1888

Experiments with fungicides

L. H. Pammel
Iowa State College

Follow this and additional works at: http://lib.dr.iastate.edu/bulletin

Part of the Agriculture Commons, Botany Commons, and the Plant Pathology Commons

Recommended Citation
Available at: http://lib.dr.iastate.edu/bulletin/vol2/iss16/6

This Article is brought to you for free and open access by the Iowa Agricultural and Home Economics Experiment Station Publications at Iowa State University Digital Repository. It has been accepted for inclusion in Bulletin (Iowa Agricultural Experiment Station) by an authorized editor of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
EXPERIMENTS WITH FUNGICIDES.

BY L. H. PAMMEL.

CORN SMUT.*

It is the general accepted opinion among botanists, that corn smut (*Ustilago Maydis*) enters the tissues of its host during the early stages of the growth of corn. These opinions are based on the careful experiments of Dr. Julius Kuehn, a German botanist.†

Last spring some experiments were started on the College Farm with a view of preventing this troublesome disease. It was expected, of course, that the results at the close of the season would show a decided advantage when seed corn was treated, but to my surprise, the results were entirely negative. In the meantime a bulletin was received from Prof. Kellerman in which the results of his experiments with corn smut are given.‡

Prof. Kellerman says that "Farther investigation is necessary in order to determine the mode of infection—a point that must be settled before we can hope to employ rational methods for the prevention of this annoying and destructive pest."

In our experiments the tests were confined to the field. It will not be necessary in this connection to give details. In one case a plat of ground was selected which had been in grass for several years, so the soil was favorable for the experiment. It ought to have had less smut than soil which had corn the previous year.

Although the weather was unfavorable, a good share of the corn planted on May 7, germinated, though the stand was greatly injured by ground squirrels. It was replanted on

---

*Abstract of paper read before the Iowa Academy of Sciences, December, 1891.
†Botanische Zeitung, Vol. XXXII, p. 122.
‡Bulletin No. 23, Kansas State Agricultural College Experiment Station, August, 1891. Manhattan.
**Figure I.—Corn Smut (Ustilago maydis).**

Figure 1. Threads of the fungus (*mycelium*) passing through and between the cells of the corn plant. Fig. 2. Spores in process of formation. The spiny spores are shown at Fig. 3; each spore is sending out a tube with small lateral bodies. Fig. 4. The lateral bodies budding in the manner of yeast. Figs. 3 and 4 after Brefeld. 1 and 2 after Tulasne, Seymour's paper Department of Agriculture Report, 1887
June 1. Treatment of first lot. Vessel I, 44—46° centigrade. Vessel II, 53—55° centigrade. In this case exact time was not kept, but it was about five minutes. Second planting was subjected to hot water treatment between 50—56° for ten minutes. Most of the time between 53—55° centigrade.

**Plat I. a.** TREATED. HOT WATER.

<table>
<thead>
<tr>
<th>Total number of smut boils.</th>
<th>Leaf</th>
<th>Staminate ears.</th>
<th>Staminate</th>
<th>Stalk</th>
<th>Ear.</th>
<th>Corn planted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td>5—7—'91</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6—1—'91</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hickory King.</td>
<td></td>
</tr>
</tbody>
</table>

**Plat I. b.** NOT TREATED.

<table>
<thead>
<tr>
<th>Total number of smut boils.</th>
<th>Leaf</th>
<th>Staminate ears.</th>
<th>Staminate</th>
<th>Stalk</th>
<th>Ear.</th>
<th>Corn planted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5—7—'91</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6—1—'91</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hickory King.</td>
<td></td>
</tr>
</tbody>
</table>

Plat II.—The second lot was planted on the same kind of soil. This also had been in grass for some years. Two vessels were provided with hot water. Vessel 1 treated for five minutes, at an average of 43.5° centigrade. The seed was kept in vessel No. 2, at an average of 56.5° centigrade. The stand was uneven owing to ground squirrels.
### Plat II. a. TREATED. HOT WATER.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5—7—'91 Hickory King</td>
</tr>
</tbody>
</table>

### Plat II. b. NOT TREATED.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>5—7—'91 Hickory King</td>
</tr>
</tbody>
</table>

Plat III.—One row across a twenty acre field. This field was in corn previous year. Seed corn rolled in with smut spores. Sample a treated with hot water five minutes, at 58° centigrade. Sample b not treated.

### Plat III. a. TREATED. HOT WATER.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>31</td>
<td>2</td>
<td>5—7—'91</td>
<td>Yellow Dent</td>
</tr>
</tbody>
</table>

### Plat III. b. NOT TREATED.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>3</td>
<td>9</td>
<td>2</td>
<td>21</td>
<td>3</td>
<td>5—10—'91</td>
<td>Yellow Dent</td>
</tr>
</tbody>
</table>
Plat VII was planted in the same field as Plat III, soil was lighter, otherwise the conditions were the same. Seed of sample a was treated with ammoniacal carbonate of copper.

Ammonia ................................................................. 1 quart.
Carbonate of copper ................................................ 3 ounces.
Water ......................................................................... 22 gallons.

To 25 c c of this solution there was added enough water to make 1,000 c c. The seed remained in this solution one hour.

Plat VII. a. TREATED WITH AMMONIACAL CARBONATE OF COPPER.

<table>
<thead>
<tr>
<th>Total number of smut boils.</th>
<th>Leaf</th>
<th>Staminate</th>
<th>Stalk</th>
<th>Staminate ears</th>
<th>Ears</th>
<th>Variety of corn</th>
<th>Time of planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>2</td>
<td>1</td>
<td>21</td>
<td>3</td>
<td>2</td>
<td>Yellow Dent</td>
<td>5—13—'91</td>
</tr>
</tbody>
</table>

Plat VII. b. NOT TREATED.

<table>
<thead>
<tr>
<th>Total number of smut boils.</th>
<th>Leaf</th>
<th>Staminate</th>
<th>Stalk</th>
<th>Staminate ears</th>
<th>Ears</th>
<th>Variety of corn</th>
<th>Time of planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>1</td>
<td>1</td>
<td>20</td>
<td>10</td>
<td>Yellow Dent</td>
<td>5—13—'91</td>
<td></td>
</tr>
</tbody>
</table>

The results of some of the other treated plats are as follows:

Plat IV. Sample a, hot water. Total number of smutted plants, 48, against 51 sample b, not treated.

Plat V. Sample a, hot water, 61° centigrade, ten minutes. Both samples dusted with smut spores.

Total number of smutted plants, sample a ....................... 43
Total number of smutted plants, sample b ....................... 49

Plat VI. Sample a, treated with ammoniacal carbonate of copper solution as Plat VII, using 25 c c of the solution, ad-
Ding enough water to bring it up to 500 c c, a little less than a quart.

Total number of smutted plants, sample a.................................. 17
Total number of smutted plants, sample b.................................. 20

Plat VIII. Sample a, treated with copper sulphate.

Total number of smutted ears in sample a.................................. 25
Total number of smutted ears in sample b.................................. 21

At the suggestion of Prof. Kent plat IX, sample a was treated with pure North Carolina tar—corn rolled in with tar and placed over an open water bath. It was then carefully dried. Corn failed to germinate well, being less than one-sixth of a stand. Failure to germinate may be due to the heat applied in placing it over the bath or that tarred corn did not allow the moisture to enter. The latter, Prof. Kent thought, might be the probable cause of failure. Even this treatment did not prevent smut.

In no case was smut entirely absent when treated with hot water. The experiments sometimes show a gain in favor of treatment and sometimes a loss. With ammoniacal carbonate of copper it is in favor of the treated; with copper sulphate just the other way. All of the plats, with the exception of I and II, were unfavorable for the experiment, as they were in corn last year, and so the soil must have been full of smut spores. In plats I and II the results are not decisive.

It may be interesting to know just in what part of the stalk smut commonly appears, since in our plats more stalks than ears and leaves are affected. In plat V it appeared on the following nodes or joints, counting from the ground. Not treated row, 1, 5, 1, 3, 2 (1 and 3), 3, 2 (2 and 3), 3, 5, 2 (2 and 3), 8, 5, 4, 4 (6 and 7), 5, 4, 2, 1, 4, 5, 3, 1. Twenty-two of the stalks were smutted below the fourth node. Eighteen below the third node. In the treated row, 1, 4, 6, 3, 1 (2, 3 and 4), 3, 5, 1, 5, 2, 4, 2 (6, 7 and 8), 1, 2, 2, 2, 1, 3, 4, 3 (2 and 1), (5 and 6). Twenty-three were smutted below the fourth node, nineteen below the third node, out of a total of thirty-one. In plat IV, out of a total of 35, smut boils in not treated row, thirty-two were below the fourth node, twenty-six below the third node. In treated row, nineteen smut boils appeared below the fourth node, and fourteen be-
low the third. All the other plats ran in about the same way. This, with tables on appearance of smut, shows plainly that stalks are smutted more than ears, and also that it appears most commonly in the lower part of the stalk. It would be interesting to know whether injury or some other condition of the plant causes smut to appear at these points.

ARE COPPER SALTS INJURIOUS?

There is a widespread belief that copper salts may prove injurious to the root-systems of plants. To determine in how far they might be injurious, if at all, some experiments were made in the College green-house with the following fungicides in three different strengths, ammoniacal carbonate of copper, Bordeaux mixture, eau celeste, modified eau celeste, and ferrous sulphate. The ground was divided off in lots of 25 feet each, with the exception of one of the two checks. This made 17 lots planted with Capital corn at two different times. The ammoniacal carbonate of copper series was planted first. Before planting, the soil was thoroughly pulverized, and to each lot of the whole series there was added 500 cc of the fungicide, evenly distributed and mixed with the soil. It was planted with corn the following day.

SERIES I. CORN PLANTED DECEMBER 3, 1891.

Lot I. Ammoniacal carbonate of copper.

| Ammonia | 1 pint |
| Carbonate of copper | 1½ ounces |
| Water | 22 gallons |

Lot II. Double the strength of lot I.

Lot III. Double the strength of lot II.

Lot IV, check. In all of these, with the exception of lot IV, germination was somewhat retarded, though the actual percentage of germination in all but III, the lot with greatest amount of the fungicide, was not much lower than check. Lot III had in fact a higher percentage of germination, but in growth and root development there is a marked difference. The roots were very materially injured in all but check. In check, roots branched well, were vigorous and had an abundance of soil clinging to them. The roots of lot II were especially poor.
Few of the plants produced good roots, they were all checked and dwarfed. The tips of new roots coming out from the stem were invariably brown. The other roots were also brown in many cases. In the check, there was in no instance any browning. This lot was alongside of lot III.

**Germination.** *Lot IV* (check). December 2, 7 germinated; 3, 21; 4, 32; 5, 46; 7, 70; 10, 110; 14, 144; January 6, 1892, 157. In different periods the percentage of germination was as follows: December 5, lot I, 10.66; lot II, 4.24; lot III, 0; lot IV, 26.28. December 14: lot I, 78; lot II, 60; lot III, 20.66; lot IV, 82.28. January 6: lot I, 89; lot II, 98.18; lot III, 52.66; lot IV, 93.71. This plainly shows that rapidity of germination was in favor of lot IV, soil not treated. Lot I germinated well and lot II excellent, showing a higher percentage than IV. In lot III, where the solution was twice as strong as in lot II, germination was low. The greatest difference appeared in other directions, especially in growth and root development.

**Growth.** *Lot IV.* Growth started uniformly, and the plants had a healthy, vigorous look. 124 of these plants had three leaves, 6 with two leaves and less. The average height was 6.6, measuring from the ground to the tip of the longest leaf on the stalk.

*Lot I.* 183 with three leaves, 68 with two leaves and less. Average height, measured as in last case, 4.27 inches.

*Lot III.* 12 with three leaves, 67 with two leaves and less. Average height was 4.4.

*Lot II.* 36 with three leaves, 126 with two leaves. Average height, 4.25 inches.

**Root System.** *Lot IV.* Excellent root system, numerous small roots, branching freely. Roots well covered with soil.

*Lot I.* Roots not branching well, and much inferior to those of check. Parts of roots and of stem near seed brown, many of the second set of roots brown.

*Lot II.* Root system poorly developed; roots in many cases brown; scarcely any branching. Tips of second set of roots brown, as well as stem close to kernel. Little soil clinging to roots.
Lot III. No production of roots in many cases. Where the roots have developed they are weak, showing numerous brown corroded spots. Many "seeds" rotting in the ground.

Series II. Corn Planted December 2, With 100 Kernels to Each Lot.

Lot I. Bordeaux mixture.

Sulphate of copper ........................................ 6 ounces.
Slaked lime .................................................. 4 pounds.
Water ......................................................... 22 gallons.

Lot II. One-half the strength of lot I, lot III double the strength of I.

The difference between the treated soils and check is not marked. The germination was rather low, but this was probably the fault of the seed corn used. January 16, 1892, most of the plants in check, as well as treated lots, had three leaves. Root system and growth excellent, with an occasional injured root in the treated.

Lot I. Eau celeste.

Sulphate of copper ........................................ 1 pound.
Ammonia ..................................................... 1 1/2 pints.
Water ......................................................... 24 gallons.

Lot II. One-half the strength of lot I.

Lot III. One-fourth the strength of lot I.

Germination in all lots irregular. Lot I had a higher percentage than the others. An occasional root was injured in all. On the whole the growth was excellent and the root system well developed. Most of the plants had three leaves.

Lot I. Modified eau celeste.

Sulphate of copper ........................................ 4 pounds.
Ammonia ..................................................... 3 pints.
Carbonate of soda ........................................ 5 pounds.
Water ......................................................... 24 gallons.

Lot II. One-half the strength of lot I.

Lot III. One-fourth the strength of lot I.

Germination was better than in any of the others. January 16: Lot I, 73 per cent; lot II, 77; lot III, 82; check, 43.33.
The plants had a healthy look and made a good growth. Most of the plants had three leaves, with an excellent root system.

Lot I. Ferrous sulphate.

Six grammes of ferrous sulphate in one liter of water.

Lot II. Double the strength of lot I.

Lot III. One-half the strength of lot I.

Germination. January 16: Lot I, 31 per cent; lot II, 40 per cent; lot III, 70 per cent. Plants made an excellent growth, and looked healthy and vigorous. Most of them had three leaves. The root system was well developed; an occasional root injured.

Conclusions. Unfortunately only one trial can here be recorded, since the second planting on the same lots was almost totally destroyed by an unfortunate accident. Yet in those treated with ammoniacal carbonate of copper, the injury to the roots was most marked. In some cases, in the strength used, it prevented the development of roots. With the other substances there was scarcely any difference. Failure in germination was probably due to other causes.

In this work, as well as some of the other experiments, I desire to acknowledge the assistance of my former assistant, Prof. P. H. Rolfs, now of the Florida Experiment Station, and my present assistant, Mr. F. C. Stewart.

Experiments in Preventing Rust of Wheat.

Rust of wheat in Iowa is due to two species of parasitic fungi, \((Puccinia graminis)\) and \((Puccinia rubigo-vera)\). For the benefit of those readers who are not familiar with the life history of rust a short account may not be out of place. Common Grass-rust \((Puccinia graminis)\) occurs on various grasses, especially Red Top \((Agrostis alba var. vulgaris)\), Quack Grass \((Agropyrum repens)\), Colorado Blue Stem \((Agropyrum glaucum)\), very common on oats, and less common on wheat. The first thing to attract the attention of the farmer is reddish spots on the stem and leaf, about the middle of June. These are the pustules of the fungus, and contain the
summer or uredo-spores. These germinate immediately, and during warm, moist weather spread rapidly from plant to plant. When wheat or oats is ripening these are replaced by blackish or brownish pustules. The latter contain the resting spores known as teleuto-spores. The teleuto-spores are two-celled and do not germinate till the following spring. Each cell then produces a tube that bears small lateral spore-like bodies, the sporidia. When these fall on the Barberry leaf they produce a small tube which enters the plant through the epidermal cells. Soon there is produced an abundant mycelium, the vegetative threads of the fungus. Later there appear flask-shaped bodies on the upper surface of the leaf, and directly opposite and somewhat later, small, cup-shaped affairs known as aecidia. These cups contain a large number of one-celled spores that germinate immediately. When these spores come in contact with a grass leaf or sheath, a branched mycelium is produced on the surface. These germ tubes find their way into the grass leaf by way of the stomata. In a short time red rust appears.

The uredo-stage was observed about Ames a little earlier than June 15. Some time after the cluster cups were discharging their spores. As uredo-spores germinate immediately it is not hard to understand how a single infected wheat or oats plant early in the season can spread the disease rapidly, provided, of course, that the conditions are favorable, such as rainy, hot and sultry weather. According to Prof. H. L. Bolley, the mycelium of *Puccinia rubigo-vera*, the destructive wheat fungus in Iowa, is perennial in the tissues of wheat in Indiana, in other words, wheat sown in the fall often shows uredo-sori which winter over with the wheat.

The admirable researches of DeBary have shown that the Cluster Cup Fungus on Barberry and *Puccinia graminis* are stages of the same fungus. It is well known that rust was abundant in Iowa and other Western states before Barberry was cultivated. Where, then, did rust come from? In places a red rust appears on Blue Grass that has been referred to this species. At Ames this has appeared early in June. According to DeBary, however, the mycelium of this rust is not perennial in the tissues of grasses. Frank who examined the
tissues of Quack Grass (*Agropyrum repens*) failed to find that the mycelium was perennial. It is possible that the mycelium may be perennial in some grass. It is not improbable, however, that in warmer latitudes this rust is produced during the entire season, and on the approach of warm weather in spring, when grasses and cereals come out, there may be a gradual extension northward. No published accounts have been made in this country to see whether this is a fact. I understand Prof. Bolley, of the North Dakota Experiment Station, is working on this problem.

The first warm days in spring cause a rapid spreading of the disease. It is well known that some varieties of wheat and oats rust much worse than others. No variety is entirely exempt. Generally speaking the grains did not rust severely on the College Farm this year. One variety of oats, Texas Rust Proof, was so severely rusted that the crop was light, yet other varieties in close proximity to it were not affected nearly so much.

When my experiments were undertaken I was not aware that experiments were being made to treat rust. In a recent bulletin, Prof. Kellerman* reports on some experiments made this season in the treatment of rust on wheat, oats and barley. The following is a brief summary of the results of Prof. Kellerman's experiments at Manhattan, Kansas: Spraying was begun on April 21 when the plants were from two to three inches high. The fungicides used were sulphur, potassium sulphide, chloride of lime and Bordeaux mixture. Spraying was done usually every eight days. Rains were numerous and abundant so that frequent applications were made. Prof. Kellerman's results were entirely negative.

Mr. Bjergaard† claims that hot water will prevent rust of barley. He states that it can be prevented by immersing the seed in hot water at 123° F. having previously immersed in cold water for four hours. This treatment in my opinion will need considerable more experimental proof before it can be recommended.

In the experiments on the College Farm two fungicides were used, ammoniacal carbonate of copper and Bordeaux

---

Fig. 2.—Puccinia graminis, Pers. A, young cluster cup fungus (Æcidium), underneath the epidermis, u, of bärberry leaf. I, section through an older leaf, flask-shaped bodies (spermogonia) shown at sp; the æcidia and spores in chains at a; p, cells lining æcidia (peridial cells, these do not germinate). Æcidia occur on lower surface of leaf. II, t, ripe “winter,” “resting,” or telutospores at e, epidermis. III, t, telutospore and uredospores ur. (After DeBary, Comparative Morphology, Biology, &c.)
Fig. 3.—*Puccinia graminis*; A, "winter" or teleutospore; t, germinating. B, germ-tube (*promycelium*) with lateral sporidia *sp*. C, epidermis of under surface of leaf of barberry showing crescent shaped cells of the stoma and the germinating sporidium *sp* at *i* penetrating the epidermis. D, uredospore germinating after being in water fourteen hours. E, *Puccinia rubigo-vera*, the upper cell has germinated, C, D, E magnified 390 times, the others somewhat more. (After DeBary.) F, *Puccinia graminis*, Pers.; both cells have germinated; a as sporidium germinating, magnified 600 times. (After Bolley.) G, *Puccinia coronata*, Cda.; telutospores of rust on leaves of oats, magnified about 600 times. (After Bolley.)
mixture; same formulae as given under treatment of cherry diseases.

Winter Wheat—Ammoniacal Carbonate of Copper.—The first application was made on May 23, followed by others on June 6 and 20. During my absence, my assistant, Mr. Rolfs, did the spraying and made the following notes concerning the weather and the condition of rust: On June 20 still traces of spraying of June 6. The same for June 28, 30, July 3. It rained on June 6, 21, 25, and 28. The applications were always made after the rain. On July 4 heads began to turn yellow. Much rusted, especially the upper leaves. No stalks free from rust. The check was in no worse condition than the treated. The plat treated with carbonate of copper rusted worse than that treated with Bordeaux mixture. On July 8, after my return, the following notes were made: The leaves of the treated are not so badly rusted as those of the check, though the sheath and stem are badly rusted.

Winter Wheat—Bordeaux Mixture.—Applications were made as follows: May 30, June 9 and 20. Notes made by Mr. Rolfs indicate that there were abundant traces of the mixture on the leaves on June 20, 25 and 28. On July 3 heads began to turn yellow, July 4 no difference between the sprayed and checks.

Conclusion and comments.—Only three applications were made at intervals of less than two weeks. Observations made, indicated abundant traces of the mixtures from previous applications, especially of the Bordeaux mixture. It is not improbable, therefore, that this rust (*Puccinia rubigo-vera*) entered the tissues before and during the intervals of treatment. Applications of the fungicide were entirely useless. In neither case were determinations of weight of straw and grain in checks and treated made.
LIGE AFFECTING DOMESTIC ANIMALS

HERBERT OSBORN.

The following pages on some of the parasites that affect our domestic animals are extracted with but slight alteration from the writer’s paper* published by the Division of Entomology U. S. Dept. of Agriculture, and we desire here to acknowledge the kindness of the Department officers in allowing the use of the cuts which accompany it.

It is needless to speak of the importance of the subject or to present any apology for devoting space to its consideration. The keeping of live stock for work, dairy, and meat or wool production is one of the most important industries in the state and the injuries of parasitic insects often assume important proportions. While only a few species are treated in the present paper they are such as require frequent attention.

The common lice of our domestic animals belong to two quite distinct groups of insects, and may be called for convenience the Suctorial lice (which form the family Pediculidae) and the Biting or Running lice, which do not penetrate the skin to suck blood, but feed upon the epidermal scales, hairs, feathers, etc. (which are included in the family Mallophagidae).

THE SUCTORIAL LICE.

In these there is a tubular mouth capable of being thrust into the skin to draw blood. The feet are adapted to clasping hairs and the insects are poorly adapted for locomotion except in the hairy covering of animals.

The eggs, “nits,” are attached to hairs by a glue-like substance, and the young lice when hatched resemble the adults except in size. As the entire life of the parasite is passed upon the same animal or another animal of the same kind, its range of habit is easily stated.

But very few of the species are ever found upon any other species of animal than that which they normally infest, and if so always upon very nearly related species. Whether this is due to differences in the skin, of temperature, of the size of the hair to which they must adhere and to which their feet are adapted, or to some subtle difference in the odor or taste peculiar to their particular host which leads them to discard all others, we are unable to say.

The mouth parts are necessarily capable of great extension in order to reach the blood of their hosts. Uhler says (Standard Nat. Hist., ii, p. 209): "A fleshy unjointed rostrum, capable of great extension by being rolled inside out, this action serving to bring forward a chaplet of barbs which imbed themselves in the skin to give a firm hold for the penetrating bristles, arranged as chitinous strips in a long, slender, flexible tube, terminated by four very minute lobes which probe to the capillary vessels of a sweat pore (see Fig. 1). The blood being once reached a current is maintained by the pulsations of the pumping ventricle and the peristaltic movements of the stomach."

**The Sucking Dog-Louse.** (Plate I, Fig. 2.)

(*Hæmatopinus piliferus* Burmeister.)

Although the dog has been the closest companion of man among the domestic animals from very early times, and consequently this parasite in all probability well known to keepers of dogs, it was not technically described until about the year 1838.
It does not appear to have been a very numerous or injurious parasite, apparently much less so than the *Trichodectes latus* infesting the same animal, and less annoying than either ticks or fleas. Denny says (Monog. Anop. Brit., p. 29), "I have found it upon dogs two or three times, but it is by no means of common occurrence." We have examined many dogs in quest of it, but only a single specimen has so far been our reward. Denny says (loc. cit.), "I also received specimens from the ferret." It can hardly be inferred, however, that this animal is a normal host for the species, as such an instance might occur entirely from accident, the louse having been transferred from some dog to a ferret associated with it.

This species is somewhat smaller than the lice infesting most of the larger mammals, the full-grown individuals being nearly one-tenth of an inch long. It is described generally as of a light-red or ashy flesh color, but evidently varies as the other species, according to condition of the body as well as age of specimens. In preserved specimens these colors become lighter, assuming a yellowish hue, the abdomen, except where darkened by the intestine and its contents, appearing a shade lighter than the front part of the body. The abdomen is thickly covered with fine hairs and minute warty eminences, these latter when magnified about 300 diameters appearing like the scales of a lizard or fish.

Specimens from different breeds of dogs do not appear to have been noticed as different, though a form described as *H. bicolor* by Lucas may perhaps be found to present race characteristics.

**The Short-Nosed Ox-Louse.** (Plate I, Fig. 1.)

(*Hæmatopinus eurysternus*, Nitzsch.)

This is the species that has probably been familiar from early time as the louse infesting cattle, though since this species and the following one have been generally confused, it is impossible to say which has been most common. It was first accurately described by Nitzsch under the name of *Pediculus eurysternus*, in 1818 (Germar's Mag., vol. III, p. 305), and has received mention in every important treatise on parasites.
since that date, as well as innumerable notices under the head of animal parasites, cattle lice, etc. As with other species, the disease produced has been termed phthiriasis, and as treated by Kollar and other writers it has been recognized as a most serious pest and numerous remedies tried for its suppression.

Since it has been very generally confused with the following species we shall give more particular description and show as clearly as possible how to distinguish them. The following quotation from Mr. C. W. Tenney (in Iowa Home-stead for August 18, 1882) will show that this difference is not without interest or value as viewed by a practical breeder: "Then there is a blue slate-colored louse and a larger one of the same color that vary somewhat in their habits, and the last-mentioned is the hardest to dislodge." Evidently it is the species under discussion to which Mr. Tenney refers as the "larger one." It infests particularly the neck and shoulders, and these parts are frequently worn bare by the efforts of the animal to rid itself of the irritation produced by these unwelcome visitors. Still, some cattlemen say that these parasites are of no consequence, and that they never pay any attention to them.

The full-grown females are about one-eighth to one-fifth of an inch long, and fully half that in width, while the males are a little smaller and proportionately a little narrower. Aside from the difference in size the sexes differ very decidedly in the markings and structural features on the under side of the body. The males have a broad black stripe running forward from the end of the body to near the middle of the abdomen, as shown in Fig. 1 c (Plate I).

The females have no indication of this stripe, but the black broken band of the upper side of the terminal segment extends slightly around on the under side. The most important character, however, is the presence of two little brush-like organs on the next to the last segment, as shown in Fig. 1 d (Plate I).

The head is bluntly rounded in front, nearly as broad as long and with the antennæ situated at the sides midway from the posterior to the anterior borders; behind these are located slight eminences upon which may be found the small eyes,
which are seen with considerable difficulty. At the front of the head may be seen the small rostrum or beak, the end of which is usually at or near the surface, but which is capable of extension and retraction. The end of this beak is armed with a double row of recurved hooks (see Fig. 1 b). The function of these hooks is doubtless to fasten the beak firmly into the skin of the host, while the true pumping organ must consist, as in the Pediculi, of a slender piercing tube, though we can see only slight indications of this tube within the head, and we have not seen it nor do we find any record of its having been seen fully extended in this species. Professor Harker says the rostrum can be pushed out, but his figure shows only the basal portion with the crown of hooks and nothing of the tubular parts inclosed within.

The thorax is wider than long and widest at the posterior margin where it joins the abdomen. The legs project from the side, are long and stout, and especially adapted to clasp­ing and clinging to the hair. An extra provision for this purpose consists of a double plate having fine transverse ridges in the basal joint of the tarsus. This structure appears to have been first described by Professor Harker (Agricultural Students' Gazette, vol. I, p. 162). The abdomen differs greatly in form and size, according to the degree of distention, which accounts for the discrepancies in the different figures of this species. It may be called flask-shaped and more or less flattened according to the amount of matter contained in it. There is a row of hornv tubercles along each side and a row of chitinous plates along each side of the upper surface of the abdomen. The spiracles are located in the tubercles at the sides, and there is one to each of the last six segments omitting the terminal one. In color there is some variation, as would be surmised from a comparison of descriptions by different authors. The general color of the head and thorax is a light brown approaching to yellowish, with touches of bright chestnut on the head and legs and margins of the thorax, also touches of dark brown on these parts, more particularly on the dorsal portion of the thorax. The abdomen in fresh specimens has a general bluish aspect, not so noticeable in preserved specimens, besides its color depends evidently in large degree upon its contents. Denny says "grayish-
white or ochraceous gray,” which would apply well to preserved specimens, but his plate shows it a blue-gray. Harker says brownish gray. It appears to us that the term used by Mr. Tenney, blue slate-colored, comes quite as near describing the average appearance as any that we have seen. The tubercles at the side of the abdomen and the chitinous plates are chestnut-colored, while the most of the upper surface of the terminal segment in the female and the ventral stripe in the male are black.

The females deposit their eggs on the hair, attaching them very near the skin. Fig. 1 e represents one of the eggs, showing its attachment to the hair and the distance from the root of the hair in the specimen drawn. The adhesive substance evidently invests the egg during oviposition and is touched to the hair, the egg then slightly drawn along so as to leave the glue-like mass to form a firm union around the hair and to the egg. The egg is elongate-shaped, tapering at the lower end, and having a cap-like covering at the upper end. The surface is set with very minute points just visible under an inch objective, but showing clearly with a power of 300 diameters. At the surface no connection is to be seen between different points, but focusing a little below the surface brings into view what appear to be minute threads or channels running from point to point and giving a reticulate appearance to the eggshell. The points cannot correspond to the circular bodies represented in Denny’s figure (E, Plate xxv, Monog. Anop. Brit.) which have much more the appearance of protoplasmic granules of the egg contents. The shape of the egg in his figure is also entirely different from that of the specimen from which our figure is drawn.

The young louse escapes from the outer or unattached end, whether by pushing off the cap-like portion or simply pushing through this portion which appears to be thinner than the rest and may be simply membranous, is not, so far as we know, determined. No marked changes, except in size and the development of the chitinous patches, occur from hatching to maturity.

This is one of the most difficult parasites to destroy, and once settled upon an animal should receive prompt and thorough treatment. The main reliance of veterinarians seems
to be stavesacre, and this can doubtless be depended upon to accomplish the desired end. Mr. Tenney recommends the seed of common larkspur steeped, and the animal thoroughly washed with the liquid. He says: "I have known one application to destroy every insect and egg; two will suffice if done thoroughly." Of course this and the stavesacre are nearly identical, both plants belonging to the genus *Delphinium*. Washes of carbolic acid soap or of tobacco infusion are also effectual, but washes of any kind are of course ill-adapted to use in midwinter, the time when there is frequently most necessity for treatment. Mercurial ointment, sulphur, or tobacco smoke, kerosene and lard, or kerosene emulsion, road dust, ashes, etc., may be resorted to, according to the circumstances. Infested animals should, if possible, be placed apart from the others, and much trouble may be saved by this precaution.

Experiments with fumigation have shown this to be a method available when other plans are undesirable, though from the equipment necessary, and the fact that it requires some time in application, it may not prove of as general service as the washes, especially the kerosene emulsion.

The method may be said in brief to consist of a tight box-stall just large enough to admit the largest animal to be treated, one end having a close-fitting door to admit the animal, the opposite end a stanchion in which the animal is fastened, and covering the open part of this end, and made to fit tightly around the head just in front of the horns, is a canvas sack open at both ends, the inner one nailed to the stall and the outer with a running cord to draw it down to the animal's head, thus leaving the eyes and nose in open air. An opening at the bottom of one side admits fumigating substance, sulphur or tobacco, the latter apparently the most effective. In burning this we used a wire screen to spread the tobacco, placing this over a tin trough containing a small quantity of alcohol. It could be burnt, however, with coals or using a small quantity of kerosene. The time of exposure necessary will vary some with the strength of fumes, but one to two ounces of tobacco and exposure of 20 to 30 minutes was found effective. Pyrethrum might be better even than tobacco.
This species has been said to occur also on horses, but if this is the case it must be in rare instances, and there need be little apprehension of horses becoming infected with it by transmission from cattle with which they may be associated.

THE LONG-NOSED OX-LOUSE. (Plate I, Fig. 3.)

(*Hematopinus vituli* Linn.—*tenuirostris* Burmeister.)

In connection with the preceding species this louse, as already stated, has long been familiar to cattlemen; it has also been known to entomologists for a considerable time, but its history from the entomological side is not entirely clear. It seems to have been first technically described by Linnaeus under the name of *Pediculus vituli*, which name has been followed by Fabricius, Berkenhout, Stuart, and Turton, and, with the exception of the change in the generic name, by Stephens, Denny, and English and American authors generally. Nitzsch describes it under the name of *Pediculus oxyrhynchus*, which name was Latinized by Burmeister to *tenuirostris*. This designation has been followed by Giebel and Piaget, but why the earlier name of Linnaeus was dropped we fail to discover. It seems more proper to retain the name given by Linnaeus.

In this species the body is about one-eighth of an inch long and not more than one-third of that in width (see Fig. 3). The head is long and slender, the antennae set near the middle each side; there is but a very slight protuberance behind the antennae and no eyes visible. The head sets well back into the thorax, forming an acute angle behind; the thorax is longer than wide, and has a distinctly showing spiracle above the second pair of legs; the abdomen is elongate, without chitinous plates and devoid of any tubercles along the sides; the terminal segment is also devoid of black horny band; the brush-like organ on the under side of the abdomen (see Fig. 3) is slender, while the terminal segment is set with numerous rather long hairs.

In all of these points it will be observed there is a distinct difference from *eurysternus*. The brush-like organ on under surface of the abdomen, common to females of related species and which is wanting in young of all species, must be taken as
distinct evidence of the maturity of the specimens. If, however, there were any doubt on this point a study of the young of *eurysternus* gives equally conclusive testimony. In the very youngest *eurysternus* we have seen the chitinous tubercles along the sides of the abdomen inclosing the spiracles are distinctly to be seen, while the head, though longer proportionately than in adults, is by no means equal in length to that of adult *vituli*. A young *vituli* found, it is true, associated with *eurysternus* shows this elongation of the head still more markedly. In color there is little difference in the two forms, this species having rather duller colors upon the head and thorax. The abdomen of young specimens, when full of blood, appears dark red, but the bluish-gray hue is more prominent in adults. The eggs of this species have not been described and we have not had the good fortune to discover them. The young are even more slender than the adults.

The remedies that are available for the preceding species will prove effectual for this, and it is evidently less difficult to subjugate than that form.

The Hog-Louse. (Plate I, Fig. 5.)

(*Hæmatopinus urius* Nitzsch.)

Occasionally this species appears in formidable numbers, since we often hear of swine badly affected with lice, and no other species is known to attack this animal.

Giebel credits this species to Moufet, citing the *Theatrum Insector. (1634, 266)*, while Piaget states that it is cited by Moufet on the authority of Albertus (IV., C. 205), which would carry its recognition back to the thirteenth century. Linnaeus described it under the name of *Pediculus suis*, which name has been most commonly followed, but Nitzsch revived the name of *urius* and this name has been followed by Giebel and Piaget. Along with other parasites it received frequent mention by both early and modern writers. Denny speaks of it as rare in England, but common in Ireland. He says (Monog. Anop. Brit., p. 35):

"This species is found in great numbers on swine, but it does not appear so generally spread as might be expected from the dirty habits of the animals. It most frequently oc-
... curs on those fresh imported from the sister isle. It was many months before I could obtain a single example. I had applied to both farmers and pig butchers, neither of whom seemed to approve of the idea which I had conceived, that of their pigs being lousy, but referred me to those of the Emerald Isle as being sure to gratify my wishes (forgetting, I suspect, that the Irish pigs come to this market to meet English buyers). I accordingly visited a colony just arrived, where I most certainly met with a ready supply; but here they were confined almost entirely to lean animals, and wherever I found a pig fat or healthy no game were to be seen."

Most stockbreeders have probably seen instances of its abundance, and from the frequent mention of it in the agricultural papers, it would seem to be quite common throughout the country, and while, perhaps, less generally distributed than the ox-louse, to multiply some times so as to cause much more apparent damage to its host. The fact that they are more commonly found on poor or runty animals should not be taken as evidence that they have a preference for such animals, but rather that the animals upon which they have multiplied rapidly have, in consequence, become emaciated and unhealthy. That they do not increase more rapidly and become a much greater nuisance may be in part because the majority of hogs are sold and slaughtered at a comparatively early age, and with each one slaughtered must perish the parasites which have been supported by it, unless, perchance, an occasional one escape the scalding trough and succeed in finding another host. Of the vast number of hogs shipped to market and slaughtered at the great packing houses, none can bequeath the insects they have nurtured to their followers. The amount of injury and the consequent need of precautionary measures are, therefore, much less for this species than for many others.

This is one of the largest species of the family, full grown individuals measuring a fourth of an inch or more in length. It is of a gray color, with the margins of the head and thorax and most of the abdomen dark. The head is quite long, the sides nearly parallel, with strong eminences just back of the antennae, which are set on the sides of the head, midway...
from rostrum to occiput; the legs are lighter with dark bands at the joints; the spiracles are inclosed by a black chitinous eminence, and there is a broad black band on the last segment, broken near the middle. (See Fig. 6.)

The male has the abdomen marked beneath with a large black area extending forward from the end of the terminal segment, so as to occupy the central portion of the last three segments.

There is a curious provision in the feet for strengthening the hold upon the hair, which does not seem to have been hitherto described.

It consists of a circular pad-like organ or disc in the outer portion of the tibia which is received in a conical cavity in the end of the tibia, and which can be forced out so as to press upon the hair held between the claws of the tarsus and the end of the tibia.

Ordinarily, and always in the dead specimens, this is withdrawn so as to appear simply as a part of the end of the tibia, and the spines located on its margin, appear to belong to the tibial rim, but if examined with sufficient magnification when the louse is alive it is easy to observe the extrusion of the organ.

Whether similar organs exist in related species is yet undetermined, but it seems quite probable that they should, since in the specimens examined microscopically we have usually to deal with dead and preserved individuals in which this structure would almost certainly escape notice.

The eggs are one millimeter and a half in length (.06 in.) by three-fourths of a millimeter in width (.03 in.). They are light yellow or dusky whitish in color, and taper slightly to the point of attachment. The circular lid-like portion is large, occupying nearly all the surface of the free end of the egg. They are attached usually near the base of the hairs.

On account of the thinness of the hair, the application of remedies, where necessary, is quite easy. Washes of tobacco water or dilute carbolic acid, and the application of kerosene in lard, or kerosene emulsion by means of force pump, sulfur ointment, etc., are recommended. The application of fine dust may be provided for naturally by allowing the hogs a chance to roll in the roadway or any place well supplied
with fine dust. Where this is impracticable the dust, ashes, or powdered charcoal may be applied directly to the neck and back of the infested animal. The species is not known to attack any other of the domestic animals, and hence no precautionary measures in this direction are necessary.

**THE SUCKING HORSE Louse (Plate I. Fig. 4).**

*(Haematopinus asini* Linn. — *macrocephalus* Burm.)*

This species was figured by Redi (Exp., Pl. xxii, Fig. 1) and was described by Linnaeus under the name of *Pediculus asini*, presumably his specimens being taken from the ass. Later Burmeister described specimens from the horse under the name of *Pediculus macrocephalus*. Denny retains the name given by Linnaeus and states that it is common upon the ass, and that he also had specimens from the horse, from which circumstance he suspected Burmeister’s *macrocephalus* to be the same. Giebel and Piaget both follow the name of Burmeister, and Piaget separates as a variety the form occurring on the ass, and gives it the name of *colorata*.

It seems hardly probable that it occurs in this country in sufficient numbers to cause much trouble on horses. Possibly examination of mules, asses, or donkeys would show greater abundance from the fact that horses in general are more carefully groomed than their somewhat despised relatives. The size is about the same as that of the ox-louse, but it differs very decidedly in the form of the head, which is long, slender, and the sides of the head nearly parallel, as shown in the figure (Fig. 9), taken from Comstock’s “Introduction to Entomology.”

Careful grooming may be looked upon as at least favorable to the reduction of numbers in this species. In case they become too numerous the application of a little kerosene to the card or curry comb used in grooming the animals will be found of value. Where more vigorous treatment is necessary the measures recommended for the ox-louse may be adopted.
THE BITING AND RUNNING LICE.

*(Mallophaga.)*

This group embraces all the biting lice infesting birds and mammals. They are very distinct, indeed, from the preceding group, though frequently placed with them under such unnatural divisions as *Anoplura*, *Pediculines*, etc.

The bodies are usually hard and horny and much flattened. They possess madibulate mouth parts adapted to cutting and biting the hairs, feathers, epidermal scales, or excretions on the bodies of their hosts. The jaws are situated on most forms underneath the head and near the center, the clypeus projecting and forming the most anterior portion of the head. The eyes when visible are located back of the antennæ. The antennæ are five-jointed except in *Trichodectes*. The thorax is generally narrow and frequently but two divisions are apparent. The legs are adapted to clasping (*Philopteridae*) or to running (*Liothediae*), the tarsi in the first case being short and fitted for clasping against the tibiae, and in the second case being long and provided with two claws well adapted to running. The members of the first division occur on both mammals and birds, those of the second, except *Gyropus*, are limited to birds. Wings are entirely wanting and the abdomen contains nine or ten segments and is usually oval in shape.

In life history this group agrees with the preceding. The eggs are glued to the hairs or feathers of the host animal and open with a circular cap or lid at the free end. The larvæ are less flattened, shorter in proportion, and without the hardened parts common to the adults covering a part of the surface. The length of life and rapidity of multiplication has not been determined for any species so far as we know, and the habits of the insects make any such determination a matter of great difficulty.

The effect of these upon the host animal may be less important than that of the suctorial lice, but judging from cases where serious results follow the efforts of the animals to rid themselves, and from the known irritation due to the crawling of anything among hairs and feathers, it cannot be
doubted that they cause much inconvenience to the creatures which become their involuntary supporters.

**BITING LICE OF HORSES, MULES, ASSES, ETC.**

*(Trichodectes equi of Authors.)*

The original reference by Linnaeus to the lice of horses and asses under the name of *Pediculus equi* most certainly refers to the common *Trichodectes* infesting these animals, but Piaget has reached the conclusion that this reference is to the form subsequently described by Giebel as *Trichodectes pilosus*, and that the form described by Denny as *equi*, and which has since almost universally been treated as the Linnaen species, was in reality a different insect from that described by Linnaeus under the same name. He therefore describes this form under the name of *parumpilosus*. It is certainly somewhat confusing to be obliged to drop the familiar designation for so common a species, and were it not that the conclusion has been reached by one who is probably the highest living authority regarding these insects we should hesitate to introduce the change. The figures given by Piaget, however, leave no doubt that there is a decided difference between *pilosus* and *parumpilosus*, and it is equally certain that our common species belongs to the latter form; so, if there is no question as to Linnaeus having the form *pilosus* in hand, we certainly have no right on technical grounds to apply the term *equi* to our common form. We will therefore introduce descriptions and comparisons of the two forms, and adopt, for the present at least, and on the authority of Piaget, the names given in his "Les Pediculines."

*(Trichodectes pilosus Giebel.)* (Plate II, Fig. 7.)

This, according to Piaget, is the form originally designated by Linnaeus as *equi*, and which, if that is correct, was the basis for a name which has been widely used to designate the biting lice of the members of the horse family. The original reference dates back considerably more than a century, and doubtless, the insect was familiar many centuries before that, as the horse and ass have been too familiar as domestic apri-
mals to allow the parasites common to them escaping entirely the notice of man.

According to Piaget this occurs upon both the ass and the horse, while the following species he has found only on the horse.

We have not been fortunate enough to secure examples of this form, though we have the other in great abundance, so we are compelled in describing to depend upon the excellent description and figures of Piaget, the latter being reproduced (in Fig. 7) for comparison. The head in this form is shorter and less rounded in front, that of the male being still less rounded than the female, while the abdomen is more slender and tapering. The transverse bands are also represented as less conspicuous. Perhaps the most striking point, however, is the position of the antennæ, which stand well forward on the head, so that the front border of the head and base of the antennæ are nearly in line.

The habits of the species and the remedies applicable to it are naturally identical with those of the other related species.

*Trichodectes parumpilosus* Piaget (Plate II, Fig. 6).

While it does not seem possible that all the writers previous to Denny should have overlooked this form which appears to be the more common one, at least on the horse, it may be true that Denny was the first one to give it a thorough description and careful drawing. He speaks of it as common on the horse and ass, but Piaget says he has never found it on the ass and there is of course a possibility that Denny did not distinguish between this and the preceding species.

In this species the head is decidedly rounded in front, the antennæ inserted well back, so that the head forms a full semicircle in front of the base of the antennæ. The abdomen is more slender and tapering than in *scalaris*, but less so than in *pilosus*, as shown in Piaget’s figures. The color is much the same as in the allied species, the head, thorax, and legs being a bright reddish brown or chestnut and the abdomen of a dusky yellowish color, with about eight transverse dusky bands occupying the central or anterior portions of the segments and extending from the middle line a little more than
half way to the margin. They are hardly as conspicuous as in *scalaris* and apparently rather longer and more conspicuous than in *pilosus*.

The habits of this species are well known and have received mention for many years. They seem to accumulate more particularly upon colts or horses in pasture, but their presence becomes most manifest in the latter part of winter, when they may become so numerous as to cause great irritation to the animals infested. They occupy more particularly the region of the neck, and also accumulate around the base of the tail and between the legs, and the animals will frequently rub bare places in these regions in their attempt to rid themselves from the irritation.

It is unnecessary to give any special notice regarding treatment, as they must be attacked on the same plan as other species.

Even if it proves that this species does not ordinarily infest the mule or donkey it would be policy not to allow these animals, if infested, to associate with horses, as we have no assurance as yet that they can not thrive on any of the members of the equine family.

**Biting Lice of Cattle** (Plate II, Fig. 8).

(*Trichodectes scalaris* Nitzsch.)

This species, which is a very abundant one upon cattle and occurs the world over, appears to have been first technically described by Linnaeus (System Naturæ, vii, p. 1017, No. 9), under the name of *Pediculus bovis*, and evidently the same species is referred to under the name of *Pediculus tauri* (*Fauna Suecica*, 1946). Notwithstanding these descriptions, both of which were under a different genus from that in which it is now placed, the species was again described by Nitzsch (Germar's Magazine, 3, 296) under the name of *Trichodectes scalaris*, and it has been known by this name in all of the numerous writings subsequent to this description. It has been treated by all writers upon the parasites of animals and is one of the best known species of parasitic insects. The effects upon the cattle infested are often quite serious on account of
their great number, but they are apparently less injurious than the suctorial species which infest cattle. This injury depends, of course, upon the numbers occurring upon the individual, and somewhat upon the irritability of the animal infested. This species much resembles the form occurring upon horses, but is somewhat shorter and the abdomen tapers less towards the extremity; the dark bands across the abdomen are also more distinct. They are generally found in greatest abundance in the spring of the year, at which time adults and eggs are discovered in great numbers. Their development corresponds with the other species, and they are subject to the same methods of attack.

They are very distinct from the suctorial species in appearance, and this difference is recognized by practical men, who speak of them as the "little red lice," as contrasted with the "blue lice," and they recognize, too, the difference in the trouble caused by the two species.

The application of kerosene emulsion or of tobacco decoction at seasons when this is practicable is effective, and we have found the process of fumigation described under sucking ox-louse to be effective, and this of course is applicable at all seasons of the year, even in cold weather, without danger to the animal.

The Louse of the Sheep (Plate II, Fig. 9).

(Trichodectes sphærocephalus Nitzsch.)

Redi is credited with the recognition of this species, and following him Linnaeus described it under the name of Pedi- culus ovis, and later still it was described in detail under the name given above. Denny's reference to it would indicate it as rare in England, and we have not met it here, though we have received specimens from Canada. If it is of rare occurrence it may be considered as fortunate, for, if abundant, it would be rather difficult to contend with on account of the long wool of the host.

The name indicates its characteristic feature, namely, the rounded head. The color agrees closely with the related species.
Where it occurs it would be the best plan to pay close attention to destroying them at the time of clipping the sheep, even if they are but few in number, as at any other time the labor of making thorough applications for them is greatly increased.

The Biting Louse of the Dog (Plate II, Fig. 11).

*(Trichodectes latus* Nitzsch.)*

Something over a century ago DeGeer mentioned a species of parasite on the dog under the name of *Ricinus canis*, which probably referred to this species, and another mention by Olfers under the name of *Pediculus setosus* probably preceded the description by Nitzsch under the name which the insect has borne since 1818.

Probably every one who has had much to do with dogs is aware to what an extent this parasite may multiply and how troublesome it is to this friend of man. It is generally believed that the lice are more troublesome to puppies than to old dogs, and it is not at all unlikely that the insects migrate when possible from older to younger animals.

In color this species agrees pretty closely with the other species and it is of about the same length as the cat louse, a little more than one millimetre, but it is much broader in proportion, being more than half as wide as long, and the head is short and the front but slightly curved.

The Louse of the Cat. (Plate II, Fig. 10.)

*(Trichodectes subrostratus* Nitzsch.)*

While it is possible that this parasite was referred to by Otto Fabricius about the year 1780 under the name of *Pediculus canis*, the first certain reference to it appears to have been the description by Nitzsch in 1818. Since that time it has been referred to by nearly all writers on the common parasites of animals, but so far as we know there has been no special description of the different stages, and we must assume that there is no important departure from the habits of species that are more thoroughly known.
It is a little more than a millimetre in length and has much the appearance of the species occurring on other domestic animals, but is distinguished particularly by the form of the head, which is quite pointed, and the under part of the front of the head is hollowed out in a furrow about the size of a hair. The insect will often be found adhering by the mouth parts with a hair so closely held in this groove that it is somewhat difficult to tell where the hair begins as separate from the insect.

There is no record that we have seen that indicates its presence on any other animal than the domestic cat, and, judging by our own observation, it is only occasionally that cats become infested with it. When they do the usual remedies may be administered, especially a washing with kerosene emulsion, after which the animal should be allowed to dry in a warm place, as the fur is so fine that they dry slowly.

**Chicken Lice.**

There are no less than six different kinds of lice that occur normally on the common barn-yard fowl, and at least one other species occurring on other birds that has been recorded as taken on this much parasitized species.

One of these, the *Gonicotes abdominalis*, shown in Fig. 7, Plate II, is said to be very common, but in this locality it has not been found so abundant as the following:

It is a large, conspicuous species, about 3 millimetres in length, quite broad, the head nearly circular in front and constricted behind, the thorax small, the abdomen widening to near the end and terminating abruptly. The head, thorax, and legs are yellowish, with dark margins and spots; the abdominal segments bear lateral whitish fasciae bordered with black.

The species which seems most abundant of all is the *Menopon pallidum*. (Fig. 13, Plate II.)

The annoyance that this species causes poultry is probably equal to that of all the other species combined, for it occurs in great abundance and almost every fowl examined will be found infested. Then, too, it passes readily to other species.
of birds, and many instances are recorded where horses kept near henroosts have been very seriously troubled by them. Some of these accounts seem hardly credible taken in connection with the habits of the insect, and we are inclined to think that the worst cases, at least, may have been due to itch mites on the poultry and the migration of them to the horses, though in such case we should expect the fowls themselves to show more serious injury. It is, at any rate, important to keep lousy chickens away from horses.

The louse is pretty easily distinguished from other common species infesting the hen by its light color and its great activity, running with celerity among the feathers and from them upon the hands of persons holding fowls. It is from 1 to $1\frac{1}{2}$ millimeteres in length, rather slender, and of a light straw-yellow color.

Remedies for this species must aim to reach the hiding places of the lice on the roosts and in the cracks of the walls of the henhouse as well as to destroy those on the fowl. Thorough fumigation and whitewashing, with careful attention to cleanliness, will do much to keep them in check. Pyrethrum, kerosene, etc., may be used direct upon the fowls, and if they are liberally supplied with wood ashes and road dust they will do much to protect themselves.

**Duck Lice.**

*(Trinoton luridum* Nitzsch.) Plate II, Fig. 14.

Redi seems to have been the first to give mention of this very common species, it being figured in the Exper., Pl. xii, as the louse of the Teal. It is also figured by Albin (Pl. 46) under the same common name as quoted by Denny. Nitzsch described it in 1818 under the name given above, and the species has been fortunate enough not to have received any other designation since, although it has been mentioned in most of the works referring to the parasites on domestic fowls or the parasites of birds. It is a very common species and occurs on a great many different species of ducks, so it is unnecessary to try to enumerate the hosts. So far as we have seen or can learn from record, however, it is not known to occur on birds outside of the duck family *(Anatidae).*
Aside from these species mentioned there are many others affecting domestic fowls; Pigeons, Turkeys, Geese and Guinea Hens, all supporting a numerous host of these parasites.

We have not space here to give further detail regarding them, but it may be mentioned that remedies suggested for the chicken louse apply as a rule to the other kinds and for further details the reader may be referred to Bulletin No. 7, Division of Entomology, U. S. Dept. Agriculture.
EXPLANATION OF PLATES.

PLATE I.

Fig. 1.—*Hæmatopinus eurysternus*; *a*, female; *b*, rostrum; *c*, ventral surface, last segments of male; *d*, female; *e*, egg; *f*, surface of egg greatly enlarged. (Original.)

Fig. 2.—*Hæmatopinus piliferus*. (Original.)

Fig. 3.—*Hæmatopinus vituli*, and under surface last segments of female showing brush-like organs. (Original.)

Fig. 4.—*Hæmatopinus asini* (From Comstock.)

Fig. 5.—*Hæmatopinus urius*; *a*, female, *b*, male, ventral view of posterior segments; *c*, leg, showing protractile disk of tibia. (Original.)

PLATE II.

Fig. 6.—*Trichodectes parumpilosus*. (Original.)*

Fig. 7.—*Trichodectes pilosus*. (After Piaget.)

Fig. 8.—*Trichodectes scalaris*. (Original.)*

Fig. 9.—*Trichodectes sphaerocephalus*. (After Denny.)

Fig. 10.—*Trichodectes subrostratus*. (Original.)

Fig. 11.—*Trichodectes latus*. (After Denny.)

Fig. 12.—*Goniocotes abdominalis; hologaster* of Denny. (After Denny.)

Fig. 13.—*Menopon pallidum*. (After Denny.)

Fig. 14.—*Trinoton luridum*. (Original.)

All the figures are reproduced from Bulletin 7, Div. Ent. U. S. Dept. Agriculture, and unless otherwise credited, were drawn expressly for that Bulletin by the author or finished from his sketches by Miss Lillie Sullivan under the supervision of Dr. Riley.

*The hair line in the figure is about one-fifth longer than it should be.
PLATE II.
SUGAR BEETS.

Much to the writer’s regret, circumstances have prevented the completion of part second of the sugar beet report in time for publication in this bulletin. It is now ready and will be published within a few weeks.

This note is for the purpose of urging farmers to continue the sugar beet experiments the coming season. A number of those who co-operated with us last year have expressed confidence that, with the experience thus gained, they can the coming season grow beets of much better quality. Doubtless most can do so. Last year’s experience proved to all that beets of good quality for sugar-making cannot be grown as roots are grown for cattle feed. The soil must be more carefully selected, the seed-bed much better prepared, fresh manure be not applied, and the crop more constantly cared for during the entire season. For these reasons only plat experiments should be tried—large field experiments would be apt to be slighted.

Let the soil selected be a sandy loam—not much clayey, not heavy, and not especially black. Select no soil with a a hard or impermeable layer within two feet of the surface.

If plowed deep last fall, so much the better; in this case do not plow extra deep this spring. If not plowed in the fall, and especially if the lower-soil is hard and compact, plow rather deep this spring; for to be of good quality the beet must find a loose penetrable lower-soil in which to grow downward and thus keep below the surface, and in which it can develop symmetrically. Too many of last year’s beets were mis-shapen—short and thick, often with several straggling roots, instead of being long and tapering, with a single top-root. Many also—and always the mis-shapen ones—showed they had grown too far out of the ground, because unable to penetrate downward. Either of these faults is fatal to good quality; deep tillage is the remedy, or rather the preventive. But very deep plowing in the spring (except with the sub-soil plow) is not advisable, since the lower soil
thrown up is "raw," with most of its fertility latent, unavailable, until after months of exposure. Hence the deep plowing should be done in the fall.

Have the soil well pulverized, in extra good tilth; use little or no manure—if any, well rotted; plant early, not deeper than one inch; if soil is dry, soak seed two days in half-urine-half-water, then dry for sowing; seed at rate of 15 pounds per acre; rows 18 inches apart; begin cultivating soon as plants are up; when four inches high thin out to 6 or 7 inches apart, transplanting into blank spaces,—the aim being to give each beet room to grow to only 1 to 2 pound’s weight; cultivate or hoe every fortnight until foliage prevents; at last hoeing "hill up" to cover roots completely.

Harvest not until leaves begin to yellow and wither; light frosts will not harm. If when nearly at this stage warm weather with rain should come, starting second growth, pull the beets at once; for second growth reduces quality.

The Station will perform its part of the work as last year; it will furnish the best of imported seed, in ½ pound or 1 pound parcels only, to those who apply early, enclosing stamps for postage on seeds—5 cents for ½ pound, 10 cents for 1 pound—and who agree to follow directions regarding culture and to make full report on the same. At harvest time the Station will bear expense of shipping samples (by freight, not express) to Ames for analysis.

Apply early; and especially let those join in the work who were in it last year. It is well worth while. This country will sooner or later make its own sugar. California and Nebraska have made a good start. Shall Iowa not be in the procession? Plenty of capital seeks investment in Iowa; but capital will not erect beet-sugar factories until it is demonstrated that beets of the right quality can be grown and that the farmers are willing to grow them.

Address, G. E. Patrick,
Experiment Station, Ames, Iowa.