The miscellaneous species found by the writers include, in the order of their abundance, *Tribolium confusum* Duv., *Henoticus serratus* Gyll., *Cathartus* (*Ahasverus*) *advena* Waltl., *Typhaea stercorea* L., *Anthrenus verbasci* Oliv., *Lepisma saccharina* L., *Ptinus brunneus* Duft., *Tribolium ferrugineum* Fab., *Attagenus piceus* (Oliv.) and *Trogoderma* sp.—8-22-36.

Literature Cited

(*1*) **Back, E. A.,** and W. D. Reed, 1930. *Ephestia elutella* Hübner, a new pest of cured tobacco in the United States. Jour. Econ. Ent. **23**(6):1004–6. Dec.

(*2*) **Howard, L. O.** 1900. Principal insects affecting tobacco. U.S.D.A. Farmers' Bul. **120**.

(*3*) **Jones, C. R.** 1913. The cigarette beetle, *Lasioderma serricorne* Fab., in the Philippine Islands. Philip. Jour. Sci., Ser. **D, 8**:1–39.

(*4*) **Kearns, C. W.** 1934. A hymenopterous parasite, *Cephalonomia gallicola* Ashm., new to the cigarette beetle, *Lasioderma serricorne* Fab. Jour. Econ. Ent. **27**(4):801–6. Aug.

(*5*) **Mokrzhetskii (Mokrzecki), S. A.** and A. T. Bragina. 1915. Report of the Entomological Laboratory of the Experimental Station of Salgir for 1913–14. Simferopol, Crimea. 9 pp. (Russian text; abstract in Rev. Appl. Ent. **3**:613.)

(*6*) **Runner, G. A.** 1930. The tobacco beetle: an important pest in tobacco products U.S.D.A., Dept. Bul. **737**.

(*7*) **U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, Tobacco Division.** 1930. The tobacco situation in South Africa and southern Rhodesia. U.S.D.C(ommerce). Bureau Foreign and Domestic Commerce, Tobacco Markets and Conditions Abroad **270**:5–7. (Multigr.)

Scientific Notes

The Fluorine Compounds as Insecticides. A Monograph with Annotated Bibliography.—During the last few years there has been a marked demand for new and better insecticides. This demand has been largely the result of two factors, first the need for better control of a great variety of insects which are on the increase in their economic destructiveness, and second the recognition of the health hazards of the residues from certain insecticidal sprays and dusts if they are left on food products intended for human and animal consumption.

One of the principal classes of inorganic materials investigated as substitutes for the arsenicals were the compounds of fluorine. These compounds, especially sodium fluoride, have been recognized for years for their insecticidal properties chiefly as the active ingredient of roach powders, ant poisons, dusts for chicken and cattle lice and such uses.

Prior to 1924, however, very little experimental work had been done with these compounds in tests against insects affecting field crops. Marcovitch was one of the first to recognize the possible value of these compounds for this purpose and in 1925 published the results of experimental tests of several fluorides and fluosilicates against several kinds of chewing insects. About the same time several other investigators also reported very favorable results with these compounds against chewing insects. During the next 10 years all the fluorine compounds which were considered practical from their physical and chemical properties were tested against practically all chewing insects affecting field crops.

When experimental work was started with these compounds on vegetables and fruits and other materials intended for human and animal consumption, the danger of chronic toxicity due to ingestion of very small amounts of fluorine over long periods of time was not recognized. Within the last few years, however, it has been demonstrated by Smith and others that areas in which mottled enamel of teeth is endemic coincides with areas in which fluorine is present in the water supply. Because of these facts and much other evidence supplied by toxicologists the Food and Drug Administration of the U. S. Department of Agriculture has announced a tolerance for the amount of fluorine which may be present as spray residue on food materials shipped in interstate commerce. Difficulties have been encountered in removing fluorine spray residue from fruits and vegetables to meet this tolerance and this fact has prevented recommendations for their use in some cases where toxicity to the insect and freedom from plant injury have indicated their value.

For the convenience of those interested it was considered advisable at this time to present a summary of the available information on the insecticidal properties and applications of the compounds of fluorine. There was included also the information available on fluorine spray residue removal and such methods of analysis as are applicable to this type of work. References to the use of fluorine compounds in wood preservation and like applications where insect damage may be a factor were also included but purely bactericidal and germicidal uses were not. Plant damage incidental to the use of fluorine insecticides was also considered pertinent to this review and the available information along this line was included. A discussion of the physical and chemical properties of the fluorine compounds was also included.

Over 600 references to the literature from 1898 to 1934 were abstracted with these points in mind.

It is evident that several compounds of fluorine, for instance cryolite, barium fluosilicate, potassium fluosilicate, etc., are safe to use on foliage in many cases, and possess satisfactory toxicity to chewing insects such as codling moth, Mexican bean beetle, blister beetles, cucumber beetles, etc., but cannot be recommended for use without provision being made for the removal of the residue from food materials. For moth proofing, wood preservation, roach powders, chicken lice powders, poison baits and other uses where the residue removal is not a factor, many of these compounds find quite extensive use.

It is proposed to publish this monograph in the "E" series of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. This publication will be available for distribution about January 1, 1937.

R. H. Carter, *U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.* 9-12-36

***Coccidophilus citricola* Brèthes, A Predator Enemy of Red and Purple Scales.**—In 1934–35 the Citrus Experiment Station at Riverside, Calif., introduced into California a small beetle belonging to the family Discolomidae. Brèthes (*1*) described this beetle as *Coccidophilus citricola*. E. C. Van Dyke informed the writer that "While the monotypical genus *Coccidophilus* is placed in the family Discolomidae, this is itself but little more than a subfamily of the Colydidae. The family Discolomidae structurally diverges somewhat from the Colydidae and approaches the Coccinellidae. All members of the family Colydidae are either predacious or fungivorous, none phytophagous, and no doubt the members of this subfamily share the same habits."

The specimens of *Coccidophilus citricola* received at Riverside were collected by H. Compere in Brazil, about 30 miles from Rio de Janeiro. Previously this species had been recorded from Argentina, Chile and Paraguay, so that it probably is generally distributed throughout subtropical and temperate South America.

This beetle attacks the two worst pests of citrus, *Lepidosaphes beckii* and *Chrysomphalus aurantii*. Porter (*6*) states that near Santiago, Chile, it controlled several species of *Aspidiotus*. Salvadores (*7*), on finding that it fed on *Lepidosaphes beckii* on lemon and orange trees, advocated its artificial propagation. Blanchard (*2*) found that it occurs almost everywhere in Argentina and is one of the most active checks on *Lepidosaphes beckii*. Elgueta (*4*) states that it probably restricts the spread of red scale in Chile. Compere, however, informed the writer that apparently it had little or no economic value in reducing the abundance of its hosts. Many of the citrus trees from which the beetles were collected were injuriously infested with *Prontaspis citri*, *Lepidosaphes beckii* and *Chrysomphalus aonidum*.

On September 22, 1934, a shipment was received from Compere that included 12 live adults of *Coccidophilus*. These were sent by air express and were en route seven days. No trouble was experienced in obtaining reproduction in the insectary.

In the introduction and establishment of parasites and predators the Citrus Experiment Station is aided by the several county and cooperative insectaries.

The Orange county insectary received a stock of *Coccidophilus citricola* and propagated it in large numbers. At this insectary a method was developed by Mr. Rush Bumgardner for obtaining the hosts of this beetle in enormous numbers. This is done by growing the host scale on mature gourds or squashes. When placed on racks in a warm, dry room the squashes remain in good condition for six months or a year and permit the scales to develop for several generations. The scale population may become dense enough entirely to cover the surface of the squash. This method has made possible the production and liberation of many thousands of beetles. In August 1936, Bumgardner recovered specimens of the immature stages of *Coccidophilus* from the field. Apparently this beetle is established in California.

In appearance, the adult *Coccidophilus citricola* is jet black and strongly convex. The sexes are alike in color and difficult to differentiate. Newly emerged specimens are reddish. Apparently this transitory coloration was observed in field-collected specimens by Lizar (*5*). However, he concluded that they represented a variety of the black form.

Oviposition commences within five days after emergence; the eggs are placed beneath the covering of the scale insect. They are translucent yellow and the chorion is delicate and flexible.

At 80° F the incubation period is eight or nine days, the ocelli of the embryo becoming visible two days before hatching.

The newly hatched larva has a brown, flat body, finely pubescent, and the head is black. The terminal segments of the abdomen are hairy. The first thoracic segment is light brown or gray, with two black patches. The legs are lighter in color, with black knees. The larvae cease feeding after 10 days. Then they are somewhat pear shaped, tapering toward the head and appear to be dark velvety brown. Under the microscope the epidermis is found to be covered with minute "rosettes," each consisting of five to seven spines. A few long hairs are scattered over the body.

The entire larval stage extends over a period of 13 to 20 days. At the end of this period they seek crevices in which to pupate.

The pupa is yellowish brown and very hairy. Several days after pupation each hair bears a globule of liquid at the tip. The pupal period of five days is comparatively short.

Both adult and larva when disturbed tend to adhere to the host plant with adhesive anal discs.

At a temperature between 75° and 85° F, the life cycle is 27 to 35 days.

Literature Cited

(*1*) **Bertoni, A. deW.** 1923. Principales enemigos de los coccidos importados observados en Asuncion. Rev. Soc. Cient. Paraguay **1**:53–5.

(*2*) **Blanchard, E. E.** 1922. Principales cochinillas de los citrus en Argentina. Primera parte: Cóccidos protegidos. Bol. Minist. Agric., Nacion, **27**:387–98.

(*3*) **Brèthes, J.** 1905. Descripción de un género y de una neuva especie de *Clavicornis* de Buenos Aires. Ann. Soc. Argent. **59**:76–9.

(*4*) **Elgueta, N.** 1932. Un enemigo de la Escama roja. Rev. Chil. Hist. Nat. **36**:85.

(*5*) **Lizer, C.** 1915. Une nouvelle variété de Discolomide (Col.) de l'Amérique méridionale: *Coccidophilus citricola:* Brèth. v. nov. *rufus*. Physis, Buenos Aires, **2**:43.

(*6*) **Porter, C. E.** 1913. Notas para la zoología economica de Chile (IV). Rev. Chil. Hist. Nat. **17**:98–9.

(*7*) **Salvadores, A. Z.** 1913. El durazno, reprint from Bol. Minist. Agric., Buenos Aires. 33 pp., 56 figs., 17 pls.

S. E. Flanders, *Riverside, Calif.* 8-25-36

Japanese Species of *Tetrastichus* Parasitic on Eggs of *Galerucella xanthomelaena* (Schrank).—One of the cooperative projects of the U. S. Bureau of Entomology and Plant Quarantine and the University of California is the biological control of the elm-leaf beetle in the Great Central valley of California.

During the last 30 years a number of attempts have been made to establish in the United States the European egg parasite of the elm-leaf beetle, *Tetrastichus xanthomelaenae*. Most of these introductions occurred along the Atlantic seaboard, but in 1933 two shipments were received in California and several colonies were liberated near Fresno. No recoveries of *Tetrastichus xanthomelaenae* have yet been made.

In Japan elms are attacked by a closely related beetle, *Galerucella maculicollis* Mots. A number of years ago C. P. Clausen observed that the eggs of this beetle were parasitized by an apparently undescribed species of *Tetrastichus*. As no recoveries have been made of the European *Tetrastichus*, Mr. Clausen suggested the introduction of the Japenese parasite in California. Professor H. S. Smith agreed to handle the material in California, and so arrangements were made with the Bureau's representative in Japan, R. W. Burrell, to make the shipments. Two shipments were forwarded, one in June 1934, and one in June 1936.

In the 1934 shipment about 35 per cent of 1112 egg masses were parasitized. In the 1936 shipment the parasitism of 553 egg masses was approximately 45 per cent. Only one parasite matured in a single host egg. The sexes occurred in equal numbers.

During the rearing of these parasites in California, a few observations were made on certain biological factors that probably directly influence establishment.

At a temperature of about 70° F the life cycle is 24 days. The larva is full grown seven days after deposition of the egg. Pupation occurs six days later. The pupal period is about 10 days. At higher temperatures the life cycle may be as short as 14 days. Fiske (*1*) found this to be the case with *Tetrastichus xanthomelaenae*.

The parasite emerged from the foreign material over a period of 24 days. The emergence from a single egg mass, however, was completed within 10 days.

Dissections made on receipt of each shipment revealed the presence of full-grown larvae as well as pupae. Curiously, after the adult parasites had ceased to emerge, full-grown larvae were found in considerable numbers. Although many appeared to be in a healthy condition, none completed its development. The material was 14 days in transit at a temperature of about 38° F. This exposure apparently inhibits the development of both the host embryo and the "prepupal" stage of the parasite. In a typical egg mass from which parasites have commenced to emerge, dissection showed the presence of pupae, full-grown living and dead larvae of the parasite, and dead beetle larvae.

To survive, adults must imbibe liquids within 20 hours after emergence. The ovaries of newly emerged females contain no eggs. Eggs are not fully formed until three or four days after emergence at temperatures of about 80° F. After a female deposits a number of eggs it begins to feed on the content of host eggs, a habit first noted by Marchal (*1*). The ovaries of one female seven days old, that had fed only on honey, contained 14 fully developed eggs.

A six-day-old female was placed for 13 hours in a vial containing a mass of 15 eggs. Seven days later 12 of them had changed from yellow to lavender, an indication that the parasite had become full grown. The tips of such eggs are whitish because the darkened vitelline membrane is separated from the chorion by a clear liquid. One of the remaining three eggs which were unchanged in color contained a first stage larva. Although apparently unparasitized, embryonic development in the other eggs remained incomplete.

The progeny of unmated females developed as primary parasites of the elm-leaf beetle. No mated females were available for reproduction. Copulation apparently did not take place. A possible explanation of this is that the low temperatures during shipment (when the parasites were for the most part in the pupal state) had a castrating effect on the male.

Successful establishment probably would be facilitated by holding the parasites in confinement until sexually mature. The availability in the field of liquid food for newly emerged adults may also influence establishment. Without such food the adult probably would not survive the preoviposition period.

Literature Cited

(*1*) **Howard, L. O.** 1908. The importation of *Tetrastichus xanthomelaenae* (Rond.). Jour. Econ. Ent. 1:281–9.

S. E. Flanders, *Riverside, Calif.* 8-14-36

***Geocoris punctipes* Say Observed as Predaceous upon Eggs of *Phlegethontius* sp.** —A very interesting observation was made by the writer on June 4, 1936, while examining tobacco plants in the vicinity of Oxford, N. C. A partially collapsed hornworm egg was observed and standing nearby was a nymph of *Geocoris punctipes* Say (determined by H. G. Barber). The nymph was captured and in the next few days ate several hornworm eggs. This nymph within a few days became an adult and continued to devour hornworm eggs. Other nymphs collected were noted as being cannibalistic, as were the adults. This predator was observed to be plentiful in tobacco fields on June 22, when four individuals were observed upon one tobacco plant. Although *G. punctipes* is recorded by Chamberlin & Tenhet (U.S.D.A. Farmers' Bulletin 1352) as being predaceous upon the tobacco flea beetle, *Epitrix parvula* Fab., it is believed that this is the first record of the species attacking eggs of the tobacco hornworm.

J. U. Gilmore, *U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.* 8-3-36

A Food for Rearing Laboratory Insects.—Rearing large numbers of insects for experimental purposes often presents special problems of proper nutrition. For two years past there has been used in the Division of Entomology and Economic Zoology of the University of Minnesota a formula which seems admirably suited to the rearing of diverse species of stored products insects and grasshoppers.

It has been used with success for rearing wax moths, *Galleria melonella* and *Achroia grisella,* the saw-toothed beetle, *Orizaephilus surinamensis,* Indian-meal moth, *Plodia interpunctella, Trogoderma* spp., as well as other Dermestidae and grasshoppers. Undoubtedly many other species can be reared on this food.

The formula is as follows:

I. Corn flour....................................4 parts by weight
Whole-wheat flour..........................2 parts by weight
Skim-milk powder............................2 parts by weight
Dried powdered yeast.......................1 part by weight
Wheat middlings or bran.....................2 parts by weight

Mix the ingredients thoroughly and stock in a tight container in order to prevent infestation by insect pests.

II. Mix well equal parts of honey and glycerine by volume. This mixture can be stored at room temperature.

Mix equal parts of I and II by weight. Let the mixture stand for about 24 hours to allow the liquid to penetrate the dry components of the food. Then place clumps of this mixture in mason jars provided with screen covers, inoculate with the desired species of insect and place in a constant temperature chamber adjusted to the optimal temperature and humidity. Temperature of 32° C. and 75 per cent relative humidity are used in our laboratories. The food remains soft for an indefinite time because honey, due to its hygroscopicity, absorbs moisture from the air and glycerine prevents molding and contributes further to the softness of the food. The proportions of I and II can be changed to suit the feeding habits of any given species. For some, the liquid may even be left out. The food is coarser and more to the liking of certain species when bran is used in place of middlings.

Stored-products insects as well as other species which live on a relatively dry food can be reared in mason jars for generations. In the case of chewing insects, such as grasshoppers, living on the leafy parts of plants, eggs are placed on the food in screen cages and a dish containing cotton or cheesecloth is filled with water and placed close to the food.

MYKOLA H. HAYDAK, *University of Minnesota.* 8-4-36

Long Survival of *Gibbium psylloides* Czemp.—An infestation of the ptinid beetle, *Gibbium psylloides* Czemp., was maintained for at least 18 years in a glass jar of wheat bran at Mississippi State College. The bottle was fitted with a ground-glass stopper and nothing was added at any time during the period. The infestation was first noticed in the agronomy department sometime before 1916 and the jar was turned over to the Zoology and Entomology department October 21, 1924. A layer of dead beetles gradually accumulated on top of the bran until it became an inch deep. The infestation died out in the fall of 1934 while the writer was absent from the office for several weeks. It is possible that the jar was placed in sunshine by a careless janitor for the beetles had appeared normally active only a few weeks before.

CLAY LYLE, *Mississippi State College, State College, Miss.* 8-28-36

A Crane Fly Larva Attacking Newly Set Strawberry Plants.—During March 1936, larvae of the crane fly ,*Nephrotoma ferruginea* Fab.,[1] were found to be causing severe injury to newly set strawberry plants in the vicinity of Chadbourn, N. C. These larvae were also observed destroying young tobacco seedlings in a plant bed.

Observations in an infested strawberry field disclosed that the crane fly larvae were attacking the crown of the plants and had eaten away the living tissue to a point just below the origin of the bud. All plants suffering this type of injury had died or were in a greatly weakened condition. In addition, the crane fly larvae had destroyed such portions of the leaves or petioles as were in direct contact with the soil.

Infested plants had one to three larvae feeding thereon, and as many as eight to 12 larvae were taken from a sample of soil 3 inches square and 1 inch deep, in the space between the

[1] Determined by Alan Stone.

plants. The larvae were present just underneath the soil surface. They had thoroughly pulverized the soil adjacent to the plants as well as pulverizing the soil in small depressions of the field where sediment had collected. In many parts of the field the soil surface was covered with interlacing ridges of soil, caused by the subterranean activities of the crane fly larvae.

When the first field observation was made, late in March, all sizes of larvae of *Nephrotoma ferruginae* were present, with a few pupae. The pupae were protruding slightly above the soil surface. Adults began emerging on April 20 from material placed in cages, and the peak of adult emergence occurred approximately April 25. Second-generation adults were observed in the field during the first week of May.

An application of poisoned bait consisting of calcium arsenate and wheat middlings, 1 to 20 by weight, to which were added molasses and water in sufficient quantities to make a moist, crumbly mass, greatly reduced the number of active crane fly larvae. The bait was sown broadcast over approximately one half of the infested field, leaving the other portion as a check. Three days after the bait was applied, numerous dead larvae were found on the surface of the soil on the treated area, while only living larvae could be found in the check. A week after treatment the surviving plants on the baited area showed but little feeding and no additional plants had died, while in the untreated area the number of dead and dying plants had increased.

W. A. Thomas, *U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.* 8-31-36

Injury to Lumber by *Hadrobregmus carinatus* Say.—During the past winter there was brought to our attention an instance of serious injury of elm joists in a house at Le Center, Le Sueur county, Minn., which proved to be due to the anobiid beetle *Hadrobregmus carinatus*. The infested joists, which had supported a basement floor were eaten through, except for a thin outer shell. Those composed chiefly of sapwood were so badly riddled that it was difficult to recognize structural features. One joist in which the structure was still intact contained some heartwood which was damaged.

A second similar infestation was reported from Wabasha, Minn. Samples sent in July 1936, proved to be of elm sapwood. Since apparently there was no heartwood in the infested sample, whether the beetles had damaged heartwood could not be determined.

The injury done by *Hadrobregmus* closely resembles that caused by *Lyctus* species. The emergence holes are somewhat larger and the frass somewhat coarser.

Nellie M. Payne, *Division of Entomology, University Farm, St. Paul, Minn.* 9-1-36

Potential New Insecticides.—In the search for new insecticides being conducted by the Bureau of Entomology and Plant Quarantine, several hundred synthetic organic compounds have been prepared and tested. Of the compounds tried against codling moth larvae at the Fruit Insect Laboratory, National Agricultural Research Center, Beltsville, Md., the following showed high initial toxicity under laboratory conditions (apple-plug method): *p*-nitroiodobenzene ($C_6H_4INO_2$), thiocoumarin (C_9H_6OS), and phenothioxin ($C_{12}H_8OS$). These compounds are very toxic when freshly applied, but under laboratory conditions they lose much of their effectiveness when exposed as a spray deposit for a week or so. However, derris, pyrethrum, nicotine and other potent and widely used insecticides do likewise. Experiments are in progress to find means to retard or prevent their loss in toxicity, which may be due to slow vaporization, to atmospheric oxidation, or to photochemical decomposition. The pharmacological action of these compounds on mammals is being determined. These compounds are also being tested against various insects of economic importance in other laboratories of this Bureau.

L. E. Smith, E. H. Siegler, and F. Munger, *U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.* 9-8-36

Wider Uses for Nicotine.[1]—Successful application of atomized pyrethrum in oil as a horticultural spray has been a recent development in entomology. Use of free nicotine in a similar way is being investigated at the Kentucky Agricultural Experiment Station.

It has been found that free nicotine may be directly incorporated in highly refined petroleum base oil to give a stable solution which does not deteriorate or separate out. This material, containing 1 to 3 per cent nicotine, applied as a fog, has not burned even such tender plants as beans, sweet potato and balsam. In the laboratory, nicotine in oil has

[1] The investigation reported in this note is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

given a high per cent kill of many insects,including such resistant forms as mealy bugs, white fly and adult green June beetles.

Comparative tests of the toxicity of nicotine in oil and pyrethrum in oil have shown that the toxicity of the two materials varies with the species tested. Nicotine in oil is especially toxic to many insects with a high metabolic rate. In Kentucky, free nicotine is more available than pyrethrum and costs considerably less for a toxic equivalent.

Nicotine in oil shows promise as an insecticide in greenhouses, on truck crops and small fruits, and may be adaptable for household use. Its adaptation for orchard use will depend on the development of suitable applicators, the selection of appropriate oils and the development of soluble fungicides.

P. O. Ritcher and R. K. Calfee, *Kentucky Agricultural Experiment Station, Lexington.* 9-28-36

Observations on Control of Mexican Bean Beetle in Association with Powdery Mildew Disease on Snap Beans.—In conducting experiments for the control of the Mexican bean beetle, *Epilachna varivestis* Muls., on the fall crop of snap beans in eastern Virginia the results are sometimes complicated by powdery mildew disease (caused by one of the Erysiphaceae), which alone is occasionally a serious factor in the production of the crop and when occurring in association with the former adds considerably to the severity of the injury.

During the fall of 1935 at Norfolk, Va., an experiment was being conducted for the control of the Mexican bean beetle in which the sprays and dusts listed below were being tested. Sprays.—Magnesium arsenate (2 pounds in 50 gallons of water), commercial barium fluosilicate (3 pounds in 50 gallons of water), synthetic cryolite (3 pounds in 50 gallons of water), and water suspensions of derris and cubé root (rotenone content of sprays .02 per cent). Dusts.—Synthetic cryolite 60 parts with finely ground dusting sulfur 40 parts by weight, derris–talc, derris–sulfur, cubé root–talc, cubé root–sulfur (each containing .50 per cent of rotenone), and undiluted sulfur dust. Treatments were applied on September 18 and on October 1.

Examination of the plots on September 24 (six days after the first treatment) indicated that powdery mildew fungus was beginning to show on the foliage on all plots except those on which sulfur was used as a diluent for the dusts of cryolite, derris and cubé root. The value of sulfur dusts and sprays in controlling powdery mildew disease on this crop had been previously demonstrated by Cook (1931, Va. Truck Exp. Sta. Bul. 74) as a result of experiments conducted at Norfolk, Va.

Since there was a heavy Mexican bean beetle infestation in the plots, and in view of the fact that sulfur and talc were being compared as diluents for some of the dusts, it was decided to add wettable sulfur at the rate of 2 pounds in 50 gallons of water to each of the sprays at the time of the second treatment (October 1) to avoid complication of the results and to obtain information relative to the control of both the insect and the disease.

The results of the experiment showed that wettable sulfur (2 pounds in 50 gallons of water) added to the various sprays at the time of the second treatment gave good control of the Mexican bean beetle and powdery mildew on foliage and pods. These sprays containing wettable sulfur, however, did not give control of powdery mildew for as long a period as did two applications of a dust mixture of derris cubé root, or cryolite and sulfur. These three dust mixtures gave excellent control of both the Mexican bean beetle and powdery mildew, protection against the latter being equally as effective as when undiluted sulfur dust was used. At the conclusion of the experiment the foliage of the plants in the untreated plots, and in plots treated with derris or cubé root containing talc as a diluent, was completely covered with the white fungus causing the disease, whereas plants in plots that had received treatments containing sulfur (either in combination with the regular sprays or as a diluent for the dusts) remained green and healthy. Also, a large percentage of the pods on plants that failed to receive treatments of sulfur were unmarketable owing to injury resulting from the disease, the pods on such plants being dwarfed, deformed, and badly spotted with reddish brown lesions.

Results of the experiment indicate that in instances where a Mexican bean beetle infestation occurs in association with powdery mildew disease, control of both the insect and the disease may be obtained by the addition of wettable sulfur to the Mexican bean beetle spray, or by the use of sulfur as a diluent for the dust.

Loyd W. Brannon and Neale F. Howard, *U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine.* 9-10-36