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REMARKABLE NEW CASES OF MOTHS DRINKING HUMAN TEARS IN THAILAND (LEPIDOPTERA: THYATIRIDAE, SPHINGIDAE, NOTODONTIDAE)

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ABSTRACT

During 110 night investigations of zoophilous Lepidoptera adults troubling various mammals, 10 cases of lachryphagous moths settling at human eyes were witnessed. The behaviour of 3 *Chaeopsestis ludovicae* Le Cerf (Thyatiridae), one *Rhagastis olivacea* Moore (Sphingidae) and one *Togarishachia albistriga* (Moore)(Notodontidae) attacking the author's eyes is detailed. *C. ludovicae* was particularly obnoxious due to clawing of the eyelid's conjunctiva. *R. olivacea* drank lachrymation while hovering, the tip of the 4-cm long proboscis causing little discomfort. It is argued that, should pathogen transmission really occur, then it is more likely to be due to clawing than to proboscis action in *C. ludovicae* and in notodontids such as *Tarsolepis elephantorum* Bänziger and *Togrishachia lacrimisaddicta* (Bänziger). The opposite is thought to be the case in noctuids *Lobocraspis griseifusa* Hampson and *Arcyophora* spp., which do not claw the conjunctiva. All six lepidopterous families with species known to take tears from animals are now implicated in human lachryphagy; however, 'only' 23 spp. have so far been found to suck human tears compared to about 100 known from animals.

INTRODUCTION

Adults of six lepidopterous families have been recorded to be lachryphagous, viz. Pyralidae, Geometridae, Noctuidae, Notodontidae, Thyatiridae and Sphingidae (DE JOANNIS, 1911; MARSHALL et al., 1915; REID, 1954; BÜTTIKER & BEZUIDENHOUT, 1974; BÄNZIGER,1973, 1987, 1988a). With the exception of a few Noctuidae in which females dominate as tear drinkers, in the vast majority of species only males take lachrymation., Hosts are mainly large mammals belonging to the Artiodactyla, Perissodactyla, and Proboscidea (COLLENETTE, 1928; BÜTTIKER & WHELLAN, 1966; BÄNZIGER, 1973; BÜTTIKER, 1973; RODGERS, 1986). However, man is also a host, with reports of more or less sporadic attacks by moths of four of these families (BÄNZIGER, 1966, 1988b; BÄNZIGER & BÜTTIKER, 1969). There have been no cases of moths drinking human tears thus far for the Thyatiridae and Sphingidae, although such have been suspected.

With the present study based on 110 night investigations on zoophilous moths carried out in N Thailand from August 1988 until the end of 1991, species of all six lepidopterous families now implicated in taking lachrymation from man. The study includes, besides the new cases of Thyatiridae and Sphingidae, also an interesting observation involving a notodontid, *Togarishachia albistriga* (Moore), a species not hitherto reported to settle at animal eyes.

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In addition to the five new cases of lachryphagy described in detail below, five further successful attacks on eyes were appreciated involving the pyralids *Pionea aureolalis* Lederer and *Pi. damastesalis* (Walker), and the notodontid *Pydnella rosacea* (Hampson), species already known to settle at human eyes. In addition, several times as many unsuccessful attempts by various species were witnessed. Finally, it must be pointed out that the present and previous reports do not yet include a significant number of Geometridae and Pyralidae encountered by the author at human eyes between May 1971 and August 1988 which will be reported on in due course.

Man is also visited by two further moth groups in addition to these tear drinkers: (i) those which do not take tears but lick perspiration and some other body fluids, e.g. several species of *Mythimna* (Noctuidae), and (ii) those which suck blood by piercing the skin like the rare *Calyptra* spp. (BÄNZIGER, 1989a).

Lepidopterous lachryphagy has potential medical and veterinary implications. So far, however, there is no proof that moths are involved in the spread of eye diseases although there is indication that this may occur under certain conditions in bovids (REID, 1954; GUILBRIDE et al., 1959; BÄNZIGER, 1973; NICOLET & BÜTTIKER, 1975). Since several dozen attacks on the author's eyes during more than two decades have never resulted in any complications except occasionally a temporary inflammation, the risk of disease appears to be small. By letting himself be host to these moths, a person may gain important clues which would not be obtainable from observations of moths only on animal hosts.

OBSERVATIONS

THYATIRIDAE

Chaeopsestis ludovicae Le Cerf

This is a scarce and unusual species until recently known only from the original description based on a few specimens from N Vietnam (LE CERF, 1941). It has since been collected first by my colleagues Mr. P. Sukumalanand, Dr. S. Ratanabhumma and Mrs. J. Visitpanich, subsequently by myself, and by Danish (Karsholt, Lomholdt & Nielsen) and Japanese (Moriuti, Saito & Arita) expeditions to Thailand. However, its true identity was first recognized by Yoshimoto who redescribed it in 1987. BÄNZIGER (1988b) gave an account of its biology (biotope, population fluctuation, feeding behaviour, hosts, geographic distribution, proboscis morphology). The species is unusual because of its golden wing coloration, as well as its flight period which is restricted to 2–3 weeks in October/November.

Between 1982 and 1988 some 14 specimens were seen taking lachrymation in nearly 30 attempts on zebu (*Bos taurus indicus* L.), horse (*Equus caballus* L.), mule, and water buffalo (*Bubalus bubalis* (L.)). In 12 attacks on the author six specimens imbibed perspiration from arm, hand, leg, and took saliva from mouth and nasal mucus from nostrils, but none settled at eyes.

There are only two genera of Thyatiridae with known lachryphagous species, viz. the monotypic *Chaeopsestis* Le Cerf and *Neotogaria* Matsumura which at present includes about six species (YOSHIMOTO, 1984). Like many taxa of the Thyatiridae, *Neotogaria* is very difficult to revise due mainly to the overall homogeneity of the genitalia. YOSHIMOTO

(in litt.) and BÄNZIGER (1988b) commented that *N. hoenei* (Sick), 1941, may be reduced to *N. anguligera* (Hampson), 1893. In the mean time I have captured two specimens which I consider as separate from *N. hoenei* and provisionally assign to *N. anguligera*. Both species are lachryphagous, the only two of the genus thus far known to be so.

Case 1. Doi Suthep, NW flank, 1150 m, 5 November 1989, 1900-1925 h; 19° C, half moon. Wide clearing Surrounded by secondary and some primary forest.

I was observing zoophilous moths in a herd of zebu. One *C. ludovicae* took tears from a zebu at 1840 h. Shortly afterwards a specimen flew onto my wrist where it suck perspiration for 10 min before it flew onto my naked leg and back onto the front of my head where it continued to take sweat. It flew off and back to my cheek, climbed towards my right eye, finally settling near its lower edge. The perception I now felt was more unpleasant than that experienced with most other moths, comparable to that of a particularly edgy grain of sand being rubbed between eye and lid. The source of the pain is revealed in a flash photograph (Fig. 4) I took 1.5 min after the moth settled: the right fore tarsus was hooked onto the delicate conjunctiva of the lid near the eyeball (Fig. 5), while the tear sucking proboscis applied to the eyeball caused less disturbance. Unfortunately the flash scared the moth away which did not return.

Case 2. Doi Ang Khang, 1450 m, 3 November 1990, 1950-2015 h; 19° C, full moon. Pasture near village.

One *C. ludovicae* was flying among a group of grazing mules and horses when it suddenly turned its attention to me. The animals walked away while the moth was licking perspiration from my arms, hand and clothes. Occasionally it took off to circle around my head and throat. I walked slowly away but the moth persistently followed me for some 100 m, sometimes settling, then again flying off and after me. It finally settled below my left eye to suck lachrymation. This moth also caused a very unpleasant feeling due to its claws being hooked onto the sensitive inner section of the lid (Figs. 6,7). Substantial tear flow ensued. I closed the eye, pressing the lids tightly together, but the moth would not leave. I made 8 flash photographs without the moth flying away (generally flashes cause this species to fall from the host although the moth tends to return quickly if not yet satiated). After 3 min I accidentally touched it with my camera, causing the insect to fly away before I was able to secure it in my net.

Case 3. Near stable of other hamlet in the same region, 3 November 1990, 2220-2245 h; mist had formed. Secondary limestone vegetation nearby.

I was studying another thyatirid, *Neotogaria anguligera,* which I saw for the first time take lachrymation from a mule, when one *C. ludovicae* landed on my hand. During the next 25 min it did not leave me except for short circling to find a new feeding position. Eventually it reached my right eye and started to suck my tears. Again I felt pain due to clawing of the lid (Figs. 1-3), inducing copious tear secretion. Also in this case flash photographs did not dislodge the intruder. The moth frequently changed position of proboscis and tarsi (as evidenced by serial photographs) every time causing renewed irritation. Two min later, after having indulged in this tear-letting for the second time that night, I could not bear it any longer and caught the tormentor.

Table 1. Additional records of *C. ludovicae* settling on various parts of the author's body other than the eyes (October 1988 November 1991).

Date	Time	Locality	Details of behaviour
26.x.88	1930–1940 h	Doi Ang Khang	settled on clothes and crawled over face 4 times, sucking persistently at nostrils
25.x.89	2030 h	Doi Suthep	settled on ear which was licked for quite some time
7.xi. 89	1940 h	Doi Suthep	landed briefly on my leg
31.x.90	2215–2245 h	Doi Ang Khang	flew forth and back between author and horses; circled 5 min around him, landed 4 times on his naked leg and twice on face, mostly crawling around
2.xi.90	2025–2040 h	Doi Ang Khang	brief attempted landings on author; mostly on mules
	2155 h	Doi Ang Khang	landed briefly on clothes, arm and hand
	2220 h	Doi Ang Khang	circled around author briefly
3.xi.90	2030 h	Doi Ang Khang	settled to suck dried perspiration from hand by regurgitating saliva
4.xi.90	1945 h	Doi Ang Khang	landed on clothes, arm and hand sucking perspiration by regurgitating saliva

SPHINGIDAE

***Rhagastis olivacea* Moore** (Fig. 8)

This hawkmoth can often be seen at mercury vapour lamps (MVL) in hilly areas in N Thailand but usually singly or in very few individuals. The genus *Rhagastis* has over a dozen species distributed from NW India to Japan down to Java, but *R. olivacea* has not been mentioned in faunistic surveys from Sumatra (DIEHL, 1980), Peninsular Malaysia (BARLOW, 1982), or Borneo (E Malaysia) (HOLLOWAY, 1987). According to KITCHING (in litt.) it is essentially a Himalayan species with N Thailand as its southeasternmost distribution.

R. olivacea is still the only hawkmoth confirmed to be lachryphagous although S American *Xylophanes tersa* L. (SHANNON, 1928) is a likely candidate. To conclude from the behaviour mentioned by BUTTIKER (1973), the African *Nephele peneus* (Cramer) and *N. comma* (Hopffer) are probably attracted to mammalian fluids left on the ground, as are *Cechenena lineosa* Walker and *Acosmeryx naga* Moore in N Thailand (BÄNZIGER, 1988b), which do not appear to take lachrymation.

Case 4. Doi Ang Khang, 1450 m, 25 August 1990, 1950 h; quarter moon mostly behind clouds. Same surroundings as case 2.

After some circling around four horses, one *R. olivacea* hovered in front of the eye of one horse, which was too restless to let the moth suck for any length of time. The

Fig. 1

Fig. 2

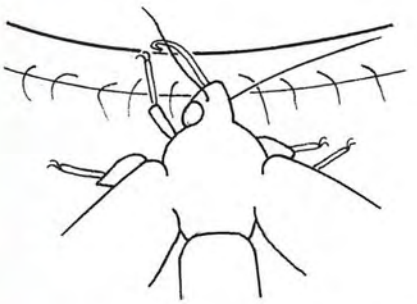

Fig. 3

Figures 1-3. *Chaeopsestis ludovicae* drinking tears from the eye of the author who photographed himself (case 3). Fig. 2: Enlarged detail; note proboscis with curved back tip applied to the groove between eyeball and lid. Fig. 3: Drawing showing the left claw hooked onto the sensitive conjunctiva of the lid.

Fig. 4

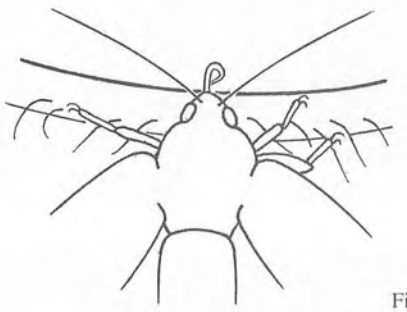

Fig. 5

Fig. 6

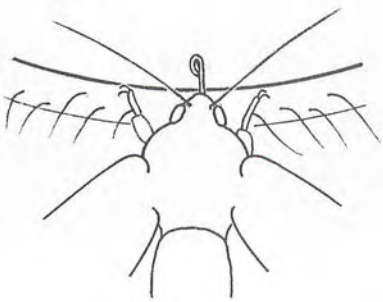

Fig. 7

Figures 4-7. *Chaeopsestis ludovicae* sucking lachrymation from the eye of the author who photographed himself (enlarged details). Figs. 4-5: Case 1, the right claw hooked onto the conjunctiva. Figs. 6-7: Case 2, left an right claws hooked onto the conjunctiva.

Figure 8. Hawkmoth *Rhagastis olivacea* which can take human tears while hovering in front of the eyes (case 4). Note 4-cm long proboscis.

Figure 9. Notodontid *Togarishachia albistriga*, mentioned in case 5, in typical resting position.

moth started to fly around me. It was now dark and I could not see the moth (I had switched off the headlight as hawkmoths are very sensitive to light) but at times I could hear its wings vibrating while hovering around my head. When the clouds cleared a bit I could discern a dark shadow balancing opposite my face. Then I felt the proboscis penetrating between my lips, like a fine straw. After this it was introduced into my nose, causing almost unbearable tickling. I had to close my nostrils with my fingers. The proboscis was poked into my mouth but soon was back to my nose until I relieved it with my fingers. Then the shadow climbed higher and the proboscis was applied to my eye. I felt no pain, the perception being surprisingly mild, compared to a cool, smooth foreign body moving between the lower lid and the cornea. After about 10 sec the proboscis was down to nose and mouth before returning once more to the eye where I experienced the same feeling. I then caught the moth by cautiously lowering the wide net over my head and the moth.

Additional cases of *R.olivacea* attacking man but not sucking from eyes (briefly mentioned, without details, in BÄNZIGER, 1988b).

Doi Suthep, E flank, 1200 m, 20 September 1986, around dusk; tiny clearing in lush evergreen hill forest; no ungulates present in area.

Dr. G. Robinson and I were preparing for MVL collecting when he called me over. I saw one *R. olivacea* circling around his head. The moth hovered 5 cm in front of his face for a few seconds as he shut his eyes, and then disappeared. Soon afterwards one *R. olivacea* was around my head. As it hovered opposite my face I felt something like a fine stick trying to penetrate between my lips, in several bursts. Then another specimen joined in. They now hovered a bit higher and their proboscides were tickling the inside of my nose, one in the left and the other in the right nostril. It was unpleasant. After some 10 sec I succeeded in capturing both of them.

NOTODONTIDAE

***Togarishachia [Poncetia] albistriga* (Moore)** (Fig. 9)

A widely distributed species found from NE India to Taiwan, down to Sumatra and Java but not Borneo (WILEMAN, 1914; KIRIAKOFF, 1968; BENDER & DIERL, 1977; HOLLOWAY & BENDER, 1985). Taxonomy, synonymy and behaviour have been treated by BÄNZIGER (1988b, 1989b). More recently SCHINTLMEISTER (1992) has shown that *Poncetia* Kiriakoff, 1962, the genus used by most authors, must be replaced by *Togarishachia* Matsumura, 1925. In the same paper, however, *Pydna kanshireiensis* Wileman, 1914 and *Stauropus sphingoides* van Eecke, 1929 are not new synonyms of *albistriga* as they had already been synonymized (BÄNZIGER, 1988b).

So far there is one record of four attacks by one individual on the author's face where it briefly settled near nose and mouth, without reaching the eyes; a more recent record (unpublished) of a specimen which settled on the author's hand; and records of two individuals circling around elephants (*Elephas maximus* L.) (BÄNZIGER, 1988b, 1989b).

In this genus of eight species, three had been previously confirmed to be tear drinkers (loc. cit.) though not *T. albistriga*. *T. siamica* (Bänziger), just recently caught from the eyes of zebu, is a new addition (unpublished). Also, the range of the species is extended to Nakhorn Srithammarat (S Thailand) and that of *T. bhutanica* (Bänziger) further west to Central Nepal (unpublished).

Case 5. Site near km 14 of road Chiang Dao to Phrao, 600 m, 15 November 1989; 1830 h, 20° C. Disturbed forest some distance away; no cattle or water buffalo present.

Drs. D. Sands, H. Fay, and myself were checking fruit-piercing moths in a mandarin orchard. At 1810 h a *Pi. aureolalis*, one of the most common visitors of human eyes, settled on my hand. It then flew to my right eye where I let it suck lachrymation briefly before collecting it. 20 min later, in pitch dark night, a much larger, dusky, at first unidentified moth settled on my face and then crawled up to my left eye. I did not let it suck for long and hurried to capture it before it could escape. It turned out to be *T. albistriga*, found for the first time at mammalian eyes. Unfortunately, in rushing to capture it I precluded an opportunity to study its lachryphagous behaviour in detail.

DISCUSSION

The notodontid *T. albistriga* is at present the only lepidopteran known to take tears only from man, but it is likely to do so also on animals. There are three reports of *T. albistriga* taking human body fluids (once tears), but it has also been caught twice near, though not on, elephant. Furthermore, as mentioned earlier, four of the eight *Togarishachia* spp. known take lachrymation from animals.

According to observations at MVL by Schintlmeister (in litt.), most notodontids arrive after midnight at lights. However, in *Togarishachia* and some other lachryphagous notodontids (with the partial exception of *T. lacrimisaddicta* (Bänziger)) the attacks on mammals typically occur early at night and for no longer than a couple of hours. *T. siamica* has in fact been seen at eyes already at 1820 h, when it is not yet completely dark in N Thailand in October. Generally, lachryphagous species of other families appear near hosts later and for much longer.

Among the Lepidoptera the sphingids have the longest proboscides. They are strongly sclerotized to give them stiffness. Thus the experience of *R. olivacea*, one of the largest tear drinkers, hovering in front of the face with a 4-cm long proboscis (Fig. 8) aimed straight into the eye is somewhat trying. This contrasts sharply with the very mild perception felt. Without photographic documentation it is not yet known how *R. olivacea* applies the proboscis onto the eye but I presume that it is, as often in Lepidoptera, in the 'flamingo' position (cf. Figs. 2-7): the most distal part is recurved downwards so that its dorsal surface touches the eye. This allows gentle, flexible and continuous contact independent of movements of the hovering moth or the host. Furthermore, the species' proboscis has only very few, tiny sensilli. Consequently the conjunctiva is not irritated as with many other tear drinkers.

C. ludovicae and the other two thyatirids, *Neotogaria hoenei* and *N. anguligera*, are probably the most energetic fliers among lachryphagous moths when considering the speed of flight and the suddenness with which they can stop or change direction. Also, they are among the most persistent ones. *C. ludovicae*'s aggressive clawing of the sensitive eyelid region (cf. Figs, 2-7) stimulates release of tears but also may cause defensive reactions by the host. These are matched by the moth's obstinacy to fly back again and

again, often to the same eye. The species does not show the type of persistence *T. lacrimisaddicta* exhibits, namely to stick to the eyelid and endure the host's repulses; *C. ludovicae* gives in, escapes, and returns (BÄNZIGER, 1988b, 1989b).

Like some *Tarsolepis* spp., *C. ludovicae* mostly do not settle firmly at eyes, but they often continue to beat the wings (observed directly and evident on photographs in which the distal part of the wings is blurred), unlike most other lachryphagous species. I presume that the frequent falling-off-the-eye of *C. ludovicae* and *Tarsolepis* spp. when hit by photographic flash is due to the fact that they are half air-borne, half settled. It has long been observed that nocturnal Lepidoptera are much more sensitive to light when in flight than when settled. Failing to fly off in cases 2 and 3 must be due to the moths' firm clinging near the eye.

To infer from the pattern of irritation inflicted by *C. ludovicae* (cf. Figs.1,2), *T. lacrimisaddicta*, and *Tarsolepis* spp., pathogen infection is more likely to occur through tarsal clawing of the tender conjunctiva of the eyelid than through proboscis action on the eyeball and lid. The latter type is assumed to occur in the noctuids *Lobocraspis griseifusa* Hampson and *Arcyophora* spp., behaviourally the most advanced moths in terms of lachryphagy. Their proboscis is rather longer and has more pronounced protuberances (sensilli, bristles, locking hooks). These noctuids settle in more squat fashion, slightly further away from the lid's sensitive conjunctiva which they do not claw. They are thus less vulnerable to the host's lid movements and eye-lash brushing, and the proboscis has a wider range of action. It is swept with characteristic movements back and forth across the eyeball, as already noted by REID (1954), evidently to induce increased lachrymation due to protuberances which irritate to some extent. *L. griseifusa*'s mouthparts can also irritate the soft parts of the lid, as again demonstrated in experiments with man (BÄNZIGER, 1973) when the moth sucks from closed eyes. This action occurs also naturally when *L. griseifusa* sucks from dozing ruminants. It can introduce the proboscis between the host's lids which irritates the conjunctiva. The clawing of the tarsi and the rubbing of the proboscis which has small protuberances, can cause microscopic lesions to tissues, both being more conducive to successful pathogen transmission than simple contact.

The method of irritation of the host eye could be of some importance to pathogen transmission. For instance, the aphids *Myzus persicae* (Sulzer) and *Macrosiphum euphorbiae* (Thomas) can transmit well over 80 and 40 different plant viruses, respectively, via the mouthparts (Kennedy et al., 1962) but not the tobacco mosaic virus (PIRONE, 1972; BRADLEY & HARRIS, 1972) which they can transmit only by clawing (BRADLEY & HARRIS, 1972). This is evidently due to the very complex interaction between the aphid, the virus and the plant. The situation is certainly different with lachryphagous moths. Lachryphagy is a more recent and less advanced feeding habit. The moth proboscis may cause fine, long and shallow scratches on the cornea, and to some extent on the eyelid of sleeping hosts. The proboscis may acquire and transfer pathogens mainly from and to the eye region only. The claws, on the other hand, come into contact with a wide array of substrates besides the lid area, and tend to cause pairs of wider, deeper punctures in the lid only.

In general, man has been viewed as an 'unnatural' or exceptional host of lachryphagous. The new results indicate that while man is not regularly or frequently visited, attacks on him are not mere freak events either. Some 23 species (about 25% of the so far known lachryphagous spp.) (BÄNZIGER, in prep.) have been found to settle at

human eyes since this behaviour was first documented in 1965. Successful sucking has occurred once every 10-12 nights on average (10 cases during 110 investigations) although this includes nights when no or very few zoophilous moths were present on animals. The incidence is higher in such favourable areas as sites near forest borders at low to mid elevations where *Pi. aureolalis* (Lederer), *Pi. damastesalis* (Walker), *F. mirificalis* (Lederer), the species most prone to settle on man, are common, and at propitious times of the year (changes of season from cold to hot, to rainy, etc.). *T. albistriga*, *Pi. aureolalis*, *Py. rosacea* (Hampson), *R. olivacea*, *F. mirificalis* and a number of other species have also successfully attacked man in the absence of animal hosts, showing that the moths did not accidentally land on the 'wrong' host. *C. ludovicae* exhibited similar persistence in attempting to land on, as well as in obstinately drinking tears from, man as with animals. That it frequently lands and sucks from places other than the eye in man is not unusual; the same occurs also on animals where it sucks from nose, mouth and even wounds. Thus man should be considered as a true albeit infrequent host.

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