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UNSUSPECTED TEAR DRINKING AND ANTHROPOPHILY IN THYATIRID MOTHS, WITH SIMILAR NOTES ON SPHINGIDS

*Hans Bänziger**

ABSTRACT

Moths *Chaeopsestis ludovicae* Le Cerf and *Neotogaria hoenei* (Sick) comb. nov. (Thyatiridae) are treated with details on the adult's taxonomy, distribution, biotope, hosts, feeding habits and seasonal population fluctuation. They were discovered only recently in Thailand, on Doi Suthep, Doi Chiang Dao and other mountains of the north. Adult males sucked lachrymation from the eyes of zebu, horses, mules and secretions from human skin, mouth and nose. Some specimens were unusually persistent in getting to the host's eye. That some thyatirid Lepidoptera are tear drinkers was completely unexpected. Attacks by *Rhagastis olivacea* Moore (Sphingidae) on the eyes of horses and mules are also reported for the first time, as is their sucking from human lips and nostrils.

INTRODUCTION

Lepidopterous families with adult moths so far known to be attracted to the eyes of certain mammals (including occasionally man) comprise the Geometridae, Pyralidae, Noctuidae and Notodontidae, as has already been established for quite some time (COLLENETTE, 1928; REID, 1954; BÄNZIGER, 1973, 1988a; BÜTTIKER, 1973; BÜTTIKER & NICOLET, 1975). To these now can be added two more families.

One family is the Sphingidae. On two occasions in 1985 and 1986 in N. Thailand at least 3 specimens of *Rhagastis olivacea* Moore were observed to fly among a group of horses (*Equus caballus* L.) and mules (E. *caballus* × *E. asinus* L.) and hover persistently in front of their eyes. On a third occasion 3 specimens attacked man – myself and one of my visiting colleagues, Dr. G. Robinson. It was a startling experience. I had beed involved in nocturnal field research on zoophilous moths for two decades, and been a willing guinea pig to all the moths which used me as a source of nourishment, which happened repeatedly (e.g. BÄNZIGER, 1985; BÄNZIGER & FLETCHER, 1988). However, until recently I had not come across hawkmoths flying around the head of a mammal, much less 2 specimens simultaneously hovering in front of my own eyes, the long proboscis directed against my face to poke inquisitively between my lips and into my nostrils. This occurred in a lush forest tract of that unique national park, northern Thailand's Doi Suthep-Pui, recently shown to shelter what still are very diverse plant and animal communities (e.g. SEIDENFADEN &

* Department of Entomology, Faculty of Agriculture, Chiang Mai University, Chiang Mai, 50002, Thailand.

SMITINAND, 1959-1964; ROUND, 1984; PRAKOBVITAYAKIT-BEAVER & SRITASUWAN, 1985; BÄNZIGER, 1988a, b), when considering the park's relatively small size and the constant and heavy human impact on it.

That some sphingids are lachryphagous was not fully unexpected (see Discussion); but this was not the case with the Thyatiridae, the other and most recent addition to the families of Lepidoptera with lachryphagous members, and the main subject of the present study. To my knowledge, no report has ever been published on thyatirid moths taking mammalian body fluids; nor have I observed species of the family to exhibit zoophilous behaviour of any kind until the present study. I was therefore surprised to discover 2 thyatirid moths, *Chaeopsestis ludovicae* Le Cerf and *Neotogaria hoenei* (Sick) comb. nov., to be avid tear drinkers, sometimes settling on man, and to suck wound exudates. The persistence with which eyes were approached by some moths was amazing, as is described in the ecological part of this paper.

From 4 specimens of *C. ludovicae* recently found among the unidentified material in the collection of the Dept. Entomology, Faculty of Agriculture, Chiang Mai University (DEFACU), it appears that my colleagues Mr. P. Sukumalanan, Dr. S. Ratanabhumma and Mrs. J. Visitpanich were the first to collect it in Thailand, in 1980 at mercury vapour lamps (MVL). The specimens are likely to represent the first known captures since the species' description in 1941, based on 6 syntypes from N. Vietnam. Two years later the species was observed by myself and subsequently caught at MVL also by other researchers, as mentioned below. I did not know the identity of the moth at that time and intended to gather more information on its feeding habits, which was difficult to obtain on account of the scarcity of the species, before publishing my observations. The identity of the moths from Thailand was first recognized and published by YOSHIMOTO (1987).

N. hoenei was unknown in Thailand before this study, and seems otherwise to have never again been collected since its discovery half a century ago in Yünnan, S. W. China.

SYSTEMATIC PART

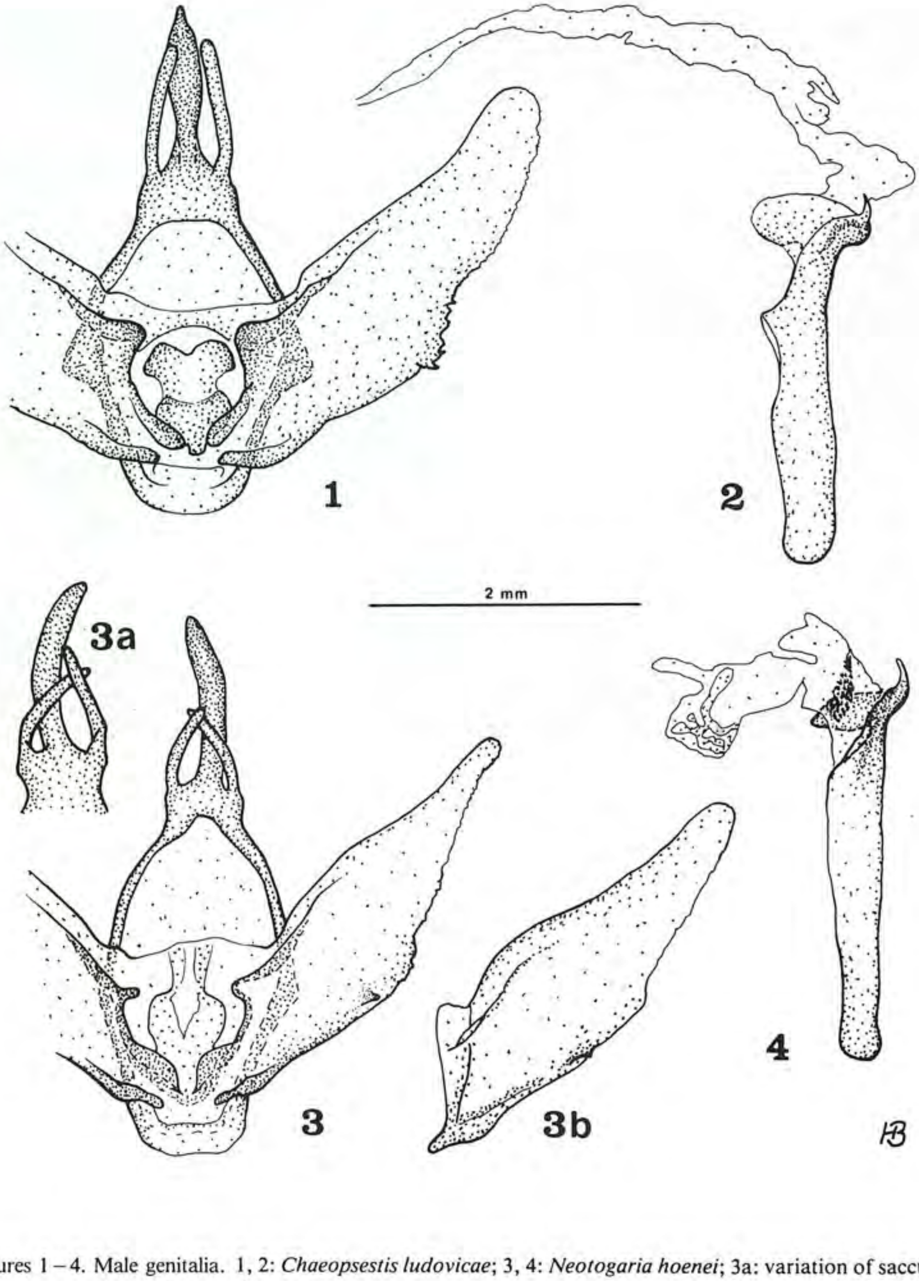
Chaeopsestis ludovicae Le Cerf, 1941

Chaeopsestis ludovicae Le Cerf, 1941, Bull. Soc. ent. Fr. *46*: 94.

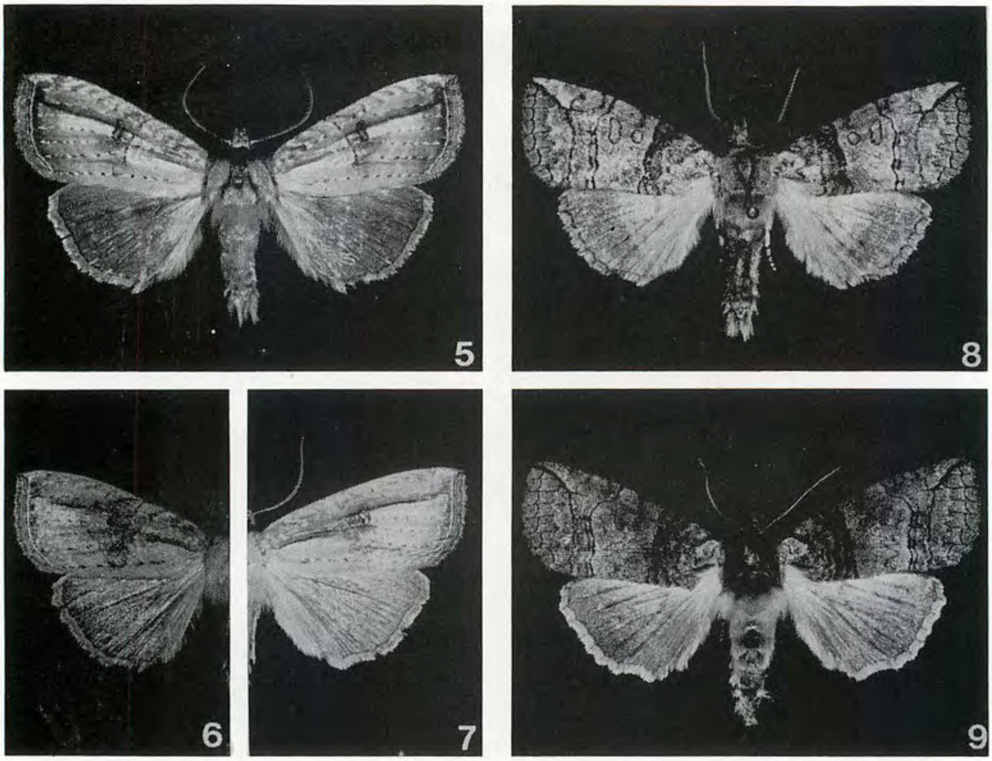
Yoshimoto, 1987, Tŷo to Ga *38*: 239.

Except for the proboscis — important for the understanding of the moth's feeding habits — the species needs no further descriptive comments as it has been treated in detail by LE CERF (1941) and YOSHIMOTO (1987). Moreover, it is a very characteristic species which cannot be confused with any other thyatirid moth. However, since it is a fairly variable species and the references on it are not readily available in Thailand, I add illustrations of the moth and its genitalia (Figs. 1, 2, 5 – 7).

The structure of the proboscis is basically the same as described for *N. hoenei*.



Figures 1 – 4. Male genitalia. 1, 2: *Chaeopsestis ludovicae*; 3, 4: *Neotogaria hoenei*; 3a: variation of sacculi; 3b: variation of valve.



Figures 5 – 7. *Chaeopsestis ludovicae*; 6, 7: variations.
Figures 8, 9. *Neotogaria hoenei*; 9: variation.

Neotogaria hoenei (Sick), 1941, comb. nov.

Spilobasis hoenei Sick, 1941, Deutsche Entomol. Z. 1941: 8.

In a treatise redescribing the genus *Neotogaria* Matsumura, 1933, and its type species *saitonis* Matsumura, 1931, YOSHIMOTO (1984) transferred several species from other genera to *Neotogaria*; namely, *Polyploca anguligera* Hampson, 1893, *P. galema* Swinhoe, 1894, *Spilobasis flammifera* Houlbert, 1921, and *S. curvata* Sick, 1941. YOSHIMOTO (1984) also expressed the opinion that *S. hoenei* probably belongs to *Neotogaria* though he excluded it from his study.

Since my Thai species did not clearly match any of the species treated there, I sent 3 specimens to Mr. H. Yoshimoto who kindly identified them as *N. hoenei.* He also commented (in litt.) that in the meantime he had examined some of Sick's type material and had no hesitation in assigning *hoenei* to *Neotogaria.* Furthermore, he very generously suggested that I go ahead and publish this "comb. nov.". Herewith I wish to acknowledge that the merit to have established it goes exclusively to him.

However, Thai specimens are fairly variable and some of them are very close to *N. anguligera*, indicating that the two may actually be conspecific. Nevertheless, before *hoenei* is sunk to *anguligera*, more material must be examined and until then we both concur that *hoenei* should be upheld.

Because SICK's (1941) description of *hoenei* is no longer adequate to distinguish it from the several similar species, it is redescribed below.

Redescription

Male (Figs. 8, 9). Wingspan 39 – 43 mm (Ø = 42, n = 7). Above head and thorax dark grey, legs and palpus paler grey, as is the abdomen, especially below. Head with 3 black cross lines; palpus with a very distinct longitudinal black line, the second segment also with a much fainter one. Dorsally on abdomen is a tuft of short, flattened black hairs rising from the 3rd tergite, followed by increasingly smaller ones on 4th to 6th tergites. Antenna so densely dentate as to appear filiform, brown. Proboscis reminding somewhat that of *Lobocraspis griseifusa* Hampson (BÄNZIGER, 1973) but shorter, distally less sclerotized and rather soft, basally broader, the passively movable sensillae much more numerous (nearly 150 per galea, maximal length 0.09 mm), consisting of a central cone with 4 edges extended into sharp unequal blades topped into acute tips. Fore wing upperside greyish, variably patterned as in Figs. 8, 9. The antemedian fascia consists of 2 black lines slightly curved, distally diverging from each other on both ends. Orbicular circular and reniform a faint kidney-shaped ring, both not always evident. Postmedian fascia similar to antemedian but intermittent, curved inwardly at about 1/3 of its length before merging with the anterior margin. A thin, well defined black line runs more or less parallel to the postmedian, half way between this and the submarginal line. This is a diffuse, pale, wavy line, often barely visible, between veins 2 and 5. A diagonal, straight, black streak from the apex to the well-defined black line is very conspicuous. The marginal line is a thin but well-defined black serration. Fringes grey. Hind wing upperside less dark grey, and quite light near base; venation dark, fringes distally whitish. Wing undersides whitish to very light grey except the marginal areas which are dark grey; these can be very wide on fore wing. Discoidal spot very faint.

Genitalia (Figs. 3 – 4). Uncus finger-shaped, socii rather shorter, slightly variable in length. Valve rhomboidally shaped, in part membraneous and hence in outline somewhat variable. The sacculus has a tiny process. Aedeagus apically with a hook and a patch of tiny denticles.

Comments. N. hoenei is closest to *anguligera*; it is possible that study of more comprehensive material may prove the former a subspecific taxon or a synonym of the latter. However, *anguligera* can be readily separated by the postmedian fascia which is more sharply angled and more inclined than in *hoenei*, although in this species the fasciae show quite some variation. In the genitalia the socii are shorter and the apical hook of the aedeagus broader and more abruptly curved than in *hoenei*. In both *saitonis* and *curvata* the antemedian fascia is distinctly more strongly curved, uncus and socii shorter, than in *hoenei*, among other differences. In *flammigera* and *galema* the antemedian is more inclined than in *hoenei*; also, in *galema* the postmedian fascia is not angled, just gently curved, while the diagonal streak at the fore wing apex is distinctly angled.

Except for *saitonis*, treated in detail in YOSHIMOTO (1984), the analysis of the *Neotogaria* spp. mentioned above is based on photographs of the types.

ECOLOGICAL PART

The thyatirid moths studied ecologically comprise the tear sucking species mentioned above, *C. ludovicae* and *N. hoenei*, and a zoophilous species not yet seen to imbibe lachrymation, *Habrosyne fraterna* Moore.

Distribution and Records

C. ludovicae

Previous records. N. VIETNAM: 2 ♂, 4 ♀, Chapa (near the Chinese border) ix.1930, L. Simon and M. Lemai leg. (syntypes, Paris Museum) (LE CERF, 1941). N. THAILAND: 2♂, Chiang Mai Prov., Chang Khian, Doi Suthep-Pui National Park, 1320 m, 27.x.1980, P. Sukumalanan and J. Visitpanich leg. 2 ♂, Doi Pa Kia, 1560 m, 3.xi.1980, S. Ratanabhumma and J. Visitpanich leg. (DEFACU) (this report). 6♂, Huay Nam Dang, Mae Taeng Distr., 25. – 27.x.1984, Karsholt, Lomholdt & Nielsen leg. (Zoological Museum, University of Copenhagen, Denmark) (this report). 2 ♂, Doi Inthanon, 1. – 3.x.1985; 5 ♂, 2 ♀, Pa Kia, (ca. 1500 m), 5.xi.1985, S. Moriuti, T. Saito and Y. Arita leg. (University of Osaka coll.) (YOSHIMOTO, 1987).

Own records. See Table 1. Additional records, all at MVL. 1♂, Pong Düad, 650 m, 15.xi.1982; 4 ♂, near Doi Pui summit, 1635 m, 17.x.1984; 6♂, near Doi

Inthanon summit, 2550m, 25.x.1986; 4♂, Doi Ang Khang, 1450 m, 29. and 30.x.1987 (DEFACU and Bänziger coll.).

N. hoenei

Previous records. S.W. CHINA:1♂, 1♀, N.W. Yünnan, Likiang, 9.v.1934, 16.x.1935, Höne leg. (Museum Bonn) (SICK, 1941).

Own records. N. THAILAND: Chiang Mai Prov., see Table 2. Additional records, at MVL. 1♂, Chiang Mai/Mae Hongson Prov., Doi Chang, 1965 m, 8.iv. 1987 (DEFACU and Bänziger coll.).

H. fraterna

I have not studied the references on the species's distribution outside Thailand, but it is known to be present in N. India.

Own records. N. THAILAND: 4♂, Chiang Mai Prov., Doi Ang Khang, 1450 m, 21.v.1986, 29.x.1987 (at MVL), 27. and 28.iv.1988 (not all caught). 2♂, Doi Inthanon, 2335 m and 2550 m, 23.v.1987 and 25.x.1986 (at MVL).

Biotope, Temperature Range and Time of Activity

So far, *C. ludovicae* has been observed mainly in, or in very close proximity of, forests from 600 m to at least 2550 m; it was scarce in the lower ranges. Its biotope therefore corresponds to Tropical Deciduous and mainly Tropical Hill Evergreen Forests, including the limestone vegetation found there.

N. hoenei, recorded roughly between 1000 and 2000 m, so far has been encountered only in areas with limestone vegetation.

H. fraterna flies in similar biotopes as *C. ludovicae* except that it has not been found below 1450 m as yet. *N. hoenei* and *H. fraterna* were more often met in open disturbed habitats than *C. ludovicae.*

The temperature at which *C. ludovicae* and *N. hoenei* were on the wing and settled on their hosts ranged from 13°C (early March and end of October) to 23°C (late April). This is quite low for a tropical region. They may be active at lower and higher extremes but so far such were not experienced at the research sites during the moths' seasonal flight periods. The time of host searching and feeding activity was mainly early at night, but *N. hoenei* was encountered after midnight a few times.

Hosts Visited and Liquids Imbibed

N. hoenei sucked lachrymation from the eyes of horse and mule; a few more specimens attempted to do so but were not successful, or imbibed skin secretions on the host's body; another specimen flew in a pigs' sty twice, without settling anywhere (Table 2).

C. ludovicae was found mainly in association with zebu and cattle (*Bos taurus*

Table 1. Observations of *Chaeopsestis ludovicae* on or near mammalian hosts.

Date	Locality	Host	Details of behaviour
28.x.82	Ban Mae Tho	water buffalo	Persistently tried to settle on host
4.xi.85	Doi Suthep[1]	zebu	Alighted twice at wound but host scared it away by vibrating the skin
		man	Sucked perspiration from skin on lower leg
16.xi.86	Doi Suthep[2]	man	Sucked perspiration from hand of colleague
29.x.87	Doi Ang Khang	horse	Sucked lachrymation at eye
		horse	2 individuals flew off host
31.x.87	Doi Ang Khang	mule,man horse	Briefly sucked at eyes of both animals, then sucked at arm, lips, nostrils of author and Karen assistant
5.xi.87	Doi Suthep[3]	man	Repeatedly settled and sucked fluids from face, arm, clothes, shoes of author and colleagues
6.xi.87	Doi Suthep[1]	zebu	4 individuals settled at the same time on 2 hosts, 2 individuals at one eye of each host
		zebu	5 individuals sucked at eyes at different times
		zebu	1 individual settled and sucked at eye 3 times, another did so twice
		zebu	Settled and sucked 6 times at eye of one host and 8 times at eye of another, each time scared off by camera flash
12.xi.87	Doi Suthep[1]	zebu, man	Sucked at zebu's eye, then for a long time took perspiration on author's hand
		man	Sucked on author's arm
		man	Settled 4 times and sucked at lips, nostrils and face below the eye of author (possibly same specimen as above)
19.xi.87	Doi Suthep[1]	zebu	Sucked at eye
8.iii.88	Doi Ang Khang	horse	Circled around host

Explanations. Ban Mae Tho: 1150 m, Hod/Mae Jaem Distr., Chiang Mai Prov.; Doi Suthep[1]: NW flank, 1150 m; Doi Suthep[2]: below Doi Pui summit, 1635 m; Doi Suthep[3]: near Khonthatharn Waterfall, 660 m. N.B. not all individuals observed were caught.

Table 2. Observations of *Neotogaria hoenei* on or near mammalian hosts.

Date	Locality	Host	Details of behaviour
9.v.85	Doi Ang Khang	horse	Flew near hosts
22.v.86	Doi Ang Khang	horse	Sucked lachrymation at eye
16.x.86	Doi Chiang Dao[1]	man	Settled on author's arm and sucked perspiration
18.iii.87	Doi Ang Khang	horse, mule	Settled on hosts' body and face but did not manage to reach the eyes
29.x.87	Doi Ang Khang	horse	Sucked at eye, another specimen attempted to settle on head
31.x.87	Doi Ang Khang	mule, horse,man	Settled several times very briefly at eye, once also on mouth of horse, mule; settled briefly on arm and throat of author; finally sucked at eye of mule for a long time
8.iii.88	Doi Ang Khang	horse	After circling around host settled on flank but was scared off by camera flash.
9.iii.88	Doi Ang Khang		Sucked effluvia of horse and mule diluted with rain on ground.
27.iv.88	Doi Ang Khang		One individual sucked twice effluvia of horse and mule diluted with rain on ground
25.v.88	Doi Ang Khang	(pig)	Flew twice in pig sty but did not settle
26.vii.88	Doi Chiang Dao[1]	horse	Flew around host for a long time; 30 min later another (or same?) individual attempted to settle on head and eyes, finally landed at mouth where it was captured
27.vii.88	Doi Chiang Dao[1]	horse	Sucked at eye but soon scared away, disappearing; another (or same ?) individual sucked again at eye of same host
		horse	Attempted to settle on head but host too restless
		horse	Attacked host for 15 min, sucked at eyes at least 3 times for a total of several min
		horse,mule	Attempted to alight for a long time then disappeared; another (or same ?) individual did so again a few min later
			One individual sucked moisture of unknown origin from the ground near horses
10.viii.88	Doi Chiang Dao[1]	mule	Flew around host

Explanations. Doi Chiang Dao[1]: N flank, 1150 m. N.B. not all individuals observed were caught.

indicus L. and *B. t. taurus* L.) (Table 1). Some 14 specimens drank tears in nearly 30 attempts. The eyes of horses and mules were visited only occasionally; attempts to do so on water buffalo (*Bubalus bubalis* (L.)) and a few more times on horse were not successful. One specimen also alighted twice at a wound of a young zebu but was chased away soon in both cases by the host's vibrating of the skin. The lower frequency of the moth at eyes of horses and mules than of zebu is probably due to the less suitable location of the former ones as compared with the latter.

Of particular interest are some 12 attacks on man (Table 1) by 6 specimens of *C. ludovicae* which sucked perspiration from arm, hand (Fig. 12) and leg, saliva from lips, and nasal mucus from the nostrils. No lachrymation was taken although the moths came quite near the eyes while crawling on the faces of me and my assistants. *N. hoenei* sucked perspiration from my skin twice (Fig. 13). It is likely that both species can occasionally drink tears from humans; failure to observe this yet is probably only circumstantial.

H. fraterna was once seen sucking body fluids, presumably from horses or mules, from a plastic sheet near a stable, and twice while taking an unknown substance from the ground. Three individuals of *N. hoenei* were seen to suck moisture mixed with decomposing organic matter, especially horses' and mules' effluvia diluted in rain, from the ground.

Behaviour

In their flying and feeding behaviour *C. ludovicae* and *N. hoenei* quite resemble lachryphagous *Tarsolepis* spp. (Notodontidae). Like these, though not quite as consistently, the two thyatirids did not stop beating the wings while sucking at the eye of a host. When they did, then the wings were held in a "V" position. The flight around the host can be astonishingly fast.

The light from an electronic flash had strong impact: the moths mostly fell off the eye without, however, reaching the ground. *Tarsolepis* spp. often fell to the ground and remained entangled in the grass; renewed attacks were not witnessed, at least not before some time elapsed. Not so *C. ludovicae* which recovered from the light in a fraction of a second and flew up again and, if not satiated, attacked anew.

The moth's persistence in this can be astonishing. In one extraordinary instance which occurred on Doi Suthep on 6 November, 1987, I took one flash photograph which caused the specimen to fall off the eye of a zebu. Before reaching the ground, it gained height, and after a short turn flew straight back to the same eye. Five more flash photographs were taken, each one causing a similar reaction in the moth which returned every time to the same eye; after the 6th photograph it flew to the eye of another zebu nearby. The same performance was repeated for another 8 flash photographs. At this point I conceded defeat in this trial of perseverance and caught the moth before it outwitted me by a sudden escape. Fig. 10 documents the 5th round of the sequence.

Figure 10. *Chaeopsestis ludovicae* drinking tears from the eye of a zebu for the 5th time after having been scared off 4 times by the author's flash photographs.

Figure 11. *Chaeopsestis ludovicae* sucking lachrymation from the closed eye of a zebu. Note the curved proboscis passing through the eye lashes.

Figure 12. *Chaeopsestis ludovicae* sucking perspiration from the hand of a Karen assistant. Note the recurved proboscis applied to the skin surface.

Figure 13. *Neotogaria hoenei* sucking perspiration from author's arm.

Figure 14. *Neotogaria hoenei* taking the sodden mixture of animal effluvia diluted in water soaking the ground.

Some species of lachryphagous moths are hardly affected by flash lights; the noctuid *L. griseifusa* just continues to drink lachrymation or may briefly coil up the proboscis but will not leave the eye.

The speed with which *C. ludovicae* in the above case was able to return to the same eye after each flash was possibly due to a faculty present in many insects, notably some wasps. By 'remembering' the configuration of the environment around the entrance to their nest in the ground the moment the wasps fly away, they are capable of quickly finding the tiny entrance when they return. If a prominent object is displaced, they have difficulty in finding the entrance. A similar mechanism possibly helps guide *C. ludovicae* rapidly back to the source of food whenever it is chased away. The species otherwise did not seem particularly efficient in reaching the eye in the first attempt.

Sucking time was a few minutes, as in most lachryphagous moths. Lachrymation was taken nearly always directly at the eye, rarely below, where tears may flow down from the eye. With their relatively soft proboscis, totally lacking any piercing armature, the two thyatirids inflict no macroscopic wounds onto the conjunctiva or cornea of the host's eye, as has been shown to be the case with all other lachryphagous Lepidoptera (BÄNZIGER, 1973); but the minute, sharp edged sensillae could irritate the tissue.

Population Fluctuation

C. ludovicae, and *N. hoenei* have interesting seasonal population fluctuations. *C. ludovicae* was on the wing in October and November, with a peak late October – early November; except for a single record in early March, the adult seemed otherwise missing throughout the rest of the year. *N. hoenei* on the other hand, appears to have 4 generations per year in N. Thailand. Because of its scarcity it is not yet possible to give exact details on the seasonal flight periods. Tentatively, nevertheless, the 4 flight peaks can be expected to occur about the first half of March, May, late July/first half of August, and second half of October.

Species of *Neotogaria*, as mentioned by YOSHIMOTO (1984), are generally known to have only one generation per year, either in spring or autumn, at least in the temperate/subtropical regions. *C. ludovicae* also seems to follow this pattern. According to early records (SICK, 1941), *N. hoenei* is unusual in having been found in May as well as in October in S.W. China. But from the present study there is little doubt that in N. Thailand it goes through 4 generations a year, each generation (egg to egg) spanning some 8 – 10 weeks, except during the cold season when development is slower. It is interesting to note that, although *N. hoenei* is atypical when compared with its relatives, its yearly population fluctuation parallels those of several zoophilous species of similar size belonging to other families.

The single individual of *C. ludovicae* observed early in March may represent a 'latecomer', the larval stage of which developed too slowly or too late to emerge in October/November before the onset of the cold.

For a better understanding of the above generation fluctuations more research on these scarce species must be carried out; most informative would be details on the immature stages which are still completely unknown.

DISCUSSION

Thyatiridae is a somewhat perplexing moth family. At first glance, externally many species look like noctuids or notodontids, and *C. ludovicae* and *N. hoenei* would fit this characterization also in their feeding behaviour. But the family is thought to be more closely related to the Drepanidae and Geometridae. These share with the Thyatiridae the abdominally located tympanal organ; but otherwise the geometrids' 'look' is more fragile, with quite thin bodies set between comparatively large wings.

Odd also are a number of further features which have already been discussed in the respective chapters. Namely, the 'abnormal' seasonal flying periods, the sensitivity to flash light in contrast to the subsequent nearly instant recovery from it, coupled with the rapid resumption of attacks on the host's eye and the efficiency with which the moths are capable of returning to it.

With some 70 valid genera in the world, Thyatiridae is a 'small' family. This compares with 2700 valid genera of Geometridae and over 3800 genera of Noctuidae listed in FLETCHER (1979) and NYE (1975), respectively. In BARLOW's (1982) work on the moths of S.E. Asia not one species of Thyatiridae is mentioned. Moreover, the thyatirid genera as recognized today differ very much less among themselves than e.g. noctuid genera do, the same applying for many taxa of the species level. In reality, therefore, the Thyatiridae's diversity is even less than what the 70 genera would let surmise. In a species-poor, homogeneous family as the Thyatiridae, the evolution of an eccentric feeding habit such as lachryphagy would seem to be far less likely than in the much larger, heterogeneous groups of the Noctuidae, Geometridae, Pyralidae, or even the moderately large Sphingidae and Notodontidae. This is one of the reasons why the discovery of lachryphagy in Thyatiridae came as a surprise.

There is a further unusual feature, at least when considering the relationship they have with the Geometridae. The majority of zoophilous Geometridae suck various mammalian body fluids from the ground or the vegetation where they have been dropped or smeared by the host, much less often directly from the body, and least from the eyes. The opposite was observed in the Thyatiridae studied: they fed, or attempted to, most frequently at eyes, less so on the body (except for man, an unusual host) and, so far, least away from the host's body (three specimens of *N. hoenei*, three of *H. fraterna*). Since the taking of such fluids from the ground or vegetation is logically the first step in zoophily and generally also the most widespread of such habits, its rarity in Thyatiridae also helps to explain why lachryphagy was unexpected in these moths while at the same time it was less surprising in Sphingidae.

Indeed, 60 years ago SHANNON (1928) reported a case involving the sphingid

Xylophanes tersa L. seen together with other moths, some of which settled at eyes and other body parts of horses in Argentina. No details on the hawkmoth's behaviour, however, were given nor on which fluids, if any, were imbibed.

In early 1972, I saw an unidentified sphingid fly for quite some time back and forth near a black rhinoceros (*Diceros bicornis* L.) in the Zoo Negara, Kuala Lumpur, W. Malaysia. The moth, however, made no clear attempts to alight on the rhinoceros and finally sucked from a pool of water mixed with excreta. In yet another report, BÜTTIKER (1973) observed fair numbers of *Nephele peneus* (Cramer) and *N. comma* (Hopffer) flying near cattle at several localities in the Ivory Coast, W. Africa. The moths did not imbibe any fluids, and their behaviour did not reveal what they were after; most likely it was related to the behaviour of the previous and the following species.

Finally, more recently, I have repeatedly seen in the mountains of N. Thailand specimens of *Cechenena lineosa* Walker hovering over small pools containing rain water mixed with urine and dung of horse, mule or pig, the long proboscis extended to drink the liquid while hovering in the air. A similar mixture of rain and animal fluids was imbibed by specimens of another hawkmoth, *Acosmeryx naga* Moore, but in this case from a settled position on the ground. Uncontaminated rainwater on leaves was available in the vicinity but this was not taken, indicating that the moths were not just after moisture. These records concerning the 5 species of hawkmoths, however inconclusive some seem to be, show that some sphingids can at least feed upon mammalian body fluids left on the ground.

Thus, the observations mentioned in the introduction of the hawkmoth *R. olivacea* being attracted to the eyes of horses and mules were not wholly unexpected, though the species' attacks on man were about as surprising as lachryphagy in Thyatiridae. A more detailed study on zoophily in Sphingidae will be published as soon as more observations become available.

Two factors, working singly or in combination, may account for the late discovery of lachryphagy in Thyatiridae. One is that research on zoophily in Lepidoptera has been carried out mainly in lowland areas, where the bulk of (domestic) ungulate and proboscidian hosts are located. Studies in the higher areas, the main habitats of the two thyatirids, have been intensified only in recent years. Secondly, the two species may have expanded their population sizes and/or geographical distribution. Although this could be due to a natural long term population trend, it may also be the result, directly or indirectly, of man-caused changes in the ecosystem, foremost of which is the increasing destruction and consequent replacement of original forests by secondary vegetation over wide areas.

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