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The New Insectary

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WM. S. FROST, Secretary.

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THE NEW INSECTARY.

Recognizing the necessity of facilities for rearing insects in a situation where all external conditions could be controlled, as well as of a suitable place for keeping the collections and apparatus of the department, the board of trustees last year authorized the construction of a building for the entomological department. This was occupied about June 25. It is a structure 16x32 feet in size, with wing 12 feet square. In the main part is the general office and work room, 16 feet square, a well finished room, provided with desk, tables, balances, shelves for collections, &c. Here are kept a general collection of all orders of insects, chiefly collected in this locality; some economic collections, showing the transformations, work and parasites of some of the common injurious insects; samples of various insecticides, and a few bee supplies.

The rearing-room, or insectary proper, occupies the remainder of the main part of the building. It is an unfinished room with dirt floor, lighted by five large windows. It is as yet but partially fitted up, owing to the fact that the rearing season was almost past when we moved into the building last spring. Breeding cages and other devices for this line of work will be in operation this year.

The wing on the east side of the main building is devoted to bee-keeping and storage of machinery, &c. The bees are placed on a low shelf along the side of the room, the faces of the hives toward the outside. Horizontal slits through the wall, one immediately in front of each hive, give the bees egress. This arrangement is called a house apiary, and presents several advantages, in our circumstances. The hives are safe from violent

winds and are in a very convenient place for working with them, as by nearly closing the door the room can be darkened until the bees will not fly in it.

PARASITES OF THE LARGE WILLOW SAW-FLY.

About the middle of May, 1891, an examination was made of 748 cocoons of *Cimbex americana*, the Large Willow Saw-fly, for the purpose of ascertaining the proportion that were parasitized. The results were as follows:

375 cocoons, or 50 per cent, contained healthy larvae or pupae; 229, or 31 per cent, contained cocoons of a large parasite, *Opheltes glaucopterus* Linn.; 25, or 3 per cent, contained several cocoons each of smaller hymenopterous parasites; 23, or 3 per cent, contained dipterous parasites; 96, or 13 per cent, contained larvae dead but not parasitized.

The subsequent rearing of these parasites furnished most of the data for the following notes.

HYMENOPTEROUS PARASITES. *Opheltes glaucopterus* Linn. As the above summary shows, this is by far the most important parasite, destroying about one-third of the whole number of saw-flies of the species under consideration. In the spring its presence is indicated by a slender black cocoon within that of the saw-fly, occupying the entire length and about half the diameter of the latter. The mature insect is $\frac{7}{8}$ inch long. The general color is orange red. The tip of the abdomen, from near the middle of the fourth segment, is black, as is also the thorax, except the scutellum and sometimes the disk. The wings are distinctly yellow, changing to brownish toward the apical and posterior border.

The insect has been observed here for three seasons, and is increasing in number with great rapidity. The fact that the damage by Cimbex in this state was decidedly less last year than for several years before, is probably explained by the presence of this parasite.

Cryptus nuncius Say. Of this species as many as eight or ten small white cocoons are found in a single Cimbex cocoon. For this reason we obtained a large number of specimens, though but a few Cimbex were affected.

As there seems to be some confusion of this species with *Cryptus extrematis* Cress., the original description of both are here reproduced:

CRYPTUS NUNCIUS, Say (Complete Works, II, 693).

"Black; abdomen excepting the base and tip rufous.

"Inhabits Pennsylvania.

"Body black; palpi white, blackish at tip; antennae of the female with a long white annulus in the middle; thorax immaculate; two impressed lines; wings hyaline; nervures brown; stigma rather slender; second cubital rather large, pentagonal,

the two angles on the radial nervure nearly rectangular; recurrent nervures almost rectilinear: tergum basal segment wholly or in part black; second, third and generally half of the fourth rufous or honey yellow; remaining segments black; oviduct nearly half the length of the abdomen; feet honey yellow; posterior pair of tibiae at tip and knees black; posterior tarsi pale yellowish.

"Length about two-fifths of an inch.

"I obtained many specimens from the larva of *Attacus promethea* Linn. several years ago."

CRYPTUS EXTREMATIS Cresson (Proc. Ent. Soc. Phil., III, 304).

"Black; antennae with a broad white annulus; legs and three basal segments of the abdomen rufous; large spot on the sixth and seventh segments, and the posterior tarsi, white; wings clear. Ovipositor nearly as long as the abdomen.

"Female. Black, shining, somewhat robust; head short and broad; antennae as long as the body, slender, black, the seventh to twelfth joints white; the third and fourth joints long, the third rather the longest, the fifth a little shorter than the fourth, and the sixth about half as long as the third. Thorax finely punctured, the dorsal lines rather deep; scutellum sub-convex, polished; metathorax finely scabrous, opaque, its base smooth and shining, the elevated lines tolerably well defined, forming a large, more or less distinct sub-rhomboidal central area, lateral tubercles not well defined. Wings faintly tinged with fuscous, nervures and stigma blackish; pale at base, areolet large, subquadrate. Legs pale rufous, the posterior femora and tibiae at tips, and the base and apex of their tarsi blackish, rest of the tarsi white. Abdomen rather stout, sub-ovate, polished, rufous or yellowish rufous; basal segment strongly arcuated, broad at tip; the fourth and following joints black, the sixth or seventh, or both, more or less white above; ovipositor about as long as the body, rufous, valves black. Length, 4 to 5½ lines; expanse of wings, 6 to 9½ lines.

"Male. Resembles the female, but much slenderer; the antennae is more or less yellowish or whitish beneath; the four anterior coxae are white as well as the posterior tarsi, except extreme tips; the abdomen much more elongated and subcylindric, the basal segment mostly all black, linear, with a projection on each side, behind the middle; the second, third and most of the fourth segments are rufous; the seventh and sometimes the sixth segment has a rounded white spot above. Length, 4⅛ lines; expanse of wings, 7 lines.

"Habitat, Mass. (Sanborn), Pa. (Auxer), Delaware (Dr. Wilson).

"This is closely allied to *C. nuncius* Say; but is at once distinguished from that species by having the white spots on the apex of the abdomen; otherwise they are similar."

A comparison of over eighty *nuncius* with over forty *extrematis* shows that the average size of the latter is decidedly greater, it is more slender, the ovipostor is distinctly longer in proportion to the total length, and the middle joints of the tarsi are always white or distinctly whitish; in *nuncius* females the hind tarsi are not even whitish, but yellowish red, but the males have the same white tarsi as in *extrematis*. In *nuncius* there is often a distinct trace of the white abdominal spots supposed to characterize the other species. In the males of *extrematis*, the antennae have a white annulus, though less conspicuous than in the females, and are also "more or less whitish or yellowish beneath;" in *nuncius* they have no white at all, but are uniformly black. We have reared *nuncius* only from *Cimbex americana* and *extrematis* only from *Platysamia cecropia*. *Extrematis* emerged as a mature insect June 12 to 18, and *nuncius* May 15 to 29.

Limneria ferrugineipes Ashmead. Of this species about 20 specimens were reared. They come from small inside cocoons, the same as the Cryptus. The perfect insect is $\frac{1}{4}$ inch (6mm.) long, almost uniform black except the mouth and all the legs, which are brownish red. They emerged May 20 to 29.

Mesochorus melleus Cresson. A Cimbex cocoon sent from Egan, S. D., contained this species. Seven specimens were reared. It is a minute yellow insect, slightly more than $\frac{1}{8}$ inch (3.3mm.) long, with eyes black and base of abdomen brown. Mr. Howard states that it is known as a secondary parasite, so it is probably to be recorded as an enemy to one of the above parasites, and a friend to the willow saw-fly; that is, as an injurious insect. They emerged May 20 to 29.

DIPTEROUS PARASITES (FLIES). *Sarcophaga cimbicis* Townsend. Two flies of this species were reared. It is an ordinary looking gray fly about the size, of the house-fly. The larvae are maggots, similar to those found in carrion. The two specimens we secured are now in the collection of Professor C. H. Tyler Townsend, of the New Mexico station. He considers them representatives of a new species for which he proposes the name above. The description is published in the Canadian Entomologist for May, 1892, page 126.

Phora cimbicis Aldrich MS.
Phora minuta Aldrich MS.
Phora setacea Aldrich MS.

Of the first of these species, three specimens were secured; of the second, one; of the third, five. All are very minute black flies. Not much can be ascertained regarding their structure unless a microscope be used. For this reason, no attempt will be made to describe them in a popular way. All three are new species, and the original descriptions, drawn up by Mr. Aldrich, will shortly appear in the Canadian Entomologist, probably in the June number.

FOOD HABITS OF THE STRIPED GOPHER.

The striped gopher (*Spermophilus tredecimlineatus*) is everywhere known in the northwest as a serious pest, on account of its fondness for sprouting seed-corn, and its habit of biting off stalks of wheat to bring the heads down within its reach. The damage done is so conspicuous that almost all farmers have joined in warfare against the little animal. Some offer a private bounty of one to five cents a head for all gophers killed on their own land. In not a few cases, county commissioners have offered a bounty, generally two cents, for every one killed in the county. Such measures as these reflect the general opinion as to the undesirability of gophers on a farm.

And yet, in spite of this, there is something to be said in their favor. Looking at the matter from a theoretical standpoint, they *may* assist the farmer by eating injurious insects and also the seeds and roots of weeds. To ascertain just what they actually do in this line is a matter of considerable difficulty. Although they are often comparatively tame they will not permit such a close approach as is necessary to settle this point by actual observation. The only alternative is to examine the contents of the stomach of gophers that have been killed. To correctly classify the small fragments thus found requires quite a high degree of special knowledge. It is therefore not to be wondered at that, while occasionally a person is found who has a theory that gophers have their good qualities, there is almost a total lack of definite knowledge on the subject.

Professor C. P. Gillette, now of the Colorado Agricultural College, conducted at Ames, Ia., while Entomologist of the Iowa Experiment Station, the only series of such examinations aside from our own, that we have learned of. He examined 22 stomachs, the gophers being killed at intervals, the earliest April 19, and the latest August 2. They were taken on various parts of the college farm, several being killed on the college campus, an area covered with sod, in which were many caterpillars of the sod web-worm and numerous cutworms. The summary and conclusions are as follows :

"By combining the percentages above given and dividing by 22 we find that 46 per cent of the contents of these stomachs was insects. If we add together all the cut-worms and web-worms found and divide by 22 we get 13 as the average number. If we suppose that the amounts found in the stomachs represents, on an average, one-half the daily food, this would give 26 as the average number of worms consumed by a single squirrel each day from Apr. 19 to Aug. 2, and 2730 as the total number (consumed by one squirrel). These figures multiplied by the number of squirrels living upon a given piece of ground will give some idea of the amount of benefit derived from them. This, without saying anything of the large number of grass-hoppers, wire-worms, and other noxious insects eaten, makes a very large credit account to be placed over against the debits charged to these squirrels. Although it would have been desirable to examine a larger number of stomachs, it seems fair from the above statement to draw the following conclusions:

1.—Insects certainly constitute a large proportion of the food of the striped squirrel.

2.—The insects which the squirrels feed on are almost exclusiveiy injurious species, chief among which seems to be cut-worms, web-worms and grass hoppers.

3.—As grass, clover, and other green stuff has been abundant wherever the squirrels were taken, and as their stomachs were often gorged with insects, that must have given them much trouble to catch, it would seem that they prefer the latter food.

4.—From the above, it seems certain that the squirrels must be a decided benefit to lawns, meadows and pastures.

5.—If the ground containing cut-worms, web-worms and wire-worms is to be turned over to corn, the more squirrels that can be harbored upon it up to planting time, the less will the crop be damaged by these insects.

6.—The squirrels would be a most valuable adjunct to any cornfield after planting, if some method could be devised to prevent them from taking the corn."

The above observations are quoted at some length, in order to compare them with the results of our experiment. June 19 and 22, corn was well up, but the planted kernels were still in condition to invite the gophers. There were few ripe seeds of any kind, so that the stomach contents were generally classfied into insects, corn and "green stuff," the last being apparently grass and other plants, a mixture difficult to analyze and not of great importance from our standpoint. The corn was readily distinguishable, while the insects were usually represented by

legs, antennae, elytra, and other hard parts, more or less fragmentary. In the case of cut-worms and other larvæ, the whole or a large piece of the skin was generally found, the soft parts having been crushed out. It was not possible, as a general thing to make out the species of the insect, but the genus or family is sufficient to indicate pretty well whether the species is injurious or not.

Nos. 1 to 7 were killed on the afternoon of June 19, between 1:15 and 4:30.

No. 1. In the road near the corner of pasture. Only grass and small grain in the immediate vicinity. Stomach quite full, mostly grain, a little green stuff, and remains of at least one beetle (probably carabid). Another gopher near this one was observed to pick grain out of horse manure in the road.

No. 2. Near No. 1. Stomach not very full, grain and grass; one beetle (Chrysomela).

No. 3. Near a little stream. Tall grass and weeds all around. A young gopher, $\frac{2}{3}$ grown; stomach half full of green stuff; remains of one beetle (Harpalus?).

No. 4. By an old straw stack; weeds, potatoes and pasture near by. Stomach very full, mostly grain and seeds, about $\frac{1}{3}$ bettles (carabid and perhaps chrysomelid.)

No. 5. Also killed by the straw stack. Stomach full; more grass than No. 4; one beetle (carabid).

No. 6. Same place. Stomach full; mostly green stuff; several beetles, 3 pieces of skin of lepidopterous larvæ, of which two seemed to be cut-worms.

No. 7. Same place. Stomach full; grain, grass, 1 cricket, 2 beetles (chrysomelid and carabid.)

The next four gophers were killed June 22, between 9:15 A. M. and 1 P. M.

No. 8. At edge of grass plat, 10 rods from corn field. Cheeks full of corn. Stomach full, $\frac{2}{3}$ corn, rest insects; 1 beetle; 1 cricket (?), about 6 cut-worms.

No. 9. At edge of creek. Stomach nearly empty; one lepidopterous larva, not a cut-worm; one or two beetles (Chrysomela); the rest vegetable.

No. 10. Same place (40 rods from corn field). Stomach moderately full of corn; 1 beetle (carabid ?).

No. 11. Same place. Stomach full; mostly insects, numerous beetles (carabid and chrysomelid), one grass hopper, one larva, not cut-worm.

The remaining four were killed June 23, about noon.

No. 12. At edge of timothy field, near millet, 30 rods from corn. Stomach moderately full, half corn, a little grass, about

4 cut-worms, two or three chrysomelid and as many carabid beetles, one grass hopper.

No. 13. On campus, grass all around. Stomach moderately full; ⅓ grass, the rest insects. About 8 lepidopterous larvæ of which one or more were cut-worms.

No. 14.—In raspberry patch. Stomach full, mostly corn and grain; one grasshopper; 3 cut-worms; 1 carabid beetle.

No. 15. In road, not a great distance from corn field. Stomach full;half-full, corn; 1 beetle; 3 or 4 lepidopterous larvæ, of which 2 were cut-worms.

Summing up the insects, we have 19 or 20 cut-worms, 11 other lepidopterous larvæ, 3 grass hoppers, and 2 crickets, all of which may be set down as injurious. The number of beetles of all kinds could not be definitely ascertained, but was 30 to 35. None of them were species which are noted either for benefitting or injuring the farmer. Those marked carabid and Harpalus, belong to a family that are in general beneficial, while those marked chrysomelid and Chrysomela belong to the leaf-eaters, of which group many species are injurious. As the beetles found in the gophers' stomachs were of both classes, there is no great preponderance on either side.

As far as our observations go, they do not give the gopher as favorable a showing as Professor Gillette's did. This line of work will be continued this season, and examinations will be made of the stomachs of larger numbers.

Unless some method can be found to prevent gophers from digging up corn, it is not likely that most farmers will give them a chance to demonstrate their good qualities. Such a method, we are informed by several good authorities, is already in existence. It consists simply in dragging the ground smooth after planting, and then sprinkling shelled corn broadcast around the edges of the field. This treatment supplies the needs of the gophers and they do not find the planted corn.

APPLYING POISON TO POTATOES.

As the college farm has raised about twelve acres of potatoes a year for several years, the best manner of apply poison to them has been an important question. In the absence of any machine specially designed for low plants, the spraying was at first done by means of two tree spraying outfits (a barrel and a tank), loaded into a wagon and drawn down the rows. This method was soon discarded, as it required two or three men and a team to spray two rows. Next a common sprinkling-pot was tried, with far better results. An operator could cover more ground, and,

in the case of large vines at least, could give a more thorough application than from the wagon with the sprayers. Still the team could not be entirely dispensed with, as barrels of water must be drawn, and it was found that the outlay for labor was still large. A machine was needed which would cover more rows at once and dispense with part of the help. Such a machine was designed, constructed, and successfully used last sea-

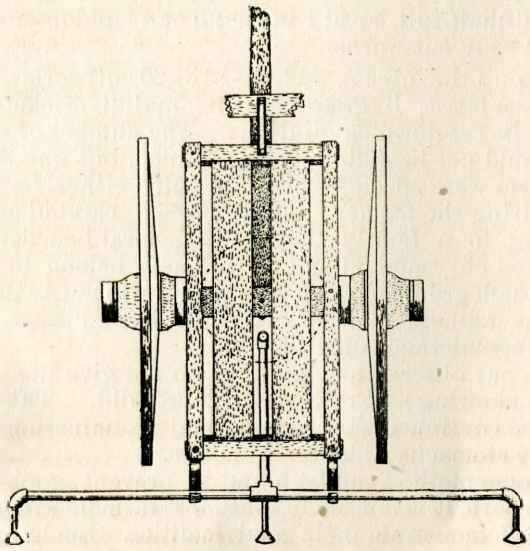


FIGURE 1.

son. It is in a degree a modification of the common street sprinkler, the delivery being arranged so that the liquid falls only on the rows. The hind wheels and axle of a wagon were taken to begin with; a tongue was added,and a platform for a barrel was built over the axle; underneath the barrel a connection was made with a long transverse delivery pipe, which was located behind the wheels, resting on iron supports running back from the corners of the platform. This pipe carried three backward. directed nozzles, at the same distance apart as the rows of potatoes (3½ ft.). Figure 1 shows the machine from above, with the barrel removed and its place indicated by a dotted circle. The sprinklers are the size used on *small* sprinkling pots, and were obtained at a hardware store. Aside from the wheels and axle, the entire cost of material was about five dollars. The frame was made quite long and the plan was to have two barrels,

connected by a pipe near the bottom; but this was not afterward carried out.

In order to do good work with the machine, it is highly important that the rows of potatoes should be a uniform distance apart. Any deviation in this respect will result in uneven sprinkling. The water used should contain no sticks, dirt, or any other material that will clog the nozzles. The pipes should be so arranged that when the tongue is raised the nozzles will be at a height of seventeen or eighteen inches from the ground. To stop the flow while going to the field and while turning at the end of the rows a rather primitive device was used, consisting merely of a stick wrapped with rags at the end, which was thrust into the hole in the bottom of the barrel. The stick was a little longer than the barrel, so that it projected at the top. London purple was the poison used, and no mixing was needed except at the time of refilling, as it took only a short time to empty the barrel. One pound of poison to a hundred gallons of water is a good proportion. In working at a distance from the water supply, it would be much better to use two barrels on the machine and thus avoid part of the travel back and forth.

BEE-KEEPING.

Five swarms of bees were received May 28, 1891, from a bee-keeper in Rochester, Minn. They came by express and stood the journey well. In common with all swarms of the region from which they came, these were very weak in number, and had no honey, but had been fed for some time previous to shipment. They were in old hives, the combs being mostly crooked so that they could not readily be taken out for examination.

Our object in getting the bees was to find out whether with ordinary care they would do well in a strictly prairie region. Our nearest native timber is over four miles away.

The weather being favorable, the bees went to work very soon after arrival. They were noticed about the flower beds and shrubbery in large numbers. In their season, raspberries, strawberries, and other small-fruit flowers were much visited. Among the experimental plats were three or four of the common clovers, $\frac{1}{8}$ acre of each. These were located about a quarter of a mile from the hives. When the plants began to blossom, about June 10, the bees began to store honey at a rapid rate, and kept it up until the plats were mowed on July 20. Roughly estimated, three-fourths of the honey yield of the season was obtained at this time. There was no buckwheat honey, as the grain was killed by frost just when it was fairly coming into bloom.

It is a noticeable and discouraging fact that, in reviewing the summer's observations, we find that the native wild flowers were but very little sought by the bees. Milk-weed (*Asclepias cornuti*) a few little yellow crowfoots (*Ranunculus repens, fascicularis,* and *hispidis*), and the Indian currant (*Symphoricarpus occidentalis*) were the only ones that seemed attractive, and these could have furnished only a small amount of honey, as they were not very numerous and, being low ground plants, the nearest were about a mile from the bee-hives. The common wild mustard (*Brassica nigra* and *sinapastrum*), which had been regarded as a very hopeful honey plant, seemed to be quite untouched, as not a single bee was observed to visit it in the whole season.

The following record of weights was made:

	Wt. on arrival.	Wt. June 27.	Wt. June 30.
Hive No. 1	32½		62
" " 2	33		56
" " 3	34½	58	
" " 4	37½	49	
" " 5	29	44	

No. 4 swarmed just before the second weighing. Considering the poor condition of the swarms when received, the above showing was thought very favorable. Sections were put in on the first week in July. Some swarms did considerable work in them. Altogether, about 80 pounds of honey was taken off, of which about 60 was of fine quality, chiefly from clover.

The first new swarm issued June 27, others came out July 1, 8, 14, and 26. Although these were all rather late, the fine work done by the bees up to July 20 led us to think they might be able to maintain themselves. The new swarms were given frames full of foundation. All went to work and for a time seemed prosperous. Aug. 28, having just returned from a short absence, the assistant discovered that two of the hives formerly occupied by young swarms had no bees in. Each contained ten to fifteen pounds of honey, and considerable pollen, but there was no sign of brood, though one had a queen-cell partly constructed. The appearance indicated that the queens had been infertile, and so the swarms had dwindled away by the natural death of the older bees. The same fate befell a third new swarm later in the fall. In this case the swarm ran down to about a hundred bees, which were chilled on a cold night in November. So only seven swarms were left to winter. These were left on the summer stands (see article "The New Insectary" for description) until Dec. 1, but the slits in the walls were closed when the cold winds began to blow, so they were well protected. On

the above date they were moved into the green-house cellar, which was the only available place to winter them. Here they were left undisturbed until Jan. 20, when it was found that one new swarm had starved to death, and the other was almost out of honey. The old swarms with one exception, were also found to have but little honey in store. All needing it were fed by inserting frames taken from the hives left vacant in the fall. This feeding was repeated at intervals until spring.

Commencing about the middle of February was a warm spell which caused the cellar to become damp. This proved bad for the bees. The old hives were so constructed that thorough ventilation was very difficult. Dysentery broke out and killed many bees. On one or two occasions the interval between feedings was a little too long. From all these causes, we have at present only one swarm. This one was the heaviest at the beginning of winter and was not fed at all. It is now in good condition.

To speculate on what might have happened had circumstances and treatment been different is not very profitable work. We have sought to present the facts. It seems safe to conclude that bee-keeping under our circumstances is a business of very doubtful profit. Bees can store honey only during summer months, as a general thing. During at least eight months they must live on what they have accumulated. Without the help of clover it seems as if our bees could not possibly have made honey enough to have wintered themselves, even under the most favorable circumstances; and yet clover field are very rare in this section of the state.

SOAPSUDS FOR CABBAGE LICE.

Probably none of our common pests is more difficult to reach than the cabbage louse. The colonies are always on the under side of the leaves and frequently work their way into the outer part of the head where the leaves are close together. Besides this, the lice secrete a floury substance, which makes them shed water to perfection.

Some time ago we undertook a line of experiments against them, using kerosene emulsion of different strengths. The result was that a weak emulsion had little or no effect, while a stronger one thoroughly applied killed the lice, but at the same time ruined the cabbage by giving it a flavor of kerosene which remained when it was brought upon the table.

After some further study, a trial was made of strong soapsuds alone, and this proved highly efficacious, giving much better satisfaction than any other remedy for the pest ever used at the station. While water alone will roll off from the insects

without wetting them, the addition of soap gives a compound that penetrates readily. The chief drawback is that many of the lice are in such positions that they can only be reached by the utmost thoroughness of application. On this account a good deal of time is required. Some kind of a spraying pump is indispensable for this work. It is also important to attack the lice early in their ravages, as there are then comparatively few to deal with, and the plants are not much weakened.

KEROSENE EMULSION FOR LICE ON STOCK.

This remedy is likely to be generally adopted as soon as its merits and the best methods of preparation and application are known. An experiment at the college farm this spring was intended to throw light on these points. We prepared our emulsion after what is known as the Cook formula, which is as follows: In two quarts of boiling water dissolve one fourth pound of good hard soap, remove from the fire, immediately add one pint of kerosene and agitate the mixture violently by running it through a spraying pump with a small nozzle back into the original vessel. In three to five minutes the liquid becomes creamy, and if perfectly made no free kerosene will rise to the surface when it is allowed to stand a few minutes. This free kerosene, if present, is a disadvantage, as when applied to stock it removes the hair, and when applied to plants it kills all the foliage it comes in contact with. In our experiment, owing probably to the fact that the pump used was out of order and would not stand a high pressure, a little kerosene separated and rose to the top. After waiting five or ten minutes until it had all risen, we drew out the perfect emulsion from beneath the surface by means of the pump and used it in our work.

Of course the quantity of the respective ingredients mentioned in the formula may be multiplied by any number, to make enough emulsion for the work proposed, or to have a supply left on hand for future use. The proportions given are such that one fifth, or 20 per cent, of the mixture by volume is kerosene (disregarding the soap, which adds but little to the volume). Before using, this must be greatly diluted. In the case under consideration, three parts of water were added to one of emulsion, thus bringing the proportion of kerosene down to 5 per cent. Even this was tenacious and stringy when quite cold, and we used it a little warm. It was applied to stock by means of a sponge, and was found to be instant death to the lice. It did not injure the hair at all. A quart is more than sufficient to treat a horse, as it penetrates to the skin very rapidly. Thus the cost of material sinks about out of sight, being about 3-16 of a cent

for a horse, and probably not over 1-16 for a calf. Almost any spraying pump will make the emulsion.

In this connection it is worth while to urge the use of kerosene emulsion for other insects. No more economical or effective way can be devised for renovating an old hen-house than to give the whole inside a thorough spraying with 5 per cent emulsion. The machine will dash it into the cracks so as to reach all vermin.

For nearly all soft-bodied insects that attack vegetation (such as caterpillars and saw-fly larvae, as well as plant lice), kerosene emulsion is a sovereign remedy. In some cases it must be used stronger than 5 per cent, perhaps as strong as 8 per cent, but it is well to try this strength on a few leaves and let them dry before making a general application. The newest leaves should be chosen, as they are more liable to be injured. If no discoloration of these is found after they are dry, it is safe to proceed; if they are blackened and wilted, the plant will not stand such strong emulsion.

KEROSENE EMULSION FOR SHEEP SCAB.

We have recently been enabled to test this remedy for sheep scab, which, as is well known, is produced by the work of a small mite in the skin. These mites differ from lice in many characteristics of structure and habits. They are much more difficult to kill, as is illustrated by the fact that two specimens placed in strong alcohol (93 per cent) continued to exhibit signs of life for nine and fourteen minutes respectively. Under such conditions, lice would live but a few seconds.

Twenty gallons of soft water was heated to the boiling point, ten pounds of hard soap (we used Kirk's "Coronet," a cheap brand) was dissolved in it, and five gallons of kerosene added, the mixture was then pumped briskly through a cheap spraying pump back into the vessel. The violent agitation thus produced caused the materials to emulsify in about five minutes. After allowing the emulsion to stand two or three minutes a little free kerosene rose to the top and was skimmed off with a shovel, perhaps to the extent of a pint in all. We then diluted the emulsion by adding forty-five gallons of water, so that it contained about 7 per cent of kerosene. We were careful not to dip any sheep while free oil was floating on the surface.

In all seven sheep were dipped during the progress of the experiment. These were affected by the scab in all degrees, some but very little and others so badly as to be almost entirely naked from its effects, and barely able to walk. They also varied

greatly as to the amount of wool they carried. One was a yearling that had never been sheared and had a very heavy fleece; another had been sheared about six weeks; others, just previous to dipping; while two, although not sheared this season, were almost naked from scab, as stated. These last ones were dipped just as the experimenter was about to return to Brookings and it was therefore impossible to study the effect upon them. Although the weather was rainy and the sheep dried off very slowly, not the slightest injury to skin or wool was shown. On the contrary both seemed to be improved. The dip was used about blood-warm, and it penetrated the scab to a very surprising degree. Except in the very worst cases, it seemed unnecessary to scrub the scabs with a brush (as is recommended with other dips) because they were perfectly saturated in an instant without it. The yellow deposit which clings to scabby wool close to the skin was almost wholly dissolved and washed out.

On making a tolerably close examination of the sheep 24 hours later, using a hand lens, no live mites were found, and but very few dead ones, even in situations where they were known to be living and abundant before dipping. Two days after dipping, a sheep was selected which we had examined several times previously and knew to have been badly infested; this sheep was laid on a table in a good light and tied down, the scabby places were clipped bare and a careful examination of over an hour's duration was made, with the same hand lens used all through the work. The result was that one single live mite was found and quite a large number of dead ones. It is a singular fact that the whole number found was not more than one-tenth of what were alive on the same area two days before. Perhaps part were washed out in dipping, but the matter is not well explained at present.

It was the opinion of several sheep-men who saw the wool after dipping that the cleansing properties of the emulsion would make it a very valuable dip, even where sheep were free from parasites. The wool certainly came out looking remarkably clean and soft. Further experiments are now arranged for to ascertain just what effect upon the value of the wool is produced by this dip.

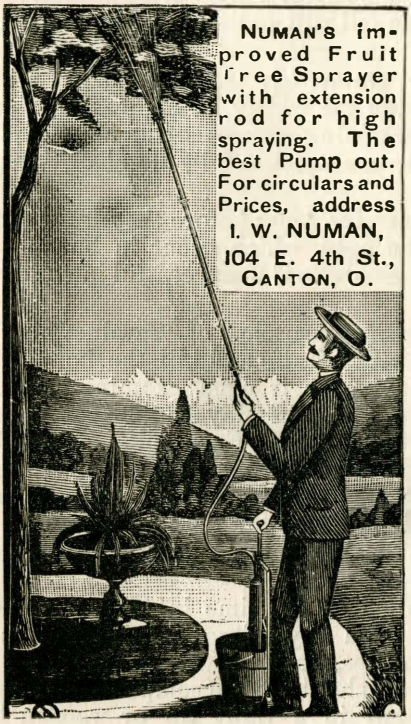
This finding of a single live mite upon the dipped sheep we do not regard as surprising, considering the thoroughness of our search. It is customary to dip twice or three times for scab with any remedy.

The cost of this dip will depend entirely upon the price of soap and kerosene. At the rate of five cents a pound for soap and eighteen cents a gallon for kerosene, the emulsion costs two

cents a gallon. We do not figure the cost of the pump, for a two-dollar spraying pump ought to be regarded as a household necessity, and will pay for itself many times in applying poisons to plants and in other uses.

A CHEAP SPRAYING PUMP.

In order to carry out the recommendations of this bulletin, it is necessary to use some kind of a spraying machine. One that has been used by us for a full season, and has proved very useful and convenient, is illustrated in figure 2. While there are others as good, no doubt, we have found this one well worth the price The manufacturer sells it for $2.00. He also offers 2 for $3.00, 6 for $7.00 and 12 for $12.00, so a club order will be a great advantage.



This machine will not produce so fine a spray as one costing twelve or fifteen dollars. It is therefore somewhat less economical of the material used in spraying, but considering the difference in first cost of the machines and the low cost of insecticides, this is not a serious point to those who work on a small scale.

GENERAL RECOMMENDATIONS.

The following recommendations, based almost entirely upon our own experience, are designed to present, in a form convenient for reference, the best remedies for some of our commonest insect pests.

WILLOW SAW-FLY.—Spray the trees with London purple or

Paris green in water, one pound to 100 gallons. This is a very easy insect to kill and there is no reason why its ravages should continue.

COTTONWOOD LEAF-BEETLE.—Spray as for the willow saw-fly. Thorough work will succeed.

PLANT LICE.—Spray with five per cent kerosene emulsion or with strong soap-suds.

CUT-WORMS.—If possible, have garden spots and cornfields thoroughly burned off the fall before. Protect young garden plants until June 20 by means of old fruit cans set around them. Any land kept *clean* all the fall will probably be free from cut-worms next year.

CECROPIA MOTH (*Large Box-elder worm*)—Collect all the cocoons from the trees during the winter, or before June 1, and destroy all except those containing groups of small white cocoons of parasites. In summer pick off by hand or spray as above.

TENT CATERPILLAR.—Examine trees before they leave out in the spring, and remove the eggs, which occur in bunches encircling the twigs. Spray as above if unsuccessful in collecting the eggs.

ASH BORER.—At the first appearance of "sawdust" on the surface, cut through bark with a knife and kill the borer. To prevent the moths from laying their eggs, examine the trees frequently in June and the last of May to find the holes in which they are preparing to emerge. Each hole is covered by a thin scale of bark, of lighter color than that surrounding it, and readily yielding to the pressure of the finger. Simply thrust the end of a wire into the hole and crush the insect inside.

POTATO BEETLE.—Sprinkle with London purple or Paris green in water, as above mentioned.

We are glad to be consulted at any time in regard to insect depredations, and will furnish any information possible in regard to life histories, remedies, spraying machines, etc. All inquiries in regard to insects should be accompanied by specimens, which should be sent in a tight tin or wooden box. Postage is one cent an ounce.

We are under obligations to the Division of Entomology at Washington for determining the names of part of the saw-fly parasites; also to Professor A. J. Cook, of Michigan, for furnishing description of *Cryptus extrematis*.

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