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NOTES ON

INSECTS AND INSECTICIDES

1888.

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NOTES ON

INSECTS AND INSECTICIDES

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The season just closed has been remarkable for the introduction of some insect pests new to our State. We speak especially of the garden web worm (*Eurycreon rantalis*); the squash bug (*Coreus tristis*); and the false chinch bug (*Nysius angulatus*).

Nothing short of prompt attack with approved remedies could save seedling crops against these foes of agriculture, and the lessons to be derived from the season's work is that cultivators of the soil should be more prompt to avail themselves of those remedies demonstrated to be effective and to use them promptly, if they would succeed in growing crops with any degree of certainty in the future.

We took the first specimen of *Pieris rapae* March 17th; *Pieris protodice* was flying at this time, and also one of the "skippers" (*Eudamus tityrus*), *Vanessa antiopa* and *Milberti* were seen in numbers March 7th.

The codling moth (*Carpocapsa pomonella*) was plentiful toward the end of the month of April, but the hackberry butterflies and white lined morning sphinx moth, so plentiful last season, almost disappeared this year.

Some species of genus *Grapta* were as early and as numerous as ever. The imported currant borer (new here) appeared in force May 26th.

The apple leaf beetle appeared May 7th, and toward the latter part of the month attacked the foliage of the grape.

The moths of the garden web worm appeared early in April and the false chinch bug and squash bug the first week in June.

The parsnip butterfly was a common species in the plains region throughout the State, and to some extent in the mountains late in May. The tomato worm appeared June 1st, feeding on the tomato and tobacco, in particular.

I am indebted to Prof. Howard, of the Department of Agriculture, and Prof. Cook, of the Michigan Agricultural College, for the identification of the garden web worm, and to a number of friends for specimens and facts in regard to some of the species mentioned.

The people of our State may aid much in reaching a better knowledge in regard to the injurious insects of this region by furnishing specimens and information from their several localities. The State is so large and offers such a diversity of climate and agricultural productions, that associated effort of this nature is more imperatively necessary here than elsewhere.

To further this end and to make this section of the Experiment Station as useful as possible to those interested, correspondence and specimens are solicited.

INSECTICIDES.

Remedies used for the destruction of insect life are designed to be effective in either of two ways, according to their structure and mode of life. These may be arranged into two classes: First, arsenical poisons, or such as kill through the stomach; the second represented by alkalies, acids and oil mixtures, which are effective only as they come in direct contact with the insect to be destroyed.

All insects which eat the structure of plants may be readily destroyed by the first mentioned; those which suck the juices only, can be destroyed by the second.

In some cases insect ravages are due to an unthrifty condition of the plant attacked, the result of soil exhaustion, or other untoward conditions resulting in stunted growth, which invites their attack.

Cabbages and cauliflower, if grown in soil lacking in available plant food, are soon overcome by the aphis peculiar to them. Beets, if grown in soil rendered hard and impervious by irrigation and lack of cultivation, soon become a prey to insect attack, whereas had the conditions been favorable these plants oftentimes overcome their insect enemies by their own inherent vigor. It pays therefore to have healthy, vigorous plants only, to keep them doing their best during the growing season, and to adopt a judicious rotation of crops.

INSECT LIFE.

Before considering remedies in detail we will first notice the four stages in insect life, commencing with the egg, from which hatches the larvæ commonly known as grub, caterpillar, maggot, etc. It is in this stage that insects are most injurious, feeding voraciously until they have attained full size, when they change their form, cease to eat and enter the third stage, when they are called pupæ.

Having remained in this stage for a greater or less length of time, they burst their cases and emerge perfect insects to lay eggs and begin again the same round of life.

In some cases these changes are well marked; in others the transformations are less complete, as in the case of plant lice and grasshoppers.

ARSENICAL POISONS.

The various forms of arsenic are beyond doubt the most practical insecticides known to science, especially Paris green and London purple. White arsenic should never be used, because its color is apt to lead to fatal

mistakes, nor can it be as readily mixed as the forms just mentioned.

We have had best success with Paris green, as it acts more promptly than London purple, and is less likely to brown the foliage of the plants treated with it.

We use both mixed with water in the proportion of one pound of the poison to 100 gallons of water. If the solution be made too strong the foliage is injured, and it acts rather as a repellant to the insect.

The exact quantity should be measured out and mixed with warm water into a paste; this is especially desirable for London purple, to secure proper diffusion with the liquid.

These poisons should always be applied through a fine nozzle, and with force; Paris green should especially be frequently agitated to keep the powder in suspension.

Upon vegetables and fruit bearing trees and vines it is important to remember that it can be used with safety only very early in the season.

As a remedy against foliage eating insects, it is simply invaluable.

The intelligent use of these forms of arsenic has rendered possible the cultivation of a wide range of useful plants, which otherwise would be impossible in the presence of the countless enemies of the plant growth of to-day.

WHITE HELLEBORE.

White hellebore is a vegetable poison. It is obtained from the powdered leaves and flowers of *Veratrum alba.* It is less dangerous as a poison than Paris green, but will without doubt cause death if inhaled in quantity. It is a specific against the currant worm when promptly applied, but is much less effective against other insects, and is best used in the dry, undiluted form. It should be kept in a closed vessel, and be applied with a bellows, thus bringing it in contact with all portions of the plant.

PYRETHRUM.

This insecticide is procured from the powdered flowers of two species of pyrethrum. Its ability to destroy insect life resides in a volatile oil, which acts on the nervous system of the insect, and which is readily lost on exposure to the atmosphere—hence the difficulty often experienced in procuring it sufficiently fresh and of the desired strength. It is inocuous to man and the higher animals, and kills insect life only by contact. We have had success with this remedy under glass structures, and when it could be procured fresh have had success with it against smooth-bodied caterpillars out doors. We have not used it this season because of the difficulty in obtaining a fresh article. In using, it should be diluted one to three parts of finely slaked lime or flour, and applied with a bellows. This should be kept in a closed vessel for a day at least, to assure the best result. One pound of the powder properly diluted will treat an acre of cabbage, and if fresh will be effective against the insects mentioned.

ONGARTH'S TREE PROTECTOR.

This is a California remedy, tried here this season for the first time with success. It proved to be very effective against the squash bug, cabbage caterpillars and false chinch bug, or wherever the kerosene emulsion would be effective. Its cost, however, would not permit of its profitable application on ordinary crops as against the kerosene emulsion, which is nearly as effective and much cheaper.

KEROSENE.

This is one of the most efficient remedies against all insect life not affected by the arsenical poisons, causing death by suffocation or by its corrosive action, and its cheapness places it within easy reach. To be applied successfully, however, it must be diluted with water, several formulae for which have been devised by various

parties. We have used the formula of Prof. Riley, of the Department of Agriculture, which is as follows:

Kerosene, 2 gallons.
Water, 1 gallon.
Soap, ½ pound.

The water and soap to be boiled and added to the kerosene, churning the whole violently with a syringe or pump until the materials have assumed the consistence of cream. The emulsion is then diluted, using one part of the latter to nine parts of water. In using it on the young leaves of plants, it is desirable to have a greater proportion of water.

The plant grower must use his own judgment in regard to this. In some cases, as against the woolly aphis on the roots of apple trees, it may be used stronger than ordinarily recommended.

Cultivators should, to avoid the hurry of the growing season, prepare this emulsion in some quantity early in spring before the rush of work, and put in a large vessel, to be corked tightly until needed.

Future work in the arid region will exhibit a necessity for its use on many occasions before a season's work is completed. A prompt application will always prove invaluable in any contest with insect enemies.

APPLYING INSECTICIDES.

Much thought and ingenuity have been given to devising apparatus for the economic and safe application of insecticides.

We have used the Woodason double-cone bellows, and while it is far from being perfect, being liable to clog, still it is the best we know of at present for the application of poisons in the dry form.

To apply insecticides in the liquid form, a force pump is required, which for work on a small scale may be used by hand. On a larger scale we have used this season a Field force pump attached to a tank, the latter placed on the seat

form of a two-wheeled cart, drawn by a horse, one of the wheels operating the pump. This apparatus does satisfactory work on level ground; if the land is rough and the horse unsteady, one is very liable to have accidents in the breaking of minor parts of the gearing. The nozzle used was the "Boss" nozzle, which did satisfactory work. To spray potatoes and not injure the vines, a six-foot axle was used, that the wheels might cover three rows and the horse walk between two rows. This arrangement proved very satisfactory. The tank sent out by this firm is too large for one horse to draw with ease. I see no reason why this pump and two-wheeled cart should not prove an acquisition to potato growers on a large scale, on level ground.

NOTES ON INSECTS.

THE CURRANT MEASURING WORM (*Eufitchia ribearia*).

This caterpillar defoliated a large planting of the Houghton gooseberry, leaving untouched the Downing. The larvæ appear early in May, are white, striped with yellow and dotted with black, and when full grown, late in June, measure nearly one and a half inches in length. This caterpillar moves by looping, or measuring, and dropping by a silken thread, when disturbed. In about two weeks the moths appear, which are of a yellowish, or cream color, with dusky spots or bands on the wings; these lay eggs on the twigs, where they remain until the following season.

THE EUROPEAN CABBAGE CATERPILLAR (*Pieris rapæ*).

This insect was very common this season over a large portion of Colorado, hovering over the cabbages in vast numbers. Our first specimens appeared early in March, and toward midsummer it was one of our most common species. This butterfly is white, spotted with black, resembling somewhat the Southern cabbage butterfly, but the black spots are better defined and the ground color lighter. The larva is pale green, finely dotted with black. This butterfly is two-

brooded, the first appearing early in the spring (March in this region), depositing its eggs, after pairing, on the under side of the leaves; the second brood appears in June, and is most injurious, this brood pupating during the winter.

Remedies—On July 15th and on the 26th of the same month, we made separate trials of the kerosene emulsion and Ongarth's liquid tree protector with success against cabbage worms. The latter was particularly effective, the worms dying whenever struck by the liquid.

THE SQUASH BUG (*Coreus tristis*).

This well known insect appeared in this region in numbers for the first time this season, and proved a serious drawback to the culture of the squash and pumpkin. It hibernates as a perfect insect, and in May appears as the vines are well above ground, feeding on the leaves by day, and depositing their eggs in clusters, glued to the under side of the leaf. The larvæ feed voraciously, soon wilting even the most vigorous vines, and rapidly attain full size. These live throughout the winter, to repeat the season following the work of the previous year.

Remedies—It is of importance, in the case of all insects that hibernate in the perfect state, that we attack them early, when their numbers are limited, and this is especially true of this enemy. The kerosene emulsion and Ongarth's liquid tree protector kept them in subjection.

THE CODLING MOTH (*Carpocapsa pomonella*).

The larva of this moth is the chief pest of our apple orchards in Colorado, as elsewhere, and although a native of Europe, is now found in almost all parts of North America.

The moth is a beautiful object; the fore wings are marked by irregular, heavy bands of pale brown on a grayish ground color, the apex being marked by a tawny, brown spot, streaked with coppery lines. The first specimens are taken here early in March, the moth continuing to come forth for two months later, according to the temperature of the place in which they have wintered.

As the apple is forming the female deposits a single egg, usually in the eye or calyx of the forming fruit; from the egg a larva is produced, with black or brownish head, the body sprinkled with elevated dots, from each of which emanates a minute hair. In about one month the larva, having eaten its way through the core of the apple, revealing its presence by a mass of reddish brown exuviæ protruding from where it entered, leaves the fruit, reaches the ground by means of a silken thread which it spins, and seeking the trunk of the tree spins its cocoon. The early brood change to a chrysalis in three days, and in about two weeks the perfect moth escapes. This second brood is on the wing late in July, the female generally selecting the late apples in which to deposit its eggs. These larvæ mature late in autumn, and spin their cocoons in come secure place, remaining in the larval state until early the following spring, when they change to a brown chrysalis, soon after which the moth appears to begin the work of the season.

Remedies—The old method of bandaging the trunks has been abandoned, as it signally failed to accomplish its purpose, for various reasons. Recourse is now universally had to spraying with Paris green or London purple. This remedy is not only very efficient, but inexpensive and easy of application. We applied London purple April 28th, and again twelve days later, in the proportion of one pound of the purple to 100 gallons of water, using the Field force pump and tank, mounted on the platform of a two-wheeled cart. Every alternate tree in a row of Duchess of Oldenburg was thus treated. This was too strong, as it hurt the foliage considerably. Probably half a pound of the purple to the same amount of water would be quite efficient, making two applications ten or twelve days apart. A similar application of Paris green in the same proportion was made in another orchard April 28th and on May 10th. This proved to be satisfactory; the foliage was uninjured, and but few

fruit affected by the codling moth was found. Careful analysis of the calyx of the fruit was made by Dr. O'Brine, Chemist of the Station, and no trace of arsenic was found—the usual winds and rains of the season secured its dispersion.

For work on a small scale, an ordinary pail and small force pump will do efficient work. The spray is produced by a flat, perforated nozzle, or the cyclone nozzle for large trees, and where many have to be sprayed we use and prefer the "Boss" nozzle. The time to make the first application is as soon as the fruit is formed, and while erect on its stem.

Another good effect of the application of the arsenites at this season is the destruction of all other leaf-eating larvæ, some of which are so injurious to the apple tree in this region during the months of April and May. It is a great gain to fruit-growers in this dry region to know that the arsenites may be safely applied to the foliage of the apple tree without danger to human life when the fruit is fit for table use.

THE APPLE-LEAF BEETLE (*Graptodera foliacea*).

This brassy-green apple insect has been injurious to the foliage of apple grafts and small apple trees for several years in Colorado. It confines its work, however, mainly to the nursery, never working high above the surface of the ground. It does not touch the pear, although working in numbers on apple grafts, on either side of them. It shows, with us, a partiality for some varieties over others, and is sometimes as destructive to the grape as to the apple. It is a pest in every valley in the State where the apple is grown. It also feeds in great abundance on the native species of the genus *Gaura*, so plentiful in this region.

Remedies—Fortunately it is easily overcome. We have to contend with it annually, and find no difficulty in getting rid of it with the arsenical preparation already

noted. On a small scale, a teaspoonful of the poison to a pail of water is sufficient. More than one application may be necessary, however, during the period at which it is active. The first application may be made the last week in May, and in two weeks more another may be necessary, as the beetles fly well and are very numerous. The species may be easily identified by its highly polished brassy-green color, its jumping habit on being alarmed, and its partiality for the apple, although it will occasionally attack the grapevine, riddling its foliage, leaving the framework of the leaf as it does that of the apple.

THE EIGHT-SPOTTED FORESTER (*Alypia octomaculata*).

The larva of this beautiful moth attacks the foliage of the grape annually, in some sections of the State, in large numbers. There are two broods, the first moths appearing in May, and the second in August. The wings of the moth, when spread, expand nearly one and a half inches. It is bluish black in color, with two large, light yellow spots on each of the fore wings, and two white spots on each of the hind wings. It is so strongly marked that it is readily recognized. The larva is a dull white with eight black lines on each segment, and a series of white spots on each side close to the under surface.

Remedies—I have always succeeded in destroying the larvæ of the first brood with a weak application of Paris green in water, in June. For the second brood, if the vines are in bearing, it will not do to apply the poison, but if the first attack has been promptly met, there will not be much trouble from the second.

THE IMPORTED CURRANT BORER (*Ægeria tipuliformis*).

For a few years past the larva of this moth has been injurious to the red currant bush in this State, appearing in this region from the middle to the last of the month of

May. The moths of this family are frequently very injurious to useful plants and are readily recognized by their wasp-like appearance, quick movements, and by the brush-like arrangement at the tip of the body. The moth is nearly one-half an inch long, color deep blue, having three yellow bands across the abdomen, a yellow collar, and yellow and blue markings on the eyes. It flies rapidly, in the hottest sun, but is easily captured. The females deposit their eggs near a bud of the current season's growth, and preferably on the outer branches. The larva, as soon as hatched, eats its way to the center of the stem, where it remains until the following summer, when the moths again appear, to repeat the work of destruction.

Remedies—The presence of the larva may be known by the sickly color of the leaves and the smallness of the fruit. The only practical remedy known, is to prune off and burn the affected branches in early spring. The pruning will also serve an additional purpose in assuring larger and better fruit.

THE GARDEN WEB WORM (*Eurycreon rantalis*).

The most remarkable insect visitation of the year to Colorado was the presence of this insect. The moths appeared in immense numbers late in April, covering the plains and reaching well up into the mountains, and embracing the greater portion of the State. The larva was first described by Dr. Riley in 1873, prior to which time it was unknown.

It is a widespread and very variable species, extending throughout the United States. The general color of the moth is a light or dark gray, marked by two irregular transverse pale lines, and a dark reniform spot on the discal cell. The perfect insect, larva and pupa, are accurately figured by Dr. Riley in the report of the Department of Agriculture for 1885. The larva fed upon a great range of plants—its favorite native food plants be-

ing species of the genus *Chenopodium*, although it fed indiscriminately upon the native weeds here. Among cultivated plants, it attacked all vegetables, except squash, egg plant and Irish potatoes. An acre of tobacco was untouched, but field and sweet corn, wheat, oats, alfalfa, clover and strawberry plants were devastated. On alfalfa, it fed to its tops, and in some cases defoliated young plum trees four feet from the ground. The first larvæ were noticed May 29 (then quite small); from this date to July 15, larvæ of all sizes were working together, and were injurious as late as July 4. The cocoons were readily found in the rubbish at the collar of the plants attacked. The larvæ appear to be gregarious, as they fed in numbers on the same plant, over which they spun an intricate web, along which they traveled with alacrity when disturbed.

Remedies—We made our first application of Paris green June 1st, using one pound of the poison to one hundred gallons of water, which proved to be very effective and not injurious to the plant, but we had to make a second application on the 20th of June, and finally on July 3rd, after which, garden plants that had been treated were not further troubled, although mature larvæ were to be obtained for some days afterwards on fields of alfalfa. We used a hand machine to spray a six-acre garden. On a large scale, and by using the barrel or tank and pump and a good cyclone nozzle, much quicker and cheaper work could be accomplished. Although we have had a formidable visitation of this insect, we do not consider it at all difficult for the gardener to control. The farmer, because of his broad acres and general lack of preparation to meet such contingencies, is apt to suffer most.

PEA WEEVIL (*Bruchus pisi*).

This weevil continues to damage field and garden peas considerably. Our seeds of all the varieties grown this

season are affected more or less. The imagoes are leaving the affected seeds in large numbers this fall, so that our crop of these pests will be lessened next season. The habits of this weevil are generally well understood by gardeners, so that a brief description of its mode of life will be sufficient. The weevil passes the winter in the peas, emerging therefrom about seeding time. As soon as the pods are formed and the seeds set within them, the weevil punctures the pod opposite each pea, and inserts therein an egg which becomes a grub, feeding on the rich store of food within. Here they remain during the winter, changing to the perfect insect in the fall, or before planting time in the spring.

Remedies—The only known remedy for this enemy of the pea is based upon a knowledge of its habits. These insects usually remain in the peas all winter, so that if the affected stock is kept over another season in tight vessels, the beetles are of course destroyed. This is a simple remedy, and if those having stock affected would unite to do this, the evil would be very much lessened in this State.

THE SOUTHERN CABBAGE BUTTERFLY (*Pieris protodice*).

The larva of this butterfly is the most injurious of the cabbage caterpillars to the gardener in Colorado. It was present in this State the past season in force, flitting over fields of cabbages in increased numbers over previous years. Of other cabbage worms we noted: *Pieris orleracea, Pluvia brassicæ and Ceramica picta,* though not in numbers sufficient to cause much damage. The latter species I have taken on the soft maple. The color of the male of protodice is a white with dark bars and spots on the front wings, hind wings without spots; on the underside the bars and spots are repeated, the tips tinged greenish yellow; the veins of the hind wings behind are greenish yellow, spotted with brown scales. The female is of the same color, the dark markings

intensified and showing a tendency to blend. The larva is at first a uniform orange with black head, changing to a greenish blue ultimately, with four longitudinal stripes.

Remedies—Against these caterpillars we applied successfully, on July 26, the kerosene emulsion and Ongarth's liquid tree protector. The latter is the more effective of the two, as it sticks to the foliage better, and, while killing when it comes in contact with the caterpillar, it also seems to render the plant obnoxious to insect life. On the same date applied hellebore as a powder unmixed, and diluted one tablespoonful to two gallons of water. This was not nearly so successful as the others.

THE FALSE CHINCH BUG (*Nysius angustatus*).

This insect appeared in market gardens in this vicinity last June for the first time. It first appeared on radishes, clustering in large numbers in the shade of the leaves near the ground. It next attacked a field of turnips, showing a preference for certain varieties, but avoiding all varieties of the rutabaga. It also did some damage to cabbage and cauliflower, but confined itself particularly to the two plants mentioned. It bears a striking resemblance to the chinch bug proper. The latter, however, has a dark head and thorax and two conspicuous black spots on the front wings. The true chinch bug feed almost entirely on the cereals and grasses, whereas the species under consideration favors cruciferous plants, and is of a paler and more uniform brown color.

Remedies—This is by far the most difficult insect with which I have had to contend the past season, because of its rapid movements and great numbers.

Applied the kerosene emulsion, diluting the latter with nine parts of water; also applied Ongarth's liquid tree protector, and hellebore, both as a powder and mixed with water. The first two are very effective whenever the liquid comes in contact with the insect, but owing to their vast numbers and ability to fly, only a small proportion of them

could be killed at one application. These insecticides were applied on July 26th, August 3rd, 11th and 21st. The hellebore seemed to be far less effective than the other two remedies. We consider this the most dangerous insect with which we have had to contend for years. There are probably two or three broods annually, and it passes the winter as a perfect insect, hence it would be desirable to burn all weeds and tops of vegetables, so as to afford them as few hiding places as possible.

FOREST TREE INSECTS.

The cottonwoods are defoliated annually by the larva of the cottonwood beetle (*Plagiodera scripta*), but are held in check by the common blackbird.

Several species of *Pemphigus* cause galls to form on the stems and leaves of the species of cottonwood. The poplar gall louse wanders in immense numbers up and down the stems and trunks of the smooth bark cottonwood in fall.

In Southern Colorado the poplar borer (*Saperda calcarata*) is injurious to *Populus angulatus* and the Lombardy poplar.

The larva of the moth *Tortrix roseana* is a general feeder, but works particularly on the young leaves of the apple in May.

The box elder is defoliated annually by the leaf-rolling caterpillar (*Cacœcia senifera*). The larva is green with two longitudinal white stripes. The blackbird feeds on them in large numbers.

The elm-leaf caterpillar (*Vanessa antiopa*) feeds on the elm and willow, and occasionally on the cottonwood. The larvæ are gregarious while feeding, and present a formidable appearance. It is the earliest butterfly to appear in spring, being on the wing in favorable weather in March.

Pear-tree slug (*Selandria cerasi*). This insect seems to prefer the leaves of the plum; it but rarely attacks the cherry or the pear in Colorado. There are two broods

annually, one late in June and another in August. The slug feeds on the lower as well as the upper surface of the leaf, completely skeletonizing it. The last brood is especially injurious.

Larvæ of the butterflies *Grapta interrogationis* and *Grapta progne* feed on the foliage of the elm and native hop vine.

Larvæ of the forest tent caterpillar feeds on the foliage of *Populus angulata.*

The common elm aphis disfigures the foliage of that tree annually.

The large caterpillar of *Telea polyphemus*, one of the silk worm moths, feeds on the apple and the elm in this locality.

NOTES ON MISCELLANEOUS INSECTS.

Rhyncites bicolor, a beetle with bright red body, black legs and sides, feeds upon roses and the raspberry in large numbers. The mature insect is sluggish, drops to the ground when disturbed ; hence is not difficult to destroy.

Systena mitis, a leaf-eating beetle, has been destructive to a variety of plants for two seasons. The potato, beet, bean and tomato were seriously injured. The beet and other *Chenopodiaceæ* suffered most. The beetle (*Chrysomela exclamationis*) bears a general resemblance to the potato beetle, and is very numerous in the State, generally feeding, however, on no useful plant, confining itself to the species of sunflower, so numerous on the plains.

Collops nigriceps, a beetle with reddish thorax and abdomen, feeds on the beet, but not in large numbers.

Conotrachelus leucophaetus, a dark brown beetle resembling a dried bud, and a near relative of the plum weevil, feeds on the beet, but not in large numbers here.

Selandria rubi, the raspberry saw fly, a four-winged hymenopterous insect, appears in this region early in

May, laying its eggs beneath the skin of the raspberry leaf. The larva is the color of the leaf, but its work reveals its presence. It may be destroyed by hellebore, an ounce to a pailful of water.

The cabbage and turnip aphis are always destructive in a dry climate. The kerosene emulsion will kill them whenever they can be reached. It is not difficult to counteract them, if the work is begun in time. The work of these aphidæ may, however, be lessened by planting those plants in rich ground only. If they once become stunted, then this insect will work their destruction.

The blister beetles (*Lytta cinera* and *Lytta attrata*) we received from the Arkansas Valley this season. They feed voraciously on the potato, beans and other garden vegetables. We are annually more or less troubled with the striped flea beetle (*Haltica striolata*). These beetles are very small, but active, and are present usually in great numbers on cabbage, radish and turnips, while the plants are still small. We made one application of Paris green on June 2nd, and succeeded in saving the plants.

Grasshoppers were very injurious in various portions of the State, owing to lack of rain on the range, rendering the latter destitute of green herbage.

The corn worm (*Heliothis armigera*), is annually injurious to corn in the ear wherever the plant is grown in the State. The moths were abundant in the month of October in Southern Colorado this year.

The bee killer (*Trupanea apivora*). This fly is numerous enough on the plains and in the mountains. It is said to prey especially on the honey bee. We have witnessed it the past season at high elevations in the mountains attacking and killing dragon flies (*Libellulidæ*). It seizes these powerful flies on the wing, and, after a severe struggle, both fall suddenly and with force to the ground, where both are readily captured.

The three-lined leaf beetle (*Lema trilineata*) was noticed in numbers on the tomato and potato. The larva is read-

ily distinguished by its covering itself with its own excrement. The beetle is difficult to take, as it flies quickly in the hot sun.

Two undetermined species of *Erythroneura* work on the foliage of the apple and grape throughout the growing season.

The species on the grape affects the smooth leaved varieties most. As the insect hibernates in the perfect state, clean culture by burning all decaying vegetation in the fall will aid much in their suppression. As a remedy we have used the kerosene emulsion with success, applying it early in the day, when the insects are sluggish.

Circular of the Chemical Section.

The Station is prepared to analyze and test fertilizers, cattle food, soils, milk, butter, water and other agricultural materials and products, and to give information on various subjects of agricultural science, for the use and advantage of the citizens of Colorado.

The Station makes these analyses *free of charge* for the citizens of Colorado, only on the following conditions:

1. That the results are of use to the public, and are free to be published as a part of the Station report.

2. That all questions in regard to the articles will be *truthfully answered* by the party or parties sending them.

3. That the sample be selected according to the instructions of the Station for sampling the same, and the person sending it sign the certificate.

Work done for individual benefit will be charged for at moderate rates.

All other chemical work proper to the Experiment Station, that can be used for the public benefit, will be made free of charge.

The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good.

Results of analyses or investigations that are of general interest will be published in bulletins, and can be obtained of the Secretary, HON. FRANK J. ANNIS, Fort Collins, Colorado.

INSTRUCTIONS FOR PROCURING SAMPLES.

Samples of water to be analyzed should be, for *ordinary* water analysis, one gallon; for *mineral* analysis, three gallons

and should be put up in *clean glass vessels*, with a *clean, new cork*, and completely filled and sealed.

Samples of milk should not be less than one pint, and should be *thoroughly mixed* before being taken.

Samples of rocks, coal or minerals should be selected by pulverizing twenty pounds to the size of hickory nuts, and selecting from these one pound.

Samples of fertilizers are made by taking a sample from the unbroken package at the top, middle and bottom; these are intimately mixed on paper, and a quart selected and put in a clean, dry bottle and well corked. *All expenses must be prepaid to the Station.*

In justice to manufacturers, dealers and consumers alike, the Station will make gratuitous analyses of the commercial fertilizers, only on samples taken by the agent of the Station, or on such other samples as are fully described on the Station forms for description, and taken in accordance with the Station instructions for sampling, and, furthermore, are properly authenticated by the certificate of the person drawing the same, and in addition, a witness who is a responsible person in the community, or the dealer from whose stock the sample is taken.

Send with each sample any printed circular, pamphlet, analysis or statement that accompanies the article, or is used in its sale.

As soon as an analysis is made, a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for explanation or protest, if desirable, before the results are published in the bulletin.

Samples of soils are taken according to the object of analysis, either, (1) from *one* or from *several* spots in the field. (2) In case several portions of earth are taken from points distributed in a regular manner over the field, all of which are carefully mixed together and ten to fifteen

pounds of the mixture, free from any large stones, are preserved as the average sample.

"Have a wooden box made six inches long and wide and from nine to twelve inches deep, according to the depth of the soil and sub-soil of the field. Mark out in the field a space of about twelve inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil, with its sub-soil, from nine to twelve inches deep; trim this block or plan of the field, so as to make it fit into the wooden box; invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box and nail on the lid. The soil will then be received in the exact position in which it is found in the field. In case of very light, sandy and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out." The above directions are issued by the Royal Agricultural Society for samples of soil for analysis.

Samples will be analyzed as promptly as possible, in the order in which they are received.

It is important that samples for analysis should be taken at the time when the fertilizer is purchased, and *immediately sent* to the Station.

I, the undersigned, certify that the accompanying sample, marked ———, was taken by me from full packages, and in accordance with the Station's instruction for sampling, and, to the best of my knowledge and belief, fairly represents the stock from which it was drawn, and that said stock when sampled was properly housed, and in good condition. I also certify that the foregoing description is correct.

Signature.

Postoffice address.

The above described sample was taken in my presence.

Signature.

Postoffice address.

Each sample sent for gratuitous analysis must be accompanied by a description made by filling out legibly and as fully as possible the blanks below.

1. Sampler's mark or name.
2. Brand.
3. Name and address of manufacturer.
4. Name and address of dealer.
5. Date of taking this sample.
6. Price per pound, ton or package.
7. For what purpose it is used.
8. The percentage of valuable ingredients, if known.
9. Such other information as the Station may require.

Copies of bulletins issued by the Station may be had on application to

THE AGRICULTURAL EXPERIMENT STATION,
Fort Collins, Colorado.