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2. The air temperature ranges within very narrow limits at the time of arrival of any given species of birds for any year in the St. Cloud area.

3. The species seem to arrive according to temperature rather than according to time.

4. Available food supply and snow cover, generally dependent on temperature are important factors in species arrival.

NOTES ON MINNESOTA TICKS *

WILLIAM A. RILEY
University of Minnesota

The classic studies of Smith and Kilbourne on the rôle of ticks in the transmission of the Texas fever of cattle led to the study of these overgrown mites in all parts of the world and each year sees additions to our knowledge of the species, their ecology, distribution and their medical and veterinary importance. There is ample opportunity for local workers to contribute important data regarding the ticks found in Minnesota and it is with the idea of stimulating interest in the group that these notes are presented.

Ticks belong to the superfamily *Ixodoidea*. Like mites in general, they have the head, thorax, and abdomen fused to form a sac-like body. The so-called "head", technically the *capitulum*, is really the fused mouth parts. In the family Ixodidae, the group to which most of our Minnesota species belong, this capitulum projects from the anterior end of the body but in the Argasidae it is ventral in position in the adult tick. The most characteristic feature of ticks is that the *hypostome*, or central portion of the mouth parts, is file-like, due to the presence of recurved teeth which served to attach the tick firmly to its host. Newly hatched larvae, or "seed ticks" are six-legged, while nymphs and adults are eight-legged.

We shall not enter into a discussion of tick morphology at this time, but in figures 2 and 3 the structures most used in taxonomic work are labeled.

Minnesotans in general are acquainted with only a single species, popularly called a "wood tick" which is so frequently encountered throughout spring and early summer. It is *Dermacentor variabilis* (figs. 1, 2, 3) the American dog-tick, which is not only found in most parts of the state but is widely distributed over the eastern and southeastern United States. The adult tick, emerging in Minnesota in early spring, attaches to dogs, wolves, cattle, horses and various large mammals, including man. The larvae, or so-called "seed ticks",

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are much smaller and feed chiefly on field mice and, to some extent, on other small rodents. It is thus a three host tick, engorging as a larva on an appropriate host, then dropping off and molting to become a nymph. The nymph, in turn seeks another small mammal, engorges and drops off to molt and transform into the sexually mature adult. The fully engorged female is over a hundred times the size of the unfed adult.

When the mature female drops to the ground, she seeks a hiding place and deposits several thousand eggs. These hatch in about a month. Under favorable conditions of temperature and with readily available hosts for each of the three active stages, the cycle from egg to egg may be completed in four months but probably it usually requires a full year or even two.

The American dog tick has been incriminated as a carrier of tularaemia, although human cases are contracted mainly from handling diseased rabbits or other infested animals. Like a related tick in the Northwest, our species is also capable of transmitting spotted fever of man. Fortunately cases of this disease are rare in Minnesota.

Less commonly seen than *variabilis* is the "winter tick" or "moose tick," *Dermacentor albipictus*, a species which infests deer, moose, elk, horses and cattle in the northern part of Minnesota. In gross appearance it closely resembles *Dermacentor variabilis* but is somewhat larger. It can most definitely be distinguished from *variabilis* by the fact that the oval spiracular plate is coarsely granular and lacks a dorsal prolongation. Biologically it differs in that it is a one-host tick, developing all of its stages on the one animal. As a result, infestations are often so heavy as to cause serious, and even fatal anemia, due to the amount of blood drawn from the host. There is no evidence that it carries a specific disease of moose, as is sometimes stated. Though the species is abundant in the northern part of the state, we have no records of its attacking man.

Under the name *Dermacentor nigrolineatus* there has long been known a tick morphologically indistinguishable from *albipictus* except in that it is inornate, or lacking in the silvery markings on the scutum. Dr. R. A. Cooley, the leading authority on the group, has shown that there are intergradations between this form and the typical *albipictus* and so regards them as of that species. Our specimens from cattle in Aitkin county are smaller than those from moose, a difference which might be due to development on different hosts.

The brown dog tick, *Rhipicephalus sanguineus* (fig. 5) is an importation from the South which has become established in some houses, boarding kennels, and dog hospitals in the Twin Cities, Rochester, and doubtless, many other places in the state. It is much smaller than the unfed adults of the American dog tick and is of a mahogany brown color, a fact which has frequently led to its identification popularly as a bedbug. Since it feeds on dogs in its imma-

ture as well as adult stages, it multiplies without some of the hazards which beset most ticks, with a result that a general household infestation often becomes thoroughly established before the source is recognized. When not feeding, the ticks in all stages hide, like bedbugs, in cracks and crevices of furniture, behind baseboards, windows and door casings and similar places. Fortunately, the species does not attack man, except in very rare instances. In the case of dogs they are known to serve as carriers of a protozoal parasite causing malignant jaundice, but no cases of this disease have been reported in the North.

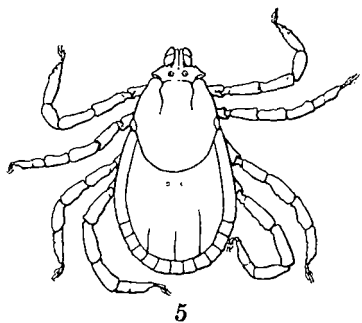
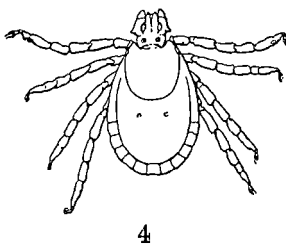
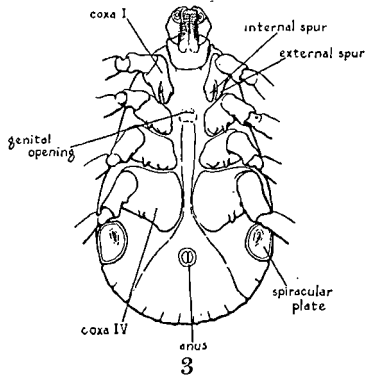
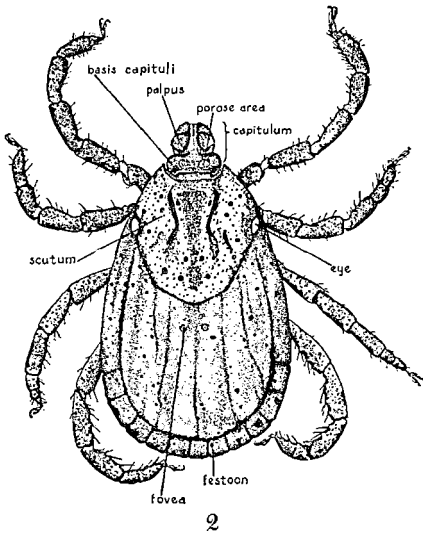
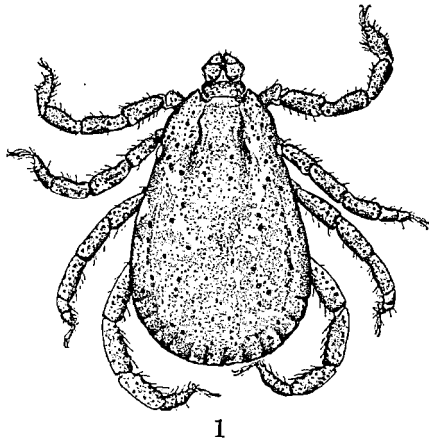
The rabbit tick, *Haemaphysalis leporis-palustris* (fig. 4) is the most common, widely distributed parasite of these animals. In the larval and nymphal stages it also attacks ground birds, such as pheasants, grouse and, occasionally, turkeys. The adult tick is only about half the size of the unengorged adult American dog tick but it often occurs in enormous numbers, causing death of its host through direct attacks. The investigations of Dr. R. G. Green have emphasized the still more significant role which it plays in maintaining tularaemia, through passing from diseased to healthy animals in the course of its development. *Haemaphysalis chordeilis* (= *cinnabarina*) is a closely related species sometimes infesting game birds and young turkeys in Minnesota. Most of our records are of pinnated grouse from the northwestern part of the state.

Ixodes hexagonus var. *cookei* has been taken in Minnesota from pocket gopher, striped gopher, skunk, weasel, dog and robin. Undoubtedly other species of the genus, not represented in the University collections, occur in the state.

To the present time only one species of Argasid tick has been reported for Minnesota. Until recently this has been regarded as *Ornithodoros talaje* a tick common in the southwestern United States and Central America. There was evidence to indicate that it was accidentally introduced into Minnesota, and certain other northern states in picking material from its normal habitats. Our records indicated that the species was established in homes in Lake City, Red Wing, Le Sueur, Elysian and Rushford. At my request, Arnold Erickson attempted to feed adult females on white rats and on bats. One specimen engorged on a bat and thirty days later began egg-laying. It was a month more before the young seed ticks emerged and were sent to Dr. Cooley, who is making a special study of the *Ornithodoros* ticks of North America. On the basis of these studies of material from various parts of the country, he and Glen Kohls have described a new species of bat tick, *Ornithodoros kelleyi*. It is very probable that all of the records of *O. talaje* in the North relate to this species. The Minnesota infestations which we have studied were associated with attic infestations by bats. Little attention has been paid to bat ticks in this region, although they offer some interesting problems.

Avoidance and Control of Ticks.—Of the ticks occurring in

Representative Minnesota ticks, drawn to scale (X10). 1, Male American dog tick, dorsal view; 2, Female of same; 3, Male of same, ventral view; 4, Female rabbit tick; 5, Female brown dog tick.



Minnesota the only species of interest to man because of its possibilities as a direct carrier of human infections is the American dog tick. This species is capable of transmitting both tularaemia, the so-called rabbit disease, and spotted fever. The chances of transmission of either of these infections is too remote to justify any tick phobia but nevertheless it is the part of wisdom for a person exposed to the attacks of the tick to examine his body and clothing carefully and remove and destroy any ticks found on return to the house. A favorite site is in the hair of the scalp and base of the skull. Particular attention should be paid to children in infested regions.

During the tick season dogs should be examined at frequent intervals and their ticks removed and destroyed before they drop off, engorged, to lay their thousands of eggs. Bathing the animal every five or six days in a derris solution made by dissolving an ounce of soap in a gallon of water and adding two to four ounces of derris powder with a rotenone content of four or five per cent is recommended by the Federal Bureau of Entomology. The derris can also be applied in powder form.

Extermination of the brown dog tick in case of household infestations is a difficult matter for it is very resistant to ordinary fumigations. Persistent use of derris powder puffed into the hiding places of the ticks or of pyrethrum-kerosene household fly sprays forced into the hiding places is the most feasible measure.

Destruction of ticks in the wild is not feasible but about homes clearing of brush, weeds and high grass will tend to reduce the numbers of American dog ticks by making conditions unfavorable for their wild animal hosts.

Identification of ticks.—In so far as time permits the writer will be glad to identify Minnesota ticks, if accompanied by data as to host, locality and date of capture. They may be sent alive, or dropped into 10 per cent formalin (1 part of commercial formalin to 9 parts of water), or in alcohol.

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DISTRIBUTION AND GROWTH OF CLAMS IN THE MISSISSIPPI RIVER ABOVE MINNEAPOLIS

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ABSTRACT

In the rivers and lakes of Minnesota are found 43 species of clams, but in the Mississippi drainage above Minneapolis, only eight species are found. These are: *Anodontooides ferussacianus* and *Lasmigona compressa*, found in the headwaters, *Anodonta grandis*, more common in the tributaries than in the river itself, *Actinonaias*