



Oklahoma Agricultural  
**Experiment Station.**

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STILLWATER, OKLAHOMA.

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# Oklahoma Experiment Station,

STILLWATER,

PAYNE COUNTY, OKLAHOMA.

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PREFACE.

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These notes have been prepared in answer to many inquiries and aim to give in plain, untechnical language some information deemed valuable to Oklahoma farmers.

## STATION NOTES—Insects.

[ J C. NEAL. ]

Several insects have proved quite destructive to crops on the Station farm, and as these are no doubt common to all parts of Oklahoma, this Bulletin will give brief and plain descriptions of each, with methods used in mitigating their ravages.

The subject of prevention of insect pests should be of intense interest to farmers, whose loss annually average ten per cent. of their crops—often, however, a much greater proportion. (*Lintner.*)

Much of this waste may be saved by the proper use of remedies.

It may be remarked, that in the lives of most of our insect depredators there are periods when they are either at a minimum of numbers or strength, and thus in a condition inviting attack. This is fortunate for agriculturalists, and one aim of this Station is to ascertain these danger periods and weak spots in the defense line of our enemies and thus be the better able to plan methods of prevention, mitigation or extermination of these ubiquitous pests.

The Station will co-operate willingly with farmers at all times, and invites correspondence upon the subject.

Many are unaware of the extent of the losses incurred from insects, and it may not be a miss to justify these statements by reference to published statistics.

A full crop of agricultural productions in the United States is now estimated to be not less than \$3,800,000,000 in value, and the loss from attacks of insects to be \$380,000,000.

In 1864 three-fourths of the wheat and half the corn of the Northwest states was destroyed by the chinch bug. (*Blissus*.)

In Illinois alone this meant a loss of \$73,000,000. (*Dr. Shimer*.)

In 1871 from the same cause, the same section incurred a deficit of \$30,000,000, and in 1887 it was \$69,000,000. (*J. R. Dodge*.)

This year, only the recent heavy rains saved the present tremendous crops of oats, wheat and corn in Oklahoma from complete destruction by this insignificant enemy.

Another insect, the *Heliothis armigera*, damages cotton, corn, sorghum and garden crops to an enormous extent each year, in its varied characters of boll worm, bud worm, tomato worm, tobacco worm, etc.

If Oklahoma ever unfortunately becomes a "Cotton State" this worm with the cotton moth, *Aletia*, and the cotton stainer, *Dysdercus*, will make the planters' life very weary indeed.

In Florida I have seen flourishing cotton fields ruined within a week by the cotton moth, and large truck patches of tomatoes rendered nearly worthless by the ravages of the bud-worm.

The loss in eight cotton states from the *Aletia* in ten years was not far from \$200,000,000. (*Riley*.)

It is astonishing that we get anything from orchard or garden, when we think how beset both are with curculios, gougers, borers, scale insects, leaf miners, tent caterpillars, plant lice, leaf rollers, flea beetles, slugs, cut worms, bugs and other insect foes.

The tremendous tax thus paid is gathered from many illy able to lose time, money and labor. The poor are least apt to resist these myriad oppressors, with remedies requiring expensive means of application, and of course on them the burden falls heaviest. Still at times, rich and poor fare alike, as when a periodical invasion takes place, like the army worm in 1861, the potato beetle in 1864, or the grass hoppers of 1873 to 1876, when the losses reached an enormous amount.

These instances certainly justify every effort in saving part of this awful waste, and it is hoped the Bulletins of this Station may contribute their mite to attain this result.

I have noted recently a few specimens of a dangerous enemy to cabbage, turnips, mustard, etc. This is a new cabbage worm.

THE IMPORTED CABBAGE BUTTERFLY—*Pieris rapæ*.



FIG. 1. MALE.

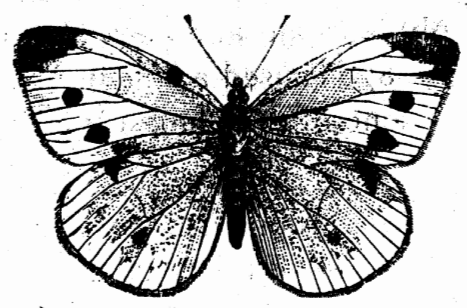


FIG. 2. FEMALE.



FIG. 3.  
a. Larva. b. Cocoon.

Perfect insect; wings white, or yellowish white with dark margins at outer angle of front wings; male with one, female with two or more dark spots near the center of the fore wings; eggs yellowish white, laid on under side of leaves of the cabbage family. They hatch in eight days into pale green worms that greedily eat the leaves, then bore to the heart of the cabbage, in two weeks attain the length of 1 1-4 inches, then leave the food plant and transform into a light green chrysalis, usually upon weeds near by. In two weeks more they emerge as butterflies. These are the usual periods, though the last brood remains in the cocoon over winter.

Spraying young cabbage early in spring with a dilute emulsion of kerosene, formula No. 6, or the Paris green formula No. 1, is very effectual, and this last not attended with danger if used some time before the plants begin to "head up." I prefer the use of Pyrethrum, or Insect powder, either as a spray—one ounce to the gallon of water—or, for small patches, used dry, with a powder-gun, on plants after rain or when wet with dew.

Prof. Bruner reports using fine corn meal thoroughly dusted over the plant, but I have not tried that, or buck-wheat flour, also occasionally spoken of in agricultural papers. Weak kerosene-pyrethrum emulsion, formula 11, perhaps is the best of all remedies. The ordinary practice of allowing old cabbage stalks to remain and sprout, simply is to aid and abet the continuance of a pest that in 1870 caused a loss in the vicinity of New York City alone of over half a million dollars.

Better clear up the garden, burn up old radish, turnip and cabbage stalks, rubbish, etc., and aid the

reduction to a minimum of these insect enemies of valuable food plants.

THE CABBAGE PLUSIA—*Plusia brassicæ*.

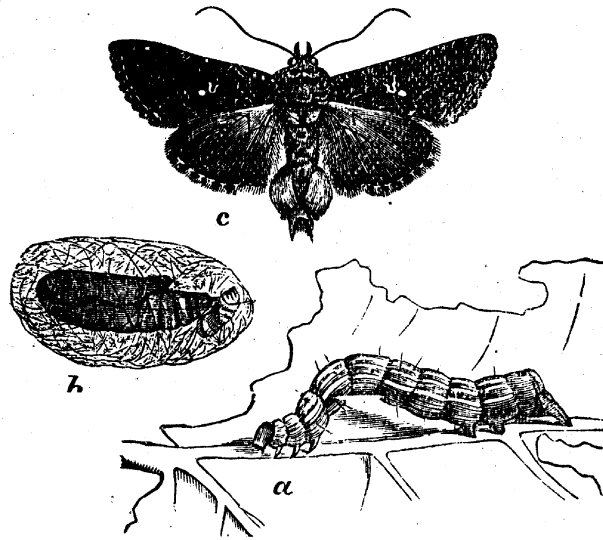


FIG. 4.

a. Larva.    b. Cocoon.    c. Moth

This cabbage worm occurred on the Station farm in great numbers, not only on cabbage but turnips, lettuce, celery and tomatoes. The moth flies at night, is dark brown-gray, with a silvery dot and U on each front wing, near the center. These insects pass from eggs to moths in from three to four weeks. The worms are apple green, with lighter lateral stripes on the back and side. When grown they spin a fine silken web, usually on the leaf of the food plant, and emerge from a brown chrysalis two weeks afterwards. There are, perhaps, five broods annually in Oklahoma.

The remedies for this worm are the same as for the *Pieris*. The *Plusia* will be easy to keep in subjection as it is attacked by a large number of insect foes, and subject to a bacterial disease that in a few days literally reduces it to a greasy spot on the leaf. This last



trouble, I hope, may eventually be utilized and the germ propagated.

### CUT-WORMS.

These are the larvæ or second stage of growth of several night flying, small, gray moths, mostly of the *Agrotis* family.

The eggs of these moths are laid on leaves of grass or weeds, near the ground. They hatch into worms that subsist on tender vegetation, feeding during the night, hiding in the day. At the approach of cold weather they burrow into the ground several inches and hybernate, coming to the surface in the spring to devour any succulent growth they can find. Some species cut off the plant, some climb even several feet to destroy buds and leaves of shrubs or small trees, some drag portions of leaves into their hiding places to be eaten during the day.

There are probably two broods each year in Oklahoma.

Deep plowing just after the first sharp, cold weather will destroy the protecting cells in which they become dormant, and expose the tender worms to attacks of birds, insect foes and the inclemencies of the weather.

Early in the spring make small balls of grass, clover, chopped cabbage or turnip leaves, sprinkled with Paris green, and distribute freely over infested patches—better cover the balls with chips, shingles or pieces of boards. The worm will eat these poisoned balls readily, as they naturally resort to places of shelter during the day, and finding both shade and food at hand, eat and die.

Where this cannot be done, and in badly infested fields, small holes around the plants will trap most of

the worms. Make the holes with a smooth stick, like the top of a broom handle.

A rim of stiff paper projecting above the cabbage plant two or more inches when set out will protect small cabbages. Devices, like salting the ground, or spraying, as a preventive, never seemed to be of value where tried.

THE BOLL WORM—*Heliothis armigera*.

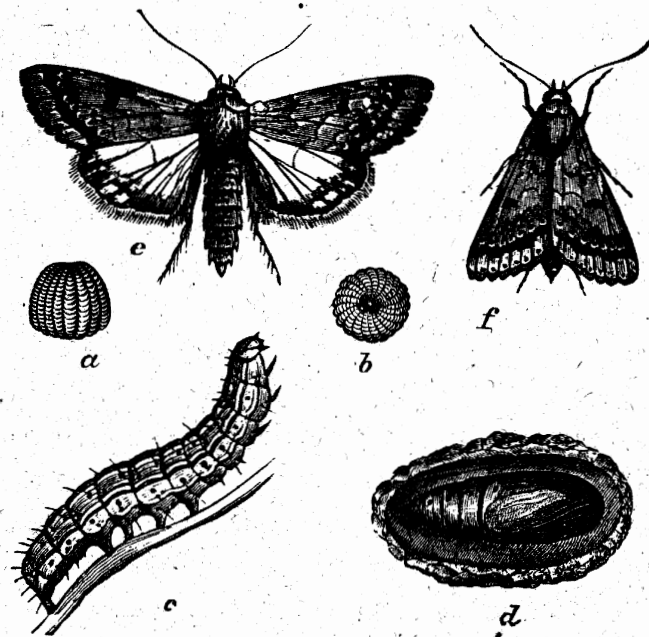


FIG. 5.

*a. b.* Eggs.    *c.* Larva.    *d.* Cocoon.    *e.* Moth.  
*f.* Same, resting.

(The eggs are drawn greatly magnified).

This year this insect proved very destructive to our early corn, varieties like Dakota Dent, Cory, Angel of Midnight, etc., suffering. At first the worms attacked the central parts, then the tassel, then the silk and the tender grains. In a small plot of very early corn not an ear escaped. Later varieties will suffer but

slightly, and it would seem that corn tasseling the last of June will almost escape loss. Perhaps we may yet find both the time for planting and the variety of corn to elude this pest.

This worm is almost omnivorous, though it has special liking for pod-bearing plants, such as cotton, okra, tobacco, pepper, peas and beans, or fruits, like tomatoes, melons, egg-plant, cucumbers, figs, peaches, plums and grapes. It is not averse, however, to young shoots of corn, sorghum and sugar-cane, and various plants, as hemp, mallow, gladiolis, etc. This year I found it in the pods of the *Astragalus*, (*A. caryocarpus*) or prairie-dog plum.

The engraving gives a very correct idea of the worm in its varied forms. The moth is tawny yellow, and flies from 5 p. m. to 7 a. m., with a quick, jerky motion, save when feeding, then it softly flutters. The female lays about two hundred eggs, and as there are most likely five generations in Oklahoma, it is not difficult to see how easily they could reach the number of 2,202,020,200 worms as the progeny of one moth in one year. Fortunately for us, there are friends as well as foes among insects, and the worms themselves are cannibals, the stronger devouring the weaker.

The worms vary in color—green, brown, gray, pink and nearly black. They feed three weeks, descend into the ground some four or five inches, form oval cells, which they line with silk, transform into brown cocoons and in three weeks emerge as moths.

The last brood, however, remains in the ground till spring, though the finding of perfect moths as early as January this year, would indicate a possibility of hibernation as moths in this section.

Late experiments by Prof. Malley show the inutil-ity of using fires or poisoned sweets, and that perhaps

it is best to hand-pick the early corn, even planting corn very soon for the purpose, and crushing the first brood found in the shoots or silk. This will diminish the second or most destructive generation. Then it is well to plow deeply in the fall, when the pest makes its minimum of numbers. These plans are especially recommended.

There seems to be a periodicity about the increase of these insects, and this year these are unusually abundant, so cotton growers may expect great trouble from this cause.

THE STRIPED MELON BEETLE—*Diabrotica vittata*.

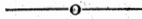


Our melons, cucumbers and pumpkins have suffered severely by two beetles, or hard shelled insects, the most prominent being the yellow and black striped bug figured above. These beetles in their earlier form as white grubs, tunneled the stems near the roots. Later on they ate the foliage, the young shoots and the center of the blooms. Now they have attacked the melons from beneath, and are eating holes in the rind. These places decay rapidly, and the unseen damage will be considerable.

These beetles have been hard to manage. Paris green in spray, or mixed with ashes or flour, seemed to do some good, but they were in such numbers that they often ruined plants in one night. Snuff and sulphur, snuff and ashes, kerosene emulsion and pyrethrum all have some effect, dusted or sprayed over the vines early in the morning. Small boxes covered with thin muslin cheese cloth, or oiled paper, placed over young plants often will prevent the access of the insects

to the stems, and should be used, as every effort should look to hindering the depositing of eggs for the first brood.

Along with this insect is another, the Twelve Spotted Cucumber Beetle, *Diabrotica 12 punctata*. The body is yellow, the head black. There are six dark spots on each yellow wing cover. The habits of this beetle are similiar to the *vittata*, but it also eats the buds of fruit trees, tender corn shoots, beans, etc. The treatment is like that for the *vittata*.



Our trial plats of clover, lupins and lentils were nearly ruined this spring by the Gray Blister Beetle, *Lytta cinerea*. A spraying of Paris green stopped them.

The larvæ of this beetle are said to prey upon the egg-clusters of various grasshoppers, and thus are beneficial, but if the appetite of the beetle for the clovers increases it may require regulating.

This beetle is well known, gray till handled when it becomes black. It is about three-quarters of an inch in length and hybernates probably here in the perfect state. The juice blisters like the Spanish fly, and can be used as a substitute for that vesicant. Formulas 6, 8, 11 can be sprayed upon plants without danger.

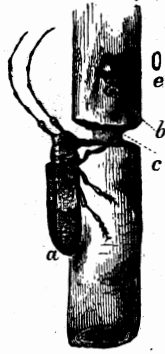
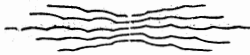
THE TWIG GIRDLER—*Oncideres cingulata*.

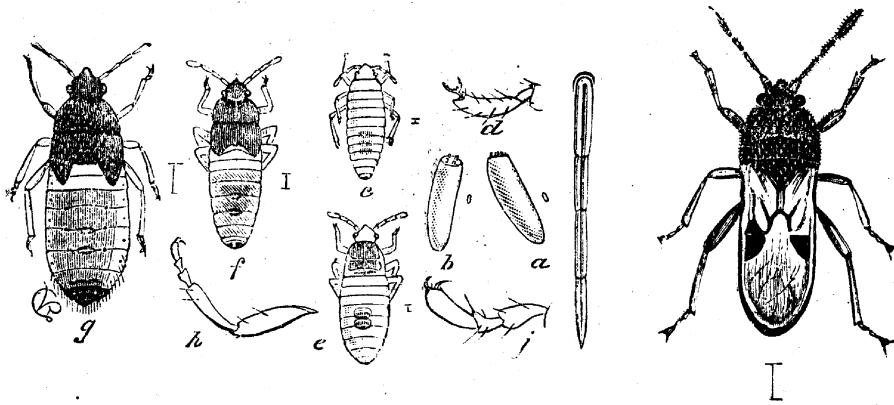
FIG. 7.

*a.* Perfect Insect.      *b.* Incision for Egg.      *c.* Cut  
Around Twig.      *e.* Egg.

This gray beetle has been reported to me as doing some damage to young orchards and pecan trees. It deposits its eggs in small incisions in the bark, then cuts a deep furrow around the limb, *below* the eggs. This kills the limb which soon breaks off. The grubs feed on the decaying bark, and when mature are ready to enter the ground, where they change to a chrysalis, and remain till the next spring.

With an insect so well guarded the only thing apparently available is to collect the fallen limbs and burn them, thus destroying the future brood.



THE CHINCH BUG—*Blyssus leucopterus*.

*a.*, *b.* Eggs Enlarged.      *c.* Eggs Just Hatched, Larvæ  
*e.* First Molt.      *f.* Second Molt.      *g.* Pupa.  
*i.* Enlarged Proboscis.

(The hair lines indicate natural size.)

This insect appeared in the oats the last of May in small numbers, and later attacked the corn. Heavy rains prevented it doing much harm. It is, no doubt, indigenous to this section. The engravings give a good idea of the insect, and its peculiar odor will often betray its presence.

The second brood hibernates in a mature state, usually under leaves and trash at the edges of fields. In the spring the female lays two hundred to five hundred eggs during three weeks, on roots of grass or grain, either beneath the earth or near the surface. In two weeks they become the red larvæ, and in forty to fifty days are mature insects. After doing damage to wheat and oats they migrate to the nearest corn or sorghum field and attack the lower part of the stem, often nearly filling up the lower axils or "boots," of the leaves. Their minute puncture induce decay, the leaves wither, the stem weakens or breaks.

Although provided with wings they rarely use them, usually migrating a-foot.

It will be hard to exterminate an insect having such a range of food—the grass family—as it has in Oklahoma.

Clean culture should be practiced, and at the first heavy frost, burn corn stalks, rubbish, wheat straw and and “trash” to destroy as far as possible the hybernating bugs. Rotation of crops should be adopted, land intended for corn, oats or wheat should be heavily fertilized in the fall, so that an early, strong growth of such crops shall take place. It is also recommended to sow winter rye among the wheat. This furnishes an early food relished by the bugs in preference to the wheat.

Late plowing also would aid in the destruction of this pest.

The most effective remedy, and one we tried at the Station, is the “Chinch Bug Fungus.” This proved fairly effective, and if there was a general concerted action by farmers early next year in spreading this disease, it would seem that the chinch bug could be reduced to the minimum of numbers rapidly.

#### THE HORN FLY—*Hematobia serrata*.

This insect, as far as I know, has not appeared in Oklahoma, but may soon be expected, and it is well to warn farmers in advance.

First noticed in New Jersey in 1887, it was in Virginia in 1889. It is now in Florida, Mississippi, (*Weed*) and in Audrain county, Missouri, “in such numbers that it is almost impossible to milk the cows. Cows fall off in milk and cattle in flesh.” (*Eckler*.)

It is smaller and darker in color than our small



house fly. The eggs are deposited in fresh cow droppings, hatching in a day into grubs. These change to brown *pupæ* in ten days, and into flies in about two weeks from the egg.

Here we may expect them to pass the winter, both as flies and *pupæ*.

There are some eight or nine generations each year and the increase is wonderful. Herds attacked by these flies have no rest whatever during the day, being driven to frenzy by the ferocious biting around the flanks, back and nose. If the cow can rub or lick the itching spot, the skin soon is rubbed off, and an ulcer formed. This the flies attack, and blood-poisoning of the animal often ensues with fatal results.

When numerous, these flies settle around the base of the horns, forming a thick belt for two or more inches along the horns, though later on, they rest on the back or near the udder.

Dark cattle suffer most, for some reason.

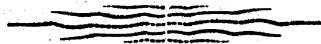
#### REMEDIES.

Where possible, with single cows, keep in a dark stable during the day, and turn out to feed at night.

Axle-grease, diluted with an equal amount of lard, or snuff one part, lard twenty parts, rubbed over the inflamed or irritated places will help a little, but nothing is better than spraying, using Formula 10, or still better, Formula 11.

One or two sprayings a week will soon diminish the furious host of blood thirsty insects.

Cattle at first do not like the spray, but soon realize its import and seem to enjoy it. (*Weed*).



## FORMULAS.

The application of poisons directly to the food-plants of insects, either as a liquid in spray or in powder, certainly will aid in greatly lessening the losses the farmer usually sustains.

Tobacco, veratrum and a few other vegetable poisons have been used, but the preparations of arsenic or Paris green and London purple, held in suspension in water are perhaps most valuable, especially for insects that devour the substance of leaves or bark.

Sucking and hard-shelled insects are easier conquered by emulsions of kerosene and essential oils, or powdered pyrethrum flowers.

To apply these insecticides efficiently, requires especial apparatus, and nothing is better for gardens and small trees than some of the many forms of "knap-sack sprayers" with "cyclone nozzles."

These cost usually about \$15.00 each, and if a neighborhood unite in the purchase of one, the cost will be a trifle to each farmer, as one seasons' use will more than repay the expense.

For orchards, larger barrel and field force-pumps are now on sale, and are a necessity.

The Formulas I give are calculated usually for the ordinary size of "knap-sack sprayer," three gallons.

FORMULA I.—Dissolve one-quarter pound hard soap in a gallon of hot water. Moisten seventy grains Paris green and add it gradually to the water, by "pumping" it repeatedly through the seive at the top of the sprayer. When of uniform color, add water to make three gallons, and mix thoroughly.

This is certain death to most insects, but should be applied with considerable force, and in fine spray to get good results.

Many authorities recommend three ounces Paris green to fifty gallons water. I think for this dry climate this too strong, and that it will scorch the leaves badly.

FORMULA 2.—PARIS GREEN AND LIME WASH—  
Make a thin white wash, one peck lime to fifty gallons of water, strain and mix two and a half ounces Paris green. Stir thoroughly before using.

I applied this the last year to a peach orchard, with a noticeable effect in the diminution of peach aphides and curculios.

Use Formulas 1 and 2 in quantities for orchards as soon as the blossoms fall.

FORMULA 3.—The same as No. 1, substituting forty-five grains London purple.

FORMULA 4.—As No. 2, using one hundred and twenty grains London purple for the Paris green.

FORMULA 5. — STANDARD SOLUTION — Dissolve one pound "sal-soda" in one quart of water over the fire. When boiling add slowly one pound powdered rosin. Stir, and when dissolved, gradually add hot water till five gallons are obtained. In this boil seventy grains "white arsenic" till dissolved, and strain the mixture.

For three gallons, diluted for use, take one quart of the Standard Solution, add eleven quarts warm water. This kills speedily all bugs, worms and soft-bodied insects, but should not be used on vegetables or fruits.

FORMULA 6—KEROSENE AND SOAP EMULSION—  
Dissolve six ounces hard soap in three quarts hot water. Boil. Take from the fire and slowly add three pints kerosene. With the spray-pump combine, by passing it around through the machine several times, till a creamy emulsion is formed. Dilute this with warm water to make three gallons.

Apply this at night, or during cloudy weather. It rarely injures trees or vines, and kills all forms of insect life.

FORMULA 7—Standard solution of No. 5 lukewarm, one quart, combine by the sprayer one pint kerosene, and dilute to three gallons with warm water. This destroys the woolly louse of the apple, and all scale insects.

FORMULA 8—The whites of three eggs beaten up with three tablespoonfuls of sugar. Add three pints water, then with the sprayer emulsify one pint kerosene and dilute to three gallons.

FORMULA 9—One pint kerosene emulsified with one quart sour milk, dilute to three gallons. This takes more labor to make, but is a good emulsion.

FORMULA 10—Use one quart kerosene in Formula 6 for horse-flies, tent caterpillars and large bugs.

FORMULA 11—To three pints kerosene add two ounces insect powder, let it remain over night. With this make an emulsion as in No. 6, but this combination is reputed to be valuable when diluted to even one hundred gallons of solution.

FORMULA 12—Boil four ounces tobacco in two gallons water, strain and use either alone or with kerosene or Paris green.

FORMULA 13—Emulsify one-eighth ounce oil of tansy with soap and water to make three gallons.

FORMULA 14—One pound hellebore powder, added to fifty gallons water, is valuable in the destruction of various slugs and saw-flies, especially those infesting currants and roses.

FORMULA 15—Infusion of quassia chips makes an exceedingly bitter solution, not poisonous, that deters many insects from eating foliage, and is valuable for potted plants.

FORMULA 16—Dry Paris green one part, flour or ashes thirty parts, well mixed and sifted, can be applied by shaking through a thin sack. This used on plants wet with dew destroys most leaf-eating insects. Care should be taken to go with the wind when applying this to prevent inhaling the poison.

FORMULA 17—Snuff and flour of sulphur, equal parts, dusted over young plants will deter flea-beetles or squash bugs.

FORMULA 18—Sifted ashes one quart, kerosene one tablespoonful. Mix well and use by sprinkling the powder over and around young plants.

FORMULA 19—Snuff one part, flour of sulphur one part, well mixed, is of some value as a discourager of insect attacks. Apply only to melons, squashes and cucumbers.

FORMULA 20—One ounce pyrethrum powder—insect powder—to a gallon of water, or mingled with dust or flour, is an effective remedy. It has the merit of being not poisonous.

