Fig. 9. — Adults of *Lobocraspis griseifusa* HMPS. on eye of waterbuffalo infested by *Keratoconjunctivitis epidemica*. Note the flow of lachrymation and the formation of pus.

It was noted on several occasions that *Pionea damastesalis* may frequent also places not actually belonging to the eyes ; we witnessed that this species may feed on lachrymal secretions on the cheeks of the host animals (cattle, waterbuffalo) heavily infested with *Keratoconjunctivitis epidemica* (Fig. 9). In one instance did we notice also *P. damastesalis* attached to a wound on the back of a horse. An attempt of visiting a human eye was witnessed at Mae Joak on the 2nd July 1963.

General remarks : This is a very common species in N. Thailand.

Development stages : Eggs : We obtained several times viable egg batches from females kept in captivity. The eggs were covered with a greyish felt-like material. The oviposition took place in vials in which strips of blotting paper were placed. The *larvae* hatched after 2–3 days.

Host plant : unknown.

2.2.8 *Pionea flavicinctalis* SNELLEN 1890 (Pyrastinae)

Own records : N. Thailand. Fang, 1 male on 6th July 1963 on waterbuffalo ; Forestry camp Ban Mae Khi Nai (nr. Fang) 8 specimens on 21st July 1963 on elephant.

Distribution : Sikkhim (HAMPSON 1896). India, Ceylon, Thailand, Laos, W. China, Formosa, Java, Malaya (WHALLEY 1965).

Eye-frequenting behaviour : Scarce on cattle, fairly numerous on elephant.

Development stages : unknown.

Host plants : unknown.

2.2.9 *Typanodes linealis* MOORE 1867 (Pyraustinae)

Own records : N. Thailand. 2nd July 1963 Horse Breeding Station, Chiangmai, Thailand, only one specimen from a mule.

Distribution : The distribution of the genus seems to be confined to S.E. Asia, Philippine Islands and Indonesia, Dharmasala, Sikkhim, Ceylon, Andamans (HAMPSON 1896) ; India, Ceylon (WHALLEY 1965).

Eye-frequenting behaviour : One record only from a mule.

Development stages : unknown.

Host plants : unknown.

2.2.10 *Bradina admixtal*is Wlk. (Hydrocampinae)

Own records : N. Thailand, Chiangmai, 28th November 1963 ; Chiang Dao two specimens on the 7th July 1963 from cattle. This species was collected only very irregularly at the Livestock Breeding Station, Chiangmai, during July 1963 from cattle and waterbuffalo ; also one record on the 28th of November 1963. One specimen was collected from cattle in the Mae Chaem District between 23rd and 27th July 1964.

Distribution : Natal, Japan, throughout India, Ceylon, Borneo, Perak (HAMPSON 1896). Africa, India, Ceylon, Burma, China, Maldiv Islands, New Guinea and Australia (WHALLEY 1965).

2.3 Geometridae

2.3.1 *Hypochrosis flavifusata* MOORE 1887 (Ennominae)

Own records : N. Thailand, L.B.S.C. This is a fairly abundant species with regular records from cattle, waterbuffaloes and pigs. On the 18th July 1963 we collected three specimens for example, and from July 1963 to 12th March 1964 numerous specimens on cattle and waterbuffaloes were found. Zoological Garden on sambar (26th December 1963).

Distribution : N. India, Sikkhim, Burma, Shan States (in E. Burma) (FLETCHER 1965).

2.3.2 *Hypochrosis korndorfferi* SNELLEN 1877 (Ennominae)

Own records : N. Thailand, Livestock Breeding Station, Chiangmai from July 1963 to 2nd April 1964 (last record).

This species was recorded ten times from cattle and waterbuffaloes in July, November and December 1963 and April 1964 in single specimens, except on the 12th December when 4 specimens were collected within the standard collecting time of 1 hour.

At the Zoological Garden, Chiangmai, single specimens were collected from the sambar on the 23rd July 1963, also from the Mae Chaem District four specimens on cattle between 23rd and 27th July 1964.

This species is less common than *H. flavifusata*.

Distribution : Sumatra and the Philippines (FLETCHER 1965).

2.3.3 *Peratophyga* * sp. nr. *tonseae* DEBAUCHE (Ennominae)

Own records : Thailand, Livestock Breeding Station, Chiangmai, on the 23rd July 1963 on pig (single record only).

Distribution : Type specimen from Celebes (not in the British Museum) (FLETCHER 1965).

2.3.4 *Semiothisa* ** *fasciata* FABR. 1775 (Ennominae)

(= syn. *Macaria fasciata*)

Own records : N. Thailand, L.B.S.C. Regularly found in small numbers on waterbuffalo and cattle; this was a fairly common species on pigs during July 1963, on 5th September, 12th September 1963 one specimen each on cattle, and on 18th and 23rd July 1963 several specimens on sambar (Zoological Garden, Chiangmai).

Distribution : Throughout India, Ceylon, Burma, Andamans (HAMPSON 1896). S. India and Ceylon (FLETCHER 1965).

Development stages : Larva green with dorsal and sublateral yellow stripes, or brown with the stripes white (HAMPSON 1896).

Food plant : According to HAMPSON (1896) on *Mimosa concinna*.

2.3.5 *Semiothisa myandaria* WLK. 1863 (Ennominae)

Own records : N. Thailand, L.B.S.C. during July 1963; also on 23rd April 1964 one specimen on cattle, on 24th July 1963 and on

* *Peratophyga aerata* MOORE, 1867, has been recorded from Japan, Simla, Kulu, Khasis (HAMPSON, 1896).

** *S. inaequilinea* was recorded from the eyes of cattle in S. Africa and referred to in the Annual Report of the Division of Entomology, Dept. of Agriculture, Pretoria (1954-1955) and by Du Toit (1958) on sheep (BÜTTIKER, 1964). The genus *Semiothisa* occurs also in N. America from where at least four species are known, viz. *S. signata*, *S. cyda*, *S. cydica* and *S. melanderi* (RINDGE, 1959). *S. notata* L. and *S. liturata* CL. are fairly common in England (GOATER, 1955/56), *S. alternaria* has been recorded in the Tessin (S. Switzerland).

12th December 1963 at the Zoological Garden, Chiangmai, on sambar.

At Ban Mae Khi Nai (forestry camp near Fang) on elephant on the 7th and 21st July 1963.

S. myandaria was also recorded from a waterbuffalo on the 30th May 1964 at L.B.S.C. during the routine weekly collecting. Also two specimens on cattle in the Mae Chaem District between 23rd and 27th July 1964.

Distribution : N. India, Canara, Nilgiris (HAMPSON 1896). India, Burma, Singapore, The Philippines (FLETCHER 1965).

2.3.6 *Scopula* * *attentata* Wlk. 1861 (Sterrhinae)

(= syn. *Acidalia attentata* Wlk., 1861)

(= syn. *Craspedia remotata* Guen., 1857 (?))

Own records : N. Thailand, Fang (Agricultural Research Station), on 6th July 1963 on cattle and waterbuffalo ; and in the forestry camp near Ban Mae Khi Nai (Fang district) on the 7th July 1963 on elephant.

Distribution : Ceylon, India, Burma, Andamans, Nicobar Island, Tonkin, Hainan, Formosa, Sunda Island (FLETCHER 1965).

2.3.7 *Somatina anthophilata* Guen. 1857 (Sterrhinae)

Own records : N. Thailand, on L.B.S.C. on pig fairly common ; also on waterbuffalo and cattle on 25th July, 15th August 1963, 2nd February and 6th February 1964, 23rd April 1964 (one specimen each).

Zoological Garden, Chiangmai, on sambar on 24th July 1963 (2 specimens).

Also 3 specimens in the Mae Chaem District on cattle between 23rd and 27th July 1964.

Distribution : Throughout India, Ceylon, Burma (HAMPSON 1896). India, Burma, Malay Archipelago, Thailand, Tonkin. China, Hainan (FLETCHER 1965).

2.3.8 *Pingasa chlora crenaria* Guen. 1857 (Geometrinae)

Own records : N. Thailand, region L.B.S.C., one specimen from the pig on 23rd July 1963. Ban Mae Khi Nai (forestry camp near Fang) four male specimens from the elephant on 21st July 1963. Mae Chaem District on 23rd/27th July 1964 on cattle or waterbuffalo.

Distribution : India (FLETCHER 1965).

P. chlora javensis WARR. ; the caterpillars have been recorded feeding on *Cajanus* in S.E. Asia (KALSHOVEN 1951).

P. chlora CRAM. 1779-1783 (= syn. *Hypochroma crenaria* Guen. 1857).

* The genus *Scopula* has a wide distribution and *S. floslactata* Haw. and other species are commonly recorded in England (GOATER, 1955/56).

Distribution : Throughout India, Ceylon, Burma, Nias Island, Java, N. Australia, Duke of York Land (HAMPSON 1896).

Development stages : Larva : olive-green with purple brown lateral stripes and longitudinal sublateral line. Pupa : red-brown with black speckles and segment mark.

P. ruginaria (larvae) were recorded from a number of crops, e.g. avocado pear, *Averrhoa*, *Nephelium*; the species is said to be very common in S.E. Asia (KALSHOVEN 1951).

Pingasa sp. is a pest of the cedar (*Cedra*) in Queensland (BRIMBLECOMBE 1958).

2.4 Lycaenidae (Lycaeninae)

2.4.1 *Lampides boeticus* L. 1767

(= syn. *Cosmolyce boeticus* L.)

(= syn. *Papilio* (*Plebejus*) *boeticus* L.)

This species is considered to be an accidental eye-frequenting lepidoptera as only once did we collect a specimen, from an eye of a domestic pig (23rd July 1963, L.B.S.C.).

L. boeticus is a species with a very wide distribution range, viz. from Mediterranean Sea, England and Continental Europe, Southern Central Europe, tropics and subtropics of the Old World, Hawaii, Australia.

3. Resting Places

3.1 Day-time resting places

Several day-time excursions were carried out mainly in the neighbourhood of Chiangmai with the aim of tracing the resting places of the various lepidoptera concerned.

On the 10th July an excursion to the secondary *Pterocarpus*-Forest near L.B.S.C. was carried out where 4 ♂ of *Pioneer damastesalis* in the lower parts of the regrowth of *Pterocarpus tuberculatus* were found. On the 11th July a total of 10 specimens of *P. damastesalis*, all males, were collected within 1 hour approximately.

On the occasion of several other occasions late in the afternoon during July 1963 it was confirmed that this species was common in this particular habitat. At the same sampling site *Lobocraspis griseifusa* and *Arcyophora sylvatica* (sex not determined) were found at several instances.

The vegetation had a height of $\frac{1}{2}$ –1 m. in a field covered with regrowth of *Pterocarpus tuberculatus*, *D. obtusifolius*, *Pentacme siamensis*, *Shorea obtusa* and other members of the dry *Dipterocarp* forest association (LOETSCH 1958). An adjoining forest comprising trees of 12–15 m height was also visited by us and specimens of all three moth species were found.

3.2 Night-time resting places

Prior to our investigations no indication existed as to the whereabouts of the adult eye-frequenting lepidoptera in their natural habitat.

On the 28th June the first indication occurred when we met 1 ♂ of *A. sylvatica* and 1 ♀ of *Pionea damastesalis* on wing in the secondary *Dipterocarpus*-Forest at L.B.S.C. The age of the trees about 6–8 years. In an adjoining clearing with regenerating vegetation (height approx. 50–90 cm.) *P. damastesalis* was also a very common species.

These findings were confirmed on the 10th July where also specimens of *A. sylvatica* and *L. griseifusa* were found in addition to several *P. damastesalis*.

On the occasion of several excursions to the Botanical Gardens and along the Doi Sutep Road it was found that *P. damastesalis* (♂) is attracted by the flowers of *Terminalia chebula*.

On the 22nd July *P. damastesalis* was again very common in the Botanical Gardens and the specimens, both sexes, were already on wing from 7.15 p.m.

The time of swarming is apparently controlled by a response to low light intensity, and in Thailand, the onset of the flight was advanced by several minutes when a full moon was exposed. We also noted that the specimens kept in the insect cages on the shaded veranda of our bungalow became active in the evening at least 20–30 minutes earlier than those exposed to out-door light conditions.

It was observed that almost all adults of the eye-frequenting lepidoptera were avoided from artificial light. Although several species were met in the center of Chiangmai township, where houses were surrounded by gardens and where cattle and waterbuffaloes were kept at variable numbers, at no time did we notice any specimens in our bungalow. A difference of behaviour towards light was noted, however, between the species belonging to the noctuidae and the geometridae/pyralidae. The members of the former family were not disturbed when using for collecting artificial light and filming. Whenever the specimens had settled at the eyes they remained there until feeding ended.

In the case of the geometrids and particularly pyralids we gained the impression that they were much disturbed by the torch light. *Filodes fulvidorsalis*, for example, was fairly common on the sambar but only 3 times did we succeed in catching a specimen.

It is of interest to note that swarming was much reduced during heavy rain; when the rain ceased the flight activity began again and continued in a normal manner.

Prior to the investigations in N. Thailand during 1963, nothing was known about the phenology of the eye-frequenting lepidoptera in S.E. Asia. Specimens of *L. griseifusa* were collected only during May and June in 1958 and 1960 (BÜTTIKER 1959, 1962 a). The expedition to Chiangmai in 1963 revealed that most of the geometrid and pyralid

species occur during the whole year round, the observations on *L. griseifusa* and *A. sylvatica* have been summarized in Tables No. 2 and 5.

4. Environment

The environment of the adult eye-frequenting lepidoptera near Chiangmai was the association of the dry Dipterocarp forest * whereas the habitat of the eye-frequenting noctuids in particular near the Fang Agricultural Research Station belonged to tropical semi-evergreen forest ** of N. Thailand.

On account of *Terminalia chebula* being at least one of the host plants of *L. griseifusa* it is of interest to note that *T. chebula* plays a small part in both forest plant associations.

An attempt was made to find out whether eye-frequenting moths occur near shifting cultivation villages on Doi Sutep. Due to several circumstances it was unfortunately impossible to obtain any information in this regard. However on a later occasion Mr. Pichai Manichote found numerous specimens in the Hill Tribe villages *** near Hot, Mae Chaem District, on altitudes of approximately 600–800 m., viz. the following species :

<i>Arcyophora sylvatica</i>	(♂ + ♀) > 20
<i>Hypochrosis korndorfferi</i>	4
<i>Lobocraspis griseifusa</i>	(♂ + ♀) > 30
<i>Pingasa chlora crenaria</i>	1
<i>Pionea aureolalis</i>	2
<i>Pionea damastesalis</i>	6
<i>Semiothisa myandaria</i>	2
<i>Somatina anthophilata</i>	3

The type of vegetation in the close surroundings of these sampling sites belonged to the dry *Dipterocarpus* forest changing gradually to the Hill Evergreen and Coniferous forests occurring above the 1000 m. level. The main tree species are *Dipterocarpus alatus*, *D. costatus* and *Hopea odorata*, developing into tall trees with large diametres.

Generally speaking the S.E. Asian flora covering roughly Indo-China, Taiwan, Thailand, Burma and Assam belongs to the palaeo-tropical vegetation belt which extends from Africa (except the Cape

* The four characteristic tree species are : *Dipterocarpus tuberculatus*, *D. obtusifolius*, *Pentacme siamensis* and *Shorea obtusa*.

** The dry Dipterocarp and the tropical semi-evergreen forests both belong to areas below the 1000 m level.

*** The villages visited were Amkud (23rd July), Mae Kae Mook (26th July), Kongkak and Pang Hin Phon (27th July 1964).

and Mediterranean strip) to Asia South of the Cancer, The Philippines, the Sunda Islands, Newguinea, The South Sea Islands and New Zealand (with the exception of the southern tip) (Fig. 10).

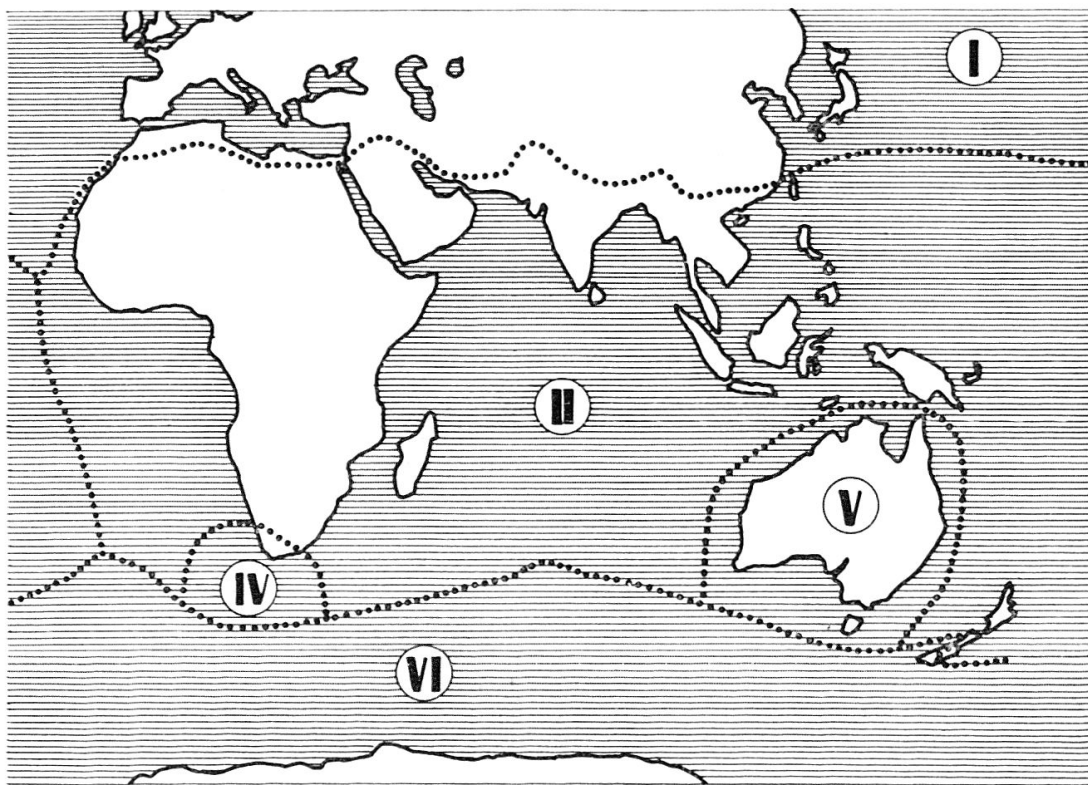


Fig. 10. — The Botanical Regions of the Old World and Australia (on the basis of ENGLER'S Syllabus, 1964).

I. Holarctic flora ; II. Paletropical flora ; IV. Flora of the Cape of the Good Hope ; V. Australian flora ; VI. Antarctic flora.

It can be assumed, therefore, that eye-frequenting lepidoptera may be found in some other areas of S.E. and S. Asia, particularly in botanical subregions where similar vegetation exists. The distribution range of several eye-frequenting moths found in N. Thailand extends over a considerable part of Asia and related lepidopterous species occur equally in many countries of that continent. We consider that in the deciduous and evergreen forests of the palaeotropical belt, in particular the Oriental Region and East Indies (Indonesia to New Guinea, etc.) eye-frequenting moths on mammalian hosts may be discovered without too much difficulty.

These notes reflect the stand of investigations as per 1st of February 1965.

5. Parasites

During our daily routine inspections of the moths kept in captivity we noted on the 12th July 1964 a specimen of *Mermis* sp. (Nematoda, Vermes), which left the body of a female *L. griseifusa*. According to the information obtained by Mr. J. W. COLES, British Museum (Nat. Hist.), London, all species of the Mermithidae have a similar life history to *Mermis nigrescens* DUJARDIN 1842, i.e. parasitic in insects or some other invertebrates in their larval stages and free-living as adults. For more details on the biology it is referred to the paper of BAYLIS (1944).

6. Conclusions and Summary

A historical review on the records of eye-frequenting lepidoptera so far found in Africa and Asia has been included. Since the discovery of this peculiar habit by NEAVE in Nyasaland and Poulton in Tanganyika during 1915 another 15 records from Africa and Asia have been published in the entomological literature.

On the basis of the observations made in Thailand it would appear that there are three different groups of eye-frequenting moths, viz. a 1st category with a strict, a 2nd category with a fairly well developed and a 3rd category with an irregular or occasional eye-frequenting behaviour. The species involved belong to the noctuids, pyralids and geometrids. The only record of *Lampides boeticus* (Lycaenidae) is most probably an accidental record as this species was observed once only.

It is still an open question whether some of the species of the second and 3rd category may feed on salty exudates (e.g. urine, sweat etc.) or on moist soils containing a certain content of mineral salts.

So far no true parasites among the lepidoptera on human beings or animals were known. However, there are marginal parasites in tineids and one pyralid as mentioned by MARTIN (1946), NEVEU-LEMAIRE (1938) and CAMERON (1964). The investigations on the eye-frequenting behaviour of moths is of a particular interest as it would appear that at least the groups of lepidoptera with very pronounced eye-frequenting habits are very close to true parasitism. Further investigations are indicated in order to find out the role played in the transmission of eye-diseases as well as in the degree of blood sucking and feeding on pus of each species observed.

Taking into consideration the strict eye-frequenting behaviour and the host specificity of the noctuids *Arcyophora sylvatica* and *Lobocraspis griseifusa* on cattle, waterbuffalo and sambar additional host records were obtained during 1963 and 1964 since the last publication (BÜTTIKER 1964 and 1965), viz.

<i>Hypochrosis korndorfferi</i>	from cattle and waterbuffalo
<i>Hypochrosis flavifusata</i>	from the sambar, and
<i>Pingasa chlora crenaria</i>	from cattle and waterbuffalo

It can be assumed that several additional hosts might be found in domestic and/or wild mammals.

With regard to the development stages of the eye-frequenting moths in N. Thailand egg, larvae and pupa are known only from a few species. We were successful in obtaining eggs and 1st instar larva of *L. griseifusa* and *Pionea damastesalis*.

It was shown that several of the lepidoptera investigated occur in N. Thailand during the whole year round. For *Arcyophora sylvatica* and *Lobocraspis griseifusa* the main flight period is during the monsoon season. A second peak of occurrence for *L. griseifusa* has been observed during December and January. It was shown that *Pionea damastesalis*, *Margaronia stolalis*, *Hypochrosis korndorfferi*, *Semiothisa fasciata* and *Somatina anthophilata* were recorded more or less regularly during the whole year round. The remaining species have not been observed as regularly due to their more restricted host spectrum, or on account of their more restricted seasonal occurrence.

Whilst conducting a large number of excursions in the neighbourhood of Chiangmai we were able to trace the day and night-time resting places of *L. griseifusa*, *A. sylvatica* and *Pionea damastesalis*. These consisted of a recently cut brush wood type of secondary dipterocarp forest.

From the information on the distribution of several moths referred to in this paper it is assumed that the eye-frequenting behaviour may occur in other parts of Asia as well, particularly in regions where suitable vegetation conditions for the same or related species prevail. This could particularly be the case in the following subregions of the palaeotropical region :

India and Ceylon
Malaya and Indonesia
New Guinea and Papua

and eventually

Melanesia and Micronesia.

With regard to the habitat the eye-frequenting moths were found in the dry dipterocarpus and the tropical semi-evergreen forests. *Arcyophora sylvatica* and *Lobocraspis griseifusa* have been found so far at altitudes of a few meters above sea level (Kampot District, Cambodia) to approximately 800 m. in the Mae Cham (Hot) District in N. Thailand.

Contrary to the observations made in Cambodia in 1958 no displacement movements were detected in any of the lepidoptera during the expedition in N. Thailand. It has to be mentioned, however, that

no observations in this regard could be made prior to the onset of the rainy season, due to the late commencement of the field observations in June 1963.

A parasitic nematode, *Mermis* sp., was found in a female of *Lobocraspis griseifusa*.

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8. References

- BAYLIS, H. A., 1944. *Observations on the nematode Mermis ingrescens and related species*. Parasitology, 36, 122-132.
- BRAAK, C., 1931. *Klimakunde von Hinterindien und Insulinde*. Handbuch der Klimatologie, 4. Teil, Berlin.
- BÜTTIKER, W., 1959. *Observations on Feeding Habits of Adult Westermanniinae (Lepid., Noctuidae) in Cambodia*. Acta Trop., 16, 4, 356-361.
- 1962 (a). *Notes on two Species of Westermanniinae (Lepid., Noctuidae) from Cambodia*. Proc. R. ent. Soc. Lond. (B), 31, pts. 5-6, 73-76.
- 1962 (b). *Biological and Morphological Notes on the Fruitpiercing and Eye-frequenting Moths*. Proc. XI. Int. Congr. Ent. Vienna, 1960, Verhandlungen, 2, 10-15.
- 1964. *New Observations on Eye-frequenting Lepidoptera in S.E. Asia*. Verhandl. Naturf. Ges. Basel, 75, (2), 231-236.
- 1965. *New Observations on Eye-frequenting Lepidoptera from S.E. Asia (Short Note)*. Proc. 12th Int. Congr. Entomology, London, 826-828.
- 1965. *Observations on the Migration of Adult Lobocraspis griseifusa HMPS. in Cambodia*. Mitt. Schweiz. Ent. Ges., 38 (3/4), 218-222.
- BÜTTIKER, W., WHELLAN, J., 1966. *Records of Eye-frequenting Moths from Rhodesia*. Rhod. agric. J., 63 (2), 24-27.
- BRIMBLECOMBE, J., 1958. *Control of the Cedar Looper*. Qd. J. Agric. Sci., 15, (3), 159-160.
- CAMERON, T. W. M., 1962. *Parasites and Parasitism*. Methuen, London.
- EGGERS, E., 1927. Schrift. Naturw. Vereins, Schleswig-Holstein, 17, 325-333.
- ENGLER, A., 1964. *Syllabus der Pflanzenfamilien*, 2, Berlin.
- EVANS, J. W., 1952. *The injurious Insects of the British Commonwealth*, London.

- FLETCHER, D. S., 1954. *A Synonymic Revision of the Genus Arcyophora* GUENÉE. Proc. R. ent. Soc. Lond. (B), 32, 197-200.
- 1965. Personal Communication. Letter on Records and/or Specimens of Moths in the British Museum (Nat. Hist.), London (dated 29th November 1965).
- GOATER, B., 1955/1956. *Nocturnal Lepidoptera at Chandler's Ford (Hants.)*. The Ent. Records, 67, 251-311; 68, 29-32; 58-60.
- HAMPSON, G. F., 1896. *Fauna of British India including Ceylon and Burma*. London, Vol. 4 + 18.
- KALSHOVEN, L. G. E., 1951. *De Plagen van de Culturgewassen in Indonesië*. 2 Volumes, 'S-Gravenhage (The Netherlands).
- KLIMA, A., 1939. *Lepidopterum Catalogus*. Pars 94, Pyralidae.
- LEWIS, D. J., 1960. *Medical Entomology in the Sudan Republic*. Sudan Notes and Records, 39, 11-24.
- LOETSCH, F., 1958. *Report to the Government of Thailand on Forest Inventory of the Northern Teak-bearing Provinces*. FAO Report No. 895, FAO, Rome.
- MARTINI, E., 1946. *Lehrbuch der medizinischen Entomologie*, Jena.
- MATHUR, R. N., SINGH, P., 1963. *Immature Stages of Indian Lepidoptera*. Nr. 13, *Pyralidae/Pyraustinae*. Indian Forest Records (New Series), 10 (6), Delhi.
- MONROE, E., 1960. *New Tropical Pyraustinae (Lepid., Pyralidae)*; *The Canadian Entomologist*, 92 (3), 164-173.
- NEVEU-LEMAIRE, M., 1938. *Traité d'Entomologie médicale et vétérinaire*, Paris.
- NYE, I., 1965. Personal Communication, Letter on records and/or specimens of moths in the British Museum (Nat. Hist.), London (dated 29th November, 1965).
- REID, E. T. M., 1954. *Observations on Feeding Revision of the Genus Arcyophora Guenée*. Proc. R. ent. Soc. Lond. (B), 23, pts. 11-12, 200-204.
- RINDGE, F. H., 1959. *Descriptions of and Notes on North American Geometridae (Lepid.)*, No. 4. Am. Mus. Novitates, No. 1968, October 29, 1959.
- SORAUER, P., 1953. *Handbuch der Pflanzenkrankheiten*, 4, 2nd part, 2nd edition, Berlin.
- WARNECKE, G., 1928. *Schriften des Naturw. Vereins Schleswig-Holsteins*, 18, 263-292.
- WHALLEY, P. 1965. Personal communication, Letter on records and/or specimens of moths in the British Museum (Nat. Hist.), London (dated 29th November, 1965).