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Host-parasite Relationships of Acarine Parasites and Their Vertebrate Hosts.
II. Lesions Produced by Myobiid Mites in the Skin of Their Hosts.

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Introduction

Little has been written about the host-response to myobiid mites, although many species of these fur-inhabiting acarines have been described. This is somewhat surprising because at least two common laboratory animals, the white mouse and the white rat, are often infested with these mites. Studies on the pathogenic effects of the mites on the host have been chiefly directed to describing the clinical appearance of disease (HESTON, 1941; COOK, 1953, 1954; FLYNN, 1954, 1955; HAAKH, 1958). The only observations we have been able to trace on the pathology of infestations have been those of WHITELEY & HORTON (1962, 1965) and GALTON (1963). WHITELEY and HORTON claimed that infestation of mice with *Myobia musculi* increases mitotic activity of the epithelium in some areas of the body and decreases it in others, and that it is due to direct injury inflicted on the host by mites. They observed that the long proboscis of the "nymph stage" was inserted into the hair follicle; they did not establish whether or not the adults contributed to the injury, as none were actually seen with their mouthparts embedded in the skin. The findings of WHITELEY and HORTON are open to question as their mice were also infested with *Myocoptes musculinus,* a sarcopti-form mite known to produce dermatological changes in its hosts (GAMBLES, 1952; WATSON, 1961).

Myobiid mites may induce severe disease in mice (GALTON, 1963; THEIS & LAVOIPIERRE, *in preparation*). GALTON described a condition in which the presence of *Myobia musculi* led to skin ulceration and a "florid generalized secondary amyloidosis with marked hepatosplenomegaly, lymphadenopathy, and renal involvement". These changes apparently resulted from the mite's feeding activity. This would indicate that the styletiform mouthparts (GRANT, 1942) are driven deep into the tissues and that the mites do not feed from "oily secretions" of the hair follicles, as EWING (1938) has asserted. Both GRANT (1942) and JAMESON (1948, 1949) found blood in the gut of mites, but WHARTON (1960) provided the most impressive proof that myobiids feed on tissue juices when he showed that Evans blue injected into mice was excreted in the faecal pellets of the acarines in as little as 15 minutes after introducing the dye into the blood stream.

Although WHARTON's study indicated that the mites feed on tissue juices, nothing was known of the feeding mechanism. GRANT's morphological study (1942) of the mouthparts indicated that the stylets of the immature stages could be

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"greatly extruded", but neither her nor WHARTON attempted to study the feeding method of these acarines. We therefore undertook the investigations now described to throw some light on this question.

We selected for this purpose *Ewingana inaequalis* and *E. lavoipierrei*, myobiid mite parasites of the bat genus *Tadarida*, chiefly because the immature stages of these acarines were associated with a hitherto undescribed papilliform swelling in the host skin in which they appeared to be partially embedded. Most of our studies were carried out on E. *inaequalis*, because its primary host, the Mexican free-tailed bat *Tadarida brasiliensis mexicana*, was readily available to us and freshly fixed material could be preparated as required. A few skin samples of *Tadarida plicata* with attached *E. lavoipierrei* collected in Malaya were also available for study, giving us the opportunity to compare the feeding mechanism of this species with that of *E. inaequalis*.

The life cycle of myobiid mites is little known. GRANT (1942) described 6 stages in their life history – the egg, 4 nymphal forms, and the adult. WHARTON (1960) believed that GRANT's "nymphal stages I and II" were not nymphal but larval, and he renamed them the "1st larva" and the "2nd larva". The second larva is a conventional acarine larva except that it shows the *anlage* of leg IV (Fig. 1). There are 2 nymphal stages, the second nymph (Fig. 2) showing full development of leg IV.

As all our studies were based on examination of histological material, we limited our observations to the relatively immobile, immature stages of the mites. The actively moving adults are difficult to fix *in situ*, removing their mouthparts from the tissue as soon as the fixative touches them. The study of the feeding mechanism of the mites led us also to make some observations on the ecology and life cycle of *E. inaequalis*.

Materials and Methods

The myobiid mite *Ewingana inaequalis* (Figs. 1 and 2) forms the main subject of this study. EWING's original description of it (1938) as *Radfordia inaequalis* was based on 3 adult females taken from a free-tailed bat, *Tadarida cynocephala* (= *Tadarida brasiliensis cynocephala*), captured in Florida, USA, in August 1934. In a recent study of myobiid mites on bats DUSBÁBEK (1968) redescribed the mite and transferred it from the genus *Radfordia* to the genus *Ewingana*, which he divided into 2 subgenera – *Ewingana* and *Doreyana*. Four species of *Ewingana* were included in the subgenus *Doreyana* – E. (D.) inaequalis, E. (D.) longa, E. (D.) doreyae, and E. (D.) isabellae. All parasitize bats of the genus *Tadarida* in the New World.

DUSBÁBEK's material of *E. inaequalis*, consisting of males and females, was collected from *Tadarida brasiliensis muscula* in Cuba the descriptions being illustrated with figures of the dorsal and ventral surfaces of both sexes. The immature stages were not described. In addition to these reports of *E. inaequalis*, BECK (1966) recorded all stages of the mite from *T. b. mexicana* in California.

This mite parasites 2 hosts, *T. b. mexicana* and *Antrozous pallidus pacificus* (BECK, 1966). The primary host, however, is *T. b. brasiliensis*, a small molossid bat, which ranges from the Yucatan Peninsula of Mexico northwards to western United States. *T. b. mexicana* in California is non-migratory, although most populations follow a regular dispersal and assemblage pattern in the fall and spring months. Colonies of this bat are present throughout the year in Northern and Central California.

PARAN (1966) described *Ewingana lavoipierrei* as *Neomyobia lavoipierrei* from 1 female collected on *Tadarida johorensis* in southern Malaya. DUSBÁBEK (1968)
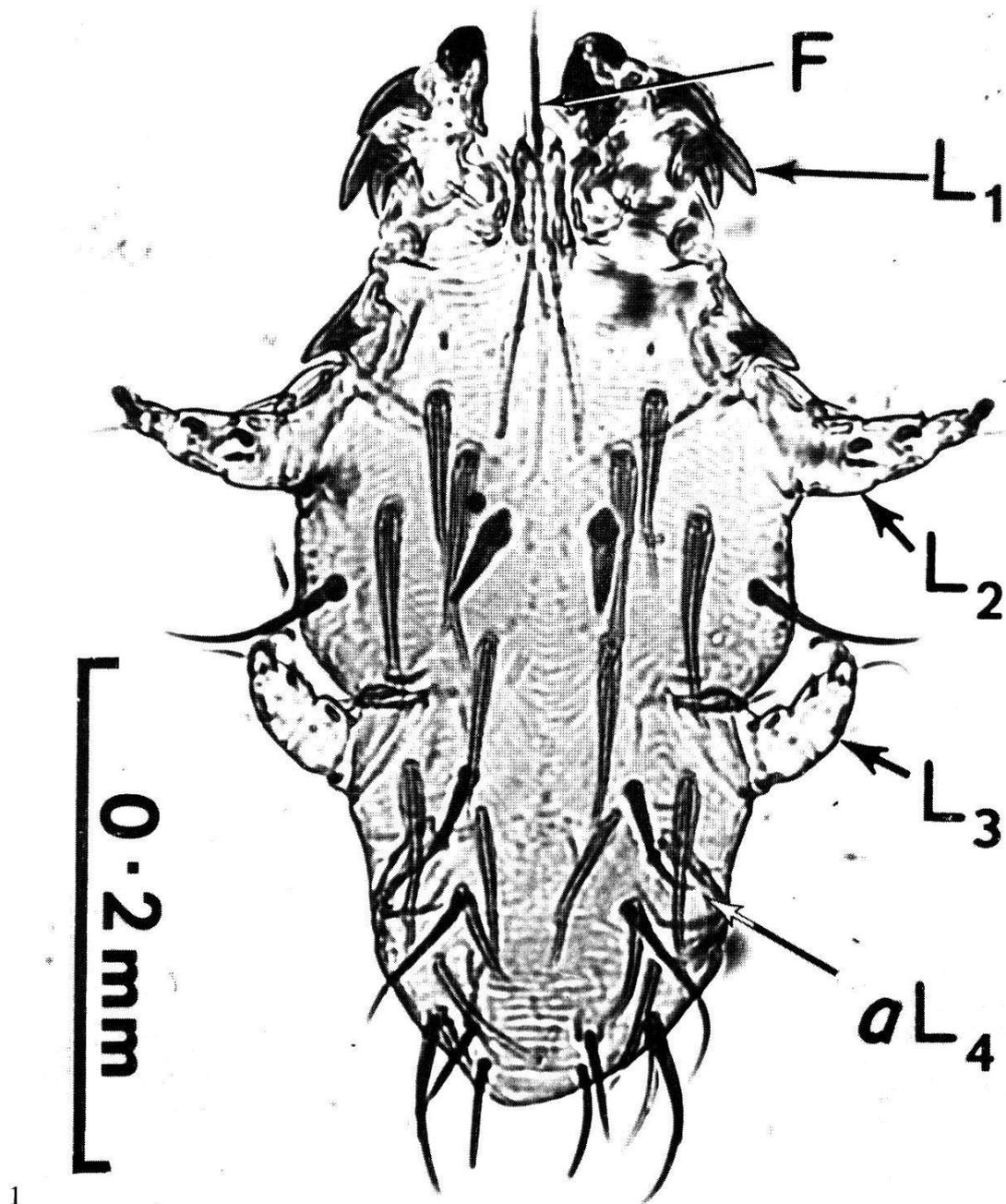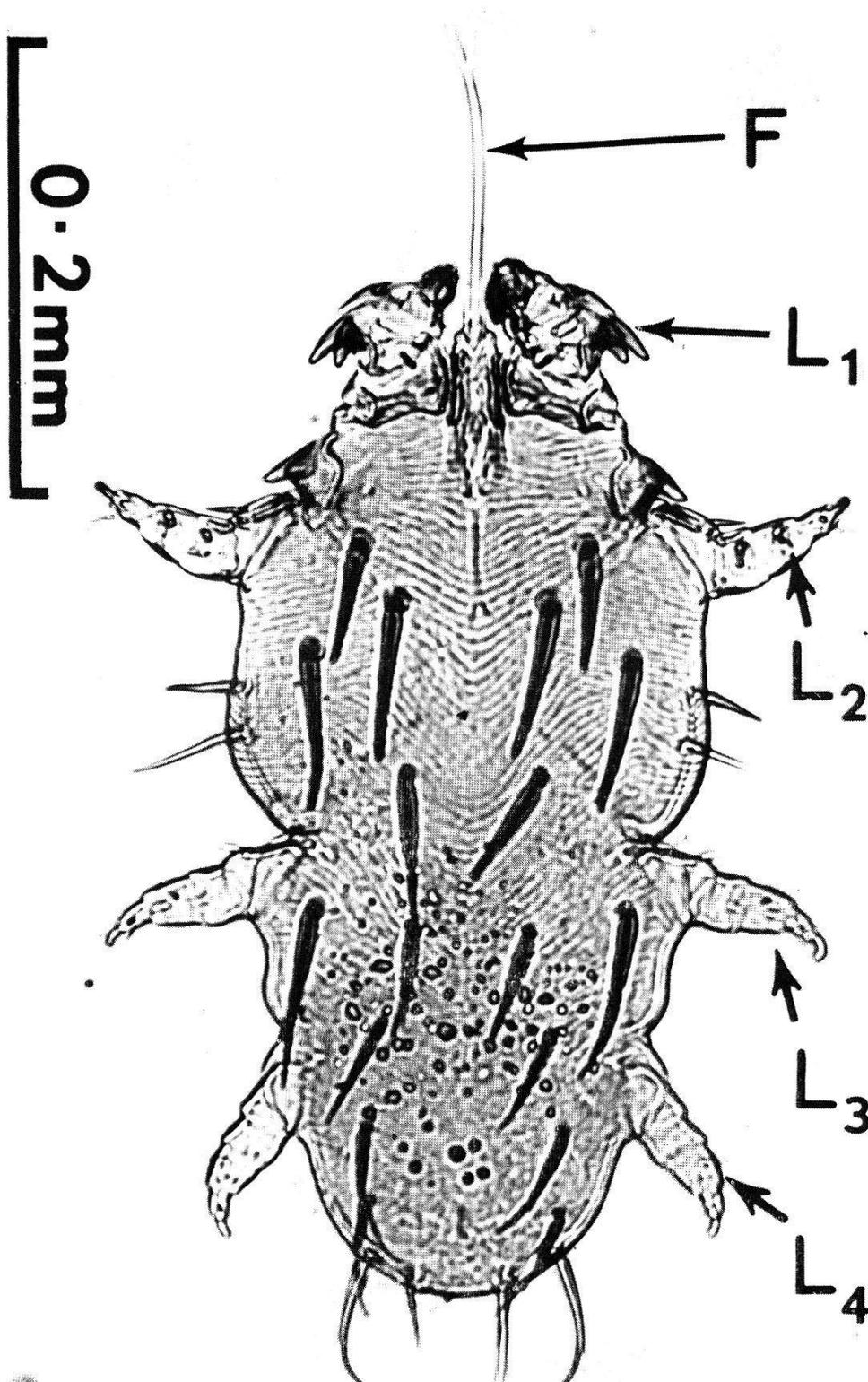
Fig. 1. Dorsal view of second larva of *Ewingana inaequalis*. F, biting fascicle; L_1, L_2, L_3, legs I, II, and III; aL_4, *anlage* of leg IV.

Fig. 2. Dorsal view of deutonymph of *Ewingana inaequalis*. F, biting fascicle; L_1, L_2, L_3, L_4, legs I, II, III, and IV.

transferred the species to the genus *Ewingana,* subgenus *Ewingana.* The male and the immature stages have not been described. *Ewingana lavoipierrei* is also found on *T. plicata* in Malaya, and from this bat we obtained the skin material for the histological study of the mite's feeding mechanism and the host response. *T. plicata,* of which *T. johorensis* may be a local Malayan variant, is widely distributed in the Indo-Australian tropics and throughout Malaysia.

The bats usually were fixed whole in Bouin-Dubosq fluid, but in certain instances we fixed only their wings, using the techniques of LAVOIPIERRE, RAJA-MANICKAM & WARD (1967). Samples of skin with attached mites were cut from the lateral fossae *(E. inaequalis* on *T. b. mexicana)* or from the eyelids *(E. lavoipierrei* on *T. plicata).* The lateral fossae (Fig. 3), ventral furrows along the sides of the body where the wings join the trunk, contain a peculiar, ladder-like arrangement of blood vessels. Each fossa, itself sparsely-haired, is bordered medially on the trunk side and laterally on the wing side by densely furred skin.

All skin material was sectioned in the conventional manner, and slides were stained with haematoxylin and eosin.
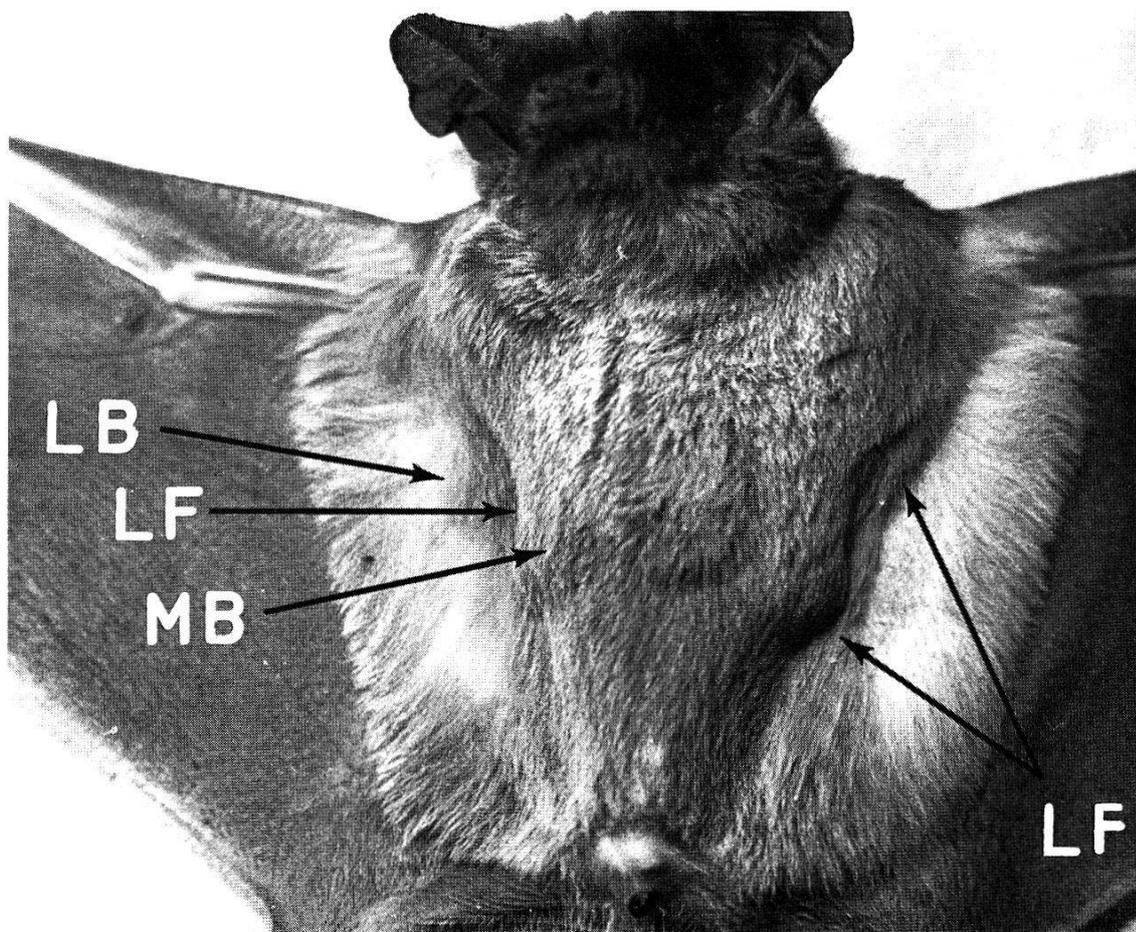

Fig. 3. Ventral view of an adult female *Tadarida brasiliensis mexicana* showing the position of the lateral fossae (LF) on each side of the trunk, partially obscured by hair; LB, densely furred lateral border of the lateral fossa; MB, densely furred medial border of the lateral fossa.

Results

Observations on the biology of *Ewingana inaequalis*

The life cycle apparently lasts about 2 months. Eggs are found at bimonthly intervals on both immature and adult bats at stable colony sites but seldom on suckling young (BECK, 1966). They are cemented, usually singly, on the basal portion of hairs and bristles and may be found between the ears, in the genital region, and along the sides of the lateral fossae. Field data indicate that the larval stages last a few days. Metamorphosis to nymphal stages takes place *in situ*. Protonymphs are rare in collections, and the protonymphal stage presumably is less than 1 week. Deutonymphs are common, sometimes lasting 3 to 5 weeks. The adult life span, although not determined, does not appear to exceed several weeks.

In suckling bats, immature myobiids may be found embedded in the skin or attached to the sparse hairs of the dorsum. In older animals, the larvae and protonymphs are usually found on the proximal sides of the lateral fossae. Deutonymphs and adults are also common in this area, but are almost as frequent on other haired portions of the host's body. We found none on the wings or limb extremities.

E. inaequalis is present in *T. b. mexicana* populations throughout the year. Infestation rates are highest in March and August during the spring period of transient movement and later in summer when host populations are at a peak, usually exceeding $50^0/_0$ from February to the end of August. Rates are lowest in October and December in Northern and Central California. Single hosts usually harbour 5 to 20 immature myobiids and 1 to 5 adults. Occasionally more than 100 mites, of which 10 to $20^0/_0$ are adults, are found.

Host density appears to be the most important determinant of the intensity and rate of infestation by myobiid mites. These mites are scarce in small populations of *T. b. mexicana* and usually absent from solitary males during the summer. The intimate association, especially of the immature stages, with the bat host reduces the effects of the external environment except as mediated through changes in the host's physiology. Embedded immature myobiids can withstand most temperature and humidity regimes endured by the bat. As *T. b. mexicana* is not a true hibernator, preferring a winter roosting temperature of $9°$ to $10°C$, mite reproduction is reduced but not stopped during the cold portions of the year.

Histological observations on the skin of *T. b. mexicana* parasitized by *E. inaequalis*

Description of the normal skin in the lateral fossae. The epidermis is thin, usually not more than 1 cell thick (Fig. 4). Thus the cellular

layers are not differentiated as in the thicker skin of other mammals such as the dog and man. The epithelium is overlaid by a thin sheet of stratum corneum.

The elongated epidermal cells, with their linear axis parallel to the skin surface, give the epithelium a flattened appearance. Interspersed among the cells, usually singly but occasionally in groups of 3 or 4 or more, are melanocytes heavily charged with melanin granules. Between the epithelium and the stratum corneum lies a very narrow zone containing a few scattered keratohyalin granules.
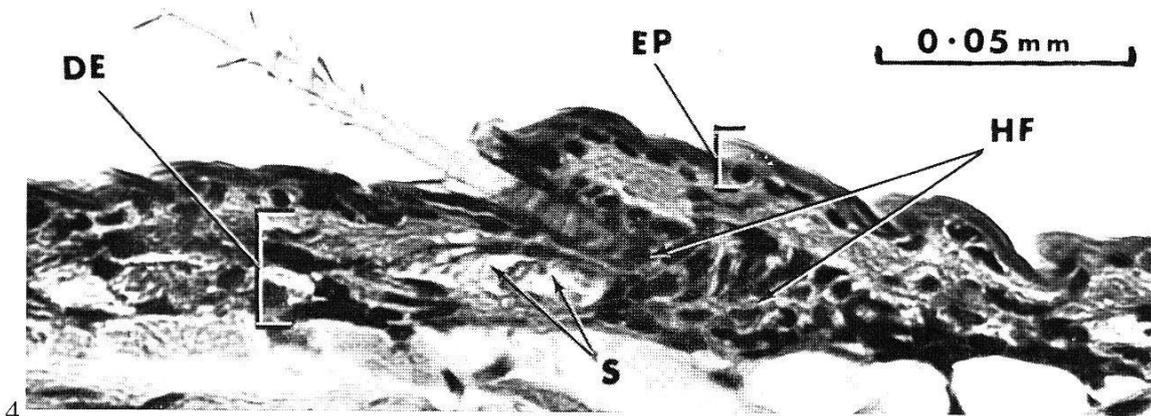

Fig. 4. Section of unaffected skin of the lateral fossa of *Tadarida brasiliensis mexicana.* DE, dermis; EP, epidermis; HF, hair follicle; S, sebaceous gland.

The skin is covered with serrated hairs slanting at an angle of about 45° to the surface (Fig. 4). The root sheath is 1 cell thick throughout most of its length, but where it invests the bulb it thickens to 2 cells. Each hair has a sebaceous gland whose duct opens into the lower third of the follicle just above the hair root.
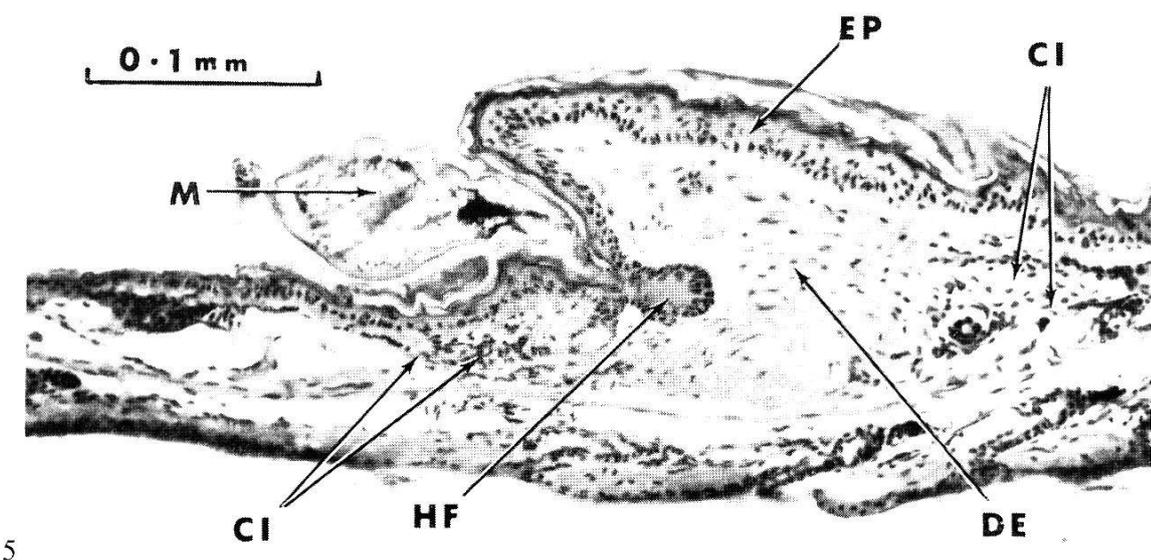

Fig. 5. Section of a mite *(Ewingana inaequalis)* parasitizing a hair follicle of *Tadarida brasiliensis mexicana.* CI, cellular infiltrate; DE, dermis; EP, epidermis; HF, hair follicle; M, mite.

General appearance of the skin reaction produced by the mites. The lesions caused by *E. inaequalis* are small papillomatous swellings varying in diameter from minute papules to relatively large tumours 0.3 to 0.4 mm in diameter and projecting 0.1 mm or more above the skin surface (Fig. 5). Essentially each tumour is composed of a fibrous mass enveloping a hypertrophied hair follicle and covered by an acanthotic epithelium. Generally the tumours are discrete (Fig. 6), but occasionally, when 2 or more are contiguous, their outlines become somewhat confused.
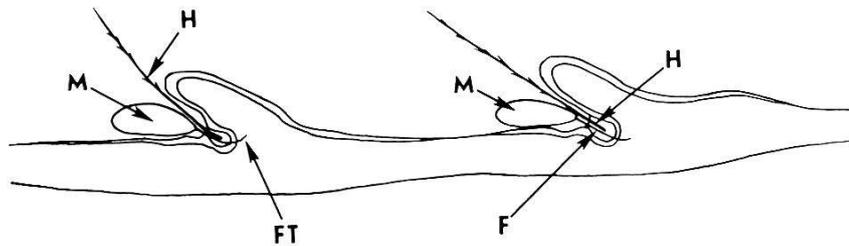

Fig. 6. Schematic figure of a section of the skin when parasitized by several mites *(Ewingana inaequalis).* F, biting fascicle of the mite; FT, tip of the fascicle; H, hair; M, mite.
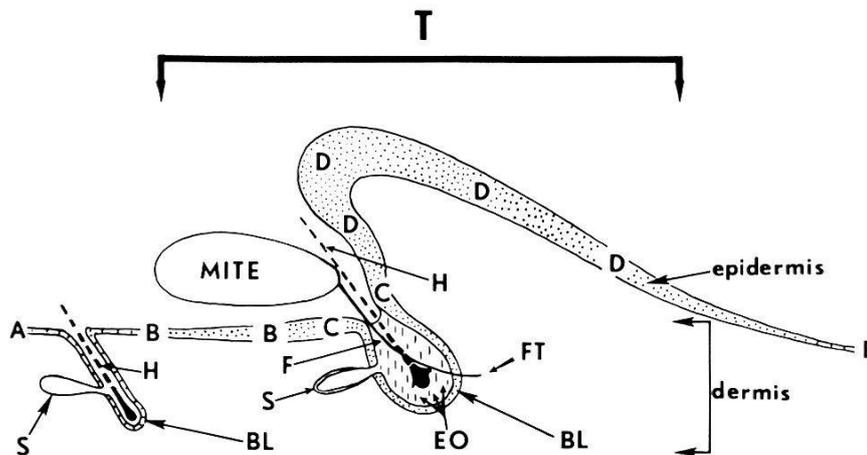
Fig. 7. Schematic figure of the parasitized hair follicle of *Tadarida brasiliensis mexicana,* illustrating changes in the epidermis discussed in the text. Not drawn to scale. A, B, C, D, E, the normal and thickened epidermis; BL, bulb; EO, eosinophilic zone; F, fascicle; FT, fascicle tip; H, hair; S, sebaceous gland.

Only larval or nymphal mites appear to be associated with the tumours, each mite being attached to a single hair with its proboscis inserted into the hair follicle (Figs. 6, 7 and 8). Usually the mites are readily visible but sometimes, particularly when the parasite has been attached for a long time, hyperplasia may be so striking that the acarine is almost hidden by the overlapping tumour.

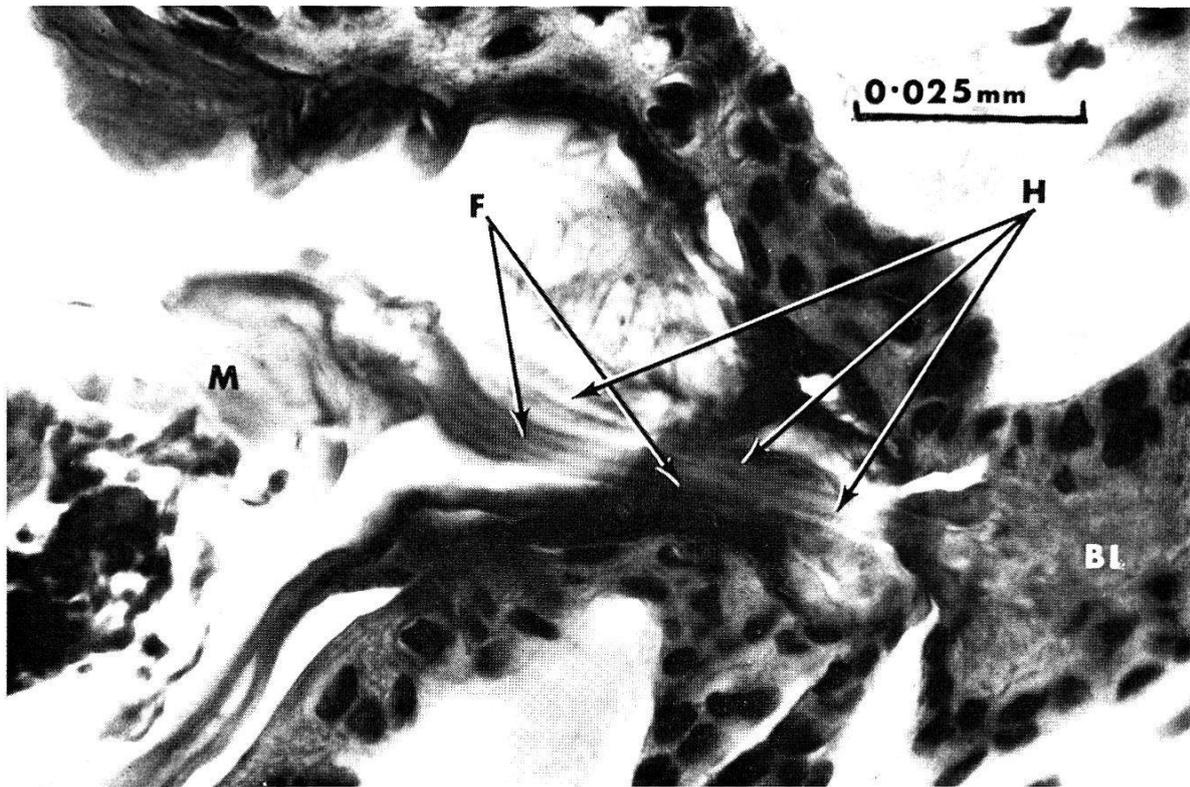*Fig. 8.* Fascicle of a mite *(Ewingana inaequalis)* lying in the hair follicle in the feeding position. The fascicle lies beneath the hair, curving around it. Its tip (out of view in the photograph) is driven into the dermis. BL, bulb of hair follicle; H, hair; F, fascicle; M, mite.

Feeding mechanism of the mite and histology of the host reaction. These are best understood by referring to Figs. 4 to 12.

Feeding mechanism. In parasitized follicles the mite is attached to the hair close to the skin by one of the anterior legs, which are adapted to hair-clinging. The biting fascicle is introduced into the follicle beneath the hair and directed downwards into the tissues close to the hair shaft (Fig. 8). As the fascicle is traced down into the follicle, it seems to curve gently around the hair traversing the hair bulb (Figs. 7 and 9) and penetrating the dermis for a distance of 12 to 15 μ (Fig. 10). Probably the serrations of the individual stylets of the fascicle facilitate this deep penetration of the mouthparts into the skin. In all the sections we examined the fascicle tip always lay in the dermis and never in the follicle. The feeding mite would seem to obtain its nourishment from the oedematous dermal tissues surrounding the hair root.

Epidermal changes. In Figure 7, T represents the extent of the reactive area limited on either side by normal epithelium (zones A and E). In zone B, over which lies the idiosoma of the mite, the cellular layer of the epidermis thickens while the stratum corneum shows a slight hyperkeratosis. In zone C the cells are more rounded and hyper-

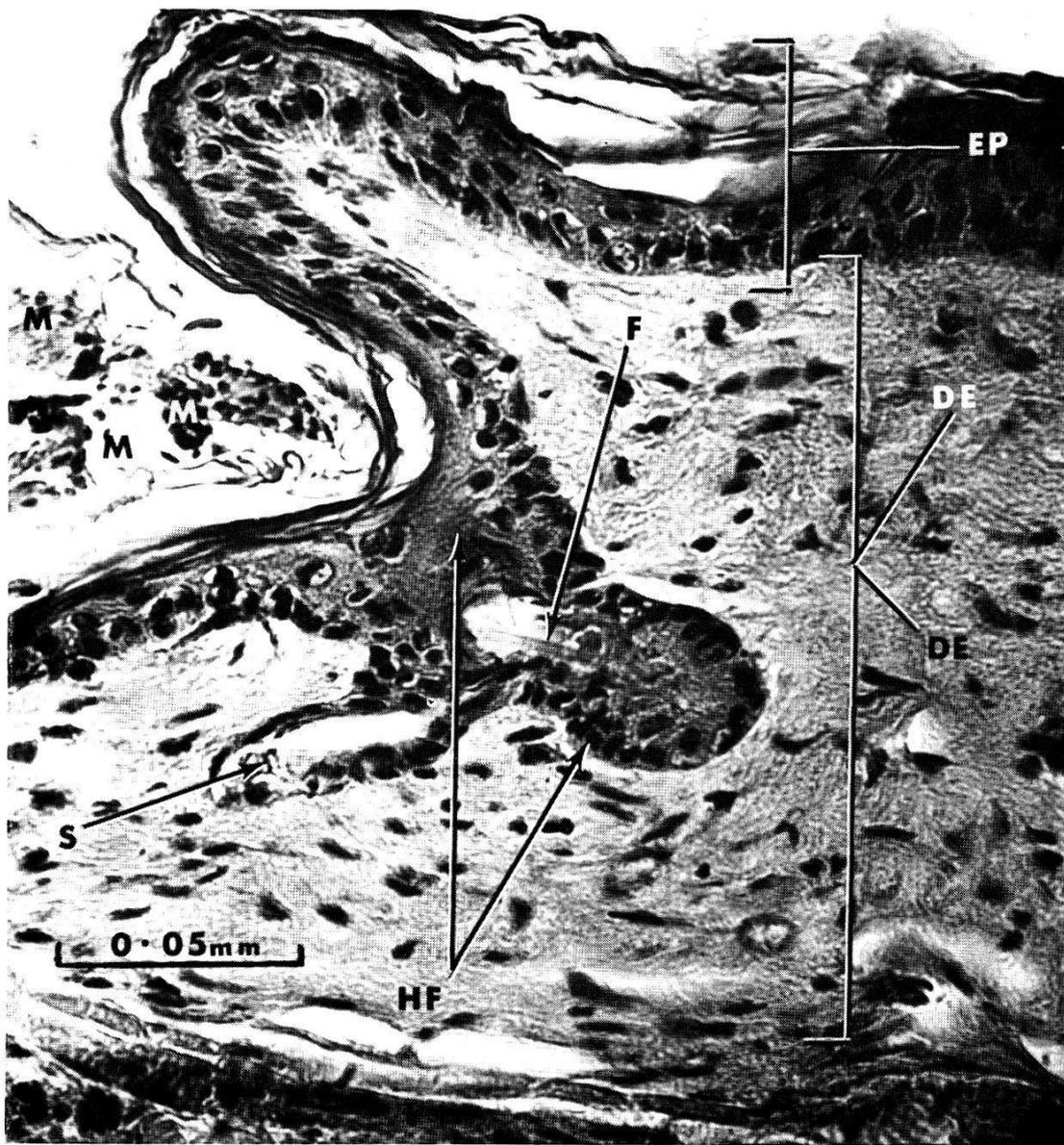*Fig. 9.* Section of the skin of *Tadarida brasiliensis mexicana* with a hair follicle parasitized by *Ewingana inaequalis.* This section should be compared directly with Fig. 4 which is photographed on the same scale. Note the pronounced thickening of the epidermis and the extensive derman hyperplasia. DE, dermis; EP, epidermis; F, a portion of the fascicle of the mite; HF, hair follicle; M, mite; S, sebaceous gland.
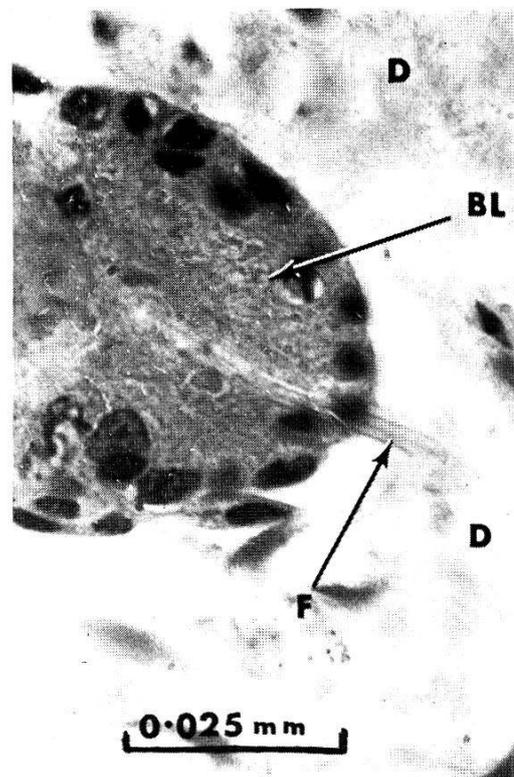
Fig. 10. Section through the base of the hyperthrophied bulb (BL) of a parasitized hair follicle. The fascicle (F) of the mite *(Ewingana inaequalis)* has traversed the substance of the hair root and penetrated into the dermis (D).

trophied, and many show varying degrees of perinuclear vacuolation. Cellular oedema, especially when the mite has been attached for a long time, may be so pronounced that the nucleus in some cells appears to be compressed by a vacuole against the cell wall (Fig. 11). The uppermost layer of the epidermis contains conspicuous deposits of keratohyalin or trichohyalin granules, which become more noticeable near the ostium of the hair follicle, particularly in follicles that have been parasitized a long time (Fig. 11).

The affected hair follicle is distinctly enlarged, the most striking change being the pronounced hypertrophy of the hair bulb (cf. Figs. 4 and 9). The cells of the root sheath are also enlarged, and in places the epidermis of the sheath may become 2-layered. The sheath extends over the expanded bulb which contains, besides the hair root, a hyaline, non-cellular eosinophilic-staining substance (Fig. 7). In histological sections stained with haematoxylin and eosin this is a conspicuous feature of the reaction, since the intense red colour of the hyaline mass contrasts sharply with the surrounding tissues. The epidermal cells investing the bulb show relatively little intracellular oedema, and their nuclei are generally large and well formed. Hairs were always present in the follicles, even in advanced reactions. The appearance of the
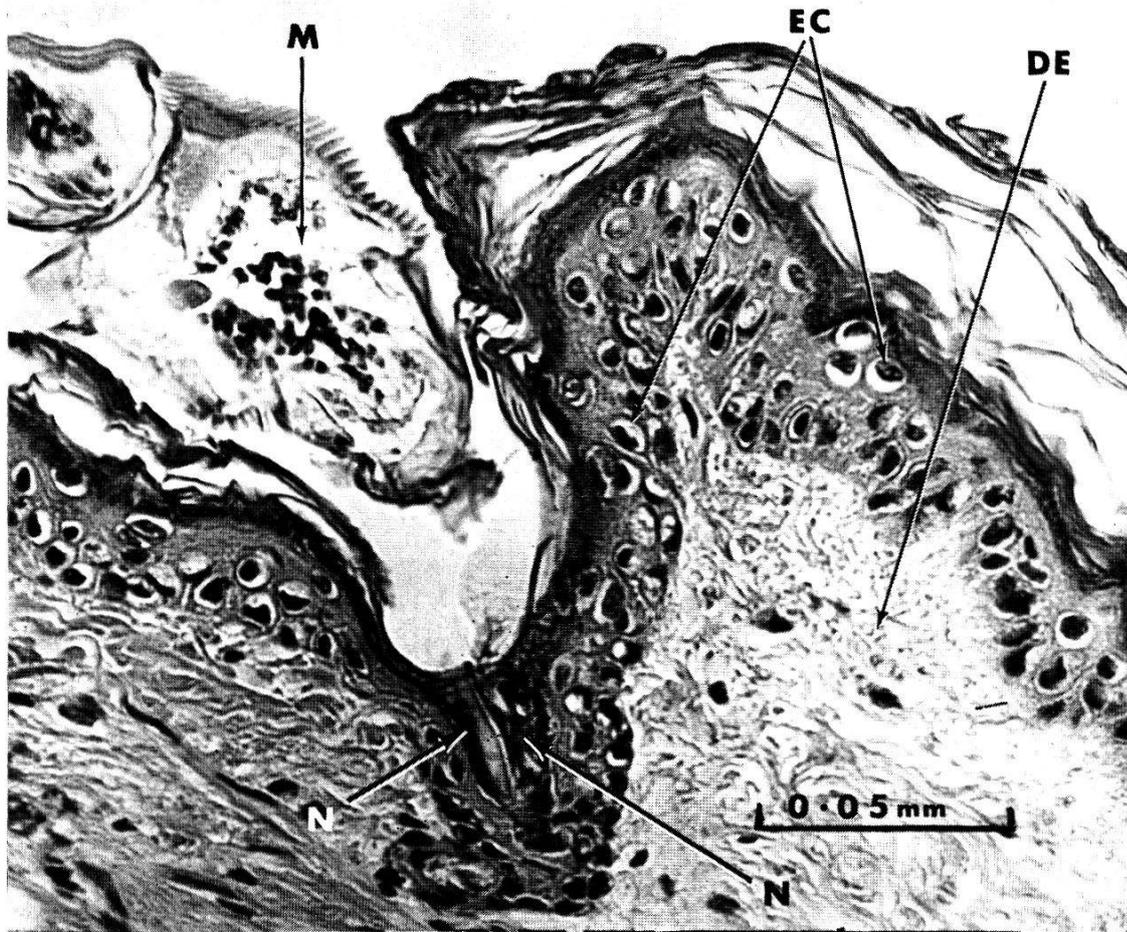
Fig. 11. Hair follicle showing effects of prolonged parasitization. The epidermal cells (EC) show pronounced perinuclear oedema and the dermis (DE) is markedly oedematous. The neck (N) of the follicle has a heavy deposit of keratohyalin granules. M, mite.

sebaceous gland of the affected follicle was particularly interesting. We found all stages in the decrescence of the gland, from a thickening of the cells near the pilosebaceous junction to virtual replacement of the duct by an epithelial rod. Usually the sebaceous gland cells had degenerated and the gland lumen resulting from an ingrowth of epithelium from the root sheath was distinctly reduced.

Epidermal zone D and the underlying dermis form an area of active hyperplasia that gives the lesion its characteristic tumour-like appearance (Figs. 5 and 7). In this zone the tissues are heaped up over the mite so that a fold of skin covers the anterior end of the acarine. As zones C and D merge, the epithelium becomes increasingly acanthotic so that the epidermis contains 3 to 4 layers of cells. The basal cells become distinctly elongated, giving the epithelium a columnar appearance (Figs. 9 and 11). Extracellular oedema is moderate, but intracellular oedema may be excessive, particularly in older lesions (Fig. 11).

Throughout zone D a moderate hyperkeratosis is accompanied by exfoliation of the stratum corneum; sometimes (Fig. 9) exfoliation may be considerable. In the uppermost layers of the epithelium conspicuous deposits of keratohyalin give the epidermis a somewhat speckled look. The epidermis regains its normal appearance as zone D merges with zone E. In the fully developed tumour (Figs. 9 and 11) mitotic figures are scanty.

Dermal changes. Although the epidermal and follicular changes are striking, the most conspicuous feature of the reaction is a pronounced hyperplasia of the connective tissue. This is characterized by the production of a dense core (Fig. 12, C) of fibrous tissue bordered by areas of cellular infiltration (Fig. 12, I_1 and I_2 and Fig. 5, CI). Zones I_1 and I_2 (Fig. 12) contain many fibroblasts, among which mast cells are
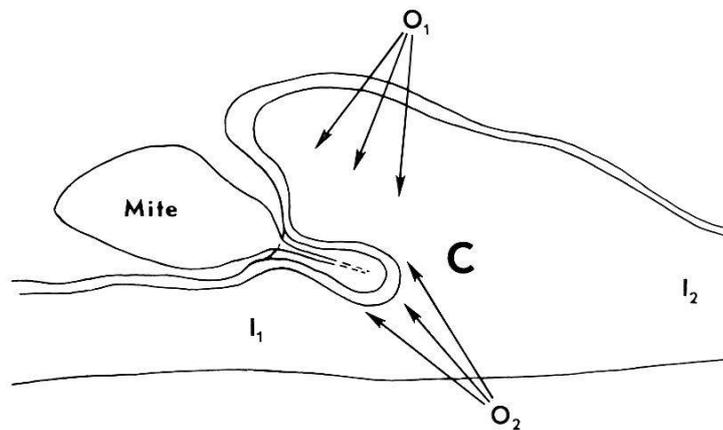

Fig. 12. Schematic figure of a parasitized hair follicle and the associated dermal hyperplasia in the skin of *Tadarida brasiliensis mexicana,* illustrating changes in the dermis discussed in the text. Not drawn to scale. C, core of the tumour; I_1 and I_2, peripheral zones in that tumour; O_1 and O_2, oedematous zones.

interspersed. Although a few mast cells are detectable throughout the lesion, they are present in significant numbers only in zones I_1 and I_2.

In a well-developed tumour, an area of circumfollicular oedema (Fig. 12, O_2) is usually recognizable. This oedematous zone produces a curious halo effect which, in sections stained with haematoxylin and eosin, highlights the vividly coloured follicle with its eosinophilic ground substance. This is particularly pronounced in the immediate neighbourhood of the fascicle tip. In older lesions oedema is often much more extensive and is most noticeable in the zones lying above and below the follicle.

The feeding mechanism of *E. lavoipierrei* and the host response to the mite

The material used in studying the feeding mechanism of *E. lavoipierrei* and the changes the mite induces in the host skin was taken from the eyelids of several *T. plicata*. The feeding method of the mite closely resembles that of *E. inaequalis*. The stylets are driven through the hair bulb into the neighbouring dermal tissues, so that the tip of the fascicle lies in the dermis. Moreover, the host reaction is strikingly similar to that produced by *E. inaequalis* in the skin of *T. b. mexicana*. Appreciable hyperplasia of the dermis with the formation of small tumours is also a feature of the reaction. Acanthosis of the overlying epithelium accompanies these changes.

Discussion

Several authors have reported the formation of papilloma-like growths as a response to the feeding activity of mites. RYCKMAN & ROOS (1955) described squamous papillomata caused by trombidiform mites, *Trombicula potosina* and *Trombicula panamensis*, in the skin of a rodent *Perognathus pernix pernix*. The papillomata consisted of polypoid structures "covered with benign stratified epithelium, which in several places showed papillary projections and elsewhere keratin-filled crypts. The stroma was dense connective tissue infiltrated with lymphocytes".

Although superficially similar in histological sections to the fibroma-like tumour produced by *E. inaequalis* and *E. lavoipierrei* in the skin of *Tadarida spp.*, the blunt, cone-shaped swellings with crateriform centres produced by *Myocoptes tenax* in the skin of the microtine rodent *Microtus agrestis* are nevertheless quite different. BÖHM & SUPPERER (1958) showed that the continuity of the epidermis is interrupted in the depths of the craters, where the mites, whose mouthparts were inserted into granulation tissue, may be found. In the skin of *Tadarida* no interruption of the epidermis or signs of ulceration of the skin appeared.

Myobiid mites have not hitherto been reported as causing papilloma-like swellings in their hosts' skin. WHITELY & HORTON (1962) showed that the epidermis of mice infested with *Myobia musculi* thickened, but the dermis was little affected, the inflammatory reaction being minimal. Dermal hyperplasia was absent. In GALTON's (1963) examples, the skin of the mice was acanthotic with an accompanying hyperkeratosis and parakeratosis; keratin cysts were present. The disease was so severe in spots as to interfere with the normal architecture

of the epidermis. Ulcers formed on the skin, and the adjacent hairless surrounding area became greatly thickened. Although "lymphoid cell infiltration was prominent", there was no dermal hyperplasia.

In *Tadarida* we found both epidermal and dermal changes resulting from the presence of the mites. Skin ulceration never occurred, and dermal changes, although conspicuously proliferative, showed little or no lymphoid cell proliferation. Eosinophils were not observed.

A striking feature of the reaction was the presence of many mast cells migrating towards the core (Fig. 12, C) of the tumour from the edges of the lesions. These were admixed with a generous sprinkling of fibroblasts. Tissue mast cells, as MICHELS (1938) observed, are "extremely numerous" in bats, but the only area where we saw them "concentrated" was the periphery of the mite tumours.

The presence of significant numbers of mast cells in zones I_1 and I_2 (Fig. 12) is difficult to interpret. So many functions have been attributed to these cells (MICHELS, 1938; KELSALL & CRABB, 1959; PADAWER, 1962; BLOOM, 1965) that it would appear imprudent at this stage to speculate on their role in the mite tumours until a much more detailed study of their genesis is undertaken. However, BLOOM believed that the histamine and serotonin liberated from mast cells "play an important part in the mechanisms by which capillary permeability is increased in inflammatory processes, thereby promoting the local leakage of protein-rich plasma into the tissues at the site of the inflammatory reaction". Such a phenomenon would be of distinct survival importance to tissue-feeding mites.

The larvae and nymphs of *E. inaequalis* and *E. lavoipierrei* are probably tissue-feeders. In the many sections we examined we always found the tip of the stylets lying free in the tissues and never inserted into the lumen of a vessel or in a haemorrhage. WHARTON's (1960) studies with *Myobia musculi* provide conclusive experimental evidence that this mite also feeds on tissue juices. WHARTON found that a $1^0/_0$ Evans blue solution injected into the blood stream of mice was excreted by myobiids after 15 minutes but that a $0.1^0/_0$ solution of the same dye did not appear in their faecal pellets, even after 10 hours. This experiment is particularly significant in the light of RAWSON's (1943) finding that in such low concentrations as $0.1^0/_0$, diazo dyes combine with plasma proteins and do not "spill over" into the tissues from the blood stream. At higher concentrations (for example, $1.0^0/_0$), however, the dye combines incompletely with proteins and leaks from the vessels. A mite that is haematophagous would certainly ingest Evans blue with the blood meal even in very low concentrations such as $0.1^0/_0$. Since *M. musculi* takes up the dye only at a $1.0^0/_0$ level, it certainly must obtain all its nourishment from the intervascular tissues, not from the lumen of blood vessels.

Using the dye technique, WHARTON (1960) showed that not only the larvae and nymphs but also the adults of *M. musculi* feed on tissue juices. His investigations are unique in this regard, as no other investigators have studied experimentally the source of the meal of adult myobiids. We believe likewise that the adults of *E. inaequalis* and *E. lavoipierrei* are also tissue feeders. Although our evidence is indirect, it is based on examination of several dozen individuals in whose gut we never found blood. However, feeding on tissue fluids is not universal among myobiids, as the adults of several species are visibly red when freshly removed from recently killed hosts (JAMESON, personal communication). Writing on *Blarinobia simplex,* a parasite of the shrews *Blarina brevicauda* and *Sorex cinereus,* JAMESON (1948) states that "Specimens of adult *simplex* crushed between a glass slide and a cover glass release red blood cells which are the same as those taken from the host; the nymphs do not appear to be blood suckers". He (JAMESON, 1949) noted that other species which seem to be bloodsuckers in the adult stage are *Eadiea condylura* of the star-nosed mole *(Condylura cristata)* and *Ea. brevihamata* of the shrew mole *(Neurotrichus gibbsii).*

Adult *Ewingana* do not, like the immature stages, lead sedentary lives but move about the host's body during feeding. Thus, it seems unlikely that a circumscribed hyperplastic reaction as severe as that during larval and nymphal feeding would have time to form because of the adult's wandering behaviour. We were not surprised, therefore, to note that the only stages associated with tumours were the relatively immobile larvae and nymphs. We did not try to follow sequentially the formation of the tumours, and development of the lesions was not related to a time sequence. From the very nature of the skin changes, however, we had the distinct impression that the process of tumour formation is probably relatively long, extending at least over several days and possibly throughout the mite's entire development from larva I to nymph II. The next step in our studies will be to make a sequential study of tumour formation.

Acknowledgments

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Zusammenfassung

Der etwa 2 Monate dauernde Entwicklungszyklus der auf Fledermäusen parasitierenden Milbenarten *Ewingana inaequalis* und *E. lavoipierrei* aus der Familie der Myobiidae wird beschrieben unter Angabe der Dauer der einzelnen Stadien sowie ihrer Lokalisierung auf dem Wirtskörper.

Besondere Aufmerksamkeit wird der histologischen Analyse der durch den Biß von Larven und Nymphen hervorgerufenen dermalen Veränderungen gewidmet. Sie betreffen die Haarpapillen, in welche die Milben ihren Rüssel einführen, und äußern sich in papillomatösen Schwellungen, die sich zu 0,4 mm dicken Tumoren auswachsen und den Ectoparasiten z. T. umhüllen. Der hypertrophierte Haarfollikel ist von einer fibrösen Masse und einem verdickten Epithelium umgeben. Neben der Haarwurzel läßt sich vielfach ein azelluläres eosinophiles Depositum nachweisen. Auch an den Talgdrüsen solcher parasitierten Haarbälge lassen sich deutliche pathologische Veränderungen erkennen. Die umgebende Unterhaut zeichnet sich durch Hyperplasie des Bindegewebes aus in Form einer dichten Ansammlung fibrösen Gewebes mit Zellinfiltrationen: Mastzellen aber keine Eosinophilen. In diesem circumfolliculären, oedematösen Gewebe findet die Milbe die Säfte, die sie beim Saugakt in sich aufnimmt. Blutgefäße werden nie angestochen.

Résumé

L'auteur décrit le développement des acariens *Ewingana inaequalis* et *E. lavoipierrei,* deux parasites des chauves-souris. La durée du cycle est de 2 mois. La durée de chaque stade et sa localisation sur l'hôte sont étudiées.

On a dédié une attention particulière aux modifications histologiques des téguments dus à la morsure des larves et des nymphes. Ces modifications concernent les papilles des poils dans lesquelles les acariens piquent leur rostre. On

observe une inflammation papillaire, qui s'agrandit en petites tumeurs de 0,4 mm renfermant en partie les parasites. Le follicule du poil, hypertrophié, est entouré d'une masse fibreuse et d'un épithélium épaissi. Souvent, un dépôt acellulaire éosinophile se trouve à la racine du poil. De nettes modifications pathologiques sont fréquemment observées dans les glandes sébacées des poils parasités. L'hypoderme montre une hyperblasie du tissu conjonctif sous forme de tissu fibreux avec un infiltrat de mastocytes sans éosinophiles. Dans ce tissu œdématique et périfolliculaire, l'acarien trouve les sucs nécessaires à sa nutrition. Les vaisseaux sanguins ne sont jamais attaqués.