COMBATING CABBAGE PESTS.

F. H. HALL AND F. A. SIRRINE.
BOARD OF CONTROL.

Governor Black, Albany.
William C. Barry, Rochester, Monroe Co.
Martin V. B. Ives, Potsdam, St. Lawrence Co.
A. C. Chase, Syracuse, Onondaga Co.
F. O. Chamberlain, Canandaigua, Ontario Co.
P. C. Schraub, Lowville, Lewis Co.
Nicholas Hallock, Queens, Queens Co.
Lyman P. Haviland, Camden, Oneida Co.
G. Howard Davison, Millbrook, Dutchess Co.

OFFICERS OF THE BOARD.

Martin V. B. Ives,                      W. O'Hanlon,  
President.                               Secretary and Treasurer.

EXECUTIVE COMMITTEE.

S. H. Hammond,                         F. O. Chamberlain,  
W. C. Barry,                            Lyman P. Haviland,
F. C. Schraub,                          G. Howard Davison.

STATION STAFF.


Geo. W. Churchill,                    Geo. A. Smith,  

Wm. P. Wheeler,                        Frank H. Hall, B. S.,  
First Assistant (Animal Industry).  Editor and Librarian.

F. C. Stewart, M. S.,                   Victor H. Lowe, M. S.,
Botanist.                                F. A. Sirrine, M. S.,
                                          Entomologists.

L. L. Van Slyke, Ph. D.,               S. A. Beach, M. S.,
Chemist.                                Horticulturist.

C. G. Jenter, Ph. C.,                  Wendell Paddock, B. S.,
*W. H. Andrews, B. S.,                 C. P. Close, M. S.,
J. A. Leclerc, B. S.,                  Assistant Horticulturists.
*A. D. Cook, Ph. C.,                    Frank E. Newton,
Fred D. Fuller, B. S.,                  Jennie Terwilliger,
*E. B. Hart, B. S.,                    Clerks and Stenographers.
F. Thompson, B. S.,                    A. H. Horton,
Assistant Chemists.                    Computer.

Address all correspondence, not to individual members of the staff, but to the New York Agricultural Experiment Station, Geneva, N. Y.

The Bulletins published by the Station will be sent free to any farmer applying for them.

*Connected with Fertilizer Control.
†Connected with Second Judicial Department Branch Station.
COMBATING CABBAGE PESTS.

F. H. HALL.

The insects which prey specially upon cabbage, cauliflower and related plants are obnoxious both to the producer and to the consumer. The former sees his growing plants destroyed by the ravages of worms and his chances for profiting by his labor daily grow less; while the consumer suffers revolting disappointment when the cabbage or cauliflower he has purchased shows, on preparation for the table, the canals and disgusting masses of excrement which mark the work of these pests on the mature vegetables.

All are interested, then, in checking the ravages of these insects, but the successful solution of the problem has been somewhat difficult; for the character of the plants and the habits of the insects both interfere to prevent success from methods applicable against other insects.

Best known of the cabbage pests and the one which until within a very few years has been the most harmful in the market garden section of this State is the green cabbage worm, the larva of the familiar white butterfly, the imported or European species, Pieris rapae. These insects pass the winter as chrysalids or pupae (the dormant stage) attached to the undersides of rails, sticks, weeds,

*This is a brief review of Bulletin No. 144 of this Station on A Spraying Mixture for Cauliflower and Cabbage Worms, by F. A. Sirrine. Anyone specially interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete Bulletin.
or in any place where they are protected from excessive moisture. Early in May, or even in April if the air is warm for several days, the butterflies emerge from the chrysalid shell, soon pair and begin egg laying. The eggs, from 100 to 300 in number, are deposited singly upon the undersides and edges of leaves of old cabbage stumps, early cabbage, kale, wild radish, cress or related plants. The egg-laying may last for three weeks, by which time the worms from those first laid have hatched, fed, grown to full size and are ready to pupate. The old butterflies live for some time after laying their eggs, so that before they have passed away those of the new brood have come out and are ready to start a new generation. This overlapping of broods makes it impossible to destroy all the pests at one application of an insecticide, no matter how successful; because any poison would be eaten only by the worms, leaving unharmed both eggs and mature insects. If all eggs and worms could be destroyed by hot water or insecticides which kill by contact, the butterflies would still remain, prepared to restock the plants with eggs. This succession of broods continues throughout the summer, four, five or even more generations arising as the season is more or less prolonged.

The cabbage looper (Plusia brassicae) has long been counted most destructive of cabbage pests in the South and for the past four years has been a worse enemy on Long Island than the cabbage worm. It is less known, however, and the injury it does is usually attributed to the cabbage worm; for the larvae or worms are quite similar in color to the other species and the moths are less conspicuous in color and fly principally on cloudy days and late in the afternoon, remaining concealed during the day under the leaves and in sheltered nooks and crannies. The worms are voracious and more general feeders, eating not only all plants of the cabbage family, but also lettuce, spinach, tomatoes, celery, carnations, chrysanthemums, smilax, heliotrope and many other forcing-house plants. They are especially destructive to forcing-house lettuce and a few moths in even a large house may soon cause irreparable injury, as a single worm may devour a newly transplanted plant in a night. The moths, worms and egg are shown in Plate I. The worms
PLATE I.—FEMALE AND MALE MOTHS, EGG, AND CATERPILLARS OF CABBAGE LOOPER.
are marked, when partially grown, by distinct white lines along the sides; and, unlike the cabbage worms, they have legs only at the ends of their bodies so that they travel by "looping" and not by crawling. In their life history they are quite similar to the cabbage worms but appear earlier in the season and continue longer, with the same overlapping of broods which prevents easy destruction. In addition they have other peculiarities which increase the difficulty of combating them. They feed upon such a range of plants that poisoned trap-crops are of little benefit; and they work largely upon the underside of the leaves where they may remain unnoticed until much damage has been done and where only very thorough application of remedies will affect them. They are also active in movements and discriminating in taste so that they quickly desert feeding places which show traces of poison or other foreign substance.

Plants of the cabbage family are specially difficult to treat with insecticides because of the crowding together of their leaves and the smoothness of the surfaces. These features of cabbage make it difficult to reach all portions of the plants and to make the insecticide adhere when applied. Any dry powder will adhere only in occasional spots upon the leaves, will generally collect along veins and midrib which are not usually eaten by the worms and will be washed off by the first light rain. This characteristic of the cabbage and cauliflower foliage, with the overlapping broods of both cabbage worm and cabbage looper and the retiring habit, activity and careful feeding of the latter make it necessary in working against them to select an insecticide that will "stay where it is put" and that will carry sufficient poison to kill the loopers even though they eat but a small quantity. The applications must be made so thoroughly that every spot of surface will be protected and the treatment repeated at least once to insure destruction of the newly hatched worms.
After repeated tests an excellent material for securing uniform distribution and perfect adhesion has been found in a resin-lime mixture. In preparing this mixture it is necessary to make a stock solution from the following formula:

- Pulverized resin: 5 lbs.
- Concentrated lye: 1 lb.
- Fish oil, or any cheap animal oil except tallow: 1 pt.
- Water: 5 gals.

Place oil, resin and a gallon of water in an iron kettle, and heat until resin is softened; add lye solution made as for hard soap; stir thoroughly; add remainder of water and boil about two hours, or until the mixture will unite with cold water making a clear, amber-colored liquid. If the mixture has boiled away too much, add sufficient boiling water to make 5 gallons.

For use, 1 gallon of this stock solution is diluted with 16 gallons of water and afterward 3 gallons of milk-of-lime or whitewash added. The resin mixture is in reality a liquid soap and the addition of the lime turns it to a hard soap which remains suspended in the water in minute particles. The poison, \( \frac{1}{4} \) pound of Paris green or other arsenite, is then added, and the particles of poison adhere to the finely divided soap particles and are thus distributed throughout the mixture in minute and uniform quantities. The soap solution is very adhesive and thus a thin film of poison is made to stick to every part of the leaf which is touched by the spray. The application must be made by a hand power machine, either a strongly-made knapsack or a barrel sprayer, as no horsepower machine will do the work thoroughly enough or carefully enough upon cabbage and cauliflower.

This resin-lime mixture received its first test upon cabbages in 1896, though it was used with perfect success against cabbage worms upon smooth-leaved turnips in 1895. Not a living worm could be found upon the patch three days after the spraying, and the protection was excellent even to the end of the season, notwithstanding heavy rains.

In the tests upon cabbage in 1896, the mixture with Paris green was used upon one farm in comparison with Bordeaux mixture, Bordeaux mixture and Paris green, Paris green and resin mixture without lime
and with an application of salt; and upon another farm with Bordeaux mixture and with an application of Paris green and flour. The cabbages were sprayed twice, once late in August and again about 18 days later. The results were surprisingly in favor of the resin mixture and Paris green. This, on all plats, was perfectly effective against the cabbage worms and only slightly less so against the cabbage loopers. The Bordeaux mixture, even when united with Paris green, and the flour and Paris green were of little advantage so far as the loopers were concerned, although quite destructive to the cabbage worms. The loopers evidently were able to avoid the spots poisoned by the dry powder and to find plenty of food which the poison had not touched or from which it had been blown. The salt was of no value whatever, as it only caused the worms to leave the cabbages and to pupate a little earlier than they would naturally do. It was estimated by the owner that the plats treated with the poisoned resin mixture yielded 100 per ct. better than the untreated plats and at least 60 per ct. better than those powdered with Paris green and flour.

The tests on cauliflower have not been as thorough nor the results as marked. The erect, crowded position of the leaves of the cauliflower makes it difficult to secure a perfect film of the mixture on the entire surface; and the mixture must not be applied after the "flower" is exposed lest there be danger of poisoning the human, as well as the insect, consumer. Yet the owner of the fields upon which the tests have been made says, "I am satisfied that it would have paid me to spray the entire field."

To make two applications upon ten acres of late cabbage after the plants are two-thirds grown would require materials worth $5.00, time in preparing stock solution 75 cents and 10 days labor, which at $1.50 a day would be $15.00, a total of $20.75, or about $2.00 per acre for treatment which will insure almost perfect freedom from injury by the worms.
As noted before, a strong, well made knapsack 

**Precautions.** sprayer must be used, as the mixture is liable to 
clog valves and nozzles and cause severe straining 
of a light sprayer. The workman must be close to his work and 
must thoroughly coat every leaf, both upper and under surface. 

There is but very slight danger of poisoning cabbage with 
the mixture as only the outer leaves are touched by the spray and 
these are thrown away in preparation for the table. Cauliflowers 
must not be sprayed after the "flower" is exposed. Only 
careful workmen should be trusted to make the late spraying upon 
the cauliflowers and all heads should be passed over that are too 
far advanced.

The poisoned resin-lime mixture has also been 

**Other uses.** successfully used in protecting lettuce from the 
attacks of the looper in the forcing house, and has 
proven efficient although somewhat liable to cause sticking 
together of the leaves and consequent injury to the heads. It 
should never be used except on head lettuce and not on this after 
the plants are one-third grown. It is not considered as good a 
protection for lettuce as the use of mosquito netting over the ven-
tilators to shut out the moths, but will be of value if the houses 
have become infested. Only one application will be necessary 
upon lettuce and the mixture should be made with 1 gallon of 
stock solution, 64 of water, 8 of milk-of-lime and ½ pound of 
Paris green.

The mixture will undoubtedly be found valuable against many 
other pests and has already been used with perfect results against 
some, notably the elm-leaf beetle.

It seems firmly established (1) that resin-lime 

**Conclusions.** mixture and Paris green, thoroughly and carefully 

applied when plants are one-third grown and 
again just before the heads are formed, will almost wholly prevent 
damage to late cabbage and cauliflower; (2) that the expense 
need not exceed $2.00 per acre, and, (3) that there need be no 
danger to the consumer from such treatment.