

External

Parasites

of

Cattle

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TEXAS AGRICULTURAL EXTENSION SERVICE
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FOREWORD _____

Several textbooks dealing with medical and veterinary entomology are available, but most orient subject matter toward human parasites. Consequently, external parasites of veterinary interest have received inadequate attention. This publication discusses the life histories and habits of the most common external parasites of cattle found in Texas. Thorough knowledge of the life history and habits of each pest should aid considerably in carrying out an effective control program. Only basic principles of control are included because insecticide registrations and recommendations frequently change. Current chemical control recommendations are included in MP-691, *Texas Guide to Controlling External Parasites of Livestock and Poultry*, available from your county Extension agent or the Department of Agricultural Information, Texas A&M University, College Station, Texas 77843.

CONTENTS _____

Principles of Control.....	
Ticks of Major Importance.....	
Lone star tick.....	
Gulf Coast tick.....	
Winter tick.....	
Ear tick.....	
Ticks of Minor Importance.....	
Black-legged tick.....	
American dog tick.....	
Cayenne tick.....	
Cattle tick.....	
Southern cattle tick.....	
Lice.....	
Biting lice.....	
Cattle biting louse.....	
Sucking lice.....	
Short-nosed cattle louse.....	
Cattle tail louse.....	
Long-nosed cattle louse.....	
"Little blue" ("capillate") louse.....	
Mange and Scab Mites.....	
Psoroptic or common scab mite.....	
Sarcoptic mange mite.....	
Chorioptic or symbiotic scab mite.....	
Demodectic or follicular mange mite.....	
Common Cattle Grub.....	
Bloodsucking Flies.....	
Horn fly.....	
Stable fly.....	
Tabanids (Horse flies and deer flies).....	
Black flies or buffalo gnats.....	
Biting midges.....	
Mosquitoes.....	
Screwworm.....	
House Fly.....	

External Parasites of Cattle

Manning A. Price • Philip J. Hamman • Weldon H. Newton*

NO OTHER CATTLE MENACE is as common as that of insect, tick and mite parasites. These pests probably cause greater losses than all infectious diseases combined. Losses are rather insidious and only partially recognized because insect, tick or mite infestations are usually not fatal. Losses from irritation, annoyance and nutritional competition are more difficult to assess.

The actual monetary loss caused by cattle parasites is difficult to determine. Young, less valuable animals are more susceptible to infestation and suffer more from parasites than do other animals. Parasitism losses result from:

1. Death of animals due to heavy parasitism.
2. Stunted growth, decreased production of milk, loss of edible meat and damage to hides. The magnitude of loss is great, although difficult to evaluate. Parasitized animals do not eat properly and, as a result, gains are lower than normal. Also, feed consumed is not fully utilized by the animals because parasites "feed at the first table."
3. Animal losses from parasite-transmitted diseases. Certain insects and ticks can transmit anaplasmosis, babesiosis, tularemia, anthrax and other lesser-known cattle diseases.
4. Lowered resistance to infectious diseases. Animals weakened by parasitism lose much of the natural immunity to disease organisms and thus are more susceptible to infectious diseases.

PRINCIPLES OF CONTROL

Effective control of livestock pests depends upon the reduction of parasite populations to a non-economic level. To control many pests, chemical measures must be supplemented by sanitation and sound herd management practices. A thorough understanding of the life history and habits of troublesome parasites is essential to effective control.

An ideal control program would be directed toward eradication of the parasite. In a few cases, such as the eradication of the cattle tick in the United States and the sheep scab mite in Australia, chemical eradication efforts have been successful. However, other attempts have not achieved this objective. Eradication of any pest is costly, but highly efficient, modern insecticides and new control techniques make it more feasible than in past years. For example, the eradication of the primary screwworm from the United States was accomplished with the sterile male technique at a mere fraction of the annual losses to the pest. Research offers much promise toward similar programs for many costly cattle parasites.

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TICKS OF MAJOR IMPORTANCE

Ticks, notorious parasites of domestic animals and birds throughout the world, are responsible for serious economic losses. In many parts of Texas, especially the eastern half, they frequently are the most common parasite on cattle. Heavy infestations cause "tick worm" manifested by a loss of condition, failure to gain properly and a severe degree of anemia. The anemic condition probably results primarily from blood removed by attached ticks. Under extremely heavy infestations, the animal becomes dull, listless and dies. Tick bites are irritating and cause the infested animal to rub and scratch, resulting in a scabby skin condition, sometimes followed by secondary infection. Hides of heavily infested animals are considerably reduced in value.

In addition to their parasitic activity, ticks also transmit several severe and often fatal cattle diseases.

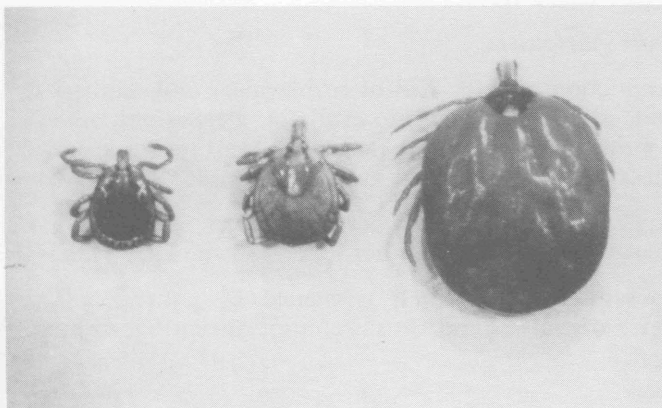
Lone Star Tick, *Amblyomma americanum* (Linnaeus)

The female lone star tick has a solitary white spot on the posterior margin of the scutum. Males are smaller than the females and have several scattered white spots on the scutum. Larvae and nymphs have no distinct white markings. Six-legged larvae are chestnut brown and pear-shaped when viewed from above. The eight-legged nymphal stage is considerably smaller than the adult and light to dark tan.

Distribution and hosts. The lone star tick probably extends as far west in Texas as brush grows, but is most abundant in the eastern third of the state. It is most populous in wooded areas where there is abundant underbrush along creek and river bottoms. Larvae, nymphs and adults have been recorded from cattle as well as most other domestic animals and many wild hosts. Larvae and nymphs usually parasitize small animals, fowls and rodents; adults usually are found on large animals.

Life history and habits. The lone star tick is a three-host tick. Each parasitic stage leaves the host after a blood meal and molts to the next stage or, in the case of the adult, deposits eggs on the ground or in some secluded place. This necessitates each succeeding stage to seek its own host. Thus, the larva engorges on its first host, drops off and molts. The nymph seeks its second host, engorges, drops off and molts. The adult engorges on a third host, mates and drops off to deposit eggs.

Unfed nymphs and adults overwinter in most of their tick distributional range in Texas. In the extreme southern range, all stages may be found on hosts throughout the year, but during the winter months they occur only in small numbers. Males emerge from hibernation about a month or 6 weeks before females. Both sexes begin to emerge from hibernation in February in east central Texas and gradually reach a peak in



Lone star tick. Left to right, male, unengorged female, engorged female.

animals in April or May. Infestations then begin to decline until late June or early July. After July, populations usually have decreased so that control measures are unnecessary.

In other sections of the state, seasonal populations vary. Nymphs may be on animals from February until September or October and into early November. The molting to nymphs of larvae that engorge early in the season maintains a fairly large nymphal population throughout the season, but there is usually a peak in April or May and another in August. Eggs from overwintering females that engorge early in the season begin hatching in May or early June. Larval activity usually is noted about this time and may continue until frost. The peak of larval activity is reached by mid-June or July.

The female deposits an average of 3,000 to 4,000 eggs, requiring about 32 days to hatch. The larvae engorge in 3 to 9 days and molt for 8 to 26 days. Nymphal engorgement requires 3 to 8 days and 13 to 46 days is required to molt. Adults feed for 11 to 24 days, mate and drop off to begin depositing eggs in 5 to 13 days. The period of active oviposition is 8 to 23 days. A life cycle requires about a year for completion.

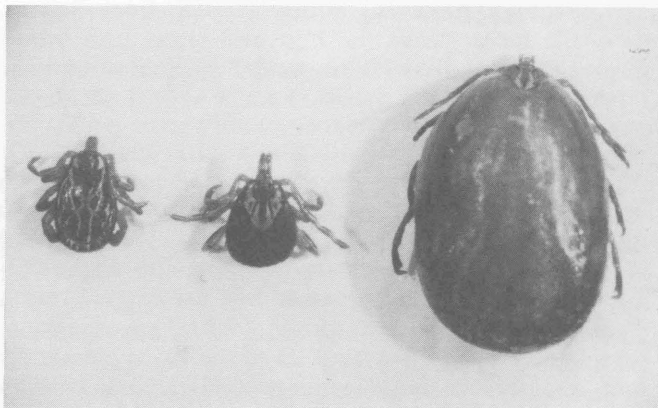
Importance and nature of damage. The lone star tick is particularly troublesome whenever it attains large populations. The long mouthparts cause deep, irritating wounds. During heavy infestations, animals suffer severely from the bite and may develop an anemic condition from loss of blood. In addition to its parasitic activity, the species can transmit certain human diseases such as Q fever, Rocky Mountain spotted fever, tularemia and others.

Gulf Coast Tick, *Amblyomma maculatum* (Koch)

The Gulf Coast tick is somewhat narrower in outline and more elongate than the lone star tick when viewed from above. The base color of both sexes is chestnut brown, but the ornamentation on the scutum differs. The white markings on the female's scutum are quite extensive. The male's scutum has irregularly connected, longitudinal yellowish-white lines. Nymphs and larvae are similar to those of the lone star tick.

Distribution and hosts. In Texas, the Gulf Coast tick is restricted to an area adjacent to the Gulf Coast. It has been reported as far away as Waco and Dallas, but seldom builds up to large populations more than 100 or 150 miles from the Gulf. Adults primarily attack large domestic and wild animals such as cattle, sheep, horses, goats, hogs, wolves, coyotes and others. Larvae and nymphs are commonly found on small wild animals, but principally attack birds. The meadow lark, bob white and other birds that forage extensively

Gulf Coast tick. Left to right, male, unengorged female, engorged female.



on the ground serve as important hosts for larvae and nymphs. Nymphs may be found occasionally on sheep and calves, and frequently on squirrels and other rodents.

Life history and habits. The Gulf Coast tick is a three-host species. This tick may overwinter in any stage, but usually overwinters in the larval or nymphal stage. The eggs, larvae, nymphs and adults are susceptible to drying up. This susceptibility appears to be an important limiting factor in its distribution, since it prevails only in the coastal areas where humidity, temperature and rainfall usually are high.

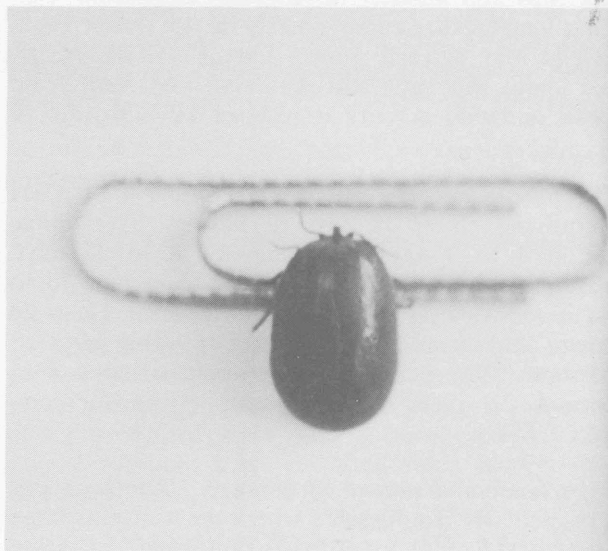
Larvae crawl about in grass or weeds soon after hatching and are usually in small clusters 2 or 3 yards from the hatching site. When a suitable host approaches they become active and attack en masse. On birds, their most important host, they attach on the head and neck, and on small mammals they are usually found on the head and ears. Larval activity begins in July and continues until late November. During warm periods in December, January and February, they may become active again. After engorging, usually from 3½ to 7 days, the larvae leave the host and crawl into bunches of grasses or weeds. Hiding under vegetation or debris, larvae molt into the nymphal stage in 9 to 12 days.

Nymphs are ready to attack soon after molting. They do not tend to gather in clusters but remain hidden until a host approaches. A searching tick makes frequent stops on the tips of vegetation. When the host is located, nymphs attach on the head and neck. They are active all during the year, but are more prevalent during late winter and spring. After engorgement is completed, usually 4½ to 7 days, the nymph leaves the host and seeks a molting place similar to that chosen by larvae. Molting time is usually 19 to 28 days.

Adults are active from mid-April to early October, but greatest activity extends from late June until the last half of September. Temperature appears to be an important factor in stimulating adults to seek a host. Adults are prevalent in the spring, but the majority remain inactive on the base of plants until summer. Peak activity usually is reached during late July and then begins to decline. Females do not completely engorge until fertilized by males. After engorging 5 to 18 days, the female drops to the ground and seeks a secluded spot for egg laying. After a preoviposition period of 2 to 5 days, the female crawls under debris or makes a shallow excavation in the ground in which to hide. Males may remain on the host for several weeks or even months after the engorged females have completed their blood meal. Unfertilized females have been observed to remain on the host for 70 days.

The average number of eggs ranges from 8,000 to 9,000, with egg-laying activity continuing 13 to 75 days or more.

Importance and nature of damage. The Gulf Coast tick usually attaches inside the outer ear but may be found outside and around the base of the ear. Its mouthparts produce deep, irritating wounds causing animals to rub the head and ears. The bites cause severe inflammation, swelling, cracking and scabbing. When the primary screwworm was an important pest in the state, this tick was probably responsible for 50 percent or more of the screwworm infestations in the Gulf Coast area. It is also a carrier of "Maculatum disease."



Engorged female winter tick.

Winter Tick, *Dermacentor albipictus* (Packard)

Winter ticks occur in two forms in the United States. Both occur in Texas. The *D. albipictus* form, in which the scutum has extensive white markings or is mostly white or streaked with brown, is more northerly in distribution. The *D. nigrolineatus* form has reduced or no markings on the scutum and is found more common in the southern portion of the state. The distribution range of the two forms overlaps with interbreeding apparently taking place since intermediate forms have been collected. The dark or *nigrolineatus* form is sometimes referred to as the brown winter tick. These ticks are readily distinguished from the two species mentioned previously because the mouthparts are short and blunt.

Distribution and hosts. The winter tick is widely distributed in Texas, but builds up to large populations through the central section from Zavala and Brewster counties northeastward to Coke and Hamilton counties. This area is characterized by low, rolling hills and sparse brush. The pest is commonly found on larger domestic and wild animals, with horses and cattle being the most commonly parasitized domestic animals. Deer and coyotes are common wild hosts in Texas.

Life history and habits. The winter tick is a one-host tick. It attaches to a host as the larva or "seed tick" and remains on the same host to molt from the larval to the nymphal stage and from the nymphal to the adult stage. The adult female leaves the host after engorgement and fertilization to deposit eggs. As the common name implies, this tick is usually found on animals during the winter. In most of their Texas range, the larvae become active during the fall or the first cool weather and remain active during the winter and spring. They have been noted to hang with the anterior end down from the tip of grass, weeds or low bushes. During the warm summer weather, they remain quiescent in a small bunch around the base of grass or other plants and do not attempt to seek a host even if one grazes nearby. During cool nights in September or October the larvae attach to a host; the adult population reaches its peak during the latter part of November or December. In January, the population begins to dwindle, and by February and March, only a few adults are found on animals. The total parasitic period for time spent on the host is usually 5 to 7 weeks, but may be as long as 18 weeks. Each female usually deposits 3,000 to 4,000 eggs that require 3 to 6 weeks for hatching.

Ear Tick, *Otobius megnini* (Duges)

The "spinose" ear tick derives its common name from the characteristic spines on the body of the nymphs and from its habit of attaching inside the host's ear. The adults have no functional mouthparts and do not feed. The adult's body is devoid of spines and less granular in appearance, with numerous pits on the upper and lower surface. The larval stage is considerably smaller than the adult, with an oval, striated body and numerous bristle-like hairs arranged symmetrically. The mouthparts are long and slender. The engorged larva appears grub-like and yellowish-white to pink. The spinose second-stage nymph is the one usually observed. This is the only soft tick that commonly attacks cattle in Texas.

Distribution and hosts. This tick is more prevalent in the arid and semi-arid sections of southern and southwestern Texas. Most Texas records of this species are from cattle, but it also is known to frequently parasitize horses and mules. Other domestic hosts include sheep, goats, hogs, cats, dogs and, on several occasions, has been removed from the ears of man. Among the wild animals that serve as hosts are coyotes, deer, cottontail and jack-rabbits.

Life history and habits. The adults do not feed. They are more abundant in and around corrals, loafing areas, and especially under and around salt and water troughs. If no males are present, the females live up to 18 months; if males are present, they mate and usually begin to deposit eggs in about 6 weeks. Each female may deposit 350 to 1,600 eggs during her lifetime, but the

average number per female is probably 800 to 1,000. Egg deposition requires up to 6 months to complete. Eggs usually hatch in 10 to 23 days but, under unfavorable conditions of temperature and humidity, the hatching period may be extended.

The young larvae crawl on weeds, grass or other objects, and when they contact the host, work their way across the shoulders, neck and head to the ears. Upon entering the ear, they crawl to the inner folds of the outer ear, and begin to suck blood or lymph. Larvae do not leave the ear when they complete engorgement, but molt to the nymphal stages in the ear. Larvae require 5 to 12 days or longer to complete their development.

Nymphs attack in the same area as the larvae, but occasionally may change their location in the ear. The feeding of the nymphs is usually slow and the two nymphal stages may require 4 weeks to 7 months. Afterwards, they detach, crawl out of the ear and drop to the ground. Then they crawl into cracks, under debris or bark, between corral planks or some similar dry situation and molt into adults in 7 to 31 days.

Importance and nature of damage. Parasitic larvae and nymphs of this species cause serious damage to livestock. They attack in the inner folds of the outer ear and suck blood. The wounds may become infected with pus-forming organisms that give rise to a condition known as "canker ear." The constant irritation causes animals to become dull, unthrifty and even to lose weight. Infested animals shake their heads and rub their ears in an attempt to relieve the irritation. The ear canals may become inflamed and frequently the eardrum is involved to such an extent that its function is impaired. Where there is serious involvement, the animals may become deaf, and heavily infested old range cows and young calves may die. The "spinose" ear tick is not known to transmit any diseases although it has been found naturally infected with the causal organism of Q fever.

TICKS OF MINOR IMPORTANCE

Several other tick species occur in Texas, some of which are of local importance. These have similar life history patterns to those previously described.

Black-legged Tick, *Ixodes scapularis* (Say)

This is a three-host tick that prevails during the winter in the eastern section of the state where it often builds up to injurious populations. It is capable of transmitting diseases such as anaplasmosis, and attacks a wide range of hosts, especially wild animals. Typical hosts include cattle, deer, dogs, hogs, horses, bob cats, racoons, coyotes, foxes and others, including a few birds. The life history pattern is similar to the lone star tick.

American Dog Tick, *Dermacentor variabilis* (Say)

This species is a three-host tick that occurs on its hosts throughout the year in the southern part of its range, but is more numerous in the spring. It is widely distributed over the eastern two thirds of Texas. High humidity favors this species; thus it is more abundant in coastal areas. Dogs are the preferred host of the adult, but it has been recorded from numerous wild and domestic animals, as well as man. Larvae and nymphs prefer small rodents. This tick transmits several diseases to man and animals. It can cause tick paralysis, especially in young animals and children.

The life history is similar to a typical three-host life cycle, but may require 1 to 3 years for completion. In Texas, the normal time required is 2 years, since all stages may overwinter.

Cayenne Tick, *Amblyomma cajennense* (Fabricius)

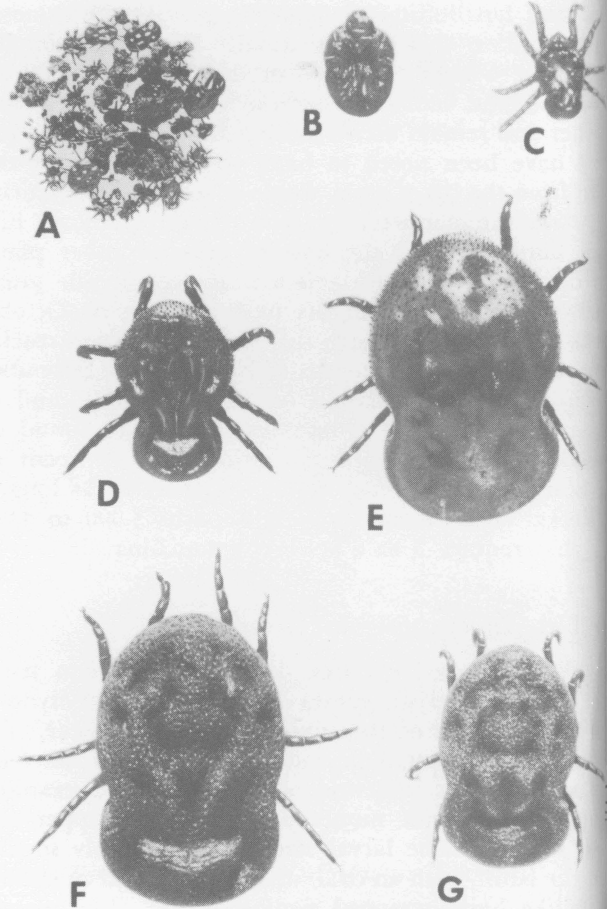
The "cayenne" tick is a medium-sized tick with characteristic ornamentation on the scutum formed by reddish-brown stripes on a pale background. It is a vector of several diseases and readily attaches itself to many kinds of hosts. It is reported to be abundant in southern Texas. Larvae, nymphs and adults commonly attack man, horses, cattle, sheep, dogs, pigs and many other animals.

Little is known about the life cycle of *A. cajennense*. It appears similar to that of the lone star tick.

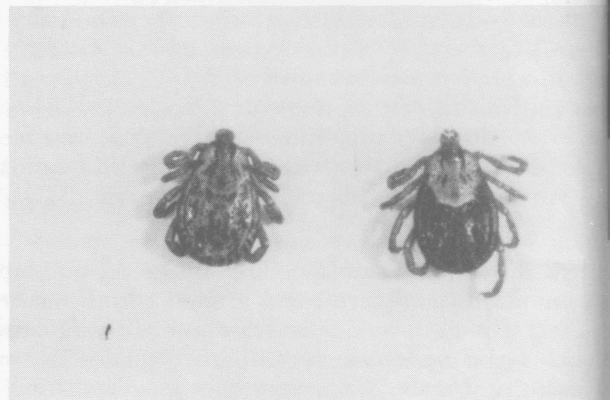
Cattle Tick, *Boophilus annulatus* (Say)

The cattle tick, sometimes called the Texas fever tick or cattle fever tick, is a one-host tick without contrasting color patterns and with short mouthparts. Larvae, nymphs and adults attack the same host. At one time it occurred in the southeastern states including the eastern two thirds of Texas. Strenuous control measures by state and federal government agencies, with the cooperation of cattle producers, eradicated this serious parasite from the United States. It is periodically reintroduced into southern Texas, but prompt control measures have prevented spread from this area.

The cattle tick occurs on deer, buffalo, horses, mules, sheep and goats. As long as it exists in northern Mexico, there is always danger of reintroduction into South Texas on cattle and deer that cross the Rio Grande despite rigid quarantine measures. Under conditions of summer temperature and high humidity, the life cycle is short. The eggs hatch in 17 to 21 days, but during cold weather may require as long as 5 or 6 months. Since this is a one-host tick and the change from one stage to another occurs on the host, the parasitic period is comparatively short, usually 20 to 36 days, but in a few cases may be as long as 55 days. The engorged female usually begins to deposit eggs 3 to 4 days after she leaves the host.



Ear tick. (a) Ticks and debris collected from ear; (b) engorged larva; young nymph; (d) partially engorged nymph; (e) fully engorged nymph; adult female; (g) adult male.



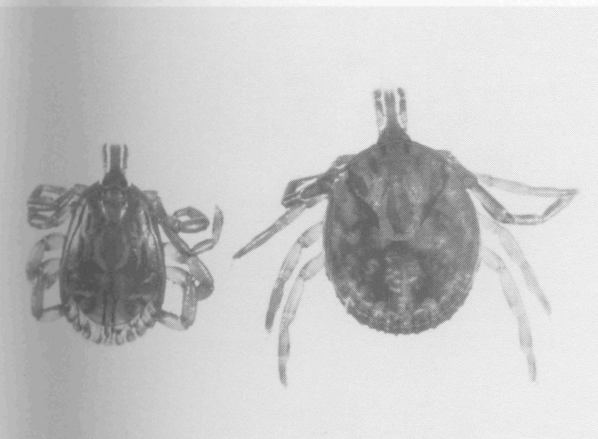
American dog tick. Left, male; right unengorged female.

During winter, the period may be prolonged to 20 to 40 days.

In infested areas, the cattle tick occurs on cattle in large numbers and is an important parasite. It also transmits babesiosis or "Texas fever."

Southern Cattle Tick, *Boophilus microplus* (Canestrini)

This species is similar in appearance, life history and habits to the cattle tick, (*B. annulatus*). It is widely distributed over the world, including South America, Central America, Mexico and Southern Florida. The danger to the Texas cattle producers is threatening because it possibly could be introduced on imported cattle or deer from Mexico. Within its range, it is an important cattle parasite and transmitter of babesiosis.



Cayenne tick. Left, male; right, unengorged female.



Female cattle ticks in several stages of engorgement.

LICE

Both types of lice—bloodsucking and biting—attack cattle. Sucking lice pierce the animal's skin and draw blood. Biting lice have chewing mouthparts and feed on particles of hair, scales, scab and skin exudations. One species of biting, and four species of sucking lice commonly infest Texas cattle. The development of both types is similar. They attach eggs (nits) to hairs and the young lice (nymphs) appear about 1 to 3 weeks later. Nymphs molt once or more before attaining adulthood. The number of molts and developmental time vary among species and according to season, humidity and other conditions.

Both types begin to increase on cattle in the fall and reach a population peak in later winter or early spring. During late spring or early summer, populations decline. Lice usually cannot survive long at temperatures above 100 degrees F. (Summer skin surface temperatures may go above 125 degrees F.) The adverse summer and fall season probably is spent in the egg stage or as adults in some protected area on the host. One species has been noted to infest the inside of the ear during these seasons.

BITING LICE

Cattle Biting Louse, *Bovicola bovis* (Linnaeus)

This is the only biting louse that is parasitic on cattle in the United States. It is readily distinguishable from sucking lice by its reddish-brown, broad, blunt, flat head and yellowish-white abdomen with dark transverse bands. It is small, varying in length from about 1/15 to 1/25 inch. Each of the six legs of both nymphs and adults terminate in a single claw.

Life history and habits. During the winter, biting lice group at the base of the tail, on the shoulders and along the back of livestock. As infestations increase, the lice spread down the side and along the neck and

may be found anywhere on the host's body. During the summer, they persist mainly on the tail, head and perhaps inside the ears.

The small, light-brown eggs are glued to the hair close to the skin. Under ideal conditions, the eggs hatch in 7 to 10 days, the average being about 8 days. Time required for the three nymphal stages to reach maturity averages about 19 days. The female usually begins egg deposition about 3 days after attaining maturity. Normally, one egg is deposited about every 36 hours for the first 15 days, but the rate decreases after this time. Females may live for as long as 6 weeks, depositing only 20 to 30 eggs each. Egg-to-adult development averages about 1 month, but varies with the skin temperature of the host as well as moisture conditions.

Importance and nature of damage. The cattle-biting louse in Texas is not as important as some of the sucking lice. Usually they are slower to build up to damaging populations. Under conditions of heavy infestations, the skin of animals may be raw and bleeding from the constant biting, scratching and rubbing to relieve itching and irritation caused by the lice. When the raw areas scab over, lesions may resemble those produced by scab mites.

SUCKING LICE

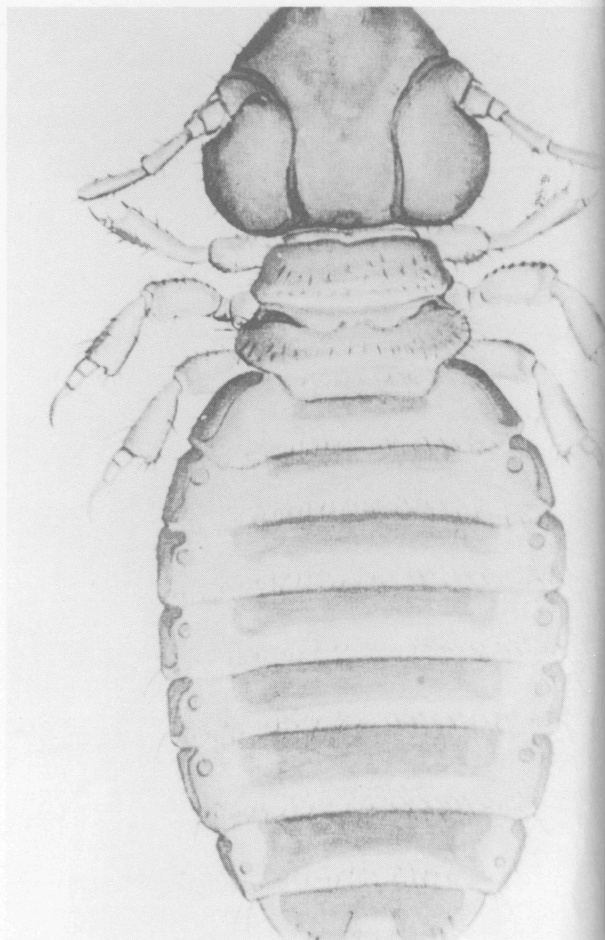
Four sucking lice parasitize cattle in Texas. Two are very common and distributed over most of the state, but the other two are not often prevalent except in localized areas.

Short-nosed Cattle Louse, *Haematopinus eurysternus* (Nitz)

The short-nosed cattle louse is commonly found on mature cattle, although younger animals also are infested. It is the largest louse found on cattle. Females are about $\frac{1}{8}$ inch long and approximately half as wide; males are slightly smaller. The head is about half as wide as the body, short and nearly as broad as long and bluntly rounded in front. The head and thorax are yellowish-brown and the abdomen is slate blue. This louse may be readily distinguished from the long-nosed cattle louse by its comparatively short head and cone-shaped plates on the lateral margins of the abdomen.

Distribution and hosts. This louse is world-wide in distribution. It may be found on cattle in any section of Texas. Cattle appear to be the normal host.

Life history and habits. The principal breeding site in winter is the top of the neck, while secondary breeding sites are the sides of the neck, the dewlap, back, base of the horns and base of the tail. If the infestation is severe, these lice may breed in any area of the animal's hair coat. During summer, a few lice usually can be found on the inside of the ear near the tip. This summer site is



Cattle biting louse.

selected to avoid the high skin temperatures resulting from direct sunlight.

Temperature limitations of this species are similar to the cattle biting louse. Eggs do not hatch at temperatures below 77 degrees F. Egg development normally begins at about 80 to 81 degrees F. Eggs are attached to hairs adjacent to the skin, but are subjected to temperature fluctuations as normal hair growth gradually removes them from the skin surface. Young lice live on the skin and are protected from severe temperature fluctuations by the hair coat. The skin temperature seldom falls below 86 degrees F. and usually fluctuates between 90 to 97 degrees F. from November to February or March, the period of greatest louse activity. There is a gradual increase in numbers beginning in late August or September, usually reaching a peak in February. The population decreases abruptly after March and persists at a low level during April, May, June and July.

Females deposit one to four eggs per day for 15 days or longer. Unlike other cattle lice eggs, these are hard-shelled, opaque and brown to brownish white. Eggs hatch in 9 to 19 days and nymphs reach maturity in 9 to 15 days. An average life cycle from egg to adult usually takes 20 to 41 days.

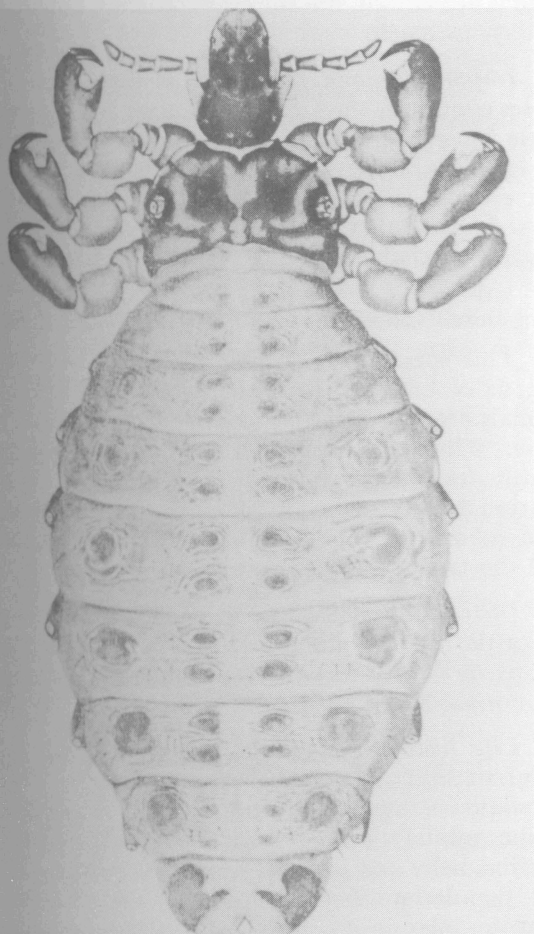
Importance and nature of damage. Infestations of cattle lice usually remain unnoticed until numbers are enough to cause annoyance. Infested animals rub and scratch against trees, fence posts and other objects to alleviate itching and irritation. This activity results in loss of hair, raw skin and bruised areas. Lousiness is first noticed on poor, weak, unthrifty animals. Cattle that harbor lice usually do not respond to feed properly and are more subject to diseases because of their weakened condition. Anemia may result from blood losses to the pests. Young calves may be stunted and, until infestations diminish in late spring or summer, may fail to respond fully to increased spring grazing and more milk production from cows. Lice do not usually cause animals to die, but older, thin range animals under malnutrition stress sometimes die from the combined stresses. Weakened animals also are more susceptible to disease, which may be the direct cause of death.

Cattle Tail Louse, *Haematopinus quadripertusus* (Fah.)

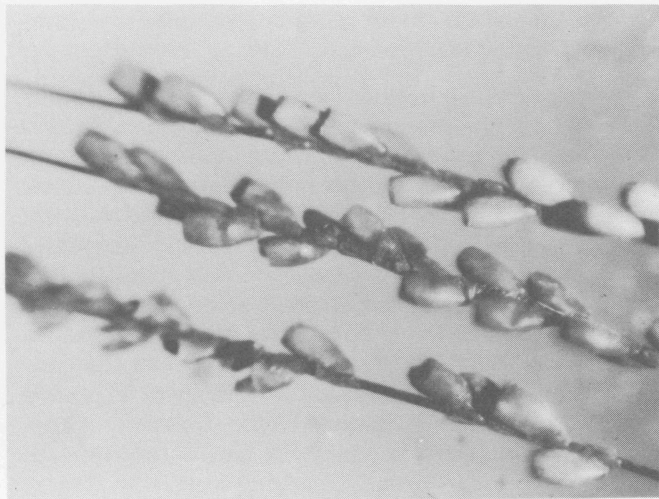
The cattle tail louse resembles the short-nosed cattle louse and has often been confused with it. The tail louse is larger (4.5 mm long) and the head, thorax and abdomen are dark brown.

Distribution and hosts. This tropical species apparently was introduced into Florida several years ago, and by 1956 spread along the coast of most Southern states. In Texas, it appears to be confined largely to the southern portion of the state, primarily the southeast. Its primary host is cattle.

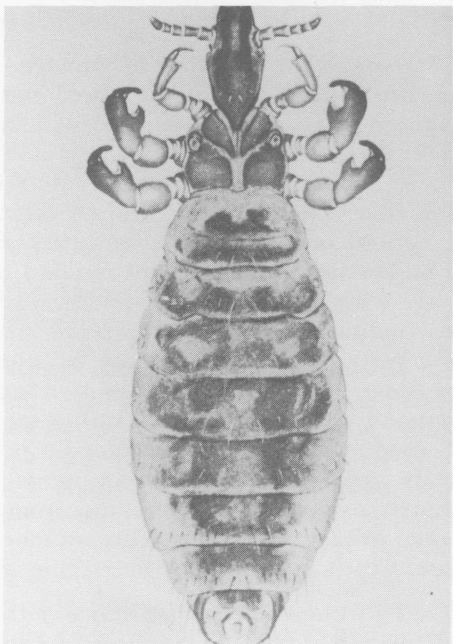
Life history and habits. The eggs are deposited almost exclusively in the switch of the animal's tail. As



Short-nosed cattle louse.



Eggs of cattle tail louse attached to hairs.



Long-nosed cattle louse.

the eggs hatch, the young nymphs migrate up the tail to the soft-skinned areas of the tail, head and neck. Calves often are heavily infested about the face as a result of sucking the dam through the rear legs and contacting the young nymphs on the switch. The life cycle is not known, but the eggs apparently require about 11 days to hatch.

Importance and nature of damage. This species causes essentially the same type of damage as the short-nosed cattle louse. The nymphs and adults tend to feed on tender areas of the skin, such as the tailhead, throat, ears and eyelids. Facial infestations in young animals may be serious. Infestations usually are more difficult to control than other species.

Long-nosed Cattle Louse, *Linognathus vituli* (Linnaeus)

This species occurs more often on young animals and dairy breeds. Heavy infestations on mature beef animals are not found as often as the short-nosed cattle louse. The long-nosed cattle louse may be distinguished readily from other cattle lice by its longer "nose" or rostrum and narrow body which gives it a slender, rather than robust, appearance. The abdomen is bluish-black and the lateral margins are smooth.

Distribution and hosts. This species has been found on cattle all over the world and may be encountered in any section of Texas. Domestic cattle appear to be the normal hosts.

Life history and habits. The most common sites of infestations are the dewlap and shoulders. When the infestation is heavy, the lice may be found on any part of the animal's body, especially the sides of the neck, top line, belly and perianal region. As spring approaches and populations begin to decline, the remaining lice seem to migrate toward the shoulder area. Females deposit about one egg per day. The eggs are elongated, oval-shaped and dark blue. They hatch in about 8 to 13 days. Nymphs require 15 to 17 days to mature and the complete life cycle from egg to egg requires 23 to 30 days.

Importance and nature of damage. This species causes less damage in Texas than the short-nosed cattle louse. The type of damage caused by the two species is the same, but the long-nosed cattle louse seldom is as abundant as the short-nosed louse.

"Little Blue" or "Capillate" Louse,

Solenopotes capillatus (End.)

This species is probably an original parasite of deer since all other members of the genus *Solenopotes* are parasitic on the Cervid (deer) family. The "little blue" louse often has been confused with the long-nosed cattle louse, but is smaller and more robust. The head is short and broadly rounded, instead of long and pointed. It is the smallest of the sucking lice found on cattle.

Distribution and hosts. The "little blue" louse is thought to be distributed in the eastern part of the United States and has been recorded only from domestic cattle.

Life history and habits. The "little blue" louse usually clusters on the front part of the animal, especially on the head and neck. However, infestations have also been noted along the top line and under the tail. These lice are especially sensitive to removal from the host and seldom survive more than 2 or 3 days off the host. Little is known about the life history except that the eggs hatch in approximately 13 days.

Importance and nature of damage. In some areas, this species is the most common louse found on cattle and may build up to extensive populations. The damage is essentially the same as that caused by other species of sucking lice.

MANGE AND SCAB MITES

Scabies in cattle, commonly known as scab, mange or itch, is a contagious skin disease caused by parasitic mites living on or in the skin. The four species affecting cattle are classified into four genera: *Psoroptes*, *Sarcoptes*, *Chorioptes* and *Demodex*.

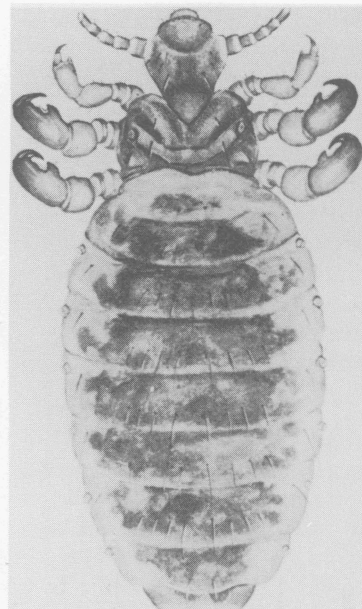
Mites are related to ticks, spiders and scorpions since the adults possess four pairs of legs. They resemble ticks more closely than spiders or scorpions. Mites vary in size and structure, but most species, especially the parasitic mites, are very small.

Annual loss to the cattle industry for these four species in the United States was estimated at more than \$4 million in 1964. This estimate does not include money spent for control efforts. Mites also transmit diseases such as scrub typhus, fowl spirochaetosis and others to man and animals. The Orbatid mites serve as intermediate hosts for early developing stages of *Maniezia expansa*, a tapeworm found in the small intestine of cattle, sheep and goats.

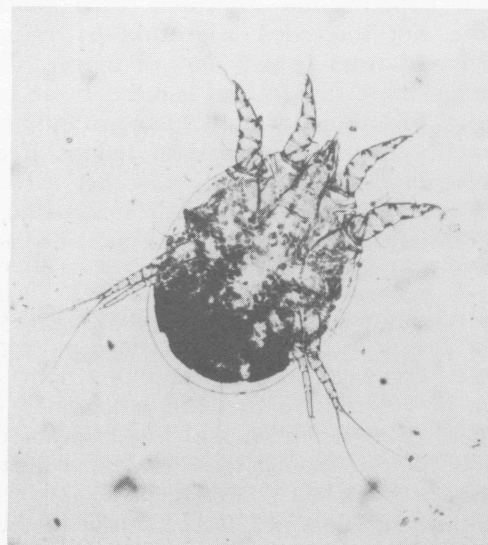
Each of the four groups produces a different type skin reaction and has different habits.

Psoroptic or Common Scab Mite, *Psoroptes equi* var. *bovis* (Her.)

Common cattle scab is caused by small, clear mites. The full-grown female is about 1/40 of an inch, and the male about 1/50 of an inch; they are barely visible to the naked eye when observed on a dark background. The body is oval, with tapering mouthparts that are longer than broad. The four pairs of legs in the adult mite are rather long. The first two pairs are close together and separated from the third and fourth pairs which also are very close together. Females have cup-like tarsal suckers borne on segmented stalk-like structures known



"Little blue" or "capillate" louse.



Psoroptic or common scab mite.

as "pedicels," located on the ends of the first, second and fourth pairs of legs. The third pairs of legs, devoid of tarsal suckers, end in a single, long setae or hair. The males have tarsal suckers on the first three pairs of legs and the fourth pair is somewhat reduced.

Distribution and hosts. The psoroptic scab mite of cattle is one of the most important mites found on Texas cattle. It is more prevalent on range animals in the western states, but has diminished in incidence since about 1938. The common scab mite attacks cattle, but similar varieties cause scab in sheep, goats and horses, as well as in the ears of rabbits. When cattle and sheep are confined together, the mites may transfer from one animal to another and produce typical scab lesions.

Life history and habits. Psoroptic or common scab mites are more prevalent during the fall, winter and spring. Populations decrease during the summer and, although lesions may disappear, sufficient numbers of mites survive to repopulate the host during the onset of cool fall weather. The mites may spread from infested to non-infested animals by direct contact. Frequently, infested bulls transfer the mites to large numbers of cows. Rubbing objects used by infested animals are also a source of infestation. Despite their close associations, the females have been able to survive off the host for as long as 38 days. Most experimental work indicates that they usually survive only about 10 days off the host, and experimental infections from contaminated pens have not succeeded after infested animals have been removed from pens 9 days or longer. The disease develops more rapidly and is more severe on weak, undernourished animals. Bulls, old cows and unthrifty animals usually are the first to show lesions of the disease. It may then spread rapidly to other cattle in the herd, especially during the winter. Lesions may be visible 15 to 45 days after exposure, but in some cases the interval may be longer.

Common scab mites complete their entire life cycle on the host. Each female deposits approximately 15 to 24 eggs on the skin or base of a hair. Eggs deposited on or adjacent to the skin hatch in 3 or 4 days, but those separated from the skin by scabs or other debris may require about 5 days to hatch. Eggs removed from the host may hatch in about 10 days, but the larvae die. The small six-legged larvae complete their feeding and molt to the nymphal stage in 2 or 3 days. The four-legged nymphs are of two sizes. Smaller ones feed and molt into sexually mature males in 3 to 5 days, whereas larger ones feed and molt to the pubescent or copulatory female in 3 to 4 days. Females usually appears about a half day or day before the males. Adults mate in about 2 days and the pubescent or copulatory female molts again into an egg-laying female. These females begin to deposit eggs about 1 day after molting.

Importance and nature of damage. Mites multiply rapidly and produce the most severe skin lesions during

fall, winter and spring. Lesions tend to disappear during the summer on range cattle, but on animals housed together or in close contact this phenomenon is less pronounced.

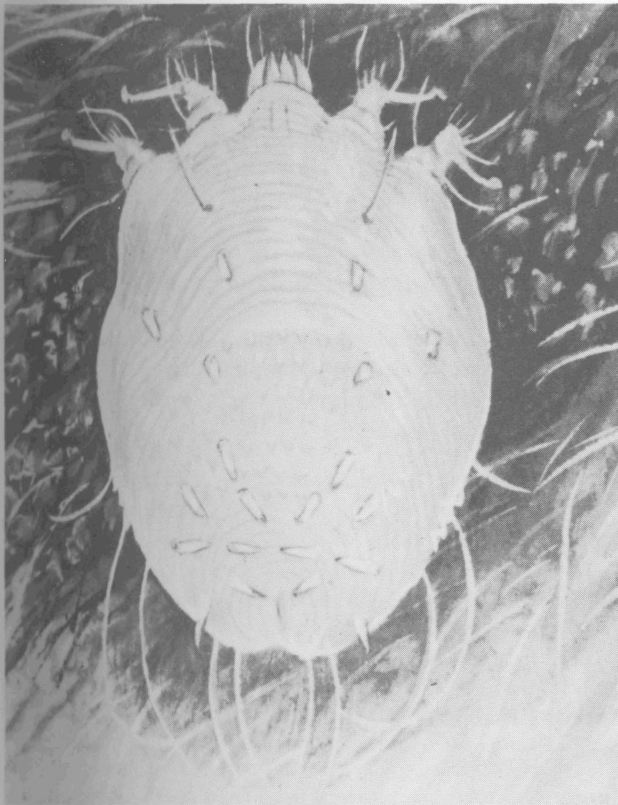
If unchecked, common cattle scab becomes a serious disease affecting cattle of all ages, classes and conditions. Typical symptoms are weight loss or reduced gains, reduced milk flow, unthriftiness and even death. Severity of the disease is compounded by cold, rainy weather coupled with a poor state of nutrition.

Mites attack any part of the animal's body that is covered thickly with hair. Lesions usually appear first on the withers, over the back and around the tail head. They may spread over the entire body, piercing the skin to obtain food and causing a slight inflammation; however, the disease is seldom detected at this early stage. As the mites become more numerous, many small wounds are made in the skin. At this stage, there is considerable itching and irritation and the animals lick themselves and rub against objects. This may cause abscesses to develop on the shoulders and rump. Papules usually form and serum exudes. The serum that oozes to the surface of the skin is soon mixed with dirt and becomes contaminated with bacteria. This mass hardens into yellowish or grayish scabs, possibly stained with blood. In the early stages, the scabs may be about the size of a pea, but as they form, the mites move to the edges of the lesions in search of healthy skin, thus increasing the scab size. As severity increases, the scabs become thick and crusty and the skin thickens. Irritation at this stage is extremely intense, usually accompanied by emaciation and anemia. Unless mites are controlled, death is likely.

Efforts should be made to detect scab in its early stages. Diagnosis depends on finding mites which cause the disease. One of the best means of detection is to make a skin scraping at the edge of the scab and transfer the scraping to a dark background. The mites may be seen as minute, grayish-white objects crawling on the background. During cold weather they may remain motionless after removal until they are exposed to a source of heat, such as direct sunlight or artificial light. Mites also may be seen on the moist, red skin by parting the hair and removing part of a small scab. If the lesion and surrounding skin are dull and dry, the mites are not active and may be difficult to find. Constant licking and rubbing by cattle is a typical symptom of scab.

Sarcoptic Mange Mite, *Sarcoptes scabiei* var. *bovis* (Robt.)

Sarcoptic mange mites, also referred to as true scab mites and barn itch mites, generally resemble common scab mites (Psoroptes), but are smaller, with a round rather than oval body. Females are about 1/50 inch long, and males about 1/60. Under magnification, the upper surface of the body is wrinkled with transverse lines. On the posterior portion there is a number of strong backward-projecting, lance-like spines. Moulting



Sarcoptic mange mite.



Sarcoptic mange infestation.

parts are bluntly rounded and as broad as long, in contrast with *Psoroptes* mites which have slender, pointed mouthparts.

Distribution and hosts. Sarcoptic mange is particularly serious in various eastern states and throughout the Midwest. The disease appears to be spreading through the exchange and sale of cattle, especially purebred beef bulls. Mites on different types of host animals are regarded as varieties of one species. Most varieties can be transferred from a normal host to other species of domestic livestock and man. There is some degree of host specificity, however, since mites usually do not survive for more than a few generations on secondary or alternate hosts. Horses, hogs, mules, man, dogs, cats, foxes, rabbits, squirrels, sheep and cattle are subject to attack by different varieties of *Sarcoptes scabiei*.

Life history and habits. The entire life cycle is spent on the host. The fertilized young female burrows into the upper layers of the skin and deposits eggs at the rate of one to three per day along the burrow as she extends its length. The egg-laying female never leaves her burrow unless she is dislodged by scratching or rubbing. She usually dies in the tunnel, which may extend almost an inch. Each female may deposit 40 to 50 eggs over a 2 to 4-week period. The eggs are attached

to the bottom of the burrow and left in a row behind the female. The eggs hatch within 3 to 5 days.

The six-legged larvae may remain in the old burrow, make a new burrow or add a side tunnel to the old one, but most apparently leave the old burrow and crawl over the skin surface. The larval stage lasts 4 to 6 days. Larvae do not molt on skin, but enter a hair follicle or make a small pocket in the skin to change to the nymphal stage.

Eight-legged nymphs may be separated from eight-legged adults, since nymphs have no genital opening. Nymphs may remain in the larval burrow, enter the skin through a hair follicle or crawl over the skin surface. Nymphs on the skin surface excavate a burrow before changing to the adult stage. Duration of the nymphal stage is about 2 days. Nymphs molt into a male or a pubescent (copulatory) female. This female stage sometimes is referred to as the immature female. The pubescent female usually remains in the burrow or "molting pocket" until she is fertilized, or she may excavate a short burrow. The young fertilized females also wander over the body surface. Mites are probably spread to non-infested animals in this stage more readily than in the larval or nymphal stages. Probably no more than 10 percent of the eggs deposited develop into adult mites.

After 2 to 4 days, the fertilized female changes to an egg-laying female which, within an hour, burrows into the skin and begins depositing eggs. Adult males wander over the skin in search of females. Adults may live up to 2 months. Sarcoptic mites are very susceptible to drying and cannot survive long periods off the host. Under ideal conditions, they have survived in the laboratory for 3 weeks. Barns and corrals that have sheltered diseased animals may be a source of contamination; however, experimental data indicate that such areas are free of mites after about 17 days.

Importance and Nature of Damage. Damage includes weight loss, unthriftiness, functional disturbances and increased death rate. Milk production in infested dairy herds is curtailed severely. Severe, untreated cases lead to progressive emaciation and perhaps death. Injury is especially severe on animals in poor condition. The highest incidence of sarcoptic mange is normally in late fall and early spring.

Mites pierce the skin, suck the lymph and also may feed on young skin cells. They cause severe irritations which result in intense itching and scratching. The resulting skin inflammation is accompanied by an exudate which hardens into a crust or scab. The skin thickens and wrinkles, reducing blood flow to the hair-producing cells and eventually the hair falls out. Large areas may be left entirely bare. Secondary bacterial infection is a frequent complication that results in pustular papules. First lesions usually are found where hair is thin, such as the escutcheon and inner and rear surfaces of the thighs. From here, they spread down the legs, up to the tail head and along the underline to the brisket. If the disease is not checked, it may spread over all of the body.

Chorioptic or Symbiotic Scab Mite, *Chorioptes bovis* (Ger.)

The chorioptic scab mite resembles the psoroptic or common scab mite, but is slightly smaller. It is slightly larger than the sarcoptic mange mite, and its body is oval and slightly longer than wide. The mouthparts are rather short and blunt in contrast to the comparatively long, sharp mouthparts of common scab mites. These mites are more active and travel faster than psoroptic mites. This characteristic helps to distinguish the two species.

Distribution and hosts. Chorioptic scab prevails in the northeastern and midwestern states, as well as Texas. In some of these states, it is more prevalent than the psoroptic scab mite and three or four times as prevalent as the sarcoptic mite. It is not unusual to find a complex of chorioptic and psoroptic scab in the same herd, and occasionally they may exist on the same animal. In the past century, eight species or subspecies of Chorioptes

have been described. Most have been collected from domestic livestock and considered to be host specific. However, recent investigations in Canada indicate that the mites are not host specific and will transfer readily from infested cattle to sheep and goats and vice versa. In the laboratory, life history studies proved that mites from different hosts will crossbreed and produce fertile offspring which can be reared on skin scrapings from most livestock as well as several related wild animals. Cattle appear to be among the most important hosts.

Life history and habits. The "pasterns" of the hind feet appear to be the most important sites of infestation but uncontrolled infestations may spread over most of the body.

Mites pass through an egg, larval, two nymphal, two female and one male stages. Egg-laying females usually deposit only one egg per day. Females that deposit eggs may live up to 3 weeks, whereas, those not depositing eggs and the males may survive 7 or 8 weeks. During the egg-laying process, the females secrete a fluid which lubricates the eggs. Later this fluid solidifies to fasten the egg to the host. The eggs apparently are deposited directly onto the skin.

The female does not deposit all of her eggs in a single location, but tends to return to the same area to oviposit. The presence of eggs from one female seemingly attracts other females to oviposit in the same locality. This results in communal groups with each egg attached to the skin scales of the host. The eggs hatch in 3 to 4½ days, but average about 4 days under laboratory conditions. Under natural conditions on the host's skin, eggs require 5 to 6 days to hatch. The larva and the two nymphal stages require 3 to 5 days each. The copulatory female may require up to 8 days for development with a preoviposition period of about 21 days. The complete life cycle from egg to egg requires 21 to 26 days under laboratory conditions.

Importance and nature of damage. The relation between chorioptic mites and the formation of lesions is not fully understood. At times, cattle heavily infested with mites do not show lesions. Probably only about 60 percent of infested animals develop lesions. In other cases, cattle apparently with only a few mites show well developed lesions. Chorioptic scab, sometimes referred to as barn itch or symbiotic mange, is milder usually and does not spread over the entire body as does psoroptic scab. Lesions usually occur on the lower hind legs up to the tail head. In severe cases of long standing infestation the lesions may extend from the tail head to the head or over the back of the animal and eventually over the entire body surface. Lesions are manifested in localized areas by small irregularly outlined nodules that exude serum. This exudate causes subsequent matting of the hair. In advanced cases the nodules tend to coalesce and the skin becomes thick and wrinkled and scabs may

become thick and heavy. Secondary infection may occur and result in the formation of pustules. Lesions usually begin to form in December, particularly when cattle are in barns or close quarters, and reach a peak sometime in February. In spring the lesions tend to disappear, although a few may persist through summer and reappear in the fall.

Demodectic or Follicular Mange Mite,

Demodex bovis (Stiles)

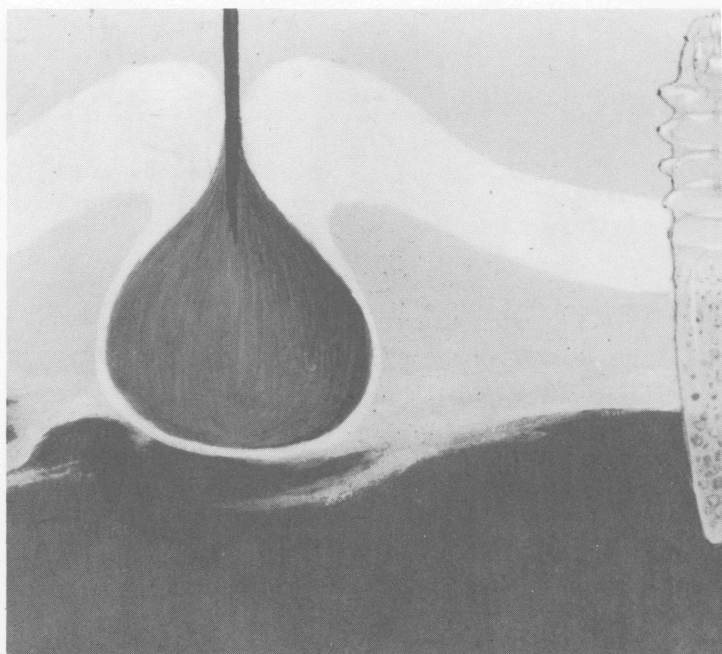
The demodectic mange mite of cattle belongs to a restricted group of parasitic mites that live in hair follicles and glands of the skin of several species of animals.

The adult mites are not visible without aid of a microscope. Their bodies are elongated and appear separated into three divisions. The legs are three-segmented, short and stubby and terminate in a pair of claws. The elongated abdomen has transverse lines on top and bottom.

Distribution and hosts. Demodectic mange in cattle appears to be widespread in the United States. It is seldom reported in Texas; consequently, its prevalence and distribution in the state is unknown. Demodectic mites appear to be host specific despite the fact that size is about the only variation between those infesting different kinds of domestic animals. So far as is currently known, those that parasitize cattle will not survive on other animals.

Life history and habits. The life history of demodectic mites is not well-known. Larvae have three pairs of legs and there appear to be three nymphal stages and the adult. They seem fairly resistant to environmental conditions and can survive several days off the host in moist surroundings. They have been known to live for 3 weeks on cool, moist pieces of skin.

Importance and nature of damage. Cattle producers often are unaware of demodectic mange in their herd because lesions may not be visible. Damage to hides has stimulated an interest in this form of mange. Most cases have been reported from old cows of dairy breeds. Lesions appear as nodules most often in the skin of the neck, shoulders, dewlap, brisket and other areas. They vary from the sizes of pinheads to walnuts. There is usually no change in the hair coat except in advanced cases. Ordinarily the lesions are not visible until hair is parted; then nodules can be detected by rubbing the hand over the animal's body with fingers pressed tightly against the skin. Nodules are usually firm and frequently filled with a whitish, "cheezy" material. When the infestation is severe, nodules may rupture and coalesce. When contents from ruptured nodules spread over the surrounding area, the disease may resemble common scab.



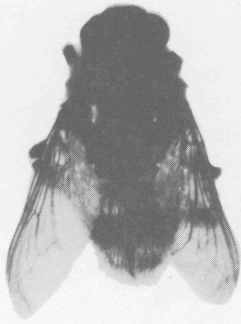
Demodectic mange mite.

COMMON CATTLE GRUB

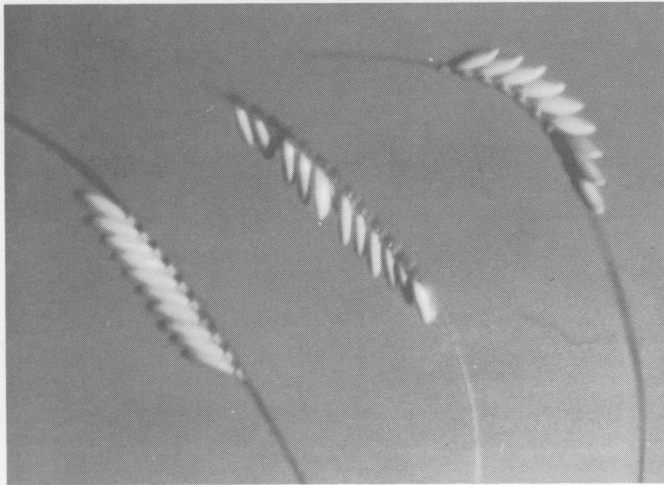
The common cattle grub is the larval stage of the heel fly, *Hypoderma lineatum* (de Villers). It occurs in all states except Alaska but is rare in the extreme southern tip of Texas. Similar species, the northern cattle grub (*Hypoderma bovis* (Linnaeus)), is abundant in southern Canada and the United States north of Texas, but thus far has not survived in Texas.

Distribution and hosts. Common cattle grub populations vary tremendously in Texas because of diverse environmental conditions. Populations within local areas also fluctuate considerably from year to year. Generally, the area west and north of a line extending roughly from Eagle Pass northeastward to Lufkin has consistently higher populations than the area south and east of this line. Local areas on either side of this line frequently experience population fluctuations ranging from low to high.

Cattle are the only important hosts of the common cattle grub. The American bison is frequently infested with a few grubs which develop normally. Horses are sometimes infested, but there is no record of a grub completing its development in a horse. Reports from India indicate that normal development may occur in sheep and goats. Many instances of infestations in humans have been recorded. In man, the first instar larva causes a condition known as creeping eruption as it travels beneath the skin. In cattle, the preferred hosts appear



Heel fly adult.



Heel fly eggs on hair.



Animal clipped to expose warbles in back.

to be (1) yearlings, (2) calves and (3) older animals, in that order.

Life history and habits. The non-feeding, sexual mature adult heel fly, about the color of a honey bee and nearly twice as large, emerges from a puparium in the soil during warm, sunny days of late winter and early spring. In the Hill Country and Edwards Plateau flies may emerge as early as November or December. Flies may mate within an hour after emergence, and females may deposit fertile eggs 20 minutes later. During favorable weather, flies usually exhaust themselves and die within 2 or 3 days; however, some survive as long as 3½ weeks if cold weather restricts their activity.

Common cattle grub adults are less aggravating than their egg-laying activities than flies of northern species and "gadding" (the characteristic reaction of cattle to heel fly activity) is less severe. Common cattle grub adults most often approach a reposing animal and attach their eggs to hairs on the udder, legs, escutcheon, belly or side near the ground without noticeably disturbing the animal. It is not uncommon, however, to see animals fleeing wildly, standing in water up to their bellies in dense shade to protect themselves from heel fly attacks. This is an instinctive reaction since the fly neither bites nor stings nor causes any pain during this egg-laying activity.

Eggs are attached in rows of two or three to as many as 25 or 30 along a single hair. Females usually produce 400 to 800 eggs with an average of 500 eggs per fly. The eggs hatch in 2½ to 6 days, and the larvae crawl down the hair and begin to penetrate the skin, usually at the base of the hair. Within 1½ to 6 hours, the larvae penetrate the skin to begin their migration through the connective tissues. Mortality of these first instar larvae is probably greater than 50 percent and likely approaches 100 percent in highly resistant animals.

The first instar larva apparently spends about 2 to 3 months migrating through connective tissues. Common cattle grub larvae spend most of this time in the submucosa of the esophagus (gullet), but they have been found in connective tissues of the diaphragm, pericardium, spleen, rumen, ribs and peritoneum. Movement of grubs through the connective tissues is assisted by their enzyme secretion.

Upon reaching the back, the grub secretes an enzyme creating a hole in the skin through which the grub obtains oxygen. It remains in the warble for 3 or 4 days before molting into the second instar, which is almost pure white. Growth during the second instar is rapid as the spiny grub feeds on pus, necrotic cells and secretions from the wall of the warble. After several days of feeding, larvae darken and molt to the third instar which is tan at first, but nearly jet black when mature. Natural mortality of grubs in the back is 50 percent.

or more and may be as high as 100 percent in some animals.

After developing 1 or 2 months in the warble, the fully-grown grub squeezes through the breathing hole in the skin, drops to the ground and seeks shelter under ground trash, leaves or other debris. Within 2 or 3 days, the larval skin hardens into a puparium, inside which the heel fly develops. The pupal stage usually varies from 20 to 60 days, depending on the temperature. Thus, one generation per year is completed.

Grubs normally appear in animals' backs from October to February, varying according to location in Texas. Warbles may appear in July or early August in the Hill Country and Edwards Plateau and certain areas to the north and south. Variations in the pattern may occur within local areas of the state.

Importance and nature of damage. Some authorities feel cattle grubs cost the livestock industry \$100 million to \$300 million per year in the United States. Gadding results in loss of flesh and reduced milk production since the animals flee from flies and are unable to graze normally. The migration and parasitism of the grubs within the animal's body cause irritation and nutritional losses. Warbles in the back lower carcass values, and breathing holes in the skin reduce the hide's leather value.

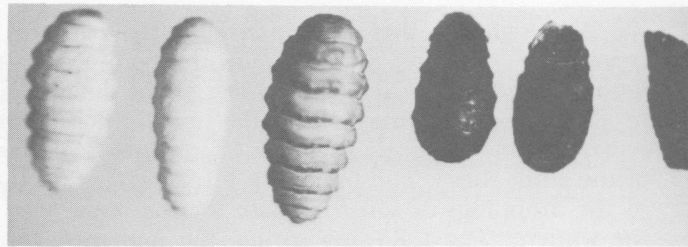
BLOOD-SUCKING FLIES

Horn Fly, *Haematobia irritans* (Linnaeus)

The horn fly is about half the size of the common house fly and about the same color. It appears early in the spring and builds up to peak populations during late summer and fall. It generally is a pest of cattle, but sheep, goats, dogs and sometimes horses are attacked. It has piercing-sucking mouthparts through which it obtains blood from the host.

Distribution and hosts. The horn fly was introduced into the United States from Europe, where it has been an important pest for many years. It was first recorded in 1887 in New Jersey. It then appeared in Maryland and Virginia and by 1892 was found from Canada to Texas and from Massachusetts to the Rocky Mountains. It was first reported in California in 1893 and in Hawaii in 1897. It is now generally distributed throughout the U. S.

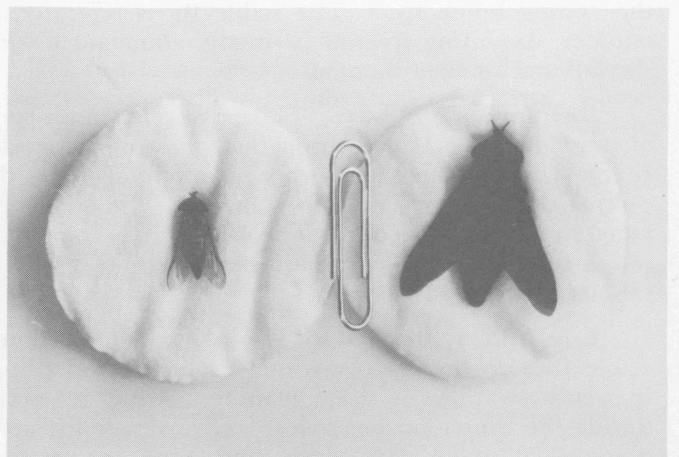
Life history and habits. Horn fly larvae develop only in fresh droppings of cattle. Females dart from the animals to fresh feces and deposit a few eggs on the surface. The manure apparently loses its attraction for egg-laying flies within 5 to 10 minutes after it has passed from the animal. The small brown eggs are difficult to see. Tiny maggots hatch in 1 to 2 days, feed in the dung and become full grown in 3 to 5 days. Pupae form inside



Cattle grubs and puparia.



A heavy infestation of horn flies.



Two common species of horse flies.

brown, seed-like puparia, either in the dung or in the soil, and flies emerge about a week later. The entire life cycle takes 10 to 14 days.

Although the flies feed intermittently, perhaps 20 times a day or more, they roost on the bodies of cattle both day and night. They often rest about the animals' heads, especially at the base of the horns. Populations remain abundant until the first frost which kills most of the adult flies. The immature forms, which are then in the droppings or soil hibernate for the remainder of the winter. The following spring, the immature forms develop to adult flies which emerge and begin the cycle anew.

Importance and nature of damage. The horn fly probably is one of the most serious pests of cattle. It pierces the skin to suck blood, causing pain and annoyance, and interferes with feeding, resting and other normal activities. Cattle lose weight, yield less milk, develop indigestion and may suffer other disorders. Cattle heavily attacked by these flies may lose up to $\frac{1}{2}$ pound flesh per day. Milk production may be reduced by 10 to 20 percent, and range animals literally "run themselves thin" trying to evade these pests. These flies usually remain on the host constantly except for egg laying.

Stable Fly, *Stomoxys calcitrans* (Linnaeus)

The stable fly often is mistaken for the common house fly; however, the common house fly is more robust, has a broader abdomen and non-piercing mouthparts. The stable fly is brownish-gray with a greenish-yellow sheen, a checked abdomen and piercing mouthparts. Although it is called the stable fly, it is found less abundantly in stables than is the common house fly. It may occur indoors during the fall and rainy seasons and will feed viciously on man. For this reason, it is often called the "biting house fly." The stable fly is typically an outdoor, day-biting fly and is usually abundant during the fall and summer months.

Distribution and hosts. This pest occurs in all parts of the United States and throughout most of the world. In the United States it appears most abundant in the central states from Texas to Canada. The stable fly attacks most warm-blooded animals, but it is commonly found on horses, mules, hogs, goats, dogs, cats, sheep, rabbits, rats and man.

Life history and habits. In the northern states, stable flies apparently overwinter as larvae and pupae in wet straw piles or dried manure. All stages occur during the winter further south. The average life cycle requires 20 to 60 days, depending upon temperature and other weather conditions. Females deposit 500 to 600 tiny, whitish eggs in four or five batches in moist straw, manure or other debris. Eggs hatch in 2 or 3 days and the larvae complete their development in the debris within 2 to 4 weeks and pupate. After 1 to 3

weeks in the pupal stage, adult flies emerge, seek a mate and begin to deposit eggs. Adults usually live to 4 weeks.

Importance and nature of damage. Where abundant, stable flies rank among the more troublesome pests of livestock. They annoy animals and interfere with their normal feeding activity. This results in loss of weight and blood, reduced gains and increased susceptibility to disease. Weakened animals cease to fight and subsequently are attacked by increased numbers of flies and other pests. The flies generally attack on the lower legs, and animals frequently stand in water for long periods to escape attack by these pests. This often results in swollen legs and joints. Milk flow may be reduced by 10 percent or more whenever these pests are moderately abundant.

Stable flies are of some importance in the mechanical transmission of several diseases such as anthrax, infectious anemia and anaplasmosis. In some areas, they are known to be vectors of several protozoan diseases such as trypanosomiasis.

Tabanids (Horse Flies and Deer Flies)

Members of this family are robust, measuring length from approximately $\frac{1}{3}$ inch for the smaller species to $\frac{3}{4}$ or $1\frac{1}{2}$ inches for the larger ones. They are various colors, but are usually gray, splattered with brown or black. They commonly are referred to as horse flies, deer flies, green heads or mango flies. About 300 species occur in North America.

Distribution and hosts. The family is distributed world wide and occurs from the low tropical areas to the world to the Arctic Circle. The largest numbers are found in Texas in the coastal and eastern sections of the state where breeding sites are more abundant. In addition to cattle, horse and deer flies feed on a wide variety of warm-blooded animals, including man. Cattle and horses probably suffer more from these pests than other domestic animals.

Life history and habits. The spindle-shaped eggs may be white, brown, or black and are deposited in characteristically-shaped masses on vegetation growing in or overhanging swampy areas, ponds or sewerage areas. Females deposit 180 to 1,000 eggs. Some species may oviposit on vegetation over decaying logs or concrete arches of bridges. The egg mass is usually covered with a mucilaginous substance that firmly cements the eggs together and to the structure on which they are placed. Length of time required for eggs to hatch is influenced by temperature and species, but under summer conditions, it is 4 to 7 days. When eggs hatch, larvae usually drop to the surface of the water or moist soil and quickly burrow into the mud, damp earth or decaying matter. Many species feed on organic matter while others are predators feeding on insect larvae, crustacea, snails, earthworms and other animal life. Some species are cannibalistic. The larval stages are usually in the

along marshes, flat creek banks, roadside ditches and irrigation overflow. Some occur only in rotting logs, decaying masses of leaves and even in vegetable fields. Time required for completion of larval development varies with the species and climatic conditions. Some species grow rapidly during the summer and autumn and slowly during the winter, requiring about a year for complete larval development. Other species may complete larval development in 48 days or less and produce two generations per year.

Mature larvae crawl to drier areas and pupate about 1 to 2 inches below the surface. The pupal period varies with temperature and species involved. Most species usually require 2 to 3 weeks, but the range is from 1 to 3 months. Females of most species are avid blood-suckers and begin searching for a host soon after emerging. Males feed on pollen and nectar. Horse flies are strong, swift fliers that like bright, sunshiny days when they may cover wide areas in search of a host. During the process of taking a blood meal, the mouthparts are inserted and withdrawn several times which increases the annoyance, loss of blood and danger of transmitting diseases.

Importance and nature of damage. Tabanids have broad, flat, blade-like mouthparts that inflict a rather large, deep and painful wound. The painful bite and "buzzing sound" the flies make while flying around animals may cause them to stop grazing and cluster together for protection. This activity causes weight loss and reduced milk flow, and the clustered animals often injure each other by hooking or kicking while they are close together for protection. Weight loss estimates have been as high as 100 pounds per animal during the season and estimates on reducing milk flow have been 20 to 30 percent.

Another important factor is the blood loss. In 6 hours, 20 or 30 flies can take almost a third of a pint of blood. Other estimates have been as high as a third of a quart where infestations were slightly more. These estimates do not include the large drop of blood that is usually left at the side of each bite.

Their intermittent feeding makes them ideal for the mechanical transmission of disease-causing pathogens. A fly interrupted during its feeding may pass readily to another animal so that both sick and healthy animals may be fed on in succession by the same fly. Anaplasmosis, anthrax, tularemia and several other diseases are known to be spread by these vicious blood-suckers.

Black Flies or Buffalo Gnats (Family Simuliidae)

Members of this family are small (1/25 to 1/5 inch in length) flies with varying colors of orange, brown and black. They are typically robust with an arched or humped prothorax; hence, the common name, buffalo gnats. They also are referred to as black flies. Of the

approximately 700 known species, only 14 have been recorded from Texas.

Distribution and hosts. This family is world wide in distribution, extending from the tropics to the Arctic Circle and to elevations of 9,000 feet. Collection records of the State Department of Health and other agencies indicate that buffalo gnats attack man and all classes of domestic and wild animals; others utilize domestic fowls and wild birds as hosts; still others feed only on cold-blooded animals. Most of the important species are not host specific. A given species may prefer a certain type of animal but will readily attack other animals.

Life history and habits. Each female deposits 150 to 500 creamy-white, shiny eggs that change to almost black before they hatch. The eggs usually are deposited in masses on some convenient object in or near the edge of flowing water. The water may be a slow-moving stream, but most species prefer rapidly flowing water and, in rare cases, they may oviposit in marshy areas. A few species also deposit their eggs singly. The time required for the eggs to hatch depends on species as well as temperature. In some cases, they hatch in 3 to 5 days; in other cases it takes as long as 30 days. In the northern and arctic areas, winter is usually passed in the egg stage. The larval stage is usually passed in shallow parts of flowing water. Larvae feed on small animals and plant materials, such as protozoa, crustacea and algae by straining this particulate matter from the water with the aid of "mouth brushes." Larvae are equipped with gill filaments which extract oxygen from the water. Consequently, they remain submerged or partially submerged and do not come to the surface as do mosquito larvae. Length of the larval stage, like the egg stage, varies with species and temperature. It may range from 10 to 14 days to 7 to 10 weeks. Some species overwinter as larvae.

The last larval instar spins a flimsy, reddish-brown, basket-like cocoon in which pupation takes place. These cocoons are attached to slightly submerged objects such as rocks, logs, roots and other debris. Pupae also have respiratory filaments by which they take oxygen directly from the water. The pupal period varies from 4 or 5 days to as long as 3 to 5 weeks, depending on water temperature and species.

Adults emerge from the pupal case, rise to the water's surface, unfold their wings and fly away. Mating usually occurs shortly after the initial flight. The complete life cycle, from egg to adult, varies from 60 days to 15 weeks and the number of generations per year ranges from one to six, depending on the species and the climatic conditions.

Importance and nature of damage. These small flies are vicious biters and serve as intermediate hosts for causal agents of diseases. There are numerous refer-

ences to animal losses along river basins in the United States as well as other countries. There have been several explosive outbreaks along the Mississippi River basin and its tributaries. Large numbers of cattle, horses, mules, hogs, turkeys, chickens, sheep, dogs and cats, as well as wild animals, were lost. During one such outbreak in the early 1920's more than 1,600 domestic animals were reported lost in Mississippi and eastern Arkansas. In the College Station area, turkey producers often suffer severe losses. The pests sometimes are quite active in the Austin area.

Animals may start to die within 4 hours after they are attacked by large numbers of buffalo gnats. Death usually occurs as a consequence of an acute toxemia, caused by a vast number of bites, or as a result of anaphylactic shock. Weakness caused by a heavy loss of blood, and suffocation brought about by inhalation of flies may also be attributing factors to animal loss. The most common disease in Texas transmitted by buffalo gnats appears to be leucocytozoon infection in turkeys. This disease, caused by a protozoan, is fatal to turkeys. A similar disease also occurs in ducks. In other parts of the world, these flies serve as intermediate hosts for several nematode parasites of man and some domestic animals.

Biting Midges (Family Ceratopogonidae)

Members of this family are small (1/25 to 1/5 inch long), slender gnats, known by such common names as punkies, no-see-ums and "sand flies." The term "sand flies" usually refers to other biting flies belonging to the dipterous family Psychodidae. The wings of biting midges may be clear or spotted and they are without the dense scales or hairs that occur on wings of mosquitoes and sand flies.

Distribution and hosts. Members of this family are widely distributed, but usually only build up to troublesome populations in coastal and isolated areas. Only a few of the 50 or more species comprising the family are blood suckers, and most of these attack a large variety of warm-blooded animals. All classes of livestock and poultry, as well as man, are included in the host list.

Life history and habits. Very little is known concerning the life history and habits of midges. Members of the genus *Culicoides* are considered the most important livestock pests. However, in certain localized areas, species of other genera also may become troublesome.

The number of eggs deposited, site of oviposition and length of time required for hatching varies with the species. Temperature is an important factor in determining the length of time required for hatching. Some species of *Culicoides* may deposit approximately 700 eggs. The hatching period varies from 2 to 12 or more days. Some species oviposit on the surface of mud and water while others deposit eggs in cracks in the soil.

Larval stages of *Culicoides* are usually found in mud, sand or debris at the edge of ponds, streams, lakes, creeks and in tree holes and under slime-covered bark. Concentrated breeding of *C. variipennis sonorensis* occurs frequently on Texas ranches around disposal systems for human sewerage or at the edge of stock tanks where manure is tromped into the soil. Larvae of some species develop as much as 15 to 30 inches below the soil surface and depend upon drying and cracking of soil for emergence. The larvae are small and worm-like and vary from almost transparent to orange, depending on the stage and species. The larval stage for *C. variipennis sonorensis* ranges from 15 to 23 days; some species in other genera normally require 8 to 10 months or longer. Those that depend on drying and cracking of the soil for emergence may develop slowly over a period of up to 2 years.

Pupae occur in the same habitat as the larvae. Many species, belonging to the genus *Culicoides*, float at the surface of the water and move with a clumsy, sluggish movement. Shortly before the adults are ready to emerge they crawl onto floating debris or to a comparatively quiet area of the water. The pupae of the species found in the soil usually wriggle to the surface before emergence.

As with many other Diptera, females are the blood suckers. Extremely aggressive, they may even crawl on feathers, hair or under clothing to get to a host. Wind and temperature appear to be the primary factors governing the activities of adults and they seldom bite in the presence of even small air currents. When the temperature drops to 55 degrees F., adult activity ceases. Animals with high body temperatures appear to be favored hosts and people performing hard labor outdoors are sometimes attacked en masse by these small, vicious pests. Inland breeding species in most localities produce two generations per year, but in the more southerly areas they may be active from March until September. Along the Gulf Coast they occur during the first month of the year.

Importance and nature of damage. The damage to cattle and horses caused by this group of small midges is not fully recognized. Most available information is concerned with damage to man and poultry. Several species are known to prefer animal blood to that of man.

In the United States, at least one species (*C. variipennis sonorensis*) has been incriminated in the transmission of blue tongue virus. This disease may cause severe losses in sheep. In cattle it is less intense. In other areas of the world, this insect transmits several diseases of cattle and horses, as well as other domestic animals and man.

Mosquitoes (Family Culicidae)

Mosquitoes are small, two-winged flies with mouthparts produced into a long proboscis, which is employed

for piercing and blood-sucking by the females of most species. Males do not suck blood. Males usually can be distinguished from females by their bushy antennae and by differences in the length or shape of palpi. Size of the different species varies considerably.

Distribution and hosts. Mosquitoes range from the equator almost to the poles and from sea level to at least 7,000 feet elevation. Mosquitoes attack all kinds of warm-blooded animals, especially domestic and wild animals and even such creatures as snakes and turtles.

Life history and habits. Although habits of different species vary greatly, all require water to produce their young. Female mosquitoes lay their eggs on water or in places that later become flooded. Eggs are elongated, about 1/40 inch long in most species and dark brown or black when ready to hatch. They usually are laid in clusters of 50 to 200, and several clusters may be laid by one female. In warm weather, eggs of most species hatch in 2 or 3 days. However, some species require a drying period. They may remain dormant for many months, then hatch within minutes after being flooded by a spring or summer rain, or a tide.

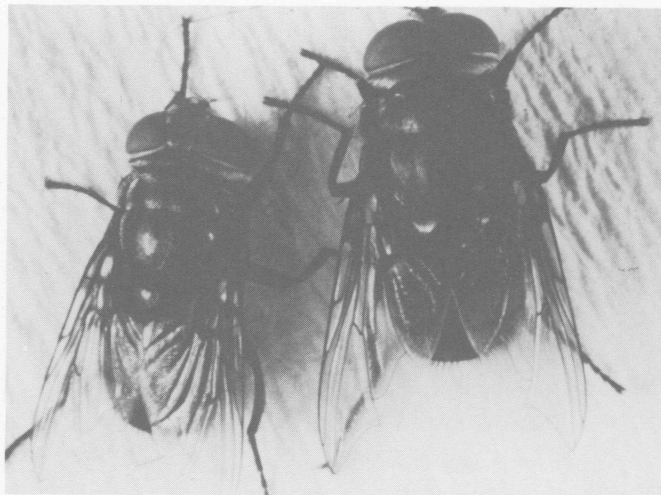
Larvae (wigglers) that hatch from eggs feed mainly on bits of organic matter in the water. Most species must come to the water's surface for air, and may have an elongated tube for breathing through surface film. Larvae usually change to pupae within a week. Pupae are comma-shaped forms, sometimes called "tumblers" because of their tumbling motion in water when disturbed. Pupae usually become adults in about 2 days. In another day or two, female adults are ready to feed.

Importance and nature of damage. In addition to the painful bites inflicted by females, these insects may cause devitalization and general unthriftiness in livestock. They also are carriers of several diseases including bird malaria and fowl pox in chickens, and sleeping sickness in horses. Several other diseases may be spread mechanically by their feeding habits.

SCREWORM, *Cochliomyia hominivorax* (Coquerel)

The screwworm fly is bluish-green, about twice as large as the house fly, has three black stripes on the back between the wings and a reddish-yellow head. The maggots are pinkish when they have completed feeding and are about ready to leave the wound. The screwworm maggot usually is distinguished from other common blowfly maggots by two dark parallel air tubes. In full-grown screwworm larvae, these air tubes are readily visible, whereas in other full-grown blowfly maggots they are more difficult to see.

Distribution and hosts. The screwworm exists only in the western hemisphere and, except for seasonal influxes from northern Mexico, now has been eradicated from the United States. However, it remains well established in Mexico and Central and South America, and



Screwworm flies. Left, male; right, female.



Screwworm larvae removed from wound.

continues to be a threat to Texas livestock producers because of the ease with which it could re-invade the state.

Any warm-blooded animal may be infested with screwworms, but they are more common in cattle, hogs, deer, sheep and goats. They have been known to infest practically all domestic animals, as well as man and poultry.

Life history and habits. The four stages of screwworm development are egg, larva, pupa and adult. Length of the developmental stages varies according to weather conditions. Under normal summer conditions, the female usually deposits about 1,000 eggs in white, shingle-like masses containing 100 to 250 eggs. She usually lays one large mass first and other smaller masses later. Eggs, firmly cemented together, are laid only upon dry skin near a wound or body opening. The eggs hatch in 10 to 12 hours under optimum conditions. With their sharp mouth hooks, the small maggots tear out pockets in healthy flesh adjacent to the wound soon after they hatch from eggs. Maggots feed with their heads in the flesh and with the posterior end exposed for breathing. In 5 to 7 days maggots become full-grown, then drop from the host and burrow into the soil $\frac{1}{2}$ to 1 inch to pupate. In warm weather, flies emerge 7 to 10 days later. After working their way to the top of the soil, flies begin looking for food and usually mate when they are 2 days old.

Importance and nature of damage. Presence of flies in the living body of man or other animal is referred to as "myiasis." While several species of flies, such as horse bots and cattle grubs, attack healthy animals, certain others such as the screwworm, parasitize animals only when there is a wound or diseased body opening to attract the egg-laying female. Such wounds as barbed wire cuts or scratches, blood spots where ticks or other flies have bitten the animals, peeling brands, sore eyes, dehorning and castrating attract the female fly. Wounds are prevented from healing, and the sickened animal hides away in the woods or brush, refuses to eat, and usually dies if not found and treated. The odor of an infested animal will attract additional flies to lay eggs and hundreds of maggots may produce a terrible sore. Other species, such as the secondary screwworm and blowflies, normally lay eggs on the carcasses of dead animals, but may also infest wounds already attacked by the screwworms. Number of larvae present and location of the wound determine how long the animal will live. If infestation is in the eyes or nasal passages or follows dehorning, meningitis frequently follows and kills the animal. Infestations about the navel of a newborn animal frequently result in peritonitis and death. In

addition to the destructive flesh-eating effect of the screwworm larvae on live animals, their activity also causes pronounced weight loss, anemia and alterations of body temperature.

Many of the more common causes of screwworm attack result from farm practices that can be corrected. Dehorning, castrating and branding should be timed so that the wounds will have minimum exposure to flies during the season of abundance.

HOUSE FLY, *Musca domestica* (Linnaeus)

The common house fly is present at one time or another everywhere. Its numbers generally represent 98 percent or more of the flies commonly collected from dwellings. It is so familiar that no description need be given in this publication.

Distribution and hosts. The house fly annoys practically all warm-blooded animals. It is associated with organic refuse, waste, garbage and other filth environments. Animal quarters are favorite habitats in which these pests breed in large numbers.

Life history and habits. This common pest has one of the shortest life cycles among insects. From 100 to 1,000 eggs are deposited at a time in two to seven batches. Each female averages 500 eggs during her life span. The entire life cycle from egg to adult may be completed in 6 to 20 days, and a new generation begins in 2 to 20 days more. The eggs hatch in 8 to 20 hours to larvae which require 5 to 14 days to complete development. Pupae develop into adults in 3 to 10 days; however, 2 $\frac{1}{2}$ to 3 days are generally required before the next egg batch is laid.

Most house flies prefer to deposit their eggs in animal manure. Larvae of house flies are believed to feed upon microorganisms causing fermentation and decay, and hence live only in moist masses of organic matter which are warm enough to promote the growth of these organisms. Feeding on this material, the maggot reaches $\frac{1}{3}$ to $\frac{1}{2}$ inch in a few days and then forms a seed-like, chestnut colored puparium from its third larval skin in which pupation takes place. Before forming the puparium, the larvae migrate to a drier part of the substance on which it has fed.

Importance and nature of damage. The primary importance of the house fly is the annoyance they cause animals, resulting in nervousness, restlessness and reduced feed intake and efficiency. House flies also are important carriers of more than 20 human and animal pathogens.